
The French Power System

Particularities with respect to CO₂ emissions

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The French Power System : Composition

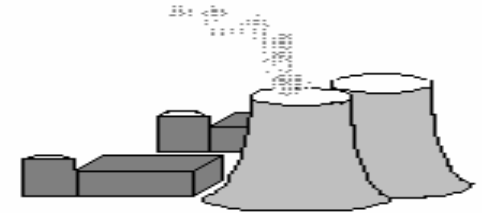
↪ Nuclear (100 % EDF)

63 GW of installed capacity

430 TWh generated in 2005 : **Base Load**

58 units (900 MW to 1500 MW)

Age : 20 years in average (lifetime over 40 years)

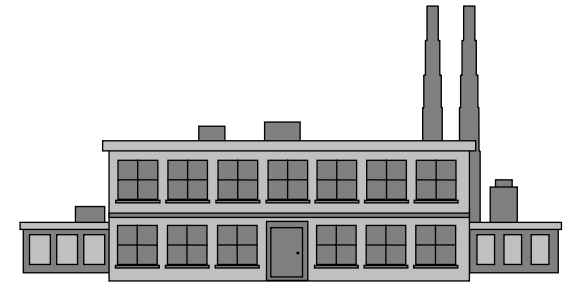


↪ Coal, Oil and Gas

27.5 GW of installed capacity

60 TWh generated in 2005 : **Semi Base, Load following**

34 units EDF + SNET Endesa + CHP



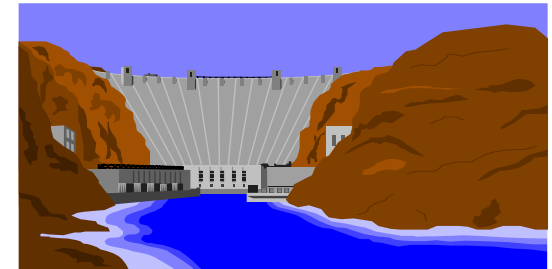
↪ Hydro :

25.4 GW of installed capacity

56 TWh generated in 2005 : **Peak & Fatal**

450 units EDF (over 20 GW) + CNR + SHEM + indép.

Age : 50 years in average (lifetime over 100 years)

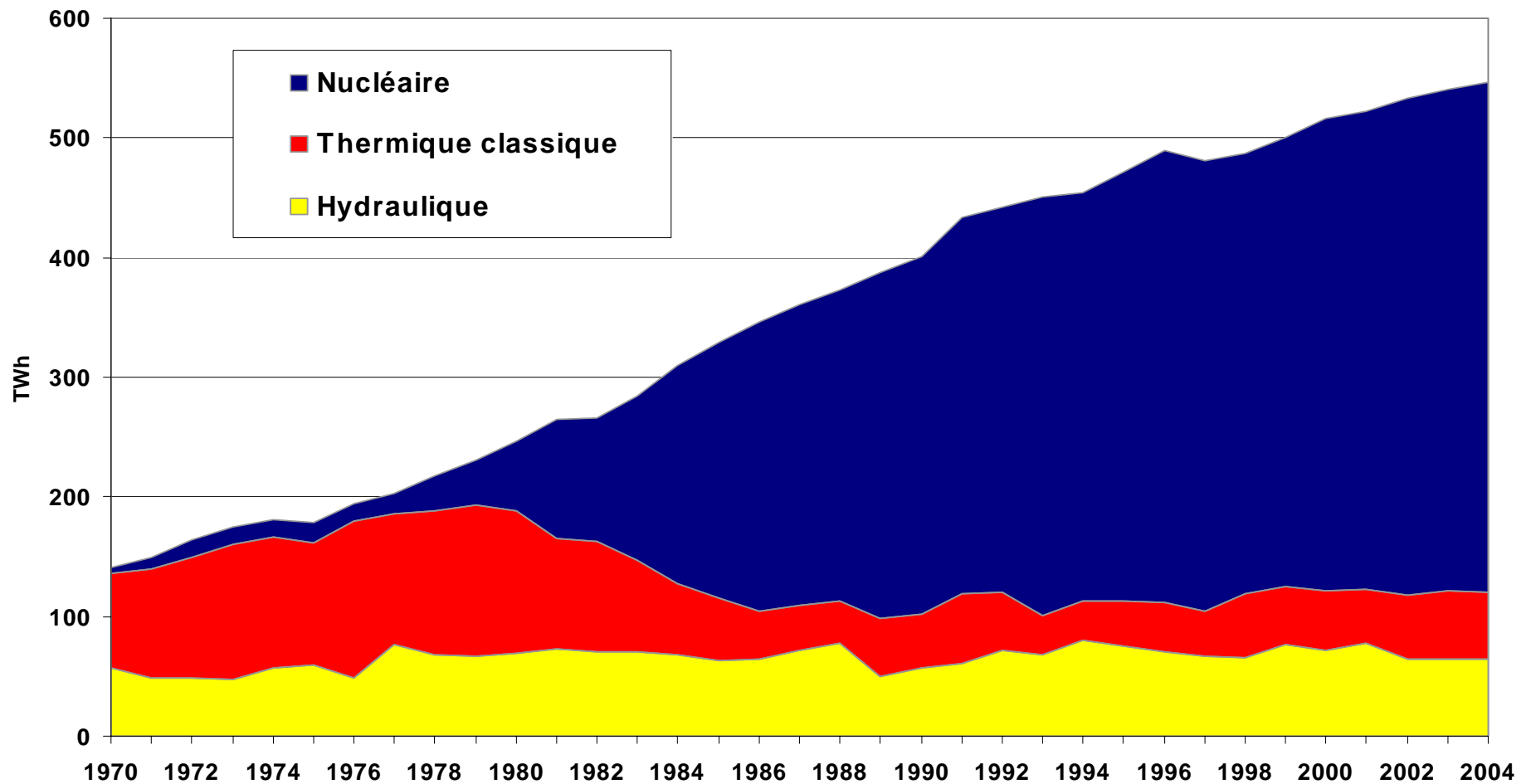


↪ Total

110 GW of installed capacity (**Peak Demand : 86 GW Feb 2006**)

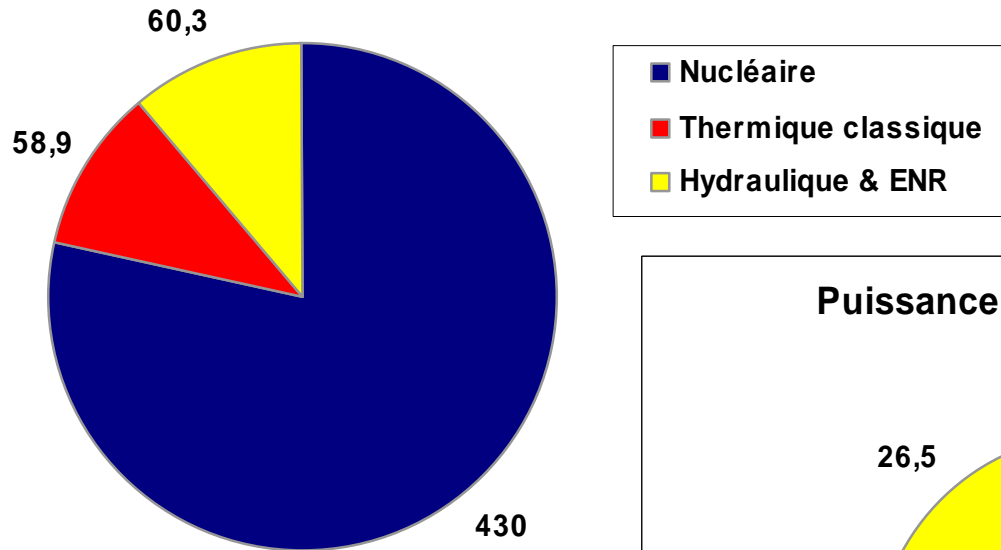
549 TWh generated in 2005 of which 60 TWh exported

Evolution of the mix in the French Power System - 1970-2004

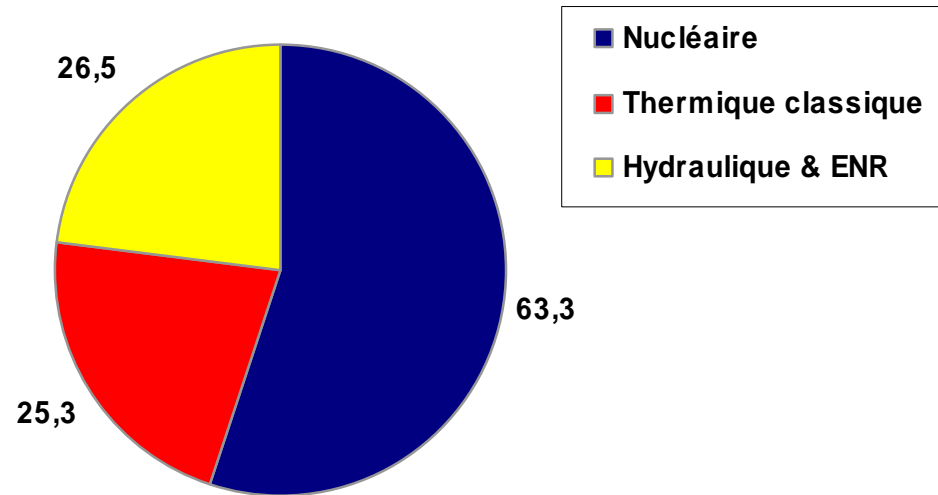


The French Power System : Peak and Base means

Production 2005 (TWh) sur réseau RTE



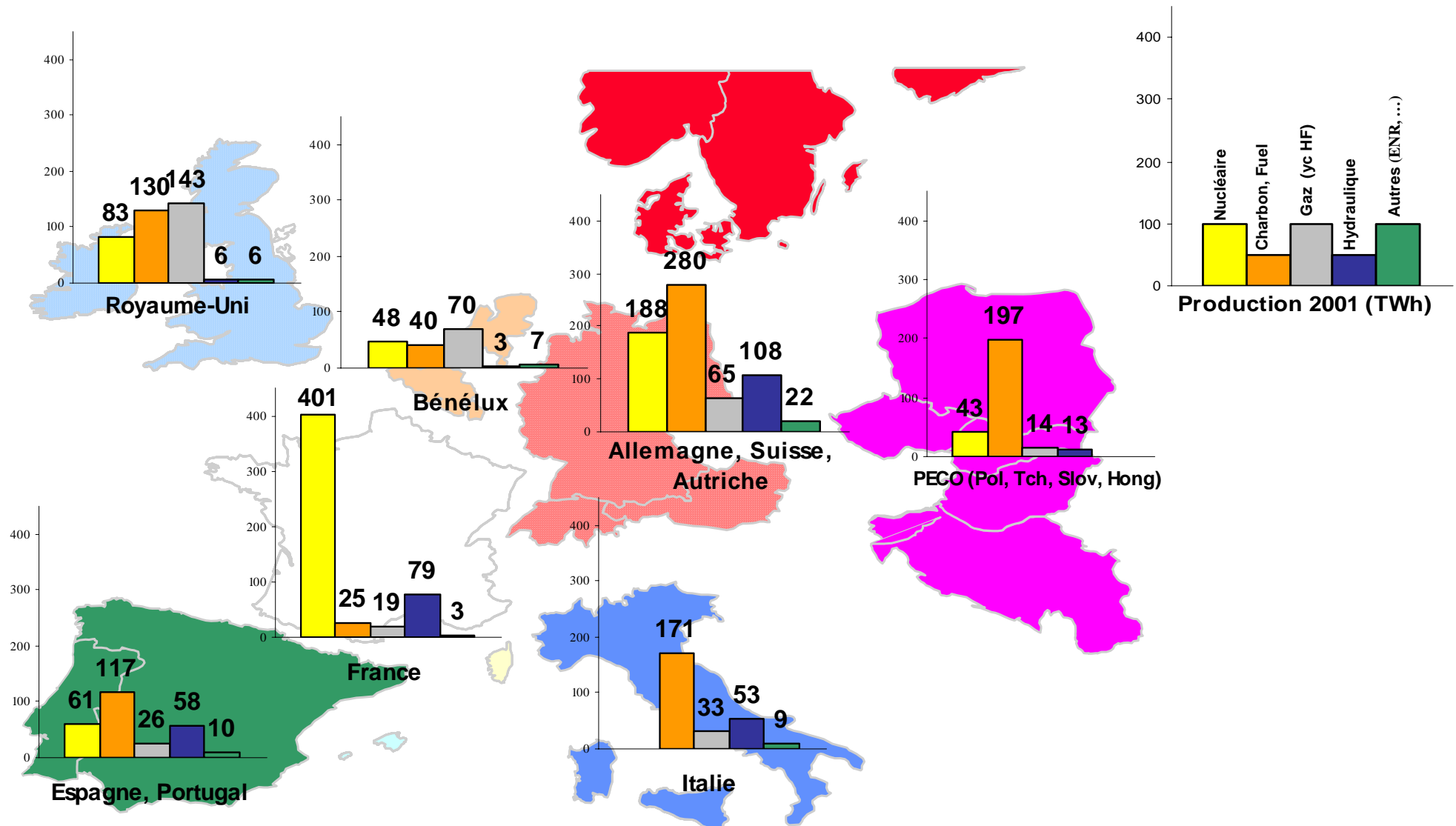
Puissance maximale 2005 (GW) sur réseau RTE



The CO2 emissions of the French Power System depend on many factors

- They depend only on the generation made by coal, and, in a lower measure, by oil plants (France have very few gas plants, used only for high peaks)
- This production depends on several factors :
 - Weather conditions (rain) : hydro production may vary between 55 and 80 TWh (this range is equivalent to 25 Mt CO₂, if produced by existing coal plants),
 - The load factor (Kp) of the nuclear plants, depending on many factors (outages for refueling and/or maintenance, unavailability for safety reasons, ...). The loss of 1% of generation corresponds to 5,5 TWh, thus to 5,5 Mt CO₂,
 - The level of the electrical demand : since nuclear is in base, every TWh of increased demand is satisfied today by coal (mainly) : importance of DSM,
 - The level of exportations : generally French nuclear replaces German coal, English gas or Italian oil plants, but, for instance, German Wind Power or Swiss hydro may replace French Coal or even Nuclear (see next slides),
 - The price of CO₂ permits on the markets (see next slides),
 - In the future, the development of Wind Power and Biomass plants will change the French Power System Mix.

The European « Energy Mix » in Generation

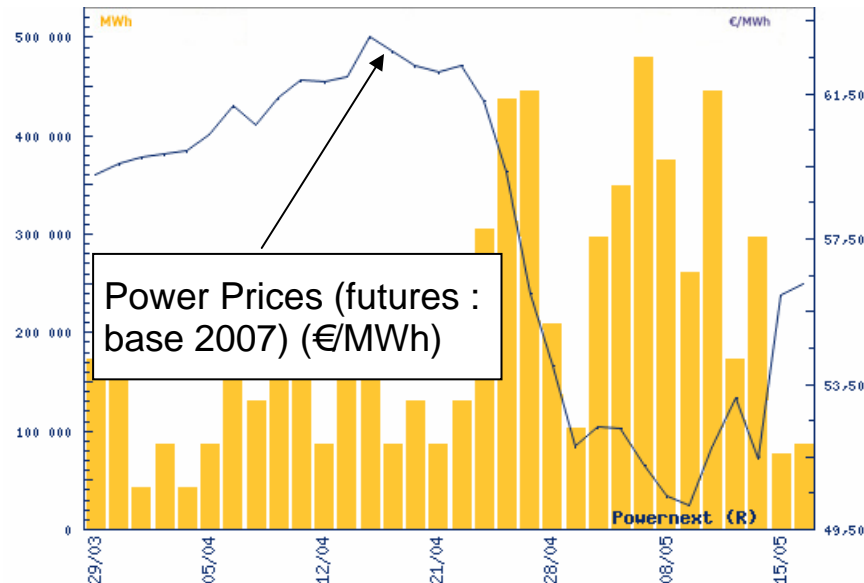
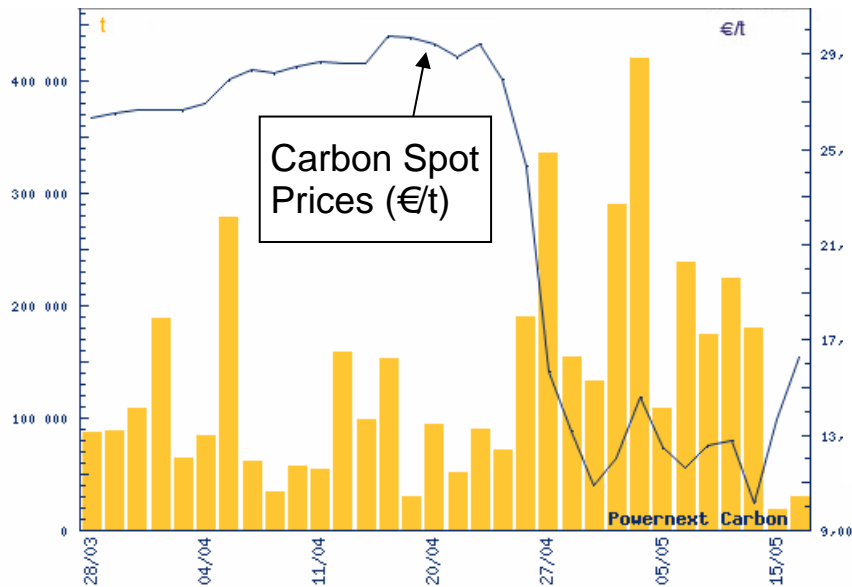


Impact of CO2 price on kWh price : a numerical illustration

	coal	gas
efficiency rate	37%	52%
resource	60 \$/t	5 \$/Mbtu
fuel power price	23,23 \$/MWhe	32,82 \$/Mwhe
fuel power price	18,59 €/Mwhe	26,25 €/Mwhe
CO2 emissions	0,340 t/MWh th	0,202 t/MWh th
CO2 emissions	0,918 t/MWh e	0,388 t/MWh e
CO2 price	20 €/t CO2	20 €/t CO2
CO2 price	18,4 €/Mwhe	7,8 €/Mwhe
fuel price incl. CO2	36,95 €/Mwhe	34,02 €/Mwhe

- Impact of CO2 is important, particularly for coal (the variable cost is doubled)
- At short and mid-term, the system is not flexible, only substitutions of fuels are possible
- Arbitrations are complex : maximizing the expectation of revenues on the two markets :CO2 and MWh

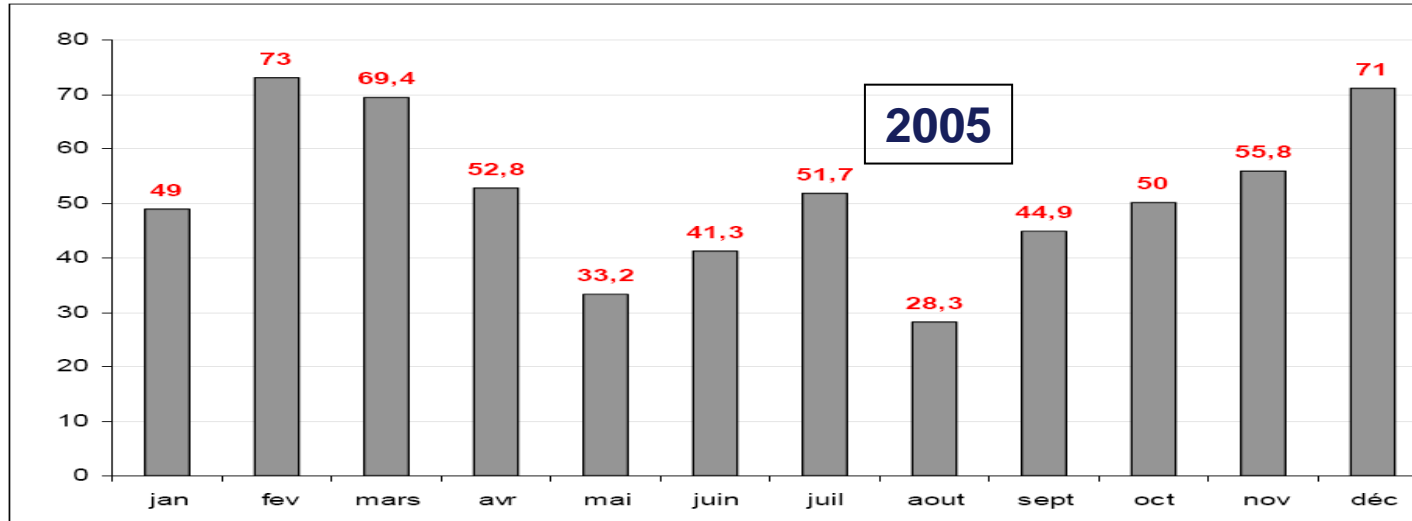
What can be deduced from the drop in CO2 prices April '06 ?



- In April 2006, CO2 prices fell from about 20 €/t CO2
- Power prices followed and fell from about 12 €/MWh
- We can deduce (or better said, the markets think) that the marginal generation means is composed of roughly 50% coal plants and 50% CCGT.

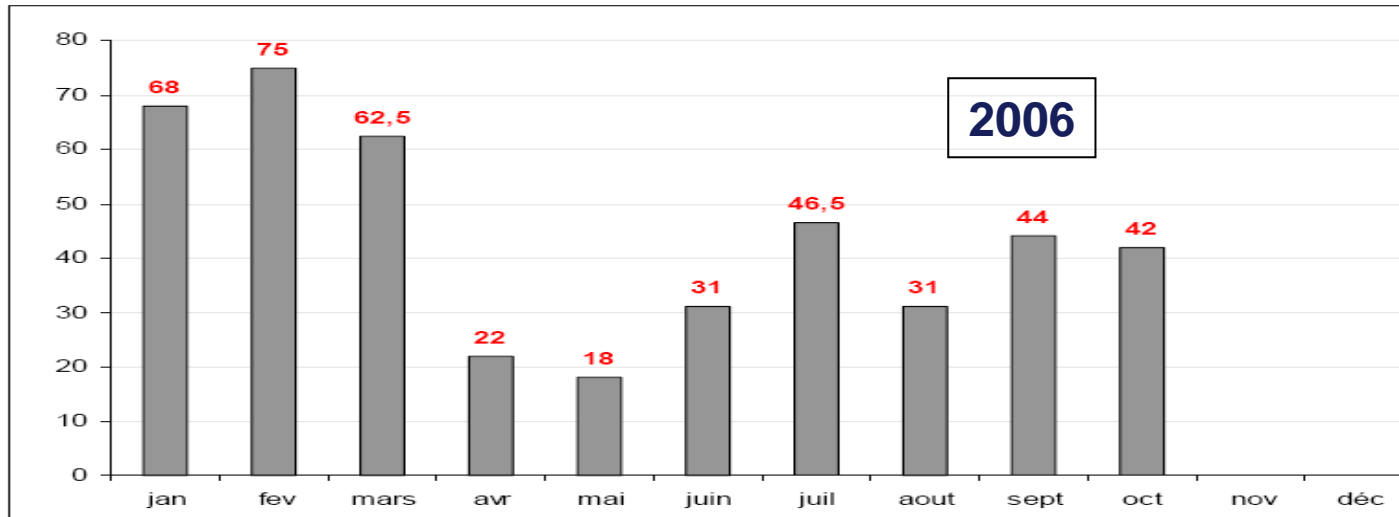
Source : Powernext

CO2 emissions variations in France in 2005 & 2006



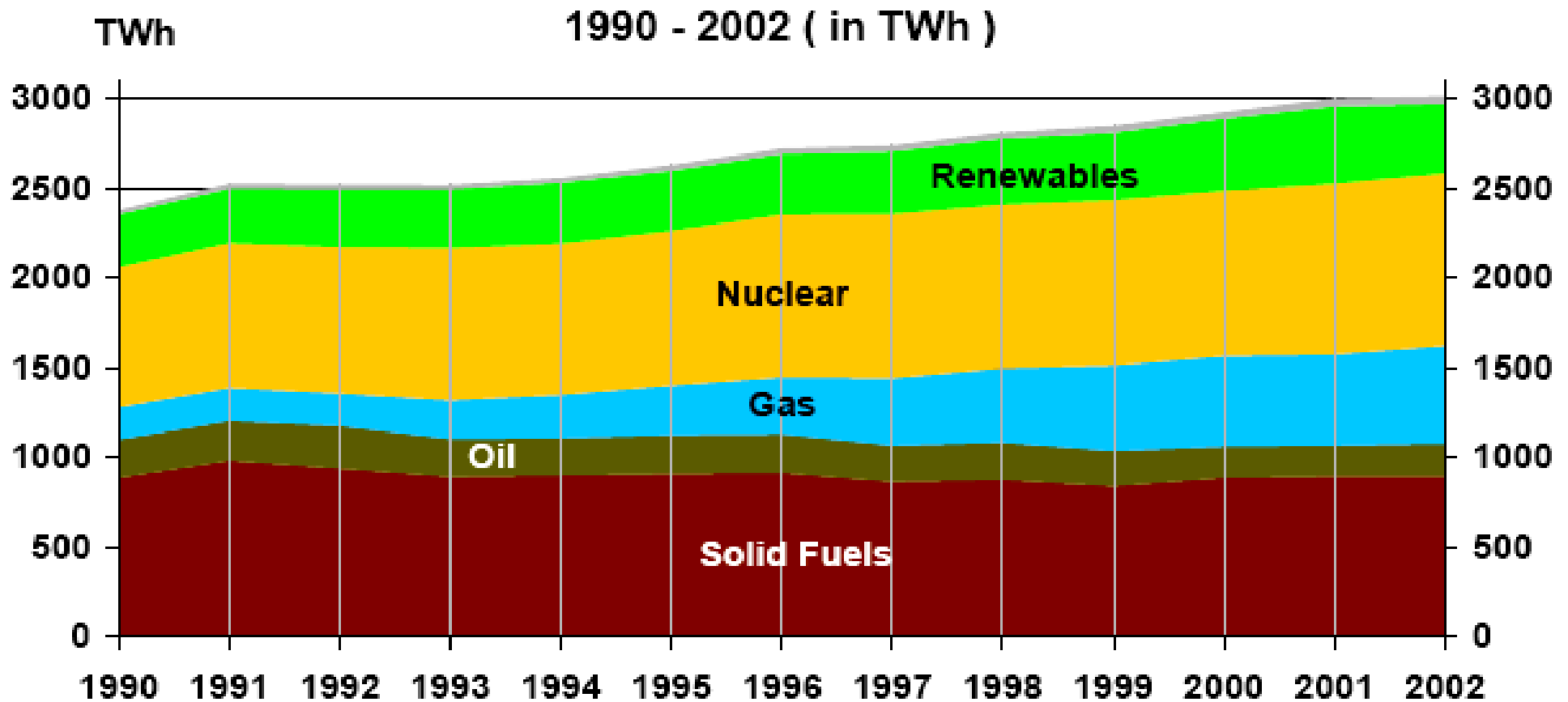
Feb 2005, Dec 2005 & Feb 2006 : cold waves

g CO2 /kWh



Aug 2005, Apr & May 2006 : low demand

Evolution of the Generation in Europe (25) over the 12 last years



What will be the Future at Mid Term ?

Within 20 years (between 2010 and 2030), 250 GW of Power have to be developed in Europe (green paper on European energy, march 2006)

The good question is : by which means ?

