

Energy Transitions in France, Germany and Europe

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Jacques PERCEBOIS

**Professor at the University Montpellier I
(CREDEN/ Art-Dev UMR CNRS 5281)**

THE CONTEXT

- I The World energy demand will increase in the future, largely because of the Asian energy needs (China, India); consequently the price of energy (oil in particular) will remain relatively high**

- II There is a lot of uncertainties, about potential of non-conventional gas and oil reserves, about energy efficiency, about electricity storage, about new technologies for generation (renewables, nuclear) or for transportation (hybrid or electric cars) but all these technologies will be costly**

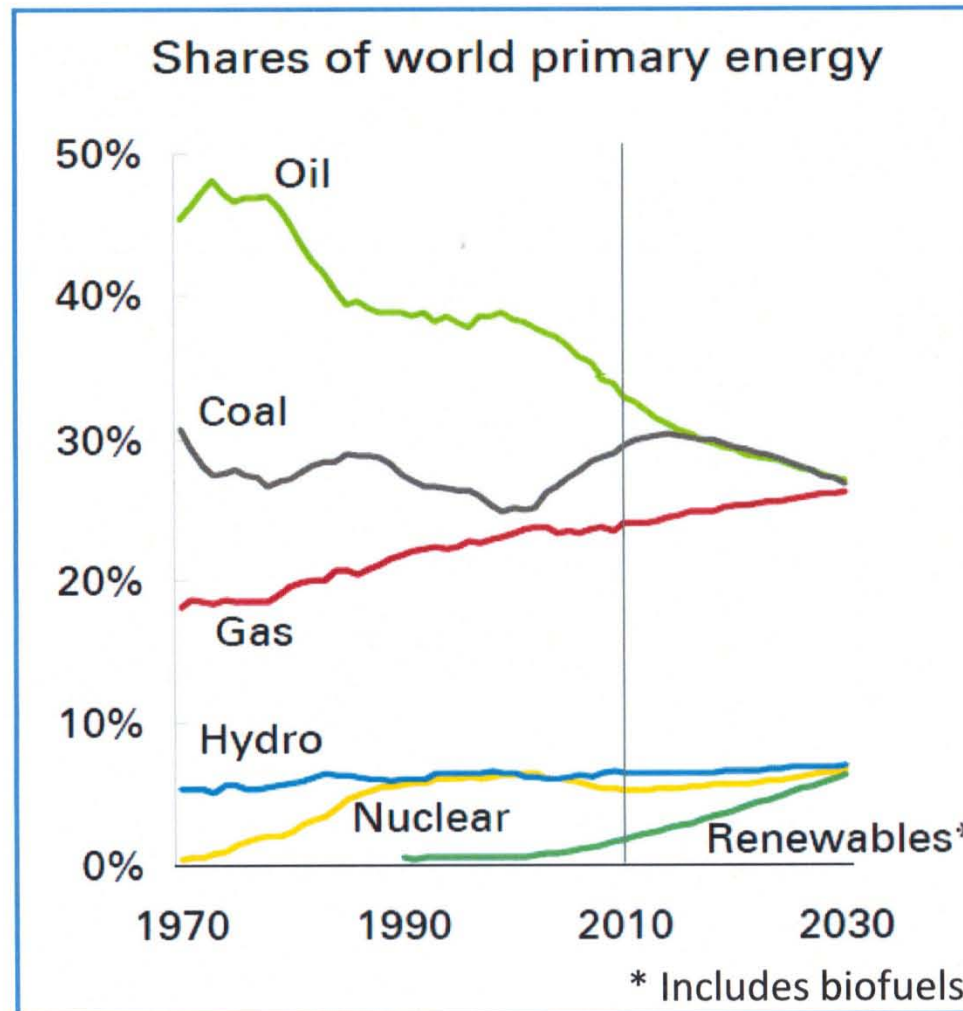
- III Fossil fuels (oil, gas and coal) will keep a major role by the year 2030 (at least 75% of the world primary energy balance, compared to 84% today)**

- IV Whatever the energy choices to be made, it will be necessary to invest a lot (electricity production and transportation, energy efficiency)**

- V The social acceptability of energy choices will be a very important constraint for the energy policy in the future**

2. De quelques (rares) certitudes : le monde comme il va...

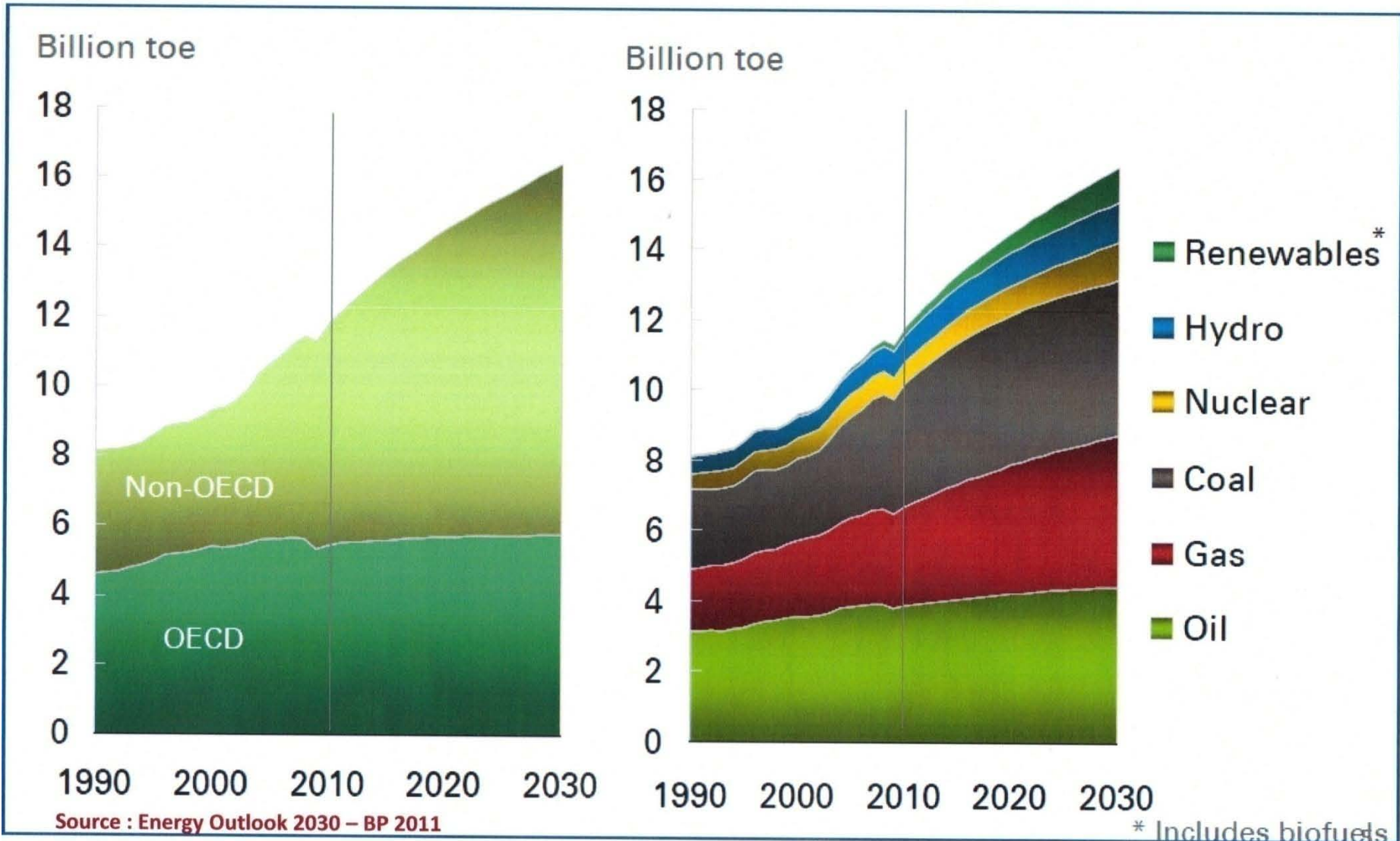
- Le pétrole décroît, le charbon se maintient, le gaz croît.



Source : Energy Outlook 2030 - BP 2011

2. De quelques (rares) certitudes : le monde comme il va...

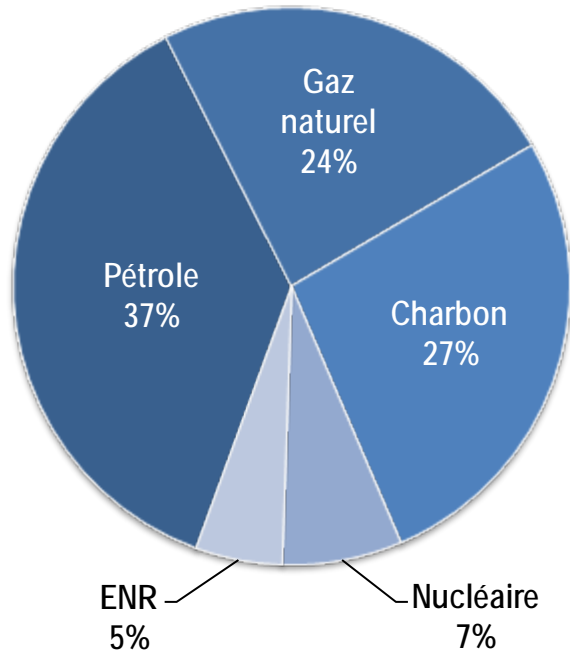
- Les nouvelles économies « tirent » la consommation.



Structure of the Primary Energy Consumption

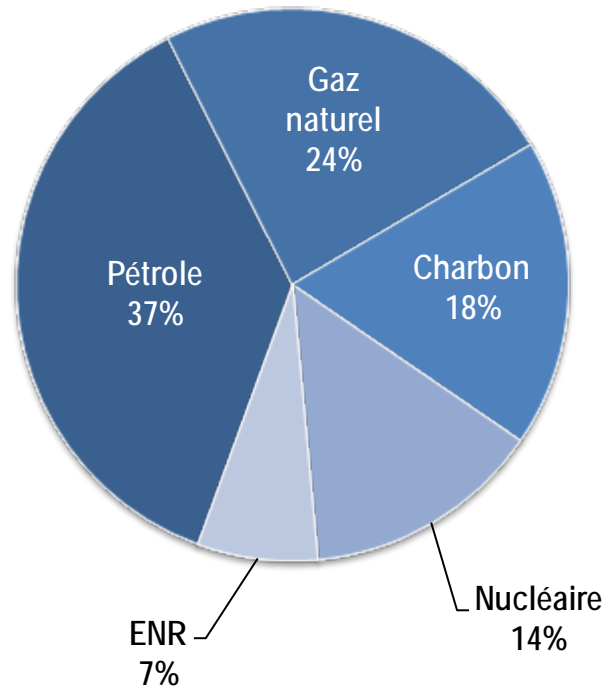
(2010 figures , wood excluded)

World
(12 800 Mtep)



Avec le bois, la part des énergies renouvelables passe à 10 %.

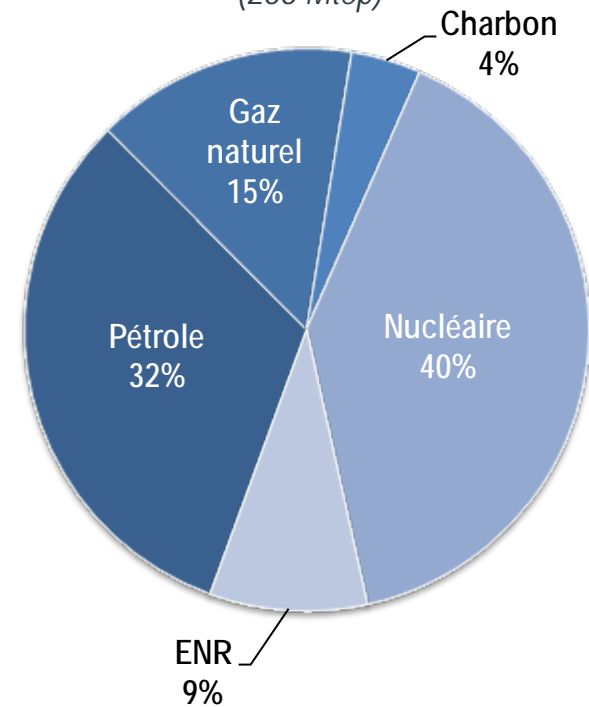
E.U.27
(1 850 Mtep)



TAUX DE DÉPENDANCE : 56 %

- Pétrole : 75 % importé
- Gaz naturel : 60 % importé
- Charbon : 40 % importé

FRANCE
(266 Mtep)



TAUX DE DÉPENDANCE : 51 %

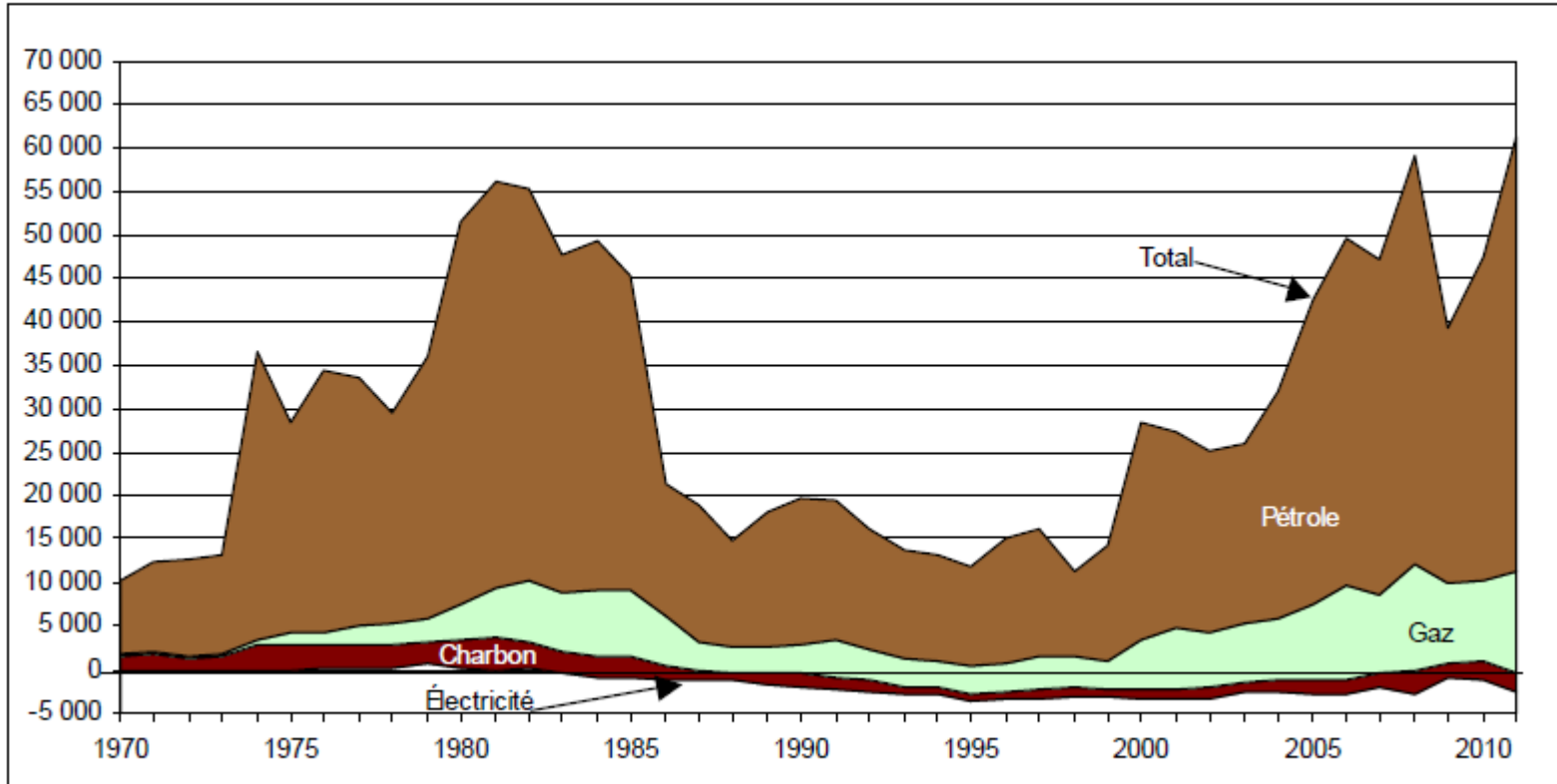
- Pétrole : 99 % importé
- Gaz naturel : 97% importé
- Charbon : 100 % importé

Energy bill of France

(net energy imports represent about 60 billion euros in 2011)

La facture énergétique déclinée par type d'énergie

En millions d'euros 2011



Source : SOeS d'après Douanes

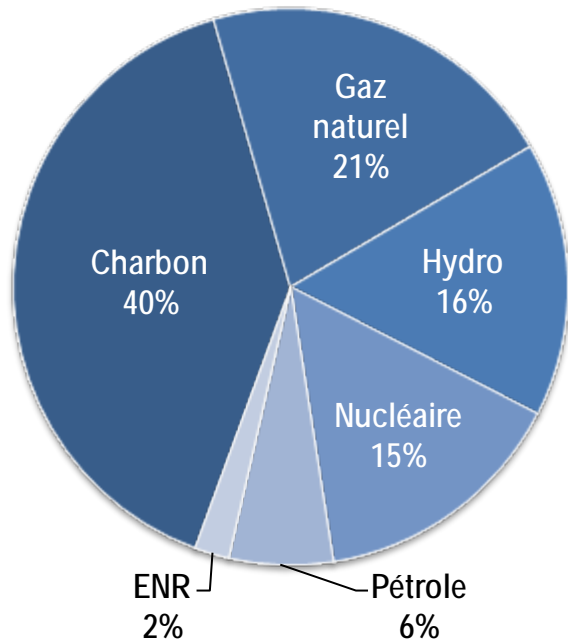
Structure of the Final Energy Consumption in France in 2010 **(Final Energy is only 60% of the Primary Energy due to losses)**

- **Structure by sector:**
 - Households and tertiary sector: 43%
 - Transportation: 31%
 - Industrial sector (+ agriculture): 26%
- **Structure by type of energy:**
 - Oil products: 49%
 - Electricity: 22%
 - Natural gas: 21%
 - Renewables (hydro excluded): 3%
 - Coal: 5%

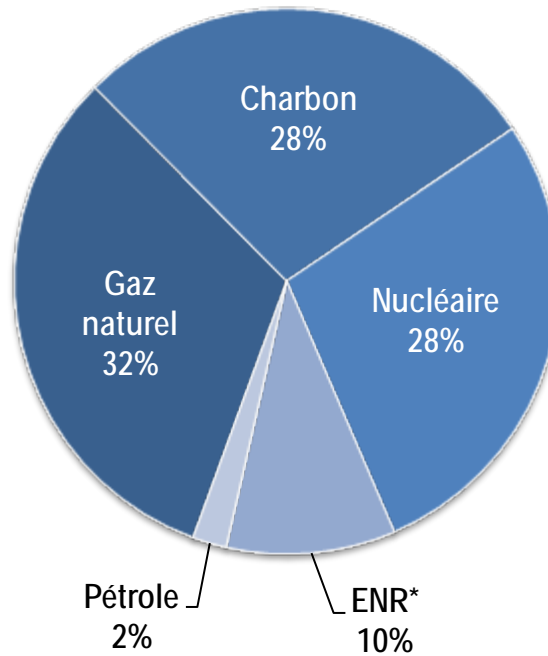
The STRUCTURE of ELECTRICITY PRODUCTION.

(2010 statistics)

GLOBAL
(19 771 Mtep)

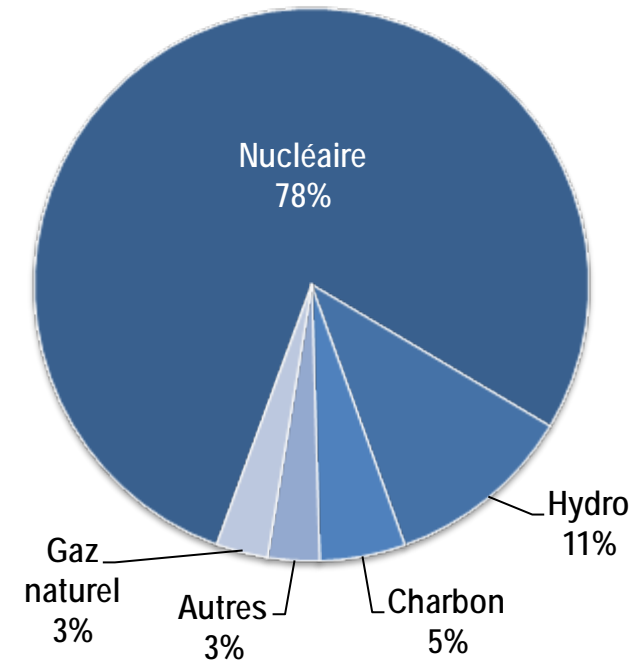


EU 27
(3 370 TWh)



* Including hydraulic power

France**
(574 TWh)



** EDF provides 90 % of production followed by CNR and ENDESA.

The French Paradox

The European Commission wants to introduce more competition into the European electricity market

But the low electricity prices set by the incumbent EDF prevent its competitors from breaking into the French market, due to the low cost of nuclear electricity compared to the higher cost of electricity produced from gas and coal. It is the reason why the competitors may buy nuclear electricity directly to EDF (only 25% of nuclear production) at a regulated (low) price (called ARENH)

The French power sector has a special status in Europe for two reasons: its proportion of nuclear energy is very high (75% to 78% of power production) and the price of electricity remains largely controlled by the government. There is a dual system for electricity pricing:

- regulated electricity tariffs fixed by the government and set largely according to the production cost of nuclear energy (TRV)**

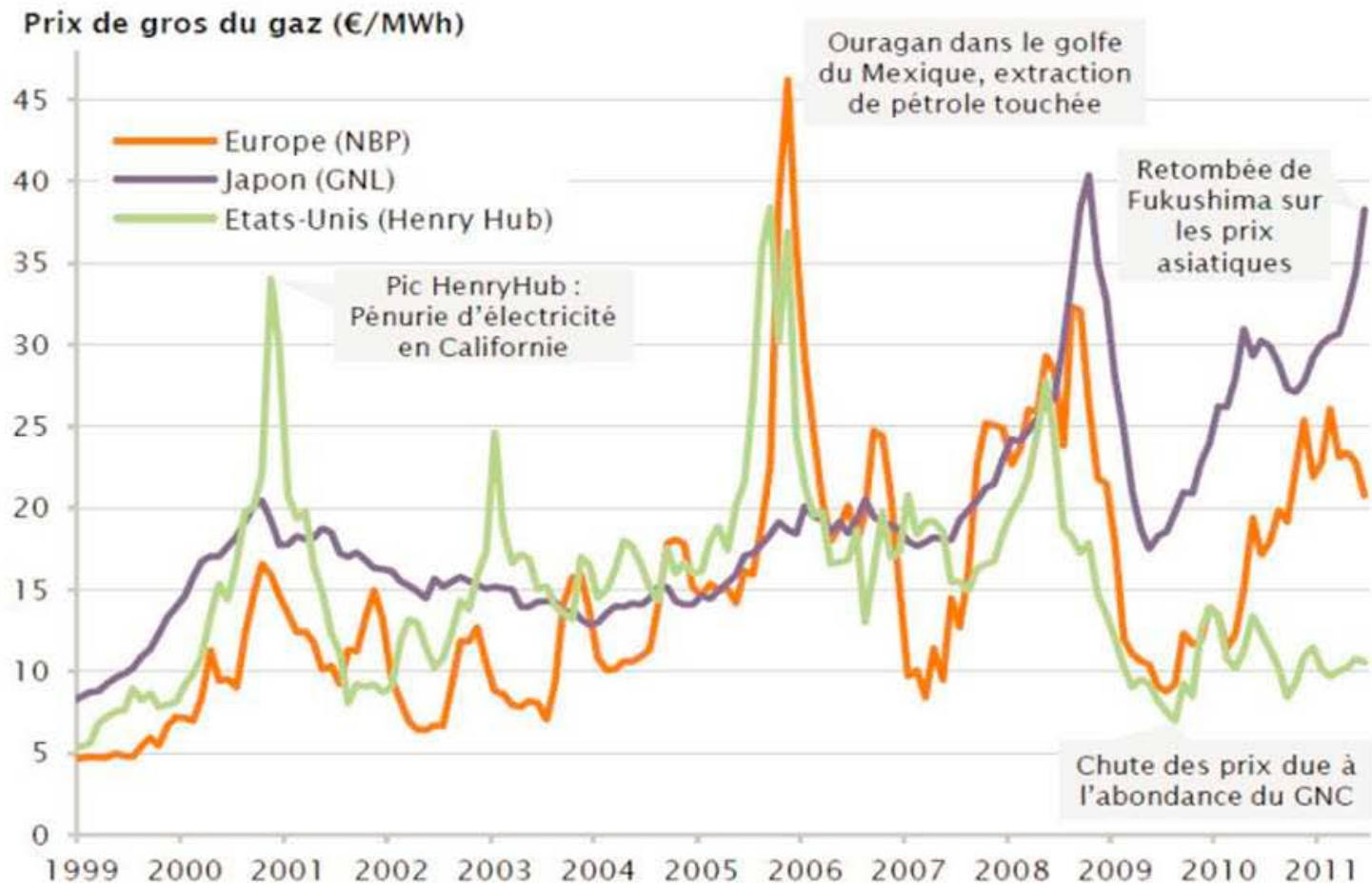
- market electricity prices paid by customers who have exercised their eligibility and largely correlated to the higher prices observed on the European wholesale electricity market (O.M.)**

We may observe such a system (duality of prices for the end-user) in several European countries

ELECTRICITY SPOT MARKET

- Electricity prices on the day-ahead market are highly volatile.
- On average the price is around 40 to 45 Euros/ MWh in off-peak periods and 60 to 75 Euros/ MWh at peak times in Europe (these prices do not take network third party access charge or taxes into account).
- During heat-waves or extremely cold periods, these prices can reach 3000 Euros/MWh (as was the case on 19 October 2009). The market mechanism has indeed rediscovered the notion of failure costs...
- **The electricity price on the spot market is today relatively low for 3 reasons:**
 - Economic crisis, i.e. a cut of electricity demand
 - Very low coal prices due to an excess of shale gas in the US :US shale gas turns US coal out the generation sector and this US coal, which is now exported, turns the European gas out the generation sector in Europe
 - An excess of renewable electricity (with high average cost paid trough FIT but with a very low marginal cost on the spot market)(N.B. The price of natural gas (largely indexed on oil prices) remains high in Europe)

Différentiel de prix entre les États-Unis, l'Europe et le Japon



Source : Gas in Focus

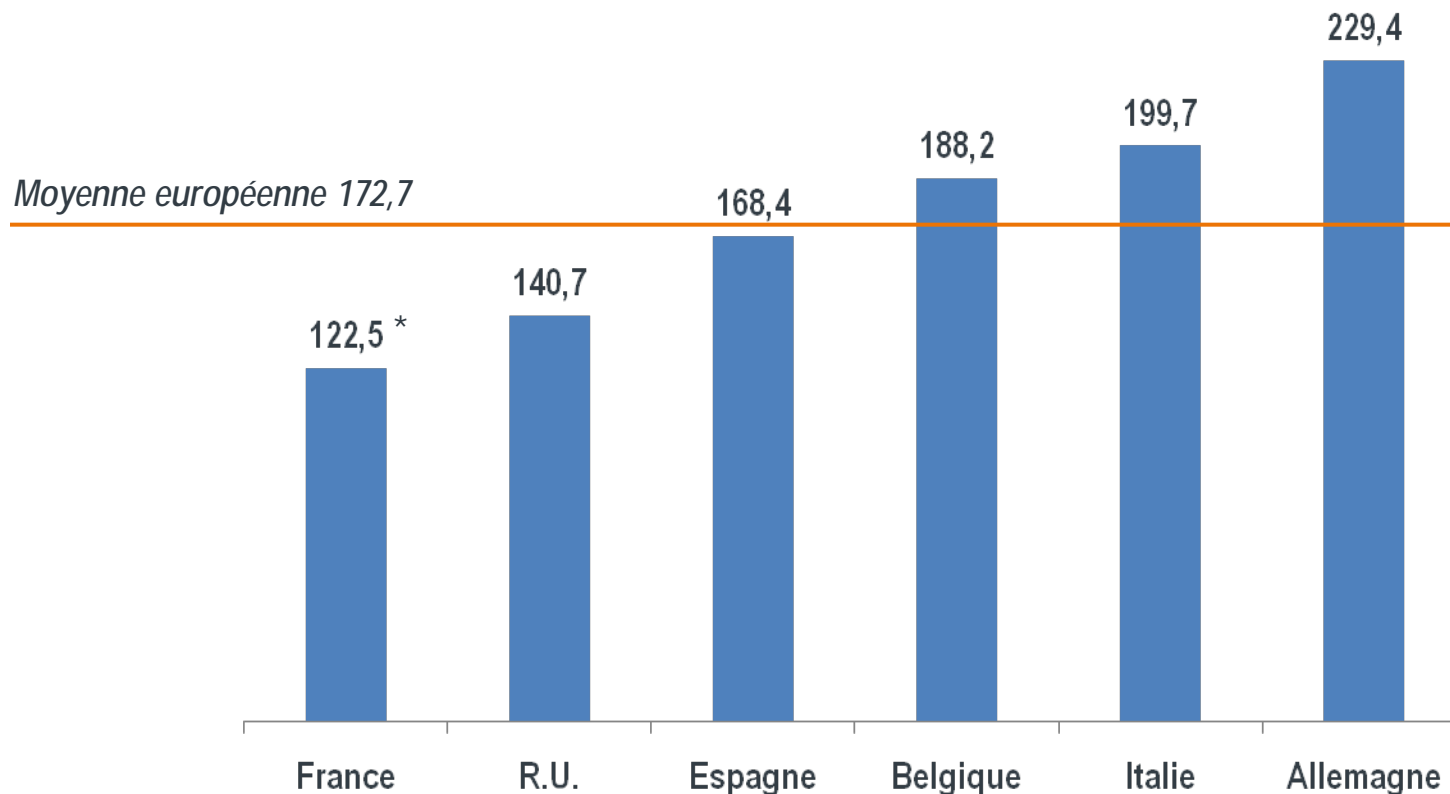
French electricity costs (Euros/MWh, 2012)

(average production costs)

(networks tolls and taxes excluded)(source: « Energies 2050 », 2012)

Power station types	Euros/MWh
Hydro-electricity	30 - 40
Nuclear (PWR) (existing fleet)	40 – 50 (75 to 100 for new nuclear EPR)
Coal (\$85/ton)	55 - 70
Natural gas (combined cycles) (\$ 12/MBTU)	70 - 80
On-shore wind	80 (feed-in tariff)
Off-shore wind	200 (feed-in tariff)
Solar (photovoltaïc)	250 – 400 (feed-in tariff)

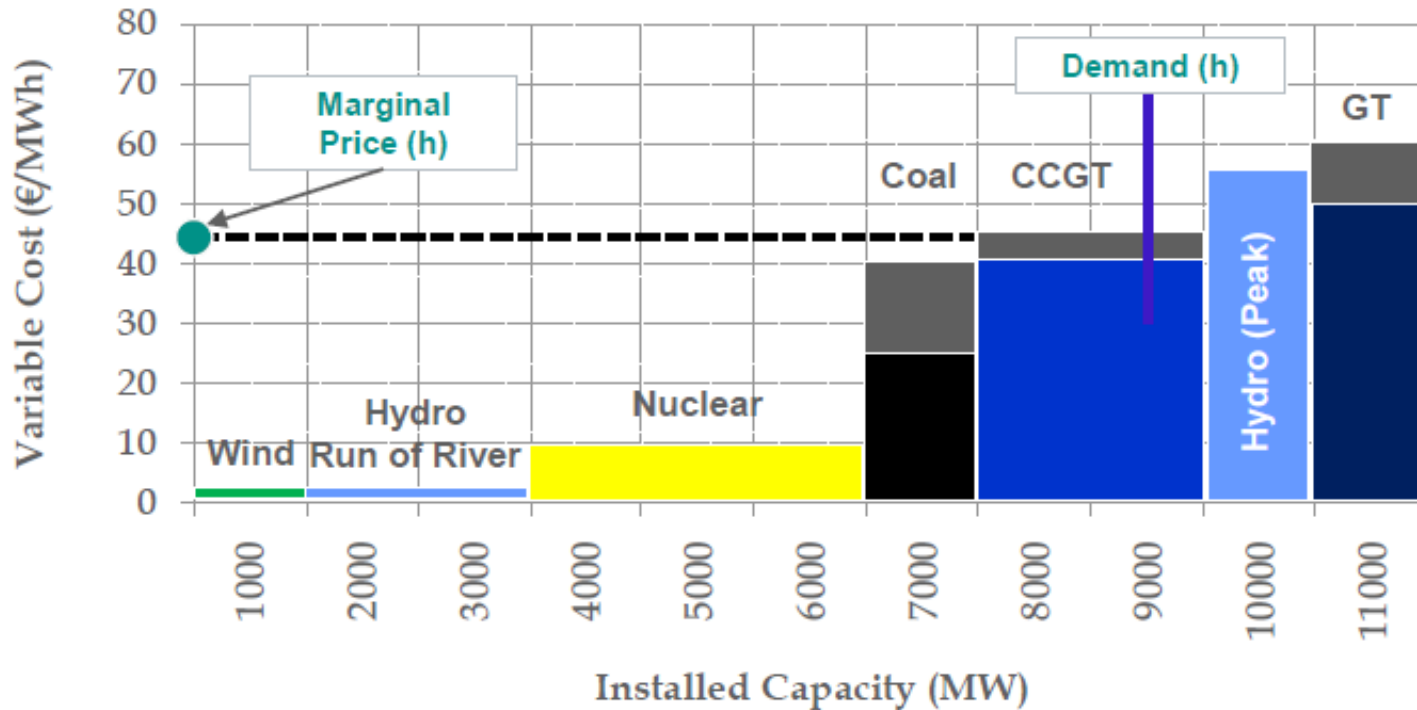
MWh paid by households in Europe (all taxes included) in 2010 (TRV in France, for a consumption of 2500 to 5000 kWh, euros)



* 126,2 après la hausse de 3% en août 2010 soit 12,62 c€/kWh

Market Electricity Pricing on the Spot

- The electricity price is always based on the marginal cost when electricity demand changes (merit order logic)
- With such a pricing system, fixed costs are recovered during peak periods when, for instance, nuclear kWh is sold on the base of the marginal cost of a thermal kWh



Source : CEEME, GDF Suez

**The best scenario for the future in France?
FRENCH MINISTER' s ORDER (former government 2012)**

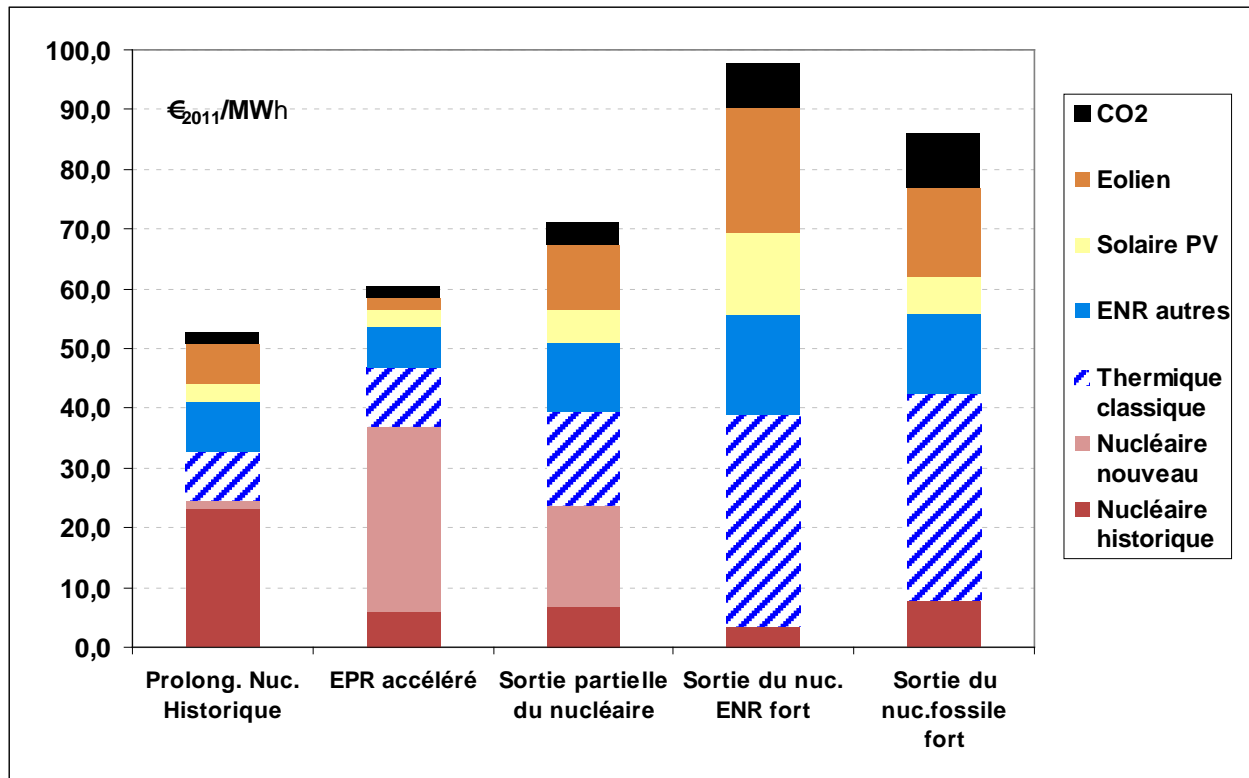
**Analysis of several scenarii about primary and final energy in France by the
years 2030 and 2050**

(« Energies 2050 » Commission chaired by Jacques Percebois and Claude Mandil)

With a focus on 4 hypotheses concerning electricity generation :

- 1) Rapid switch from second generation of nuclear power stations (PWR, 58 reactors in France) to third generation of power stations (EPR). The life of the existing park will be limited to 40 years, no more**
- 2) Extension of life expectancy of the existing park to 60 years (but new investments are required, about 55 billion euros)**
- 3) Reduction of the part of nuclear energy to 50% of electricity production by the year 2050 (50% of existing reactors replaced by renewables or gas power stations and 50% of nuclear reactors replaced by EPR when they are 40 years old)**
- 4) Total phase-out of nuclear by the year 2050. When a reactor is 40 years old, it is stopped and replaced by renewables or gas power stations.**

Electricity Production Cost (€/MWh) by the Year 2030



Source : Energies 2050

- Hors dépenses de réduction de la demande et hors coûts de réseau (raccordement et renforcement)
- Incertitudes inhérentes à l'exercice : coût des EnR, du nucléaire, du gaz,...

Recommendations of the Commission « Energies 2050 »

- **1. The best solution is to increase life expectancy for nuclear power stations (40 to 60 years). It is the less expensive solution (« No regret Strategy »)**
- **2. Such a solution should allow us to wait for new efficient technologies tomorrow (for renewables but also new nuclear reactors, i.e. generation IV with « Astrid » project)**
- **3. Priority to energy efficiency (transportation and building sectors) but efficiency is expensive (for old buildings in particular)**
- **4. Necessity to conciliate priority to nuclear with the development of renewable energies (wind and P.V.)**

Perspectives for Renewable Energies in France

- **The target: 23% of R.E. in the electricity mix by the year 2020**

- **The target by the year 2020: 19 000 MW on-shore wind, 6 000 MW off-shore wind, 5 400 MW P.V.**

- **Situation in 2012 in France (Wind)**
 - 7 182 MW on-shore wind (feed-in tariffs about 82 euros/MWh)
 - Auctions : 3000 MW off-shore in 2011 (bidding: 150 to 180 euros/MWh)
 - France :3th position in Europe
 - Régions: Picardie, Centre, Languedoc-Roussillon, Champagne-Ardenne, Bretagne, Lorraine,.

- **Situation in 2012 in France (P.V.)**
 - 3209 MW P.V. (feed-in tariffs)
 - 5th position in Europe
 - Régions: Aquitaine, Midi-Pyrénées, Languedoc-Roussillon et PACA

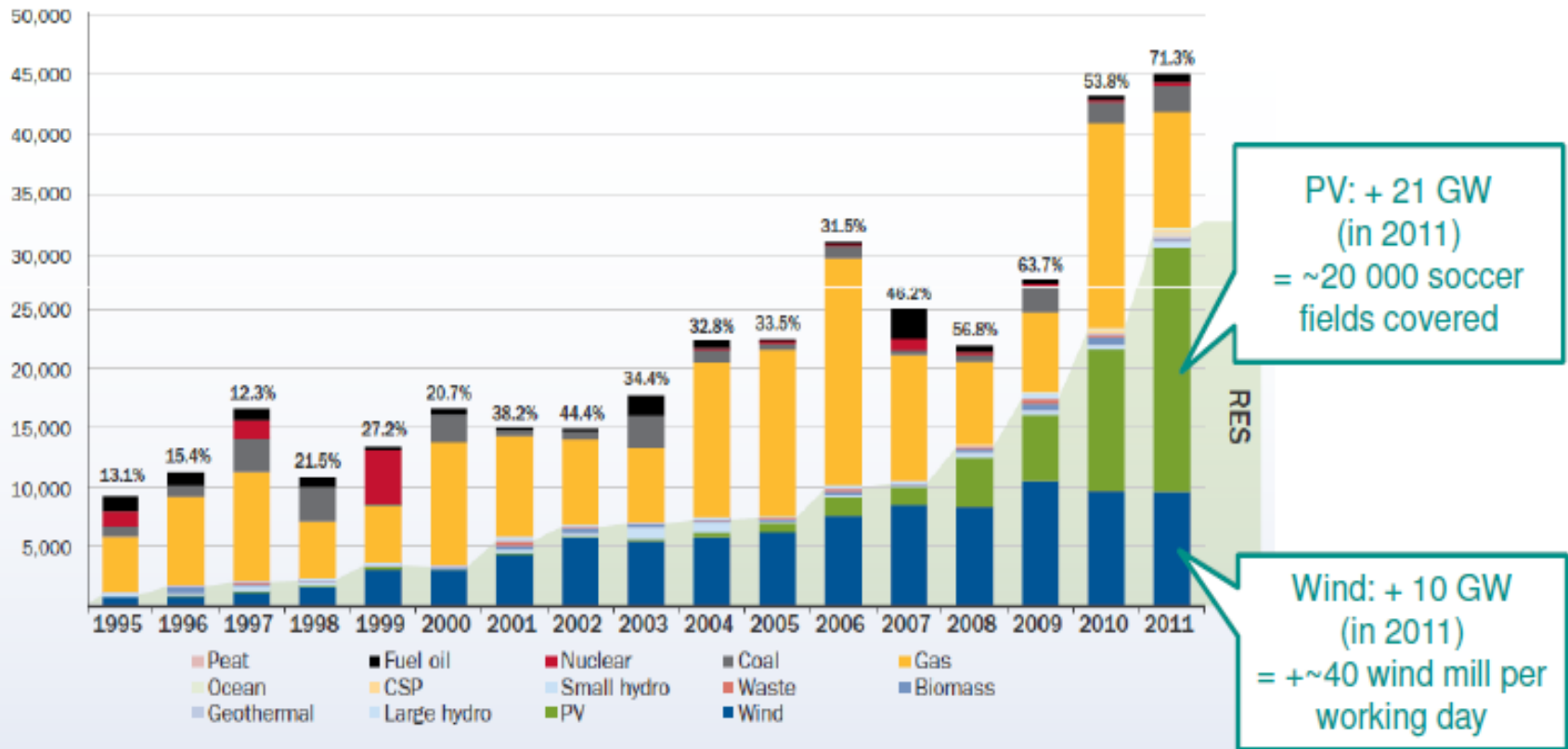
Two factors shouldn't be underestimated

(Compulsory Target: 20% of Renewables in the energy balance by the year 2020 in Europe)

- **1) Breakdown of the electricity price: 40% (generation); 35% (access to transport and distribution); 25% (taxes, CSPE included)**
- **2) It is necessary to take into account the cost of the « back-up » due to intermittence of the renewable power stations (euros 5 to 25 /MWh according to estimates of IAE?). The main system implemented in Europe to promote Renewables Energies (Wind and Solar) is the « feed-in tariffs » system... very profitable feed-in tariffs compared to the electricity price observed on the spot market. The overcost (difference between the feed-in tariff and the spot price) is paid on the bill by all the electricity consumers through taxation (CSPE in France)**
- **3) A large proportion of investments in electricity capacity in Europe is now about R.E. (71% in 2011)**

EU Installed Power Generating Capacity per Year and R.E. Share (%)

EU Installed Power Generating Capacity Per Year (MW) and RES Share (%)



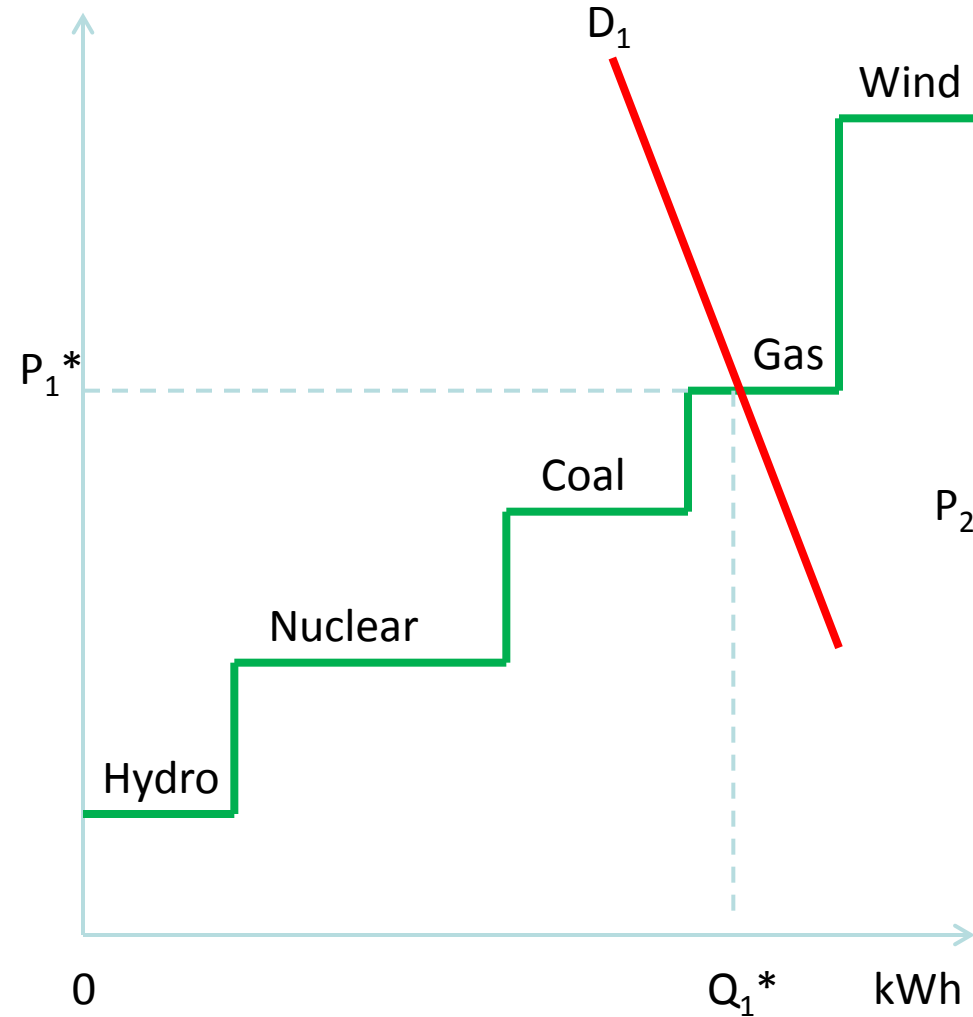
Source: EWEA Statistics 2011, February 2012

Estimates assuming 1kWc= 8m² (Paris), 1 wind mill = 2 MW, soccer field= 7266m²

Perverse effects: negative prices on the spot market (on the spot the price is based on the marginal cost i.e. the operating cost of the marginal power station)

- **The emergence of negative prices for electricity on the European spot market is the consequence of the vast development of wind power, notably in Germany. This is the result of a dual phenomenon:**
 - **a low demand for electricity during off-peak periods (at night)**
 - **strong winds which run the wind turbines at full capacity**
- **Wind power has priority on the network with purchase obligation at lucrative feed-in tariffs by the incumbent. Stopping the wind power stations is prohibited. Stopping some thermal power plants (coal or gas) for short periods is too costly and consequently it is better to sell this renewable electricity at negative prices. It is important to remember that electricity cannot be stored easily...**
- **So, some operators (dam owners in Switzerland in particular) are paid to buy up this surplus electricity, with which they work pumps to fill reservoirs. They can produce electricity at peak times when the spot price is high, selling to Italian consumers among others (such a situation was observed several times in Germany and once in France at the beginning of January 2012)**

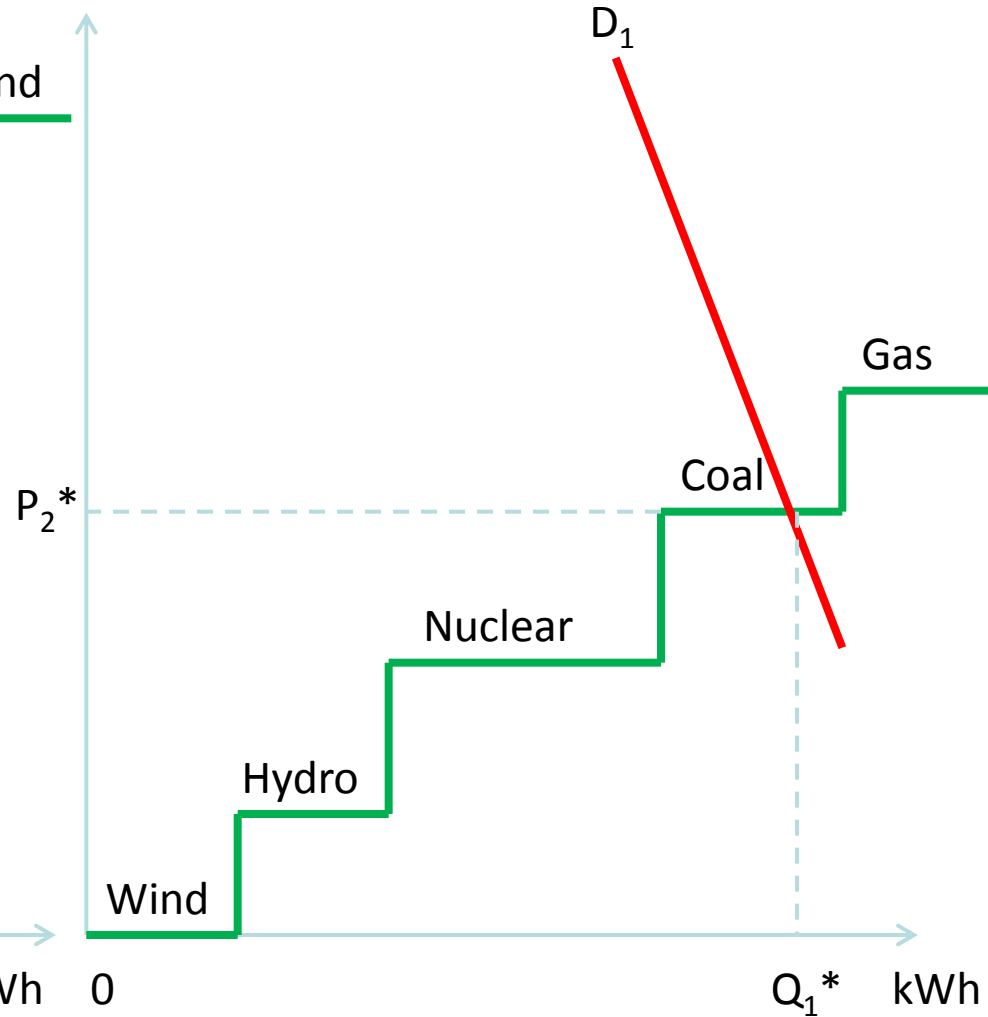
Costs



Market price **based on AVERAGE costs of electricity**

$(Q_1^*; P_1^*)$

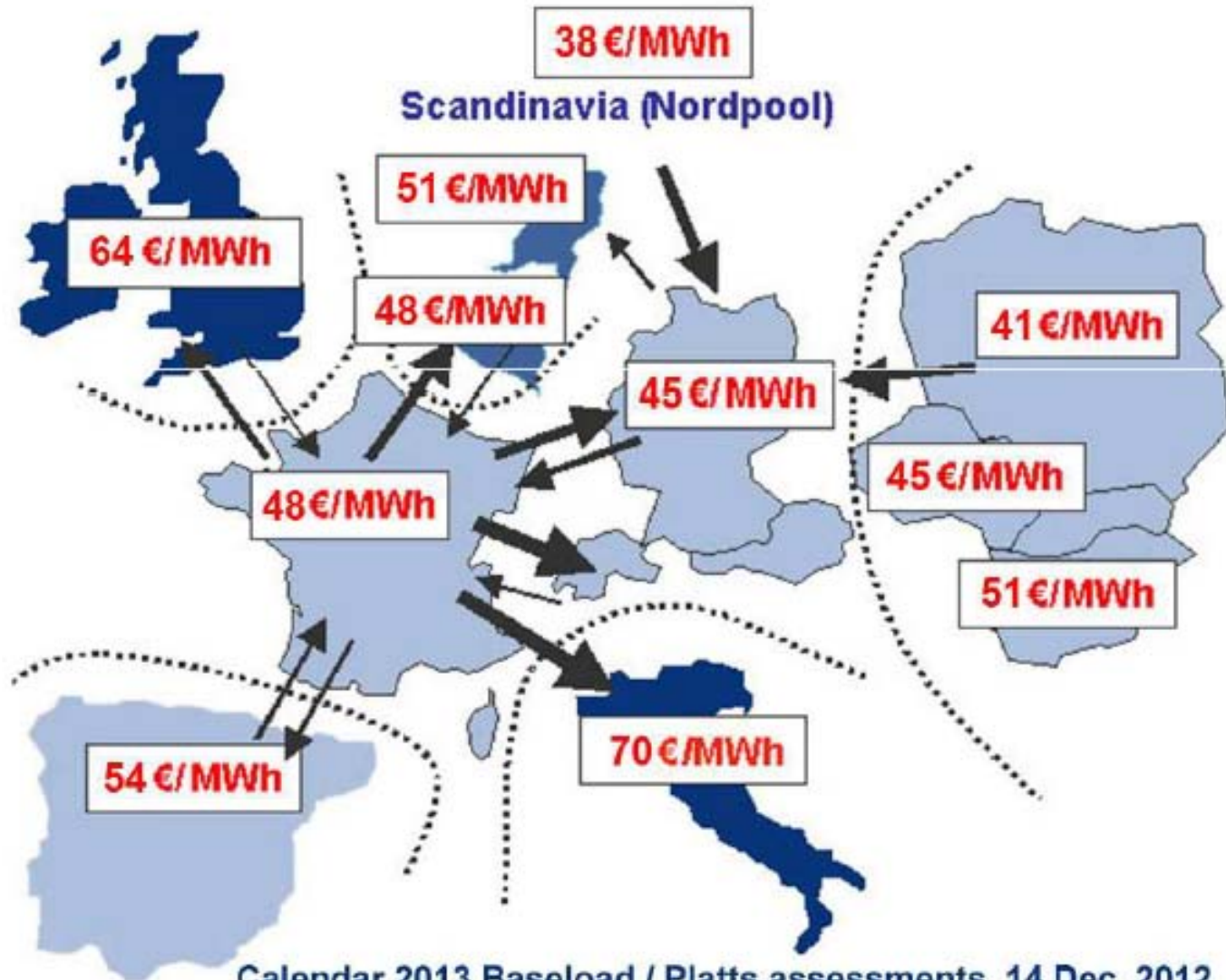
Costs



Market price **based on MARGINAL costs**
 $(Q_1^*; P_2^* < P_1^*)$

Prix forward

Source : Azouz *et al.* (EDF)



Consequence

- **It is difficult to implement a single electricity market in Europe...There is not a common energy policy in Europe but a competition policy applied to the energy field.The energy policy remains a matter of each member State of the European Union. Today energy Europe is composed of several national policies which are the result of history and geography, in particular for the electricity sector.**
- **It is a contradiction to ask the market to set the electricity price for the end-user and at the same time to leave policy-makers choose the structure of the electric park.**

THE FRENCH ENERGY DEBATE

- **1. What is the optimal structure of the energy mix for France going forward? (part of imported oil? part of imported natural gas? part of imported coal?). According to IEA, shale gas reserves may amount to 5000 billion cubic meters in France. But shale gas exploration is a taboo and hydraulic fracturing is banned for environmental reasons (2011 law)**
- **2. What is the potential of energy saving, particularly in the building sector and in transportation sector? What is the cost of the energy efficiency and who will pay for it in a context where the fuel poverty is now a very sensitive problem?**
- **3. What is the optimal structure of the electricity mix? (part of nuclear energy? part of renewables?). No one expects a total nuclear phase-out and even a large reduction of nuclear power by the year 2030 seems to be excluded**
- **4. Is it justified to subsidize renewable energy sources, in the context of a market where prices are supposed to be cost-reflective?**
- **5. Do current market price signals provide sufficient incentive to invest in peaking capacity to prevent future power failure?**

By way of a conclusion

- **1 It is too soon too make an assessment of the liberalisation process; the context has changed between the start of the liberalisation process (overcapacity, low oil prices) and today (investment is needed in the production at least for security reasons, and the price of oil is high). There is no “common energy policy” in Europe but only a competition policy applied to the energy sector. Competition is the priority but everybody wants to introduce some distortions...**
- **2 The market is giving good incentives but it is also generating "detrimental side-effects" ("market power", under-investment during peak periods)**
- **3 The key to the system is good regulation (the market is not an anarchy). The State still has something to say on it...It is the case in France and in Germany**
- **4 Do not underestimate the industrial issues of liberalisation (concerning European champions? Risk of oligopoly? To implement a kind of “EADS” for Renewables?)**
- **5 Subsidizing Renewable Energies is necessary but only for a transitory period (the consumer pays for it in developed countries; the taxpayer pays for it in developing countries)**
- **6 The main problem: to conciliate competitive energy, security of energy supply, fair prices (without cross-subsidies among consumers) and supply competition...in a context where the GDP growth rate is now low.**

It is difficult to implement a common energy policy in Europe! It is also now the case with coffee break!
It was easy in 1957. It is more difficult today!



**THANK YOU
FOR YOUR ATTENTION**