

# ***NUCLEAR ENERGY: OPPORTUNITIES AND RISKS THE VIEW OF CIVIL SOCIETY AND STAKEHOLDERS***

***"Transparency of pricing" round table:  
a reduced electricity price for the end-consumer and industry?"***

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# 1. NUCLEAR ENERGY IN THE EU <sup>(1/4)</sup>

## ➤ Characteristics of nuclear energy

- ***Carbon-free production:***

means of achieving 2020 CO<sub>2</sub> objectives: reduce greenhouse gas emissions by 20% by 2020 compared to 1990

- ***Fuel:***

- uranium cost limited as part of total production cost
- sufficiently available
  - over time (reserves for +/- 85 years)
  - stable regions (Canada, Australia, South Africa, ...)

- ***Cost:***

- relatively low-cost production technology -> new generation reactors should reduce cost further (IEA 2006 World Energy Outlook: 39 – 45 EUR/MWh)
- relatively stable cost price
- basic investment the most important component (+/- 60% of the total cost price)

- ***Availability:***

high-performance plants, load factor: 80% - 90%

- No ***peak load*** as result of a lack of modulation capacity (switching plants on and off)



# 1. NUCLEAR ENERGY IN THE EU (2/4)

## ➤ Nuclear Illustrative Programme

(Brussels, 10.1.2007; COM(2006) 844 final)

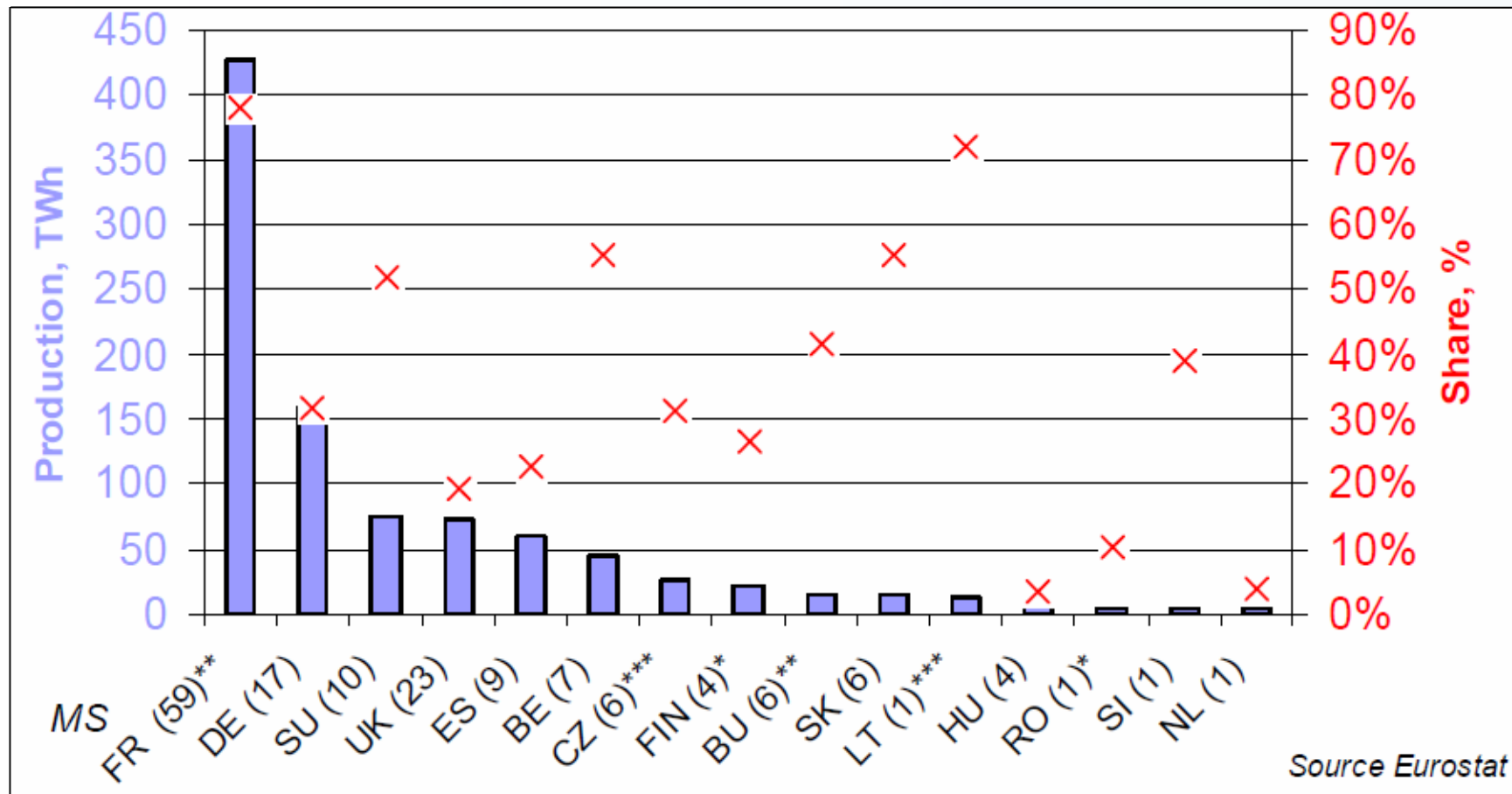
- The EU is the world's largest generator of nuclear electricity (2005): 944.2 TWh(e)
- 152 nuclear units (NPP) are operational within the EU-27, divided across 15 member states.
- Nuclear energy provides:
  - 1/3 of electricity consumption in the EU
  - 15% of total energy consumption in the EU

➡ To develop a framework at a European level such that the benefits of nuclear energy can be fully developed, and the disadvantages dealt with

- EU position:
  - Each member state is free to select its own **energy mix**, however at a European level, any move away from nuclear energy must be coupled with the introduction of other carbon-free (low-carbon) production methods (Kyoto, 2020 objectives)
  - The EU therefore needs to maintain its technological leadership in this domain, and extend this leadership where possible

# 1. NUCLEAR ENERGY IN THE EU <sup>(3/4)</sup>

## ➤ Member States (2004)



( ) Number of Nuclear Power Plants (NPPs)

# 1. NUCLEAR ENERGY IN THE EU (4/4)

## ➤ Member States prospects

(Nuclear Illustrative Programme; 10.1.2007; COM(2006) 844 final)

### **France:**

- country with the most NPPs and expertise
- net exporter of low-cost electricity
- new reactor (1650 Mwe) Flamanville (Normandy), expected to start production by the end of 2012
- In January 2009, Sarkozy announced construction of a new reactor (1650 Mwe) Penly

**Netherlands, Spain and Belgium:** extended lifespan of nuclear plants (up to 60 years)

**Finland (Olkiluoto):** new production unit (1600 Mwe)

### **Italy:**

- new NPPs from 2013 at the sites in Garigliano, Latina or Montalto di Castro
- joint venture (2009) between Enel and EDF to research construction of 4 EPR (AREVA technology) units in Italy

### **Germany:**

- new impetus for Germany's nuclear landscape since the 2009 elections
- nuclear exit delayed/reversed

**United Kingdom:** UK energy review (July 2006): nuclear energy continues to play an important role in the energy mix

**Conclusion :** - nuclear energy seems to be regaining interest (~achieving CO<sub>2</sub> objectives)  
- member states postponing exit from nuclear/planning to build new-generation NPPs

## 2. PRICE-FIXING IN EU ELECTRICITY MARKETS <sup>(1/4)</sup>

## ➤ Theoretical framework

**Liberalization process:** - Directives 96/92/EC, 2003/54/EC en 2009/72/EC (= *third package*)  
- Supply and demand mechanism

**Demand:** - highly inelastic (limited number of substitutes)  
- increasing: IEA World Energy Outlook: global energy demand is to increase by 60% by 2030



**Supply:** - electricity is an homogenous product: heterogeneity of production technology is irrelevant for electricity as a product

- *stack of supply*
- *merit order* based on marginal cost (MC) from the plant

**MC = dVC/dQ** ➡ derivative of the variable costs (VC)

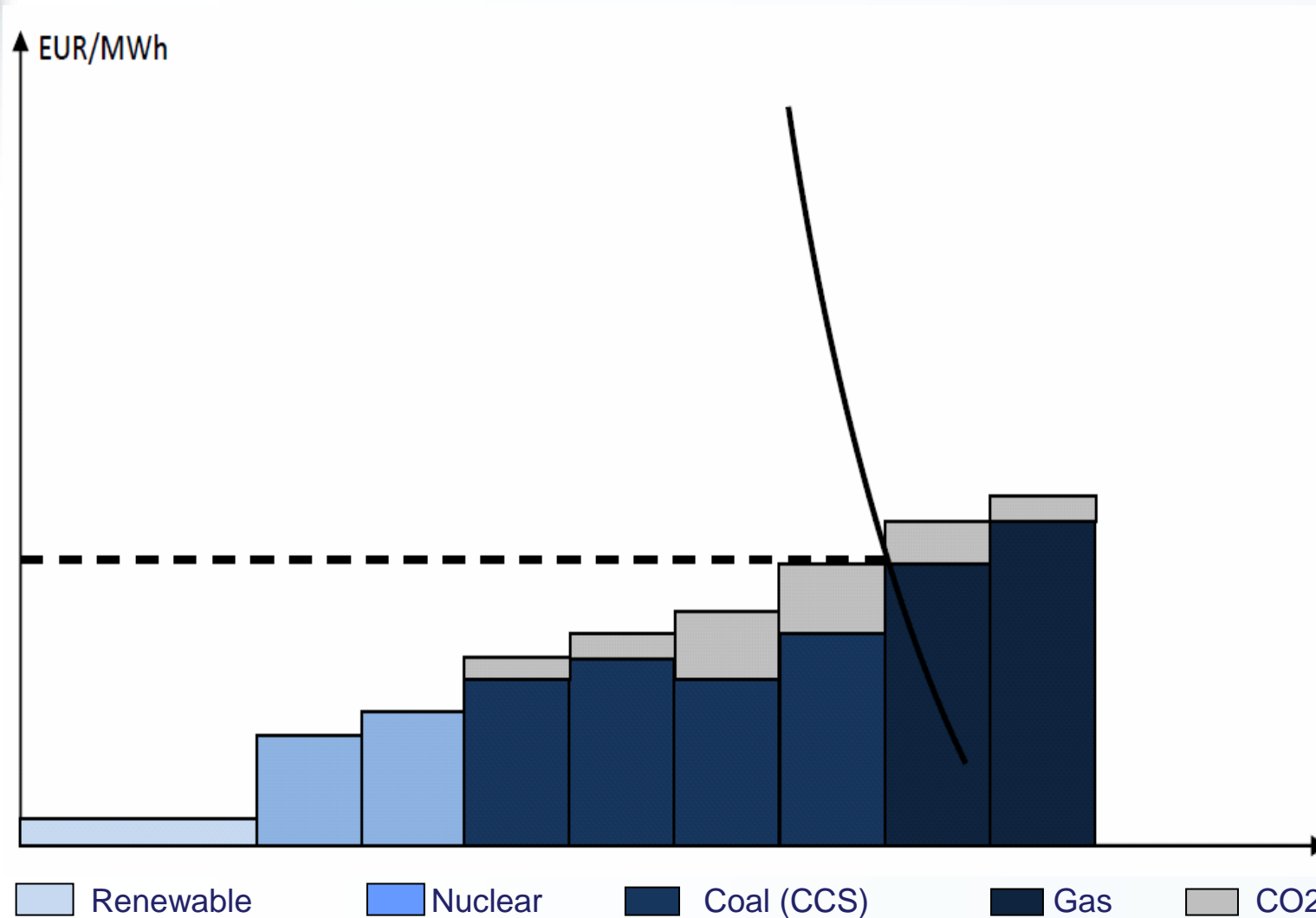
**Nuclear:** - The MCs of NPPs are relatively low: limited fuel cost  
low personnel costs  
- NPPs feature very early (*base load*) in the *stack of supply*

**Situation:**

- 1: With current nuclear capacity
- 2: Without nuclear  ce increases
- 3: With additional new nuclear capacity  ce decreases

## 2. PRICE-FIXING IN EU ELECTRICITY MARKETS (2/4)

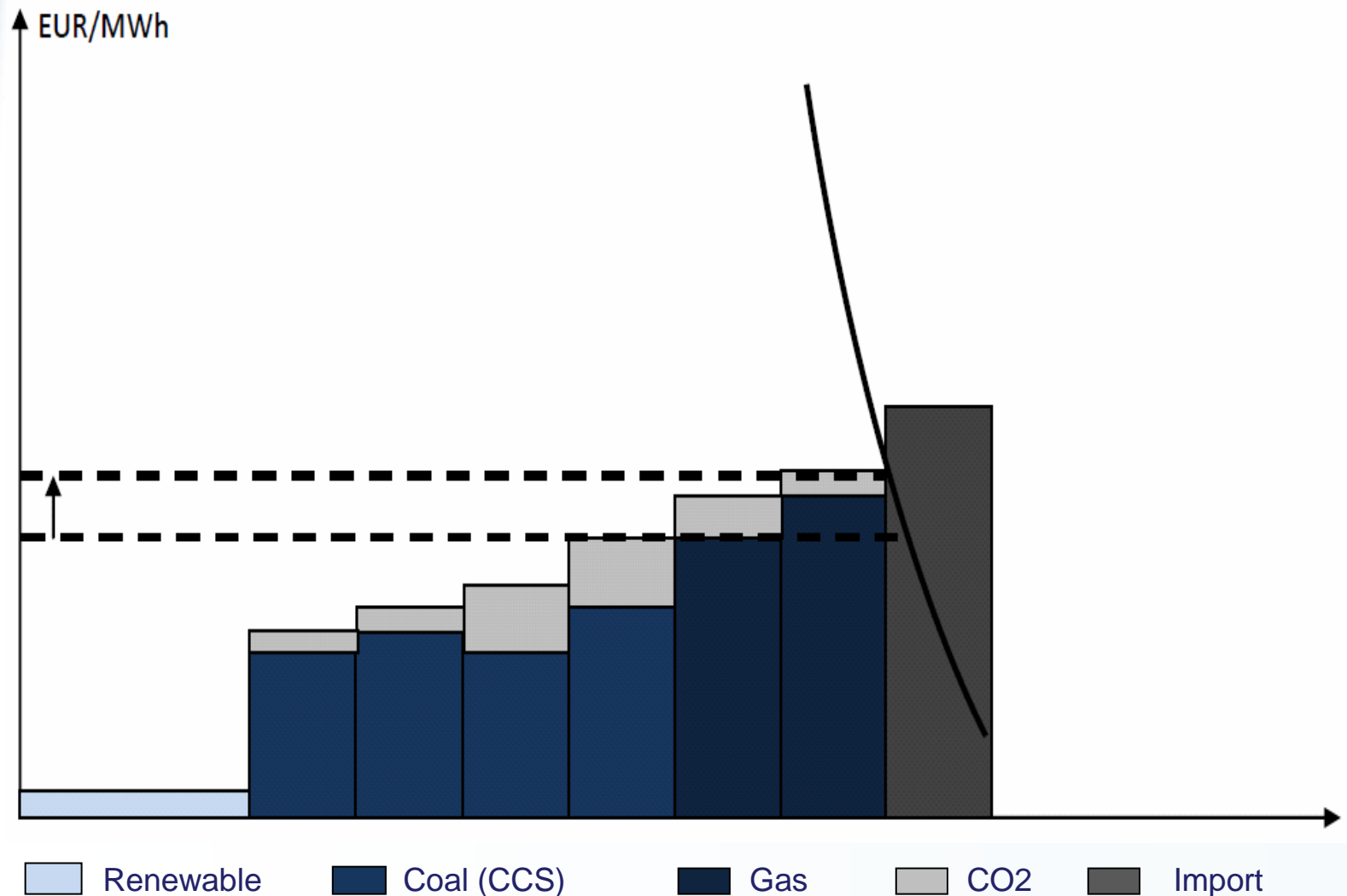
### Situation 1: current situation





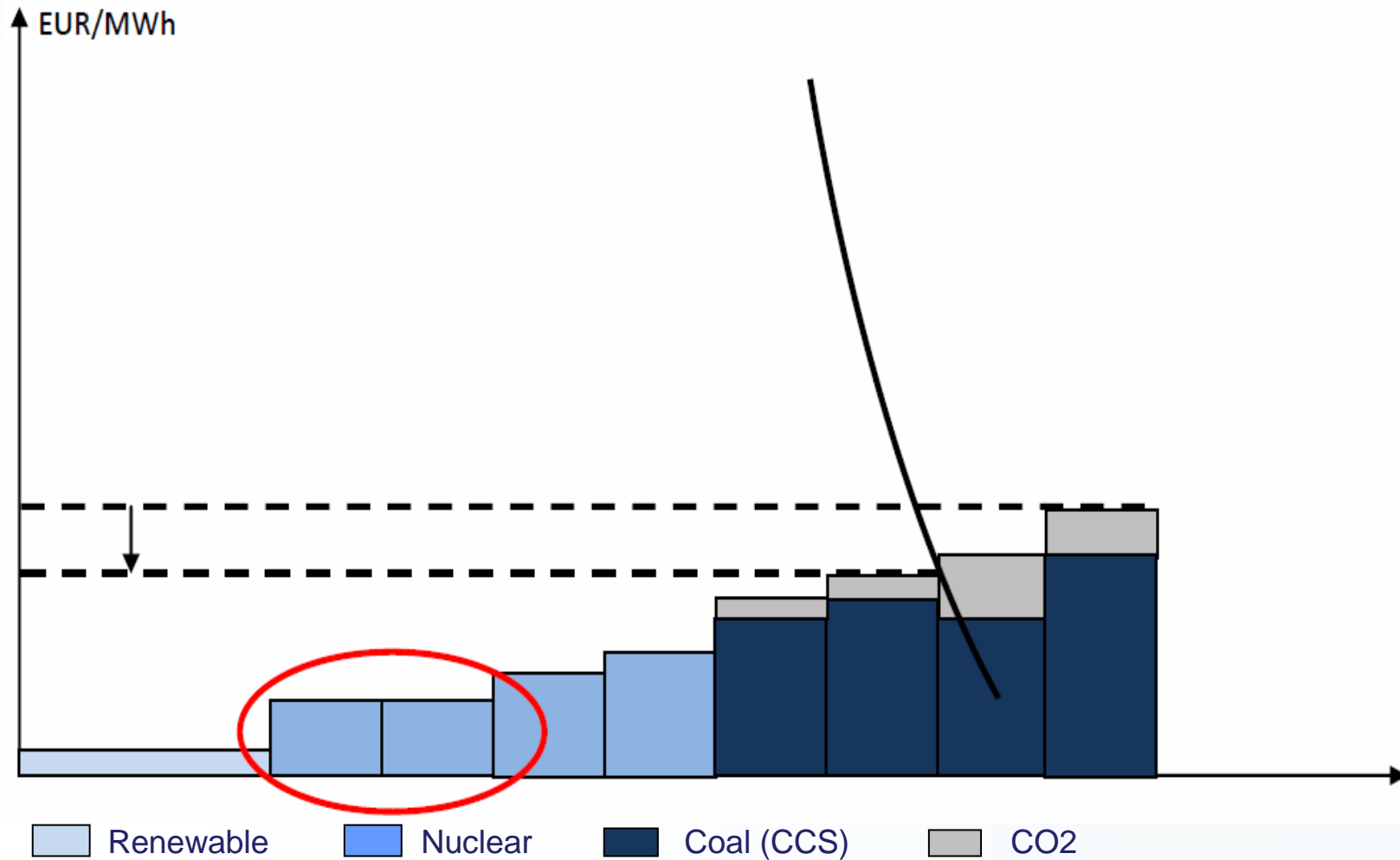
## 2. PRICE-FIXING IN EU ELECTRICITY MARKETS (3/4)

Situation 2: without nuclear → price increases (place of import?)



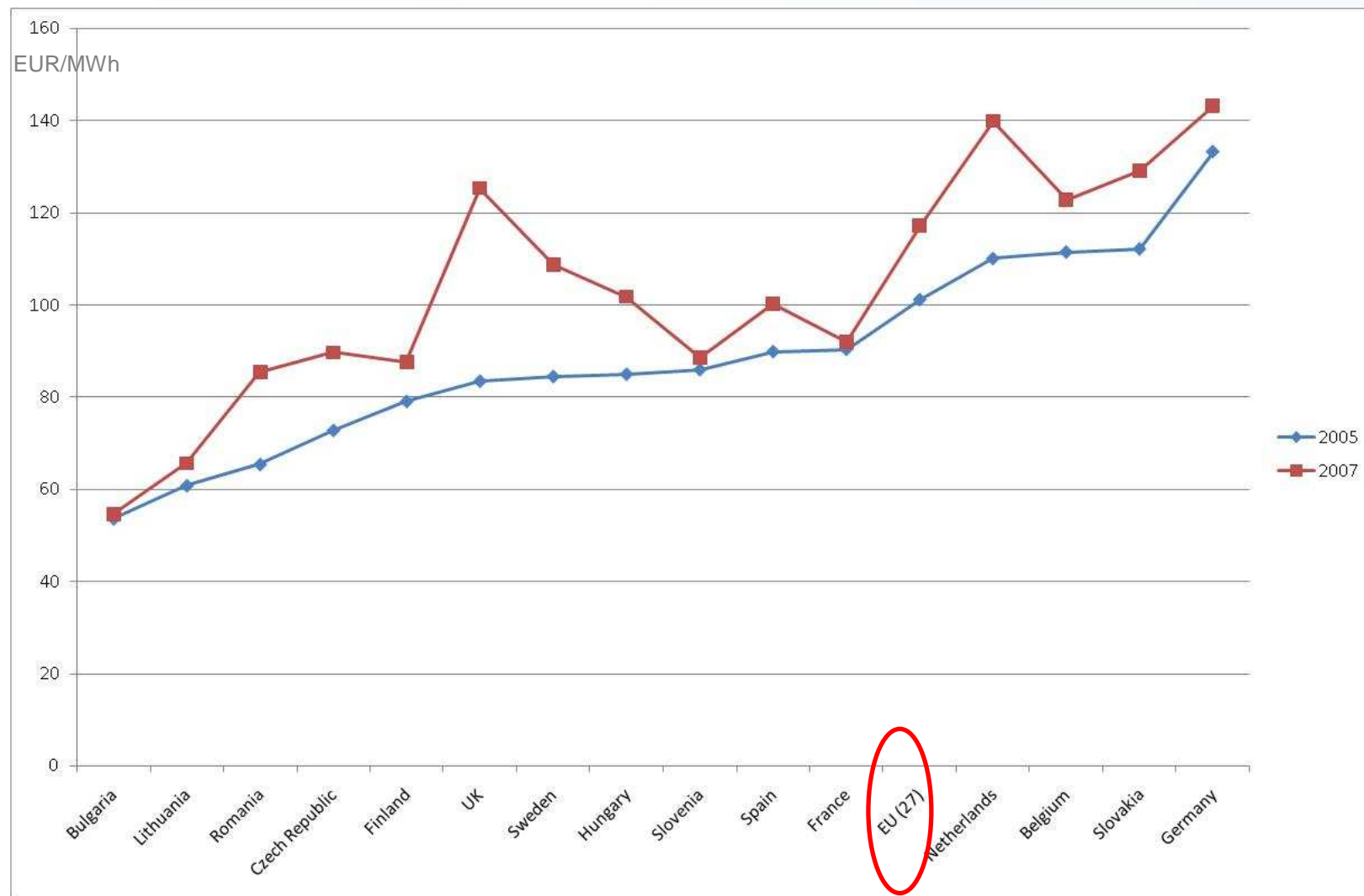
## 2. PRICE-FIXING IN EU ELECTRICITY MARKETS (4/4)

Situation 3: with new nuclear → price decreases



### 3. CASES (1/7)

**Eurostat:** Dc customer for member states with nuclear production units



## 3. CASES (2/7)

### Belgium

#### Production

- 7 nuclear plants: - Doel 1-4; Tihange 1-3
  - Installed capacity: 5,824.5 MW
  - Total production in Belgium: 81.5 TWh of which 45.3 TWh nuclear (56%)
  - Participation in nuclear plants: - Doel 1-2: 100% Electrabel
    - Tihange 1: Electrabel 50% - EDF: 50%
    - Doel 3-4; Tihange 2-3: Electrabel: 89.8%  
SPE: 10.2%
  - Electrabel -> GDF/Suez
  - SPE -> EDF (EC 12/11/2009 approval)

Conclusion: Belgian nuclear park controlled by international groups based in France

- Other production units (STEG, fuel, ...): mainly controlled by Electrabel

#### Suppliers

- Mainly: Electrabel
- Plus: SPE-Luminus
- Marginal: Nuon, Lampiris...

**Conclusion:** Belgium is an extremely concentrated market with limited competition both in production and supply.

### 3. CASES <sup>(3/7)</sup>

#### Belgium

##### - Wholesale:

Belpex electricity exchange: linked to APX (NL) and Powernext (FR)

strong coupling: Belpex was coupled to APX and Powernext 84% of the time

➡ prices on average are very similar (2008)

##### - Industry:

- Contracts based on *wholesale* prices for *base load*
- Contracts based on parameters:  $N_c$  and  $N_e$

##### - Residential:

- Electrabel: parameters:  $N_c$  and  $N_e$
- Luminus: parameter  $I_{em}$

##### - EUROSTAT:

Dc customer (2005 – 2007): Belgium: 111.6 - 122.9 (EUR/MWh)

EU-27: 101.3 - 117.3 (EUR/MWh)

Average price in EUR/MWh (excluding tax) for a Dc customer  
(consumption between 2500 and 5000 kWh)



### 3. CASES (4/7)

## Belgium

- Electrabel: Parameter  $N_c$

The parameter  $N_c$  reflects, in terms of "fuel" tariffs, the change in the cost price of the fuels for electricity production supplied to the Belgian network. Parameter  $N_c$ , updated in March 2004, is calculated according to the following formula:

$$N_c = 0.214 + 0.260 I_{fnu} + 0.375 I_{coal} + 0.240 I_{oil} + 1.195 (1 - I_{fnu}) I_{spot\ gas}$$

$I_{fnu}$ : reliability of the Belgian nuclear park

If Belgium decides to close its nuclear park, the  $I_{fnu}$  parameter eventually will fall to zero resulting in the following formula, if all other factors remain unchanged:

$$N_c = 0.214 + 0.375 I_{coal} + 0.240 I_{oil} + 1.195 I_{spot\ gas}$$

This means that the gas component has a heavier weighting: a high gas price implies a higher final price for the end-consumer.

### 3. CASES (5/7)

➤ Luminus: parameter  $I_{em}$

$$I_{em} = 0.684633 + 0.03856 * DAH311 + 0.006321 * \text{Belpex311} + 0.002479 * \text{Coal311}$$

- DAH311: gas index
- Belpex311: *base load*
- Coal311: coal

Belpex311 (in €/MWh) is the average of the *day ahead Belpex baseload* prices for the 3 months prior to the current month.

Nuclear is included in the fix term 0.684633

#### Conclusion

suppliers' parameters take into account the presence of a nuclear production park

### 3. CASES <sup>(6/7)</sup>

#### France

- Nuclear production capacity:  
59 plants (2004) -> installed capacity: 63.473 MW  
Production: 426.8 TWh -> 78% of total production (549.2 TWh)
- Highly concentrated market
- EUROSTAT:  
Dc customer (2005 – 2007): France: 90.5 - 92.1 (EUR/MWh)  
EU-27: 101.3 - 117.3 (EUR/MWh)
- TARTAM :  
system of (semi-) regulated prices

### 3. CASES <sup>(7/7)</sup>

#### Additional observations

Nuclear-plant owners are generating high profits: (e.g. Study Champsaur)

- Difference between marginal cost compared with market price (gross margin)
- Nuclear plants (historically accelerated) written-off
- Extended lifespan (*windfall profits*)

Options:

- return profits to the end-consumer (price-reduction effect)
- invest profits in green energy projects (e.g.: the Netherlands)
- ...

## 4. CONCLUSION

### **Nuclear energy in the EU:**

- important role in member states' energy mix
  - contribution to climate objectives
  - security of supply
- 
- Relatively low-cost production technology  
(presented costs do not take into account the externalized costs, e.g. insurability of nuclear damage)
  - Effect on price for the end-consumer depending on how the market works

EU Green Paper, p. 3:

*« Only when competitive internal energy markets exist will EU citizens and businesses enjoy all the benefits of security of supply and lower prices »*



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