ULCOS Trollfjord Seminar

Scenario modeling :

THE IMPACT OF THE CARBON CONSTRAINED SCENARIOS ON STEEL INDUSTRY

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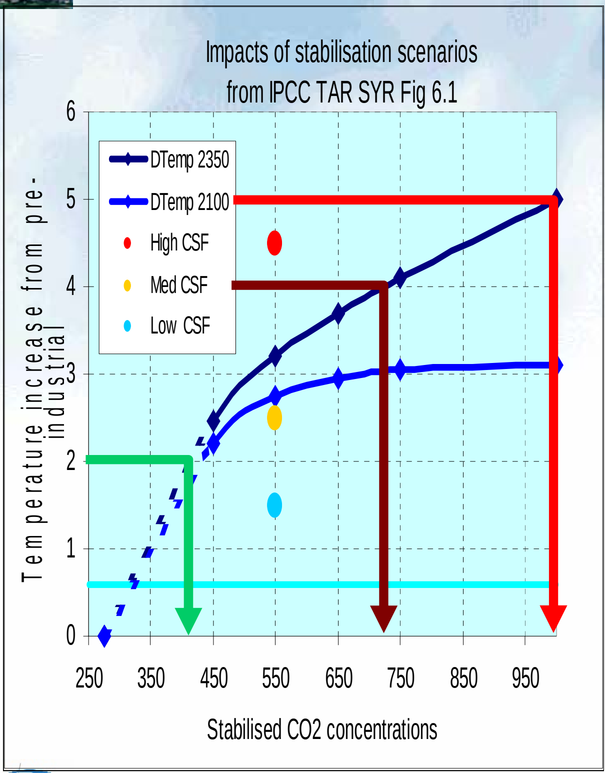
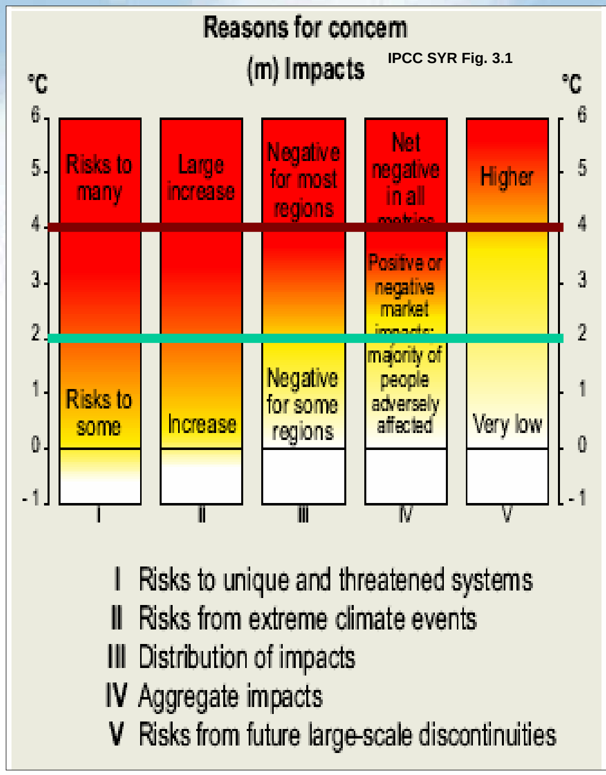
THE IMPACT OF THE CARBON CONSTRAINED SCENARIOS ON STEEL INDUSTRY

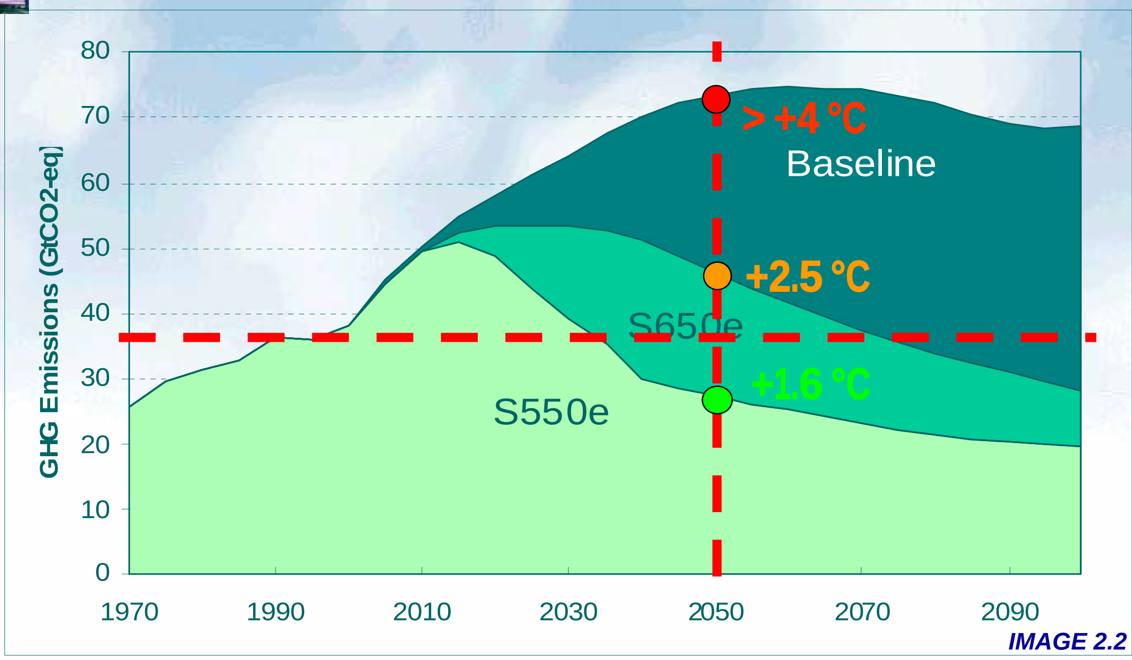
- Overview
  - Why carbon constraint scenarios ?
  - Methodology and modeling tool
- Scenario modeling
  - Reference
  - Factor 4
  - Differentiated tax
- The Carbon Constraint Cases
  - Impacts on the energy markets
  - Impacts on final consumption by sector
  - Impacts on the structural materials industry
- Conclusion
- From the first to the second phase of ULCOS

Reminder of the interelationship between Stab. scenarios → Temp. increase → Impacts





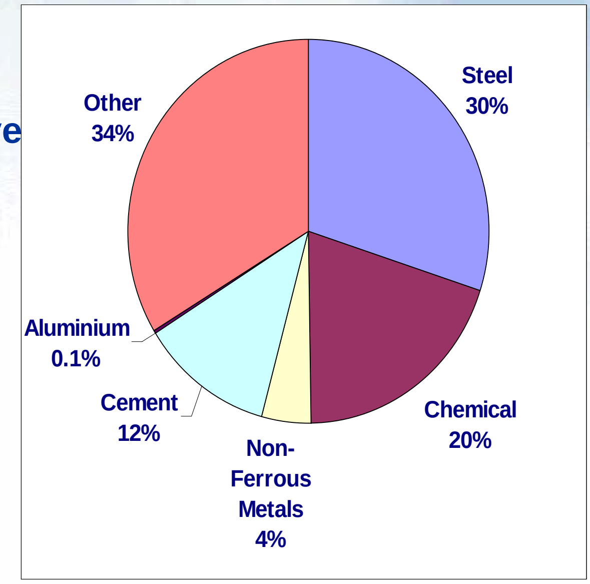
Greenhouse gas Reduction Profiles



- In 2050, world emissions should be brought back to 2000 level +/- 25%, in place of a doubling in the Baseline

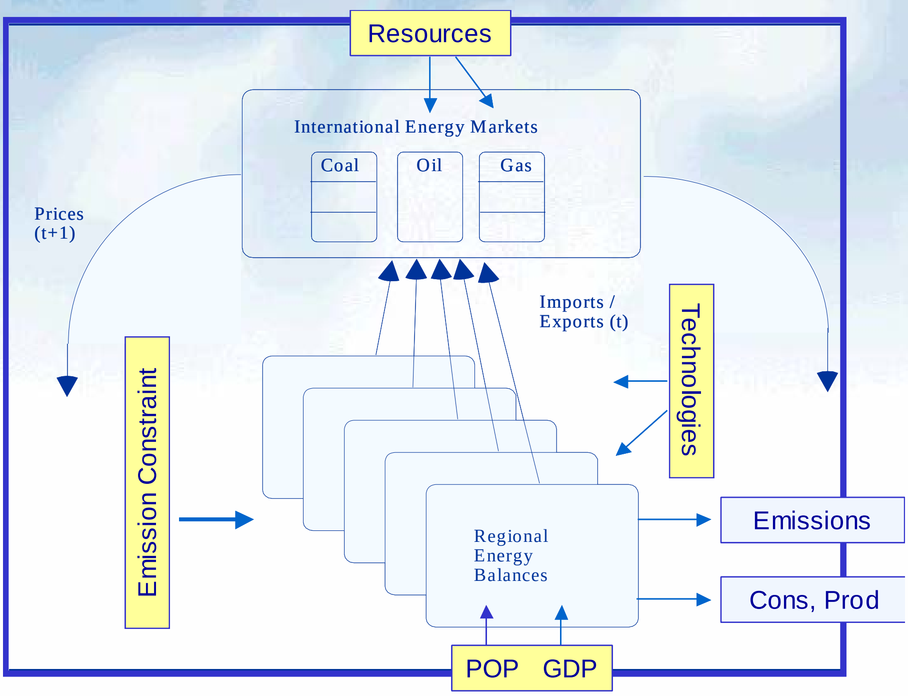
Iron and Steel and CO_2 Emission Trends

- Autonomous trend: CO_2 emissions +60% by 2030 and +100-150% by 2050
- This is not sustainable, and in many countries the steel industry would have to face stringent environmental regulations
- Emission stabilisation needed in the coming decades to achieve long-term climate objective (450 ppm in CO_2)
- Early action reduces cost on the long term
- Especially development of new technology needed



Industrial CO2 Emissions, 2005

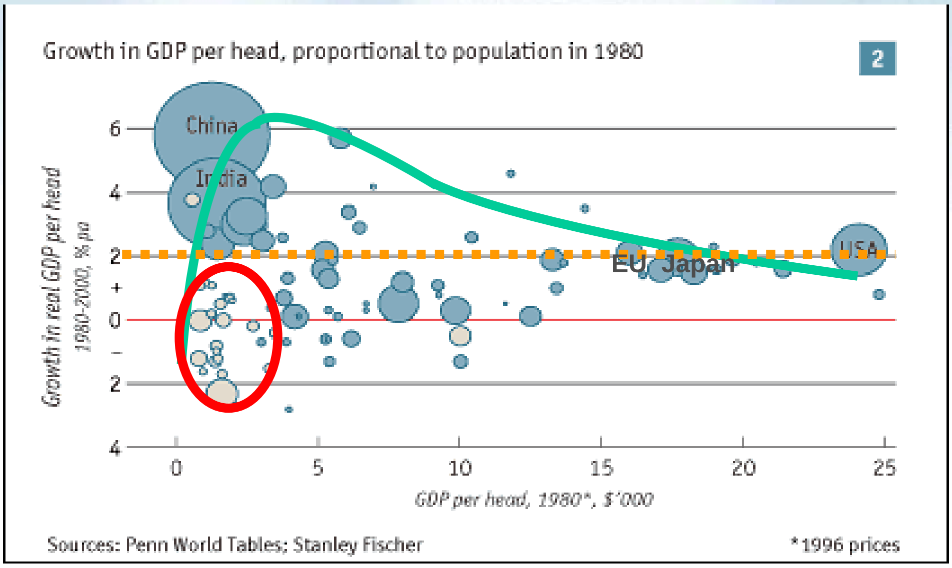
Methodology and modeling tool : The POLES model



Growth in GDP per head

◆ Rapid increase of the developing countries in the short term.

◆ Followed by an slowing down of their GDP growth per head when they attain their economic maturity

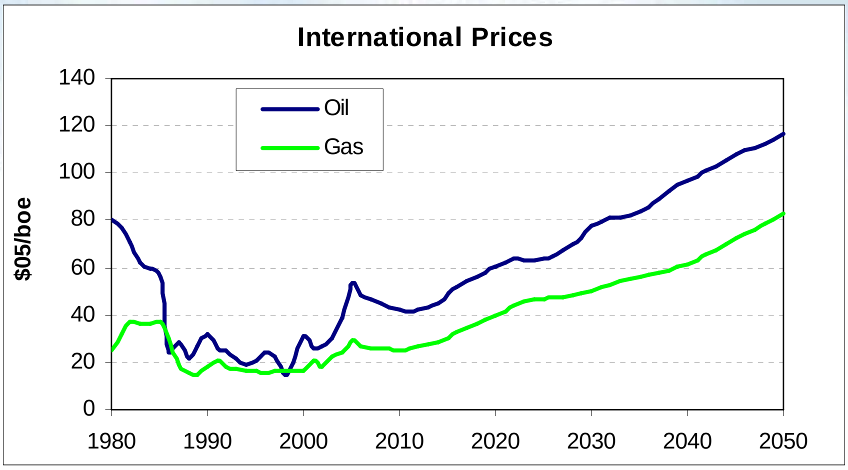


International oil and gas prices

•Progressive rarefaction of resources involves a constant rise of the prices which slow down the world demand and stimulate the world supply

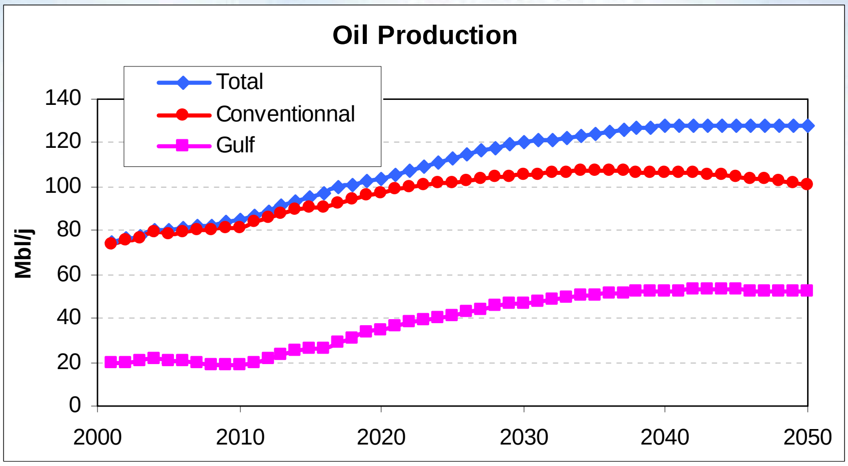
•the raising of gas prices follows that of oil, because of similar factors of rise

•the price of coal also increases, but the differential with the Mtoe does not cease growing



Oil production

•Conventional oil production will increase until 2030, then stabilize and begin to decline around 2050.
•The model's oil peak is relatively flat and also low, since it is only 20% more than current production.
•To enable this stabilization of the conventional global oil supply, the Arabian Gulf countries will have to more than double their production.



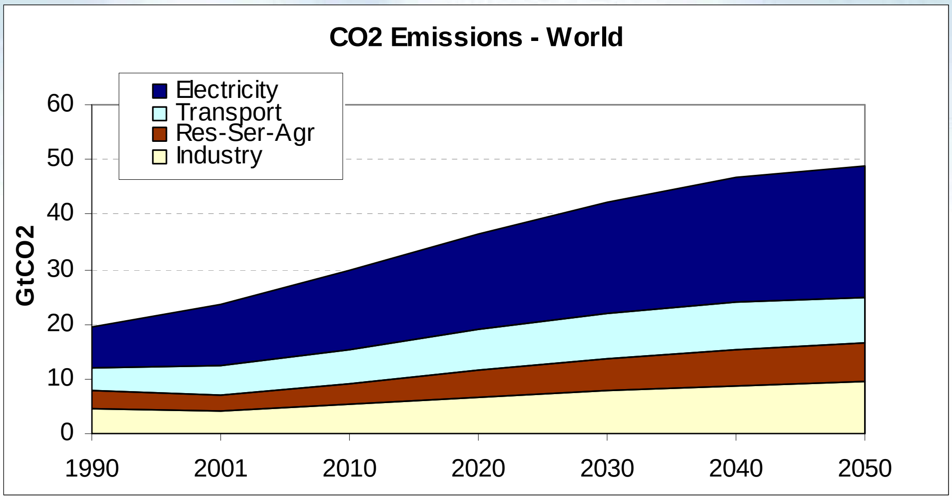
Primary production

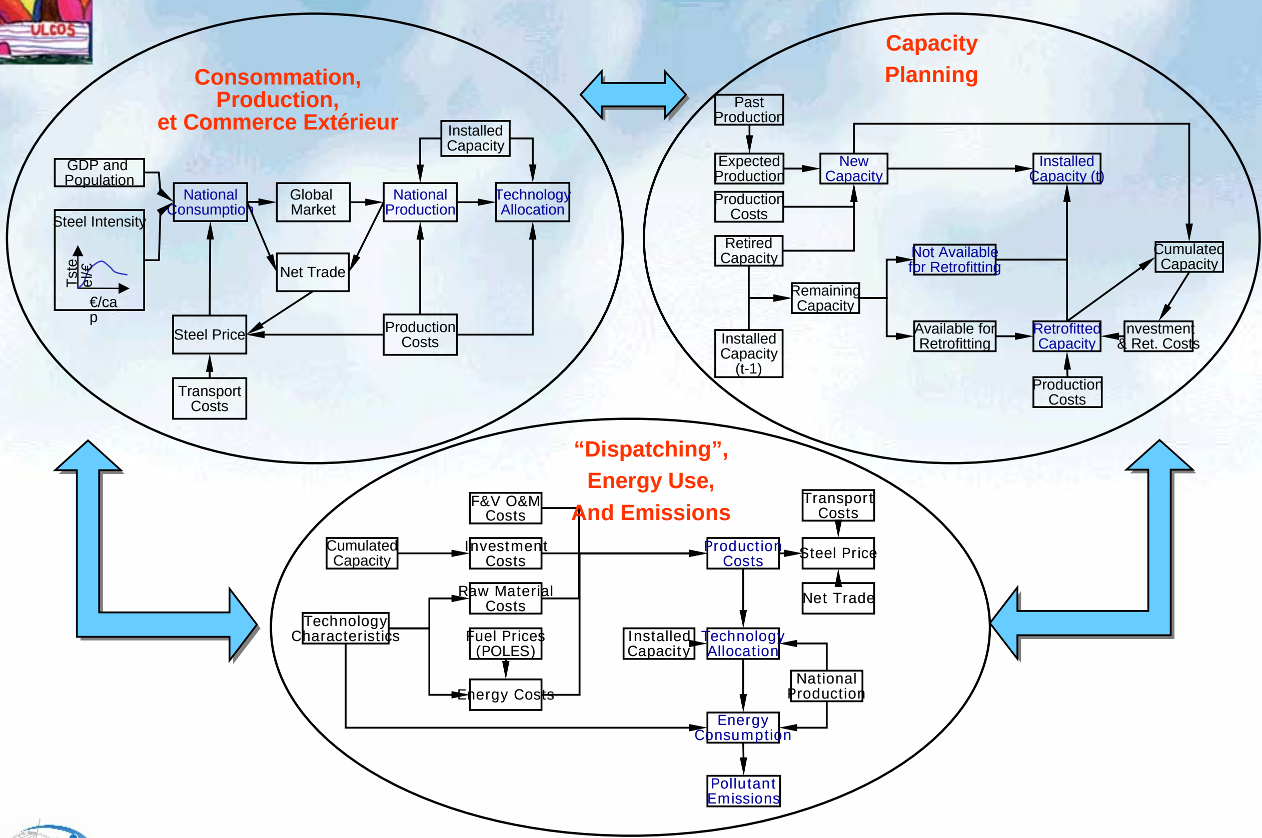
•The consumption of primary energy in the world is expected to reach 26 Gtoe in 2050, from the current 10 Gtoe.
•Oil (including non-conventional) and coal provide 6.6 and 6.5 Gtoe and natural gas 4.7 Gtoe; renewable and nuclear energy contribute 3.7 and 4.3 Gtoe.
•This represents a significant structural change in the world fuel-mix, in particular after 2030, when renewable and nuclear energy sources benefit from quite a massive development, which translates in a rapid increase of their market share: in 2050, 30% of world energy supply comes from non-fossil sources.

	2001	2010	2030	2050	*t.c.a.m.* *2001/10*	*2010/30*	*2030/50*
Primary Production (Mtoe)	**9779**	**12807**	**19624**	**25901**	***3,0%***	***2,2%***	***1,4%***
Coal, lignite	2351	3184	4875	6546	*3,4%*	*2,2%*	*1,5%*
Oil	3487	3973	6111	6635	*1,5%*	*2,2%*	*0,4%*
Natural gas	1929	3330	4703	4685	*6,3%*	*1,7%*	*0,0%*
Nuclear	671	753	1858	4343	*1,3%*	*4,6%*	*4,3%*
Hydro, geothermal	232	276	365	425	*1,9%*	*1,4%*	*0,8%*
Wind, solar	7	21	200	751	*12,5%*	*11,9%*	*6,8%*
Biomass and wastes	1101	1270	1513	2516	*1,6%*	*0,9%*	*2,6%*

CO2 emissions

• World CO_2 emissions in the reference more than double in 2050 in comparison with 1990.





Consumption d'acier (en Mt)

- **Demande d'acier :**

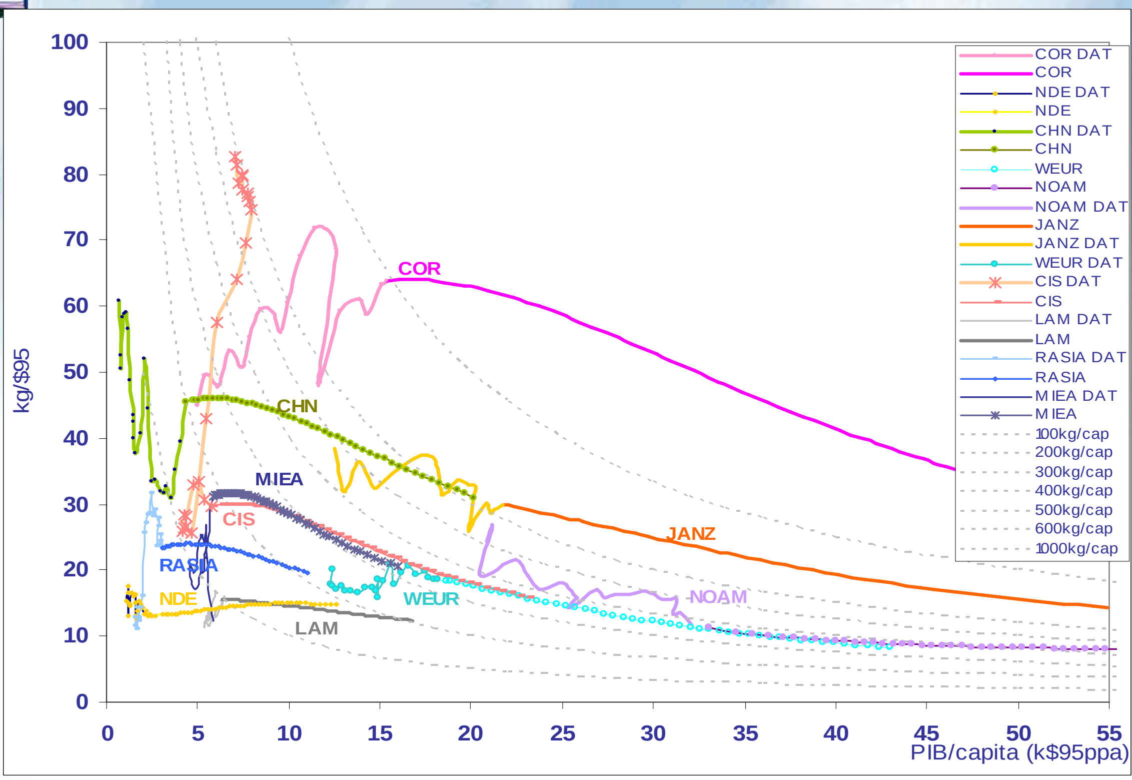
CONSTE[CountrM] = GDPPOP[CountrM] * POP [CountrM] * PGCONSTE[CountrM]

- **Intensité d'usage (en Mt/MEURppa) :**

$$y = EXP(a*LNx+b*x+c*dP)-Floor$$

PGCONSTE[ALLC] =
(((GDPPOP[ALLC]/GDPPOP DLY[ALLC])^ACSTE[ALLC]) *
exp(BCSTE[ALLC]*(GDPPOP[ALLC]-GDPPOP DLY[ALLC])) *
((STEMKTPRICE/STEMKTPRICE DLY)^CCSTE[ALLC])) *
(PGCONSTE dly[ALLC]-FLRSTE[ALLC])+FLRSTE[ALLC]

Usage intensity : Steel



Desagregated demand

- **Total consumption**

  CONSMAT = CTRANS + CBUILD + CREST

- **Consumption by sector**

  CTRANS = f(NEWVEH, CONSPEC$_{REF-F4}$)

  CBUILD = f(NEWBAT, CONSPEC$_{REF-F4}$) + f'(RETROBAT, CONSPEC$_{REF-F4}$)

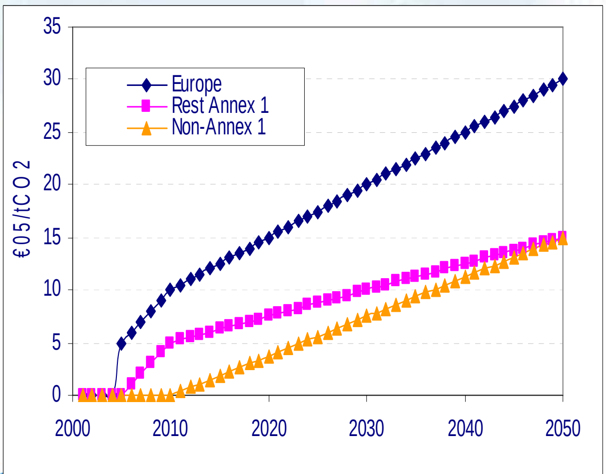
  CREST = IoU curves

F4 Carbon value

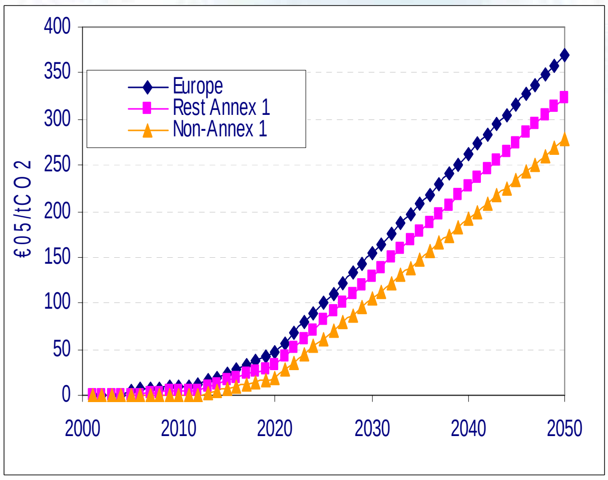
• In order to follow an acceptable profile of GHG emission it is necessary to introduce a carbon value in the economic system either in the form of a tax or by quotas on carbon emissions.

•In our F4 modelling exercise it is assumed that Europe will take the lead in implementing climate policies, followed by rest of annex B countries and developing countries in a later stage.

REF



F4



Reminder :
"Price signal" of the carbon value

100 €/tCO2 = 45 $/bl = 25 c/l ess.

increase 20 % of the gasoline

But **100 €/tCO2 = 7,3 $/Mbtu (+ 7 $/Mbtu)**

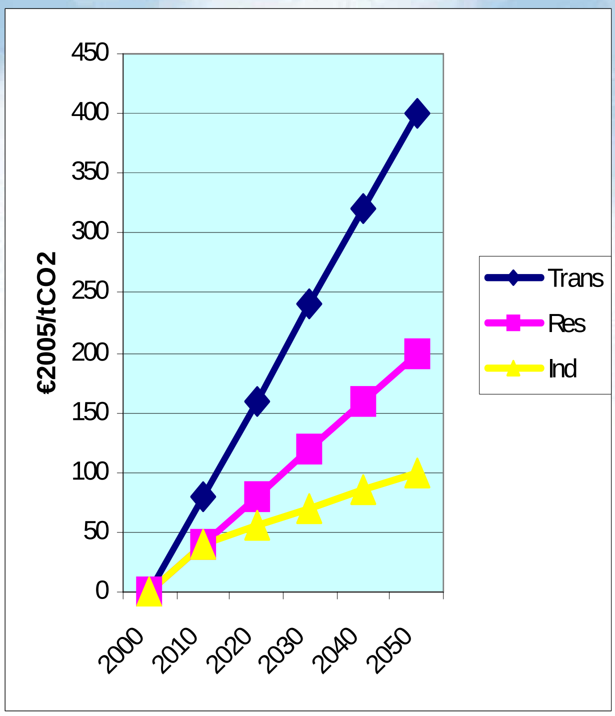
multiplication by 2 of the gas price for industry

Et 100 €/tCO2 = 290 $/tec

muliplication by 4 of the coal price for industry

Differentiated tax

- **High tax but differentiated according the sectors with the aim of doubling the final energy price**
- **It is introduced in a linear manner in order to promote an early action**
- **This tax do not permit F4 reductions.**



Source: Criqui, Greanjean, 2006

Carbon value

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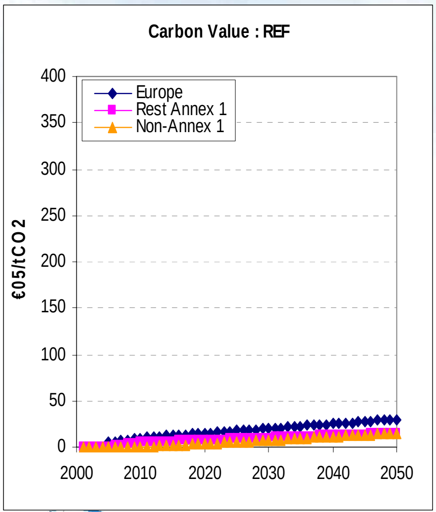
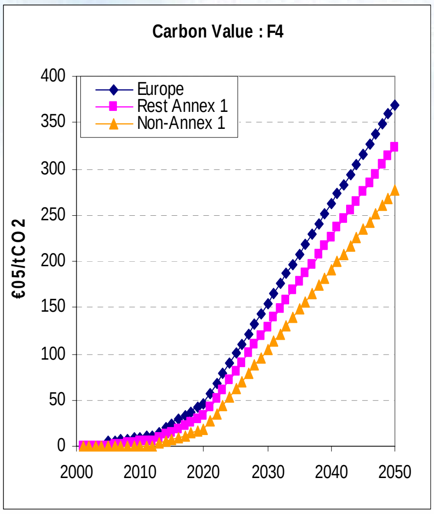
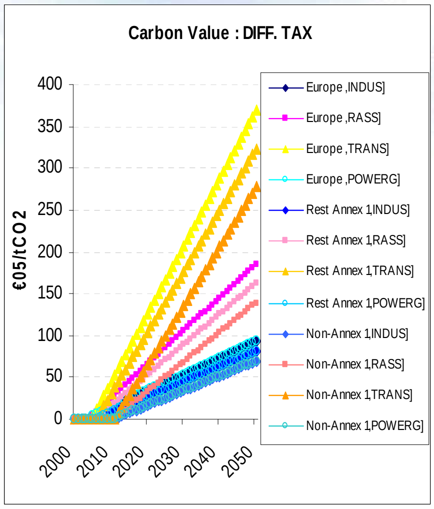


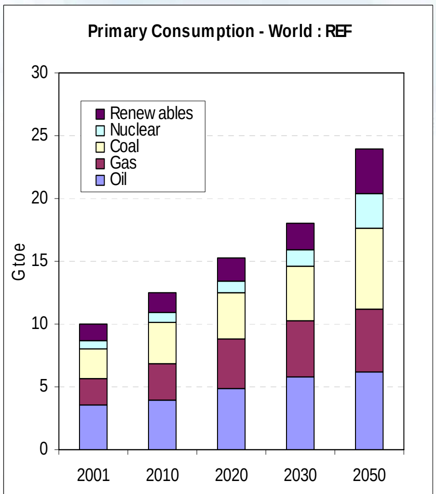


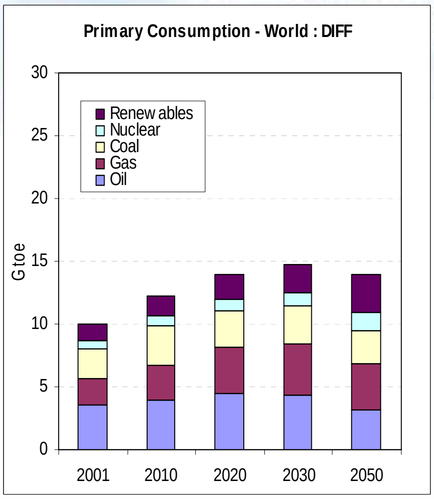


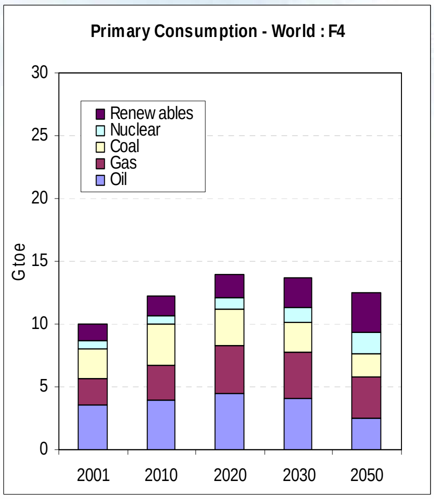
Primary consumption

Several important modifications are apparent in the energy mix, developing from 2020 to 2050, with :

- a significant reduction in the primary energy consumption from 24 Gtoe to 14 and 12 Gtoe as a result of increasing prices of energy
- and an increased contribution of renewable and nuclear power (not so much in absolute volume but significantly in share)

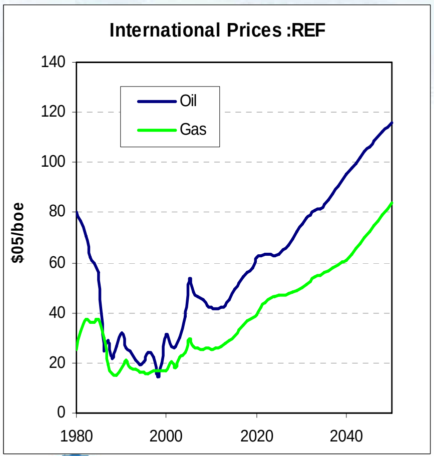


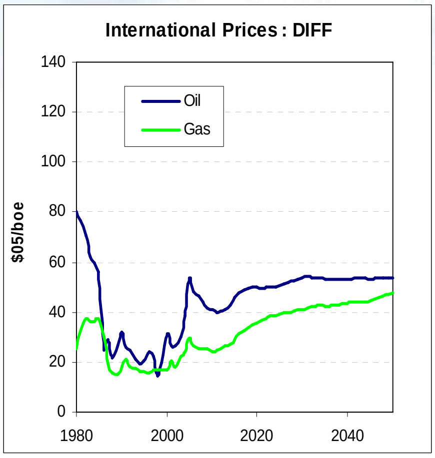


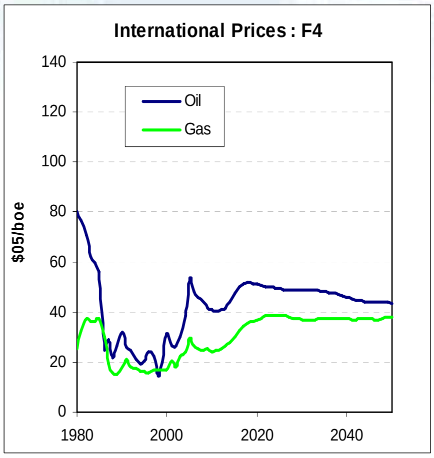


International prices

- One major feature of these scenarios is the impact on the international prices, with a fully different trajectory for the oil and natural gas prices, which stabilize after 2020, due to the strong reduction in demand.
- Of course, final consumer prices increase anyway as a result of the introduction of carbon taxes or tradable emission quotas.

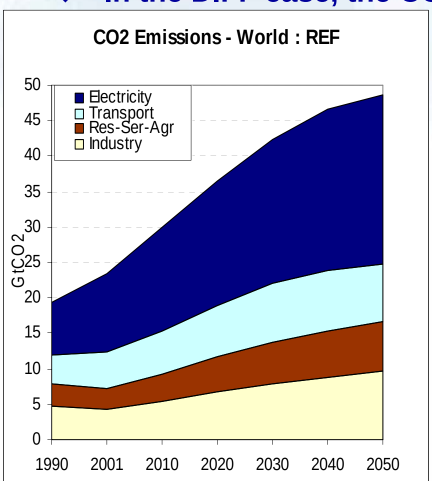


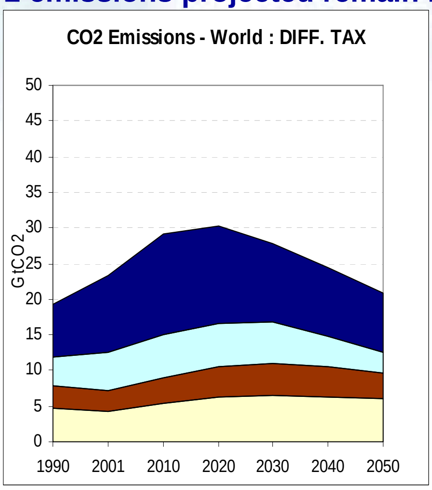


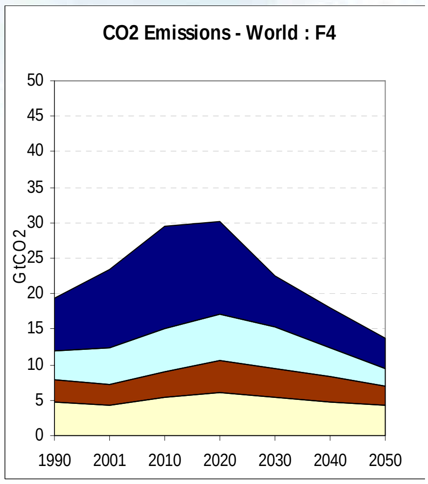


CO2 emissions

- In 2050, Instead of more than doubling of the CO_2 emissions projected in the reference scenario, the S450-F4 scenario allows decreasing emissions of about 30 % compared to the situation in 1990.
- The reduction is much more important in industrialized countries but nevertheless very significant in emerging countries.
- In the DIFF case, the CO_2 emissions projected remain in the same level as in 1990

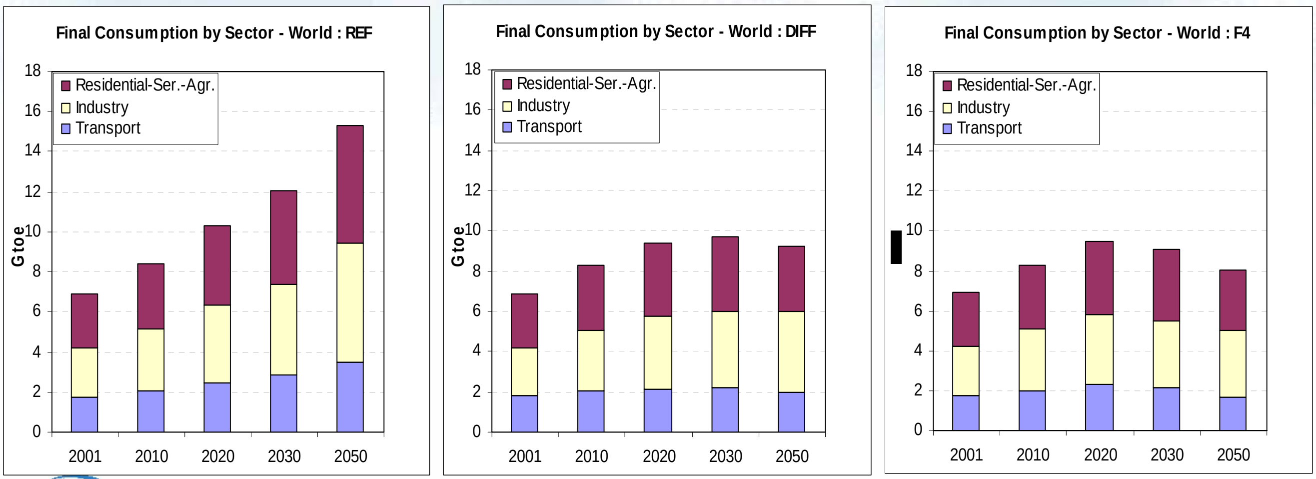






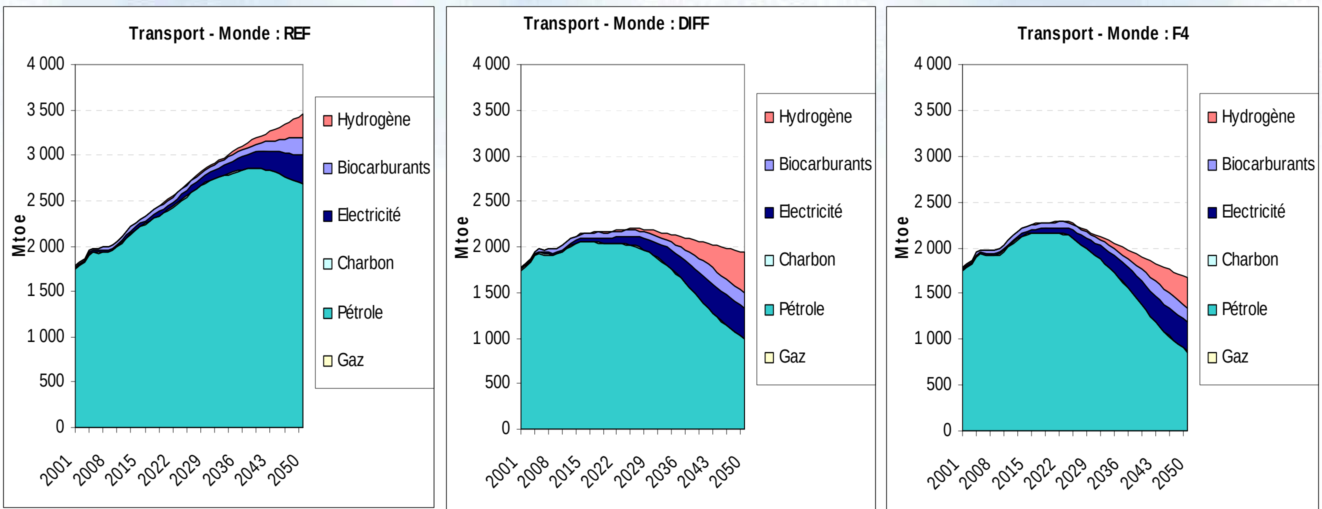
Final Consumption

- Efforts appear equally spread between residential, industry and transport sectors but this global picture may hide more differentiated situations among industrialized and developing nations.



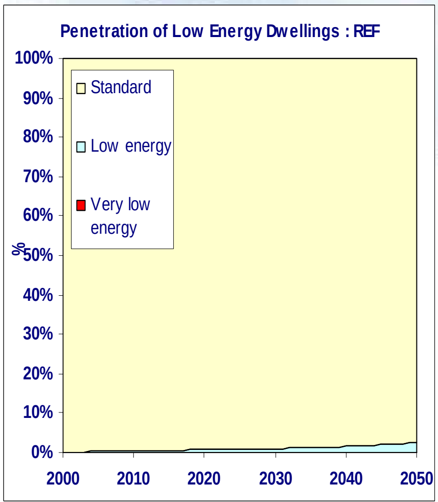
Transport consumption

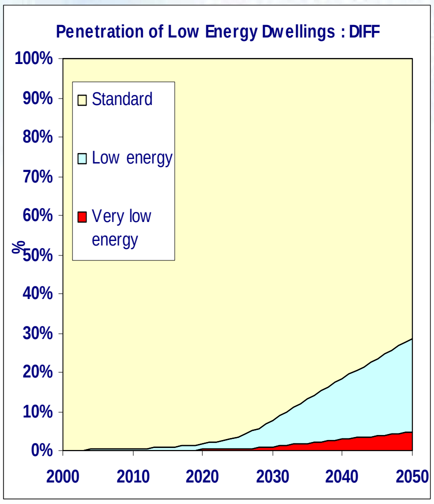
- Reductions in the total consumption of the transport sector are accompanied by an sligh increase of the consumption of H2, electricity and biofuels

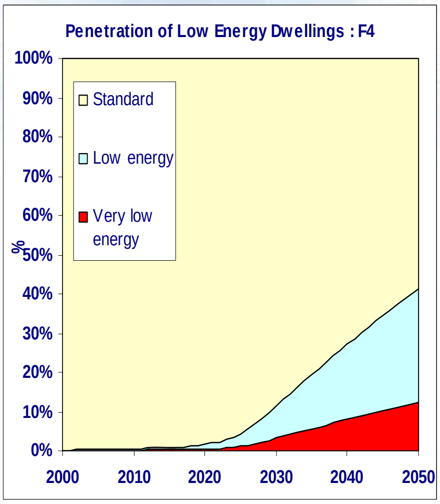


Market shares of Low Energy Buildings

- Reductions in final energy consumption in the building sector are compatible with the increase of dwellings area and comfort levels, thanks to the accelerated introduction of low and very low energy buildings.

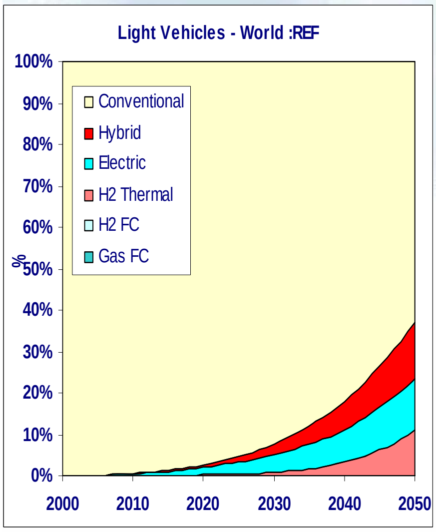


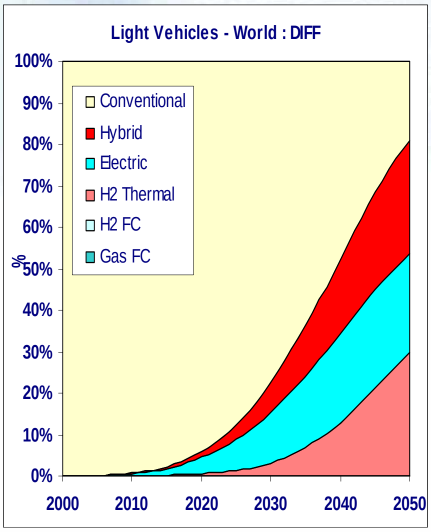


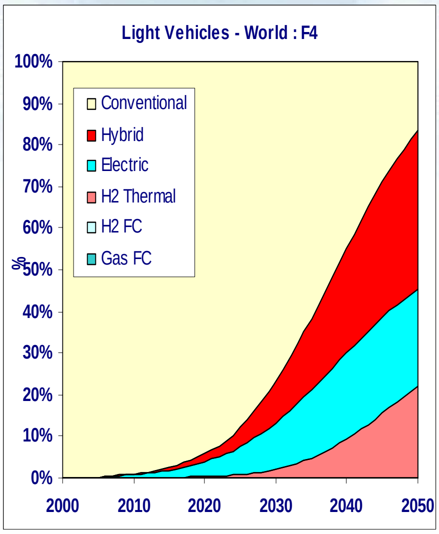


Market shares of transport technologies

- Reductions in the consumption of the transport sector are reached with the rapid introduction of low emitting transport technologies such as electric and hybrid vehicles.
- Note than in this scenario fuel-cell vehicles do not show a significant development due to insufficient competitiveness

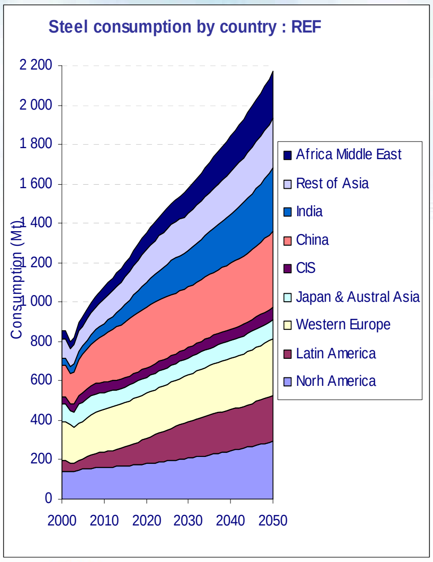


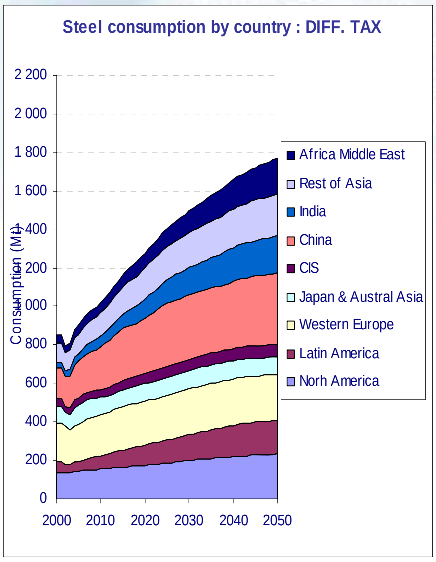


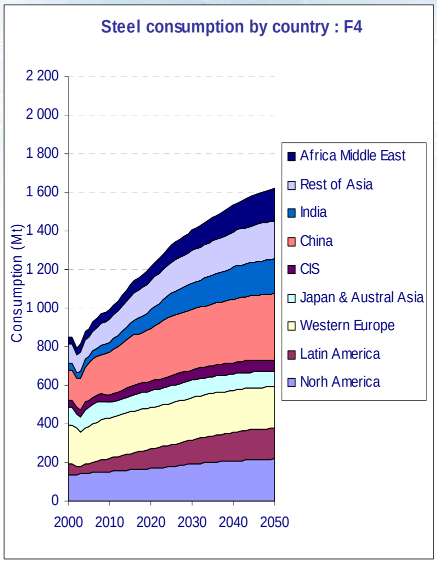


Steel demand by region

- In the structural material sector, the global demand for steel decreases in DIFF tax compared to the Reference by 18% and in the F4 by 27 % in 2050.

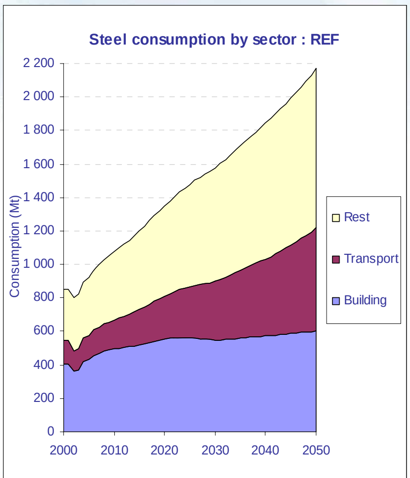


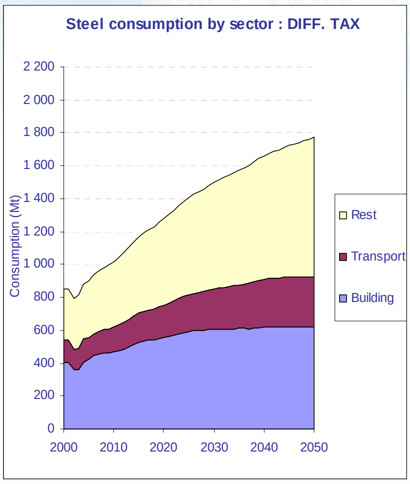


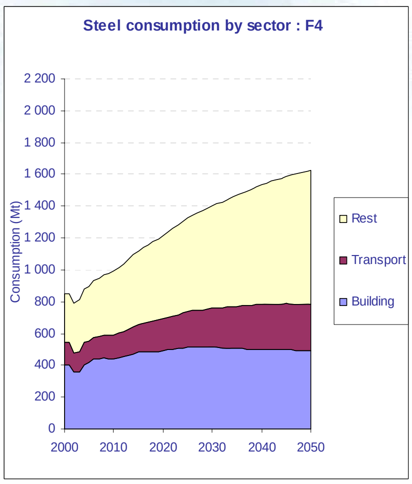


Steel demand by sector

- **In the transport sector, the assumed decrease in the unit steel consumption of the vehicles (reduction of the vehicles' weight) compensates for the increase in the renewal rate of the vehicle stocks that is implied for the rapid diffusion of new efficient vehicles.**
- **The acceleration of the building sector activity, due to the accelerated scraping of low quality buildings, more than compensates the decrease in unit consumption of steel in buildings.**

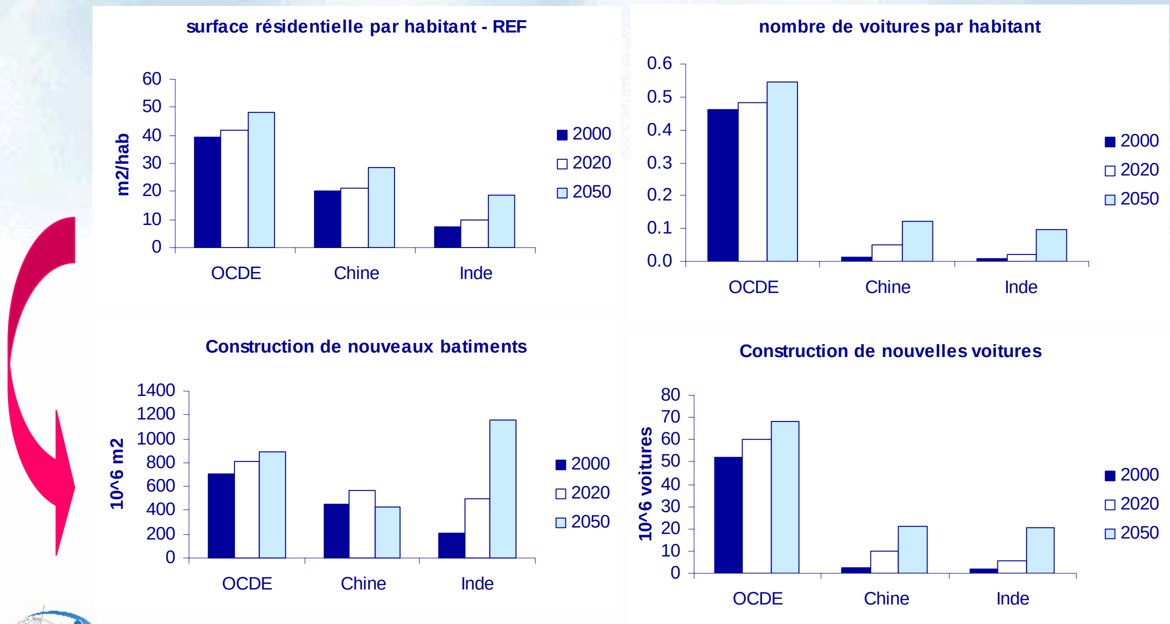






Evolution of the activities

The economic activity will be highly impacted by the increasing role of countries like China, and India.



Conclusions

- The above-described S450-F4 scenario responds to the EU target of limiting temperature increases to less than 2°C from pre-industrial situation. While the DIFF Tax case is less ambitious.
- Differentiated tax scenario provides a preliminary description of the consequences of the development of low carbon societies.
  - As far as the fundamentals of the energy system are concerned, the scenario indicates that strong climate policies may have a dramatic impact on the dynamics of primary energy markets.
  - In particular the prices of oil and gas may be much lower than in the Reference case, which constitutes a double-dividend of climate policies, at least from the consumer countries' perspective.
- It comes out that the demand for steel is much less impacted by the GHG stabilisation scenarios than the demand of energy.
- From this very preliminary analysis it comes out that :
  - the impact of total demand crucially depends on the balance of two contradictory effects the one of an accelerated production of new dwelling and transport vehicles (needed to meet much higher energy-performance standards) the one of a lower materials intensity of the new cars and buildings.
  - This is the result of simple preliminary approaches to long term materials demand, which will have to be made more comprehensive in the future.
  - Similarly the consequences of the S450-F4 and DIFF tax scenarios on production technologies dynamics and on the localization of production still need to be examined with more detail.

From the first to the second ULCOS phase

1. New choice of steel production technologies presented in the model.
2. Improved simulation of the desagregated demand for steel.
   Better participation of the industry specialists in studying further trends of the unit consumption is welcome.
3. New carbon constraints scenarios
   Other ways of burden sharing (Differentiated carbon taxes)
   Testing other profiles of carbon tax (multilinear carbon tax)
4. Better interconnection with macroeconomic models, in order to better take into account the impact of the tax in the GDP growth