Is the 3*20 objective realistic and efficient?

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The Commission has submitted to the Parliament a "Climate and Energy" package proposing a triple objective to reach by 2020:

1. 20 % decrease of CO_2 emissions with respect to 2005
2. 20% decrease of final energy consumption with respect to the trend
3. 20% of Renewable Energies in the final energy mix

The first reaction is that this "5 times 20" package seems to belong to numerology.
However, it is very important that Europe takes the lead in the fight against Global Warming and that practical measures be taken. In that respect we think that the principle of a "Climate and Energy" is quite timely.

Background

By 2050 the world population should reach around 9 billions people. Climate experts estimate that the CO_2 emissions should not exceed 11 Gt (Gigatons) or 3 Gt Carbon. This means that the average emission/cap should not exceed 0,33 tC, to be compared to the present 1,15 tC/cap. This means that we have globally to divide our per capita emissions by a factor 3,5. Equity requires that the 0,33 t/C limit should be the same for all mankind. Therefore the reduction in CO_2 emissions should be much larger for developed countries.

Rationale for quantitative objectives

This is shown on Figure 1 where one sees that the UE should divide its emissions by almost a factor 9, the US by 17 but that India might increase slightly its emissions.
It is possible to express this 50 years decrease in per cent decrease in 2020. This is done on Figure 2. It is seen that the reduction percentages are not very different. For European countries they range from 22% for Czech Republic to a little more than 16% for Lithuania.

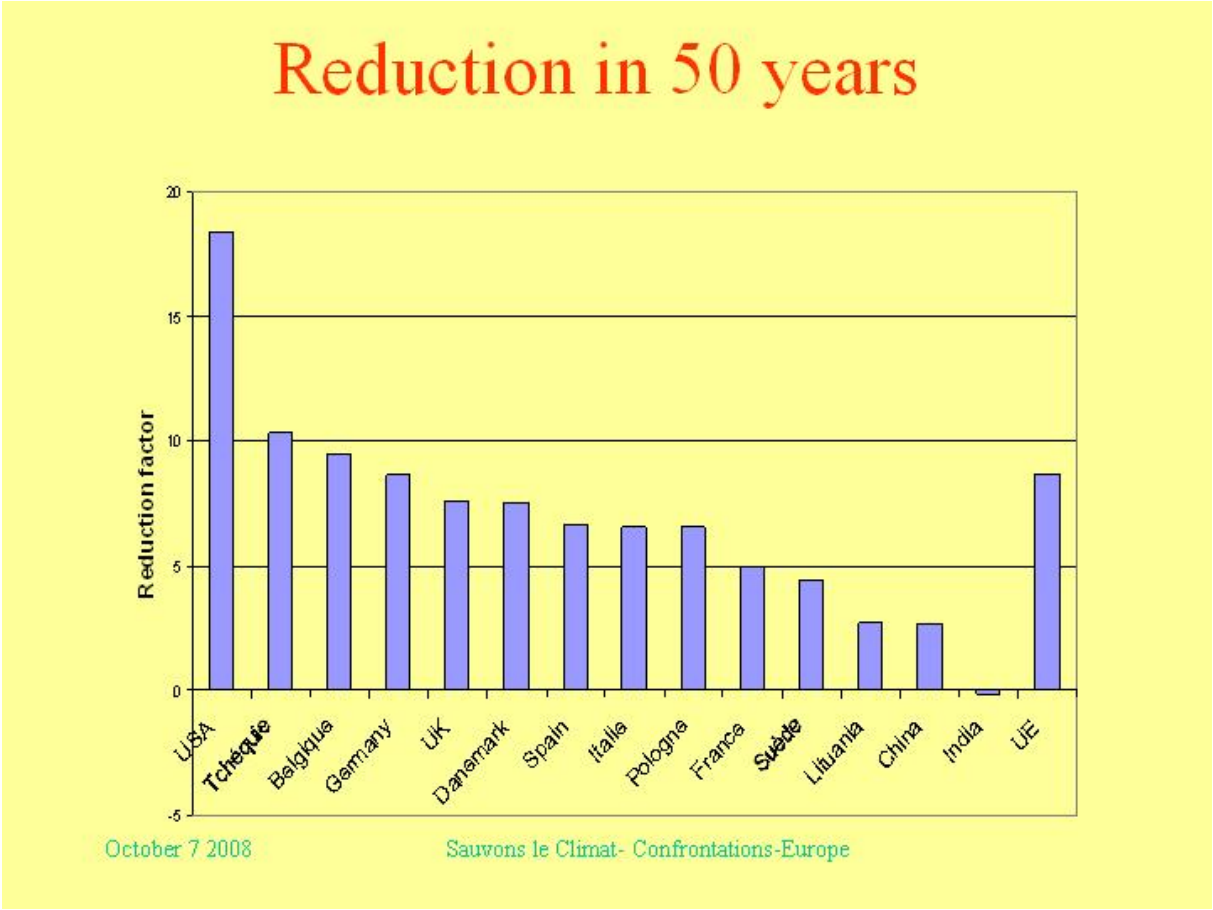

Figure 1

Reduction factors of CO2 emissions needed to reach the 0,33 tC/cap for various EU countries, the US, China and India

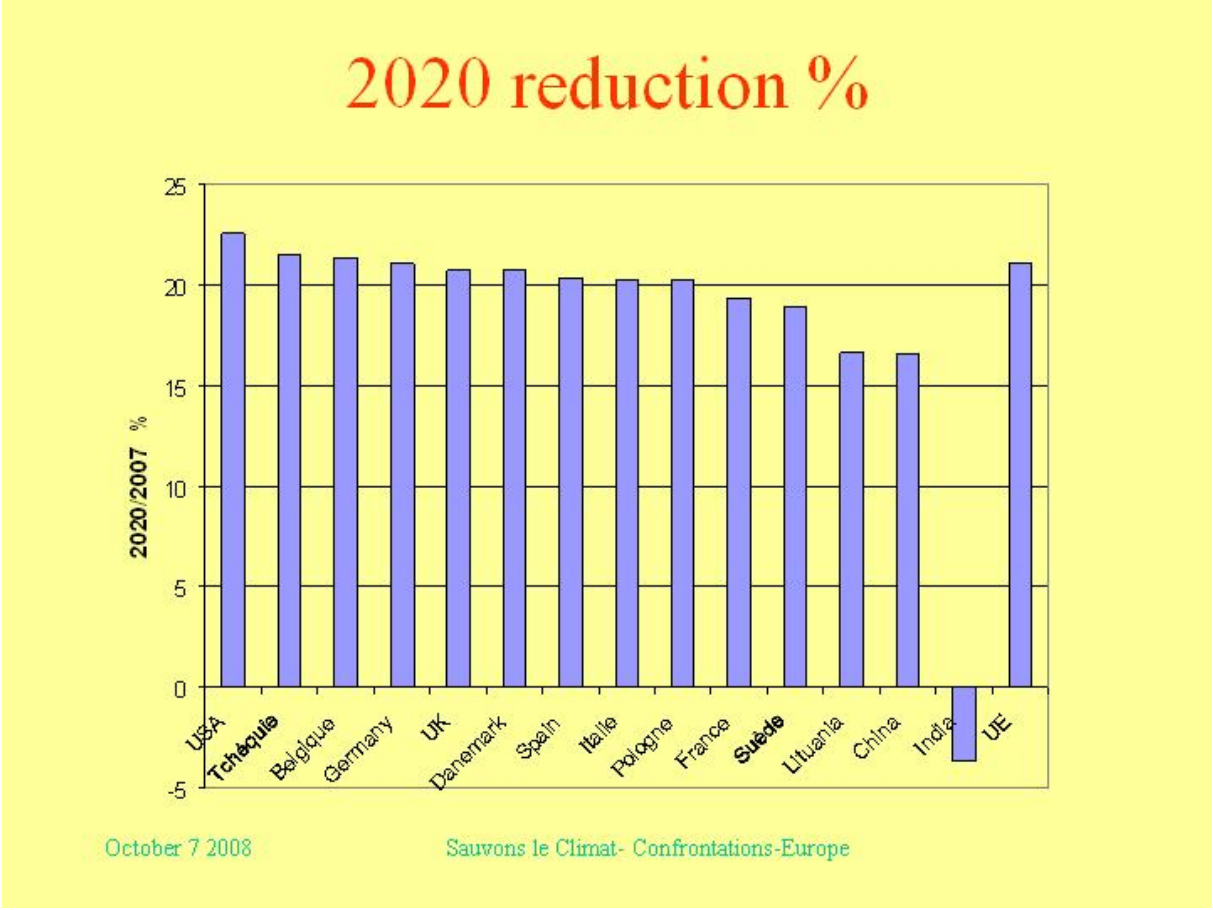

Figure 2

Percentage reduction of CO2 emission needed for a choice of countries in 2020 in line of reaching emissions of 0,33tC/cap within 50 years.

The absolute value of the per capita emissions is shown on Figure 3 for the same choice of countries. Also shown on the figure are the projections for 2020 and 2050 The difference of emissions between equally developed countries like Sweden and France on the one hand, Germany and Denmark on the other is striking. The reasons for the good performance of Sweden are very interesting to understand.

The Swedish case

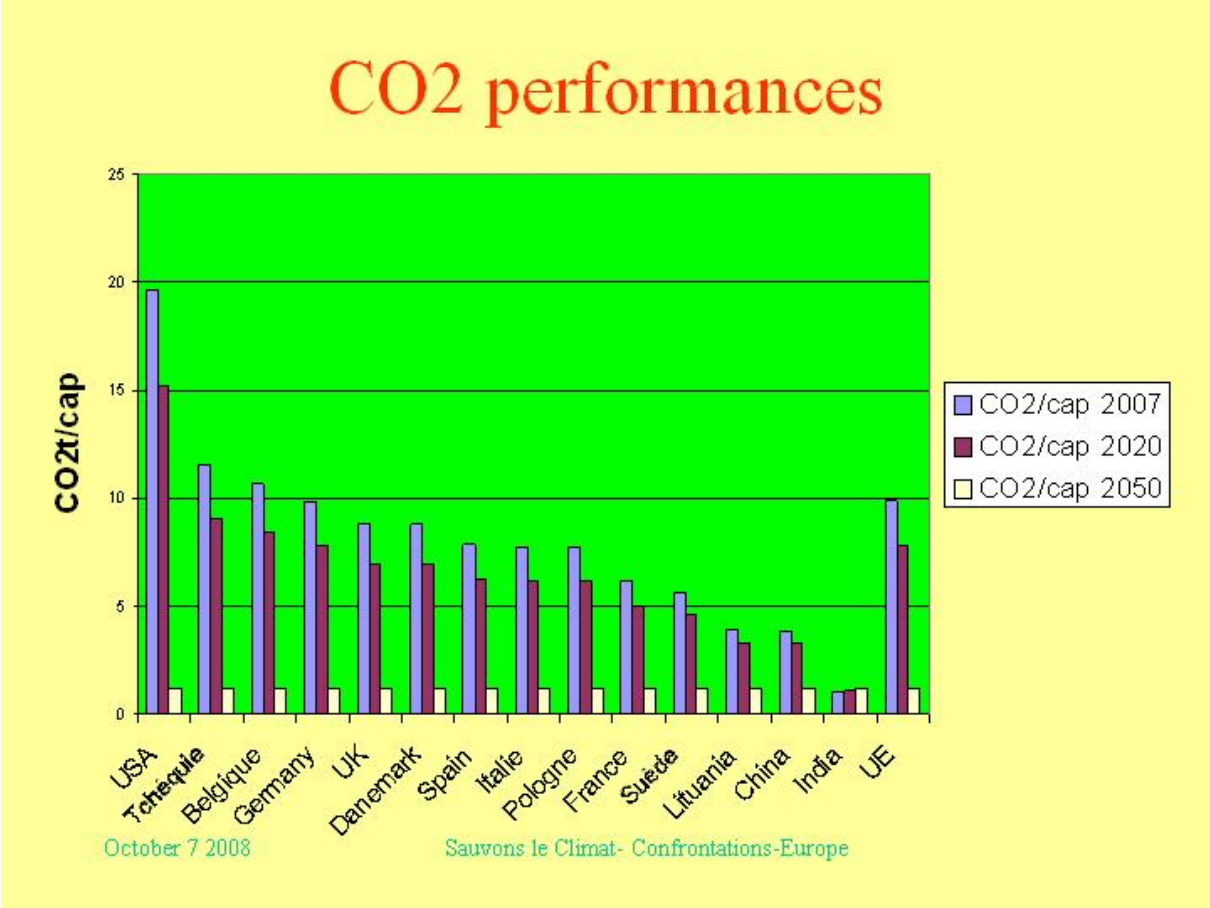

Figure 3

Evolution of CO2/cap emissions from the 2007 ones in order to reach 0,33 tC/cap within 50 years.

According to the Vulgate, the case of Sweden is quite paradoxical. Indeed the annual primary energy consumption of a Swede amounts to 5,65 tep/cap while that of the average EU citizen is 3,96 tep/cap. Even more striking is that, while the average annual electricity consumption of the EU citizen is 7 MWh/cap, that of a Swede reaches 16 MWh/cap. The electricity intensity of Sweden is 2,83 MWh/tep

The explanation of this paradox must lie in a different energy mix between Sweden and the EU. Indeed this is displayed on Figure 4. Clearly, Sweden has a much larger share of nuclear and renewable (mostly hydroelectricity) energies.

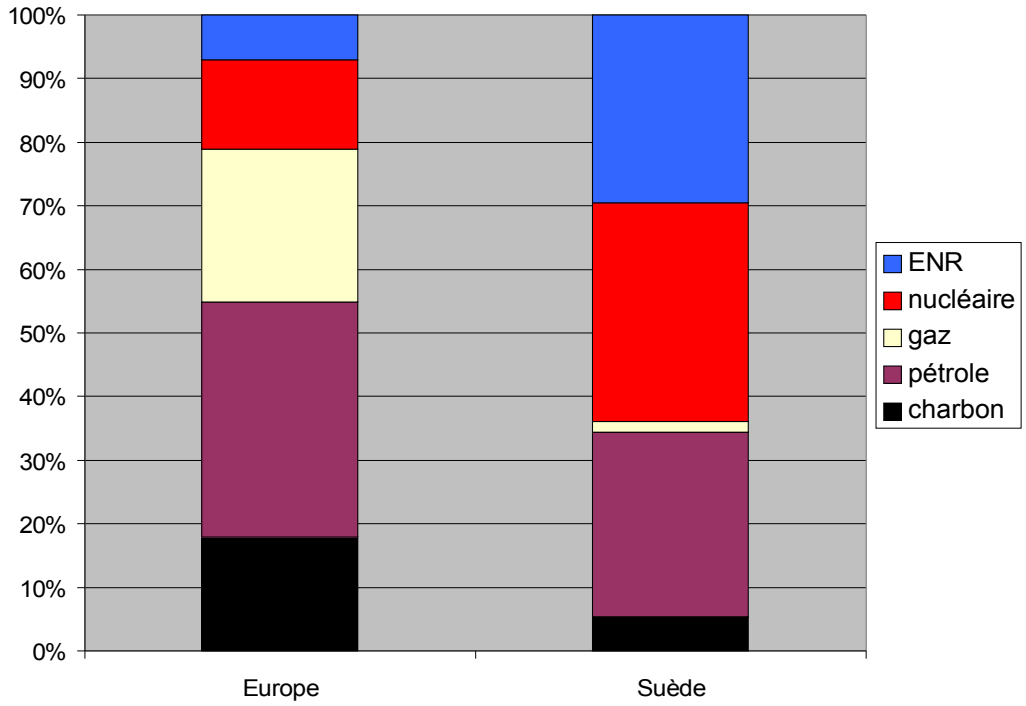

Figure 4

Comparison of the energy mix of the EU with that of Sweden. It is seen that the proportion of non emitting energy sources (nuclear+renewables) is much larger for Sweden

Figure 5 shows that Sweden produces its electricity almost completely with nuclear and renewable energies. This means that the way electricity is produce is a capital factor in the mitigation of CO2 emissions.

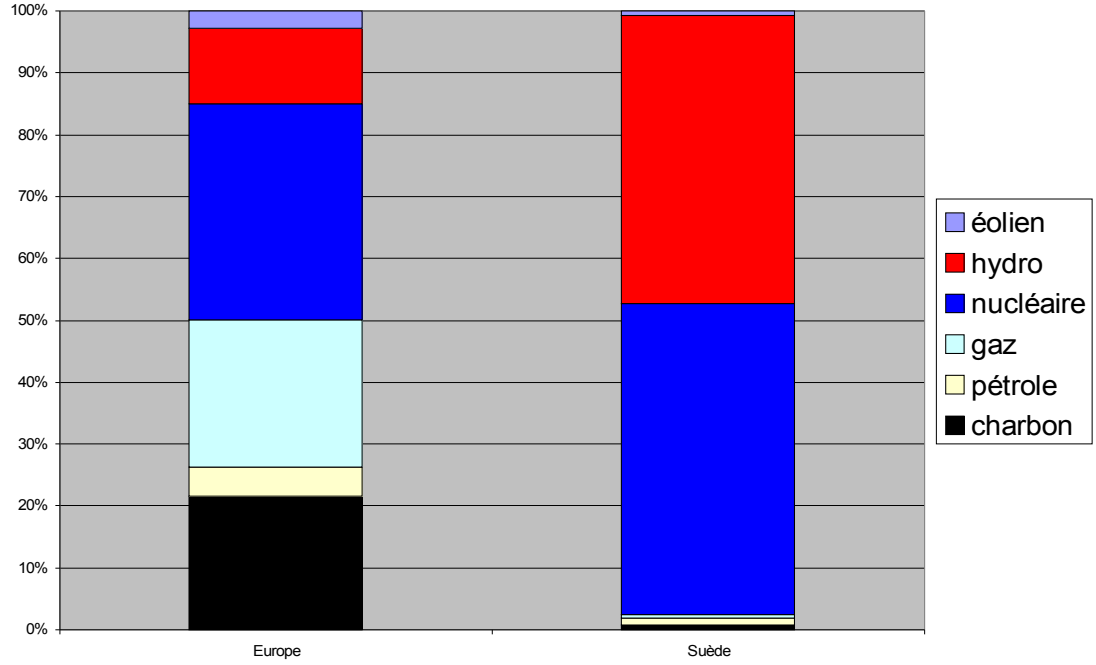

Figure 5

Comparison of the electricity mix of the EU with that of Sweden. Practically, Sweden produces its electricity without resorting to fossil fuels.

This is clearly demonstrated on Figure 6 where the CO2 intensity (amount of CO2 emitted per consumed energy) as a function of the proportion of non CO2 emitting sources in electricity production is displayed. It is shown that the nature of the electricity mix may induce changes of up to a factor 2,5 on the CO2 intensity.

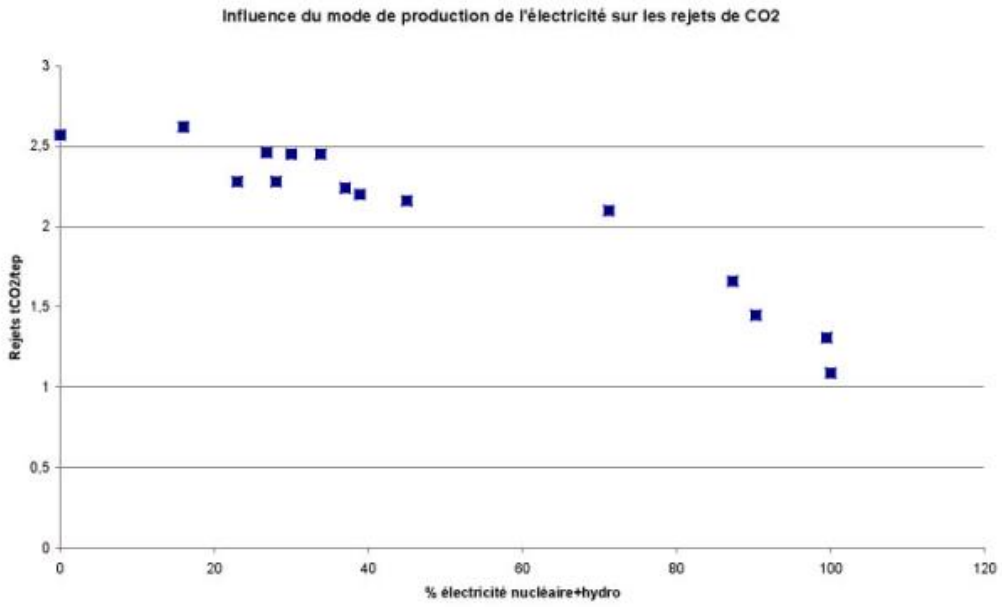

Figure 6

Dependence of the CO2 emissions intensities (tCO2/toe) upon the share of nuclear+renewable s in electricity production

Follow the Swedish example

Figure 7 shows what could be the CO2 emissions of the EU should its energy mix be the same as that of Sweden. The Figure was established assuming unchanged total primary energy consumption. This is probably optimistic since the share of electricity in final energy consumption is higher in Sweden and since, for the same final energy, the primary energy associated to electricity is larger than that associated to gas or fuel gas used for heating. However it seems that the EU could easily divide by a factor 2 its CO2 emissions by imitating Sweden.

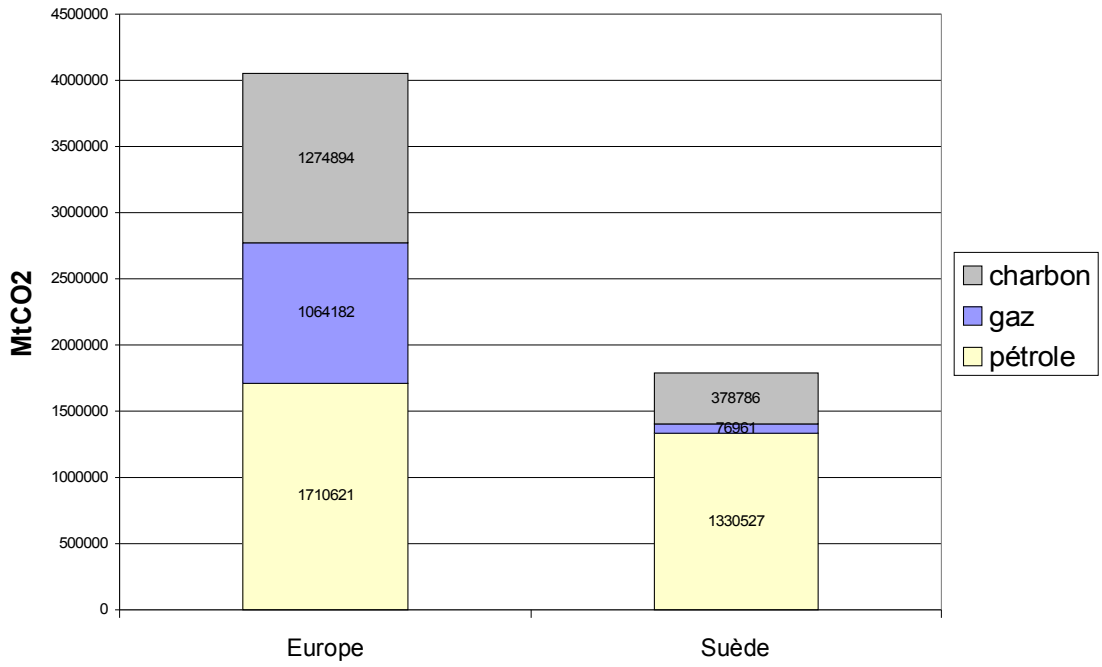

Figure 7

Illustration of what would be the CO2 emissions of the EU if its energy mix were similar to that of Sweden

Inspired by the Swedish example one can draw the following conclusions:

- **Primary energy consumption is not a relevant parameter**
- **Electricity consumption is not a relevant parameter**
- **Coal and gas electric plants should be banned**
- **Further CO2 reductions could be obtained in the transportation sector by :**
  - **Improving energy efficiency**
  - **Bio fuels, <u>after careful ecological evaluation</u>**
  - **Use electrical propulsion**

The 20% reduction of CO2 emissions by 2020 is achievable

As we have seen a switch from coal and gas electricity production to renewables and nuclear energies allows to decrease CO2 emissions by more than 50%. A 20% reduction by 2020 could be reached rather easily. Alternately fossil electric plants might be convenient provided they are equipped with Carbon Capture and Storage devices.

However, some member states do not seem to follow such virtuous path. It is particularly disturbing to see German electric companies build 30 new coal plants (most of them using the very polluting lignite) with total power of almost 20 Gwe ; from 2017 they will emit around 170 millions tons of CO2 amounting to 20% of present German emissions. Such policies will make it almost impossible for Germany, and, thus, for Europe to reach their reduction objective. If, rather than coal plants, an equivalent power of nuclear reactors would be built in order to replace older coal plants, doubling the nuclear capacity of Germany, the 20% reduction would follow up.

One may ask whether the time delay until 2020 would be sufficient to implement such a switch of the European electric system. Figure 8 shows that this is exactly what has been achieved in France from 1973 to 1985. The first reactors were ordered in 1973 and operated from 1978.

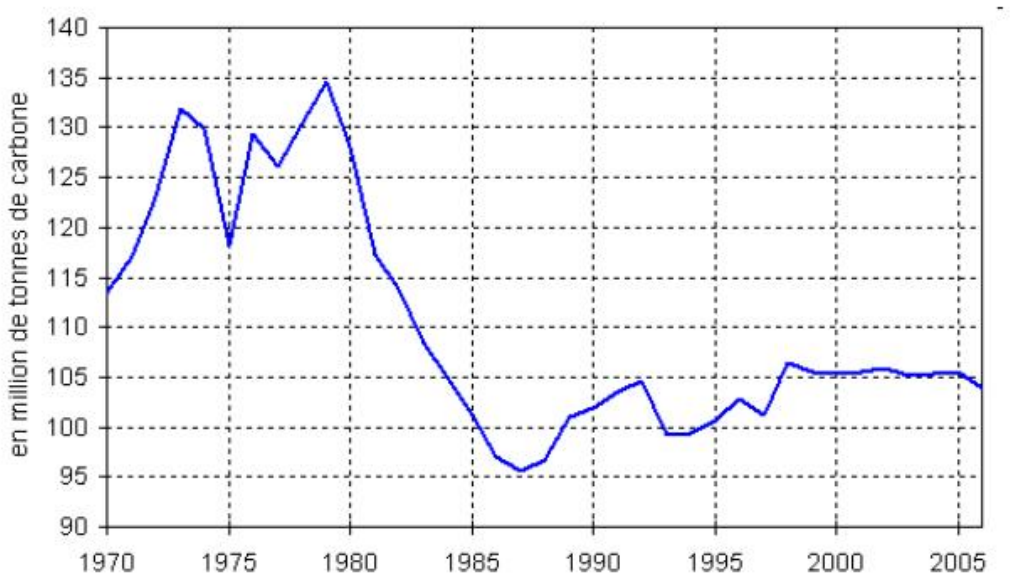

Figure 8

Evolution of French CO2 emissions from 1970 to 2005

While carbon emissions decreased by 35%, Total Primary Energy Supply increased by 12 % as can be seen on Figure 9

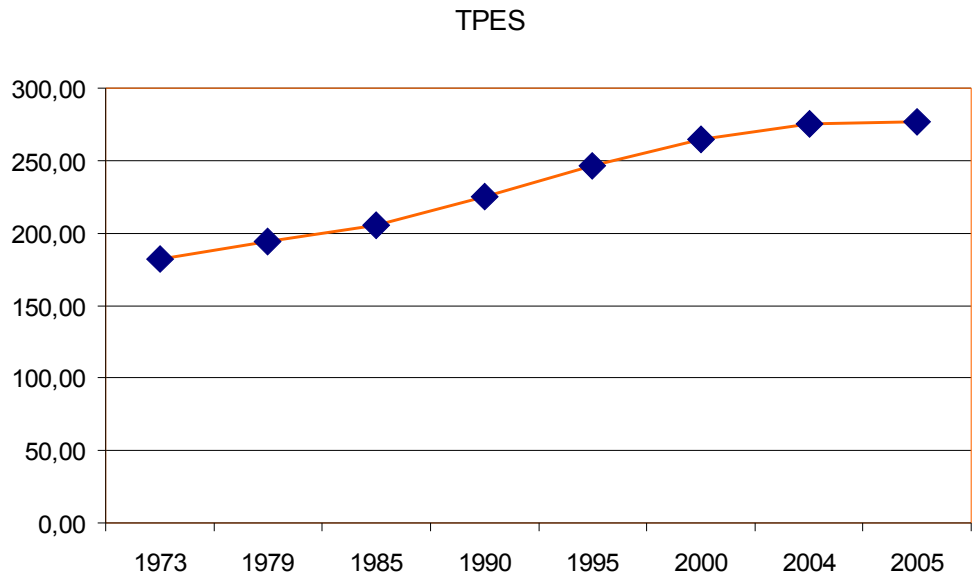

Figure 9 Evolution of French TPES from 1973 to 2007

Final energy consumption decrease

Following the "Climate Energy" energy package final energy consumption should also decrease by 20%. Up to now the most efficient way to decrease consumption of a facility is to increase its prices. The relation between price and consumption is determined by an elasticity coefficient. Generally the elasticity is larger (in absolute value) in the long term since technological and societal evolutions have time to take place in an adaptation process. Short term elasticity is smaller. The values of elasticity are usually not well known. For gasoline, consumption decreases of around 25% for a price increase of a factor 2 have been observed, corresponding to a short term elasticity close to –0,35.

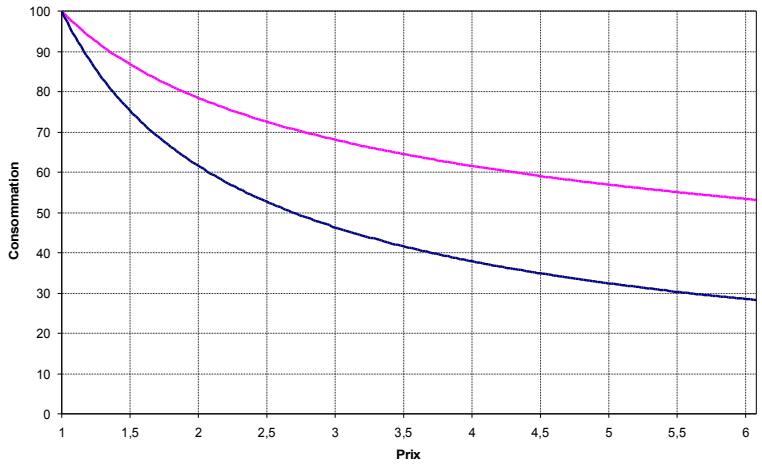

Figure 10

Variation of consumption as a function of price

Figure 10 shows typical behaviour of consumption-price relation for two examples, one for the short term, the other for long term. On sees that a 20% decrease involves a price increase between 50% and 100%. Is such an effort realistic? And is it worthwhile if CO2 decrease may be obtained otherwise?

Renewable energies

Renewable energies proportion in the energy mix depend wildly on the country, from more than 23 % for Sweden to 3% for Belgium (6% for France, 5% for Germany). The development of renewable energies, especially in the heating sector is quite desirable. However its extent depends very much on the local possibilities and one wonders whether a European regulation is wise in this field.

Conclusion

1. **One should concentrate on CO2 emission reductions. While 20% reduction by 2020 seems to be realistic, 30% reduction could be reached provided a ban on coal and gas plants unless they are equipped with operational CCS systems**
2. **The priority should be the development of Carbon free electricity production**
3. **CO2 emissions reduction target should be set for each member state by the EU. Each state should be free to use whatever means to reach this objective**.