# World CO2-energy emissions balance and impacts of the Kyoto Protocol in Europe

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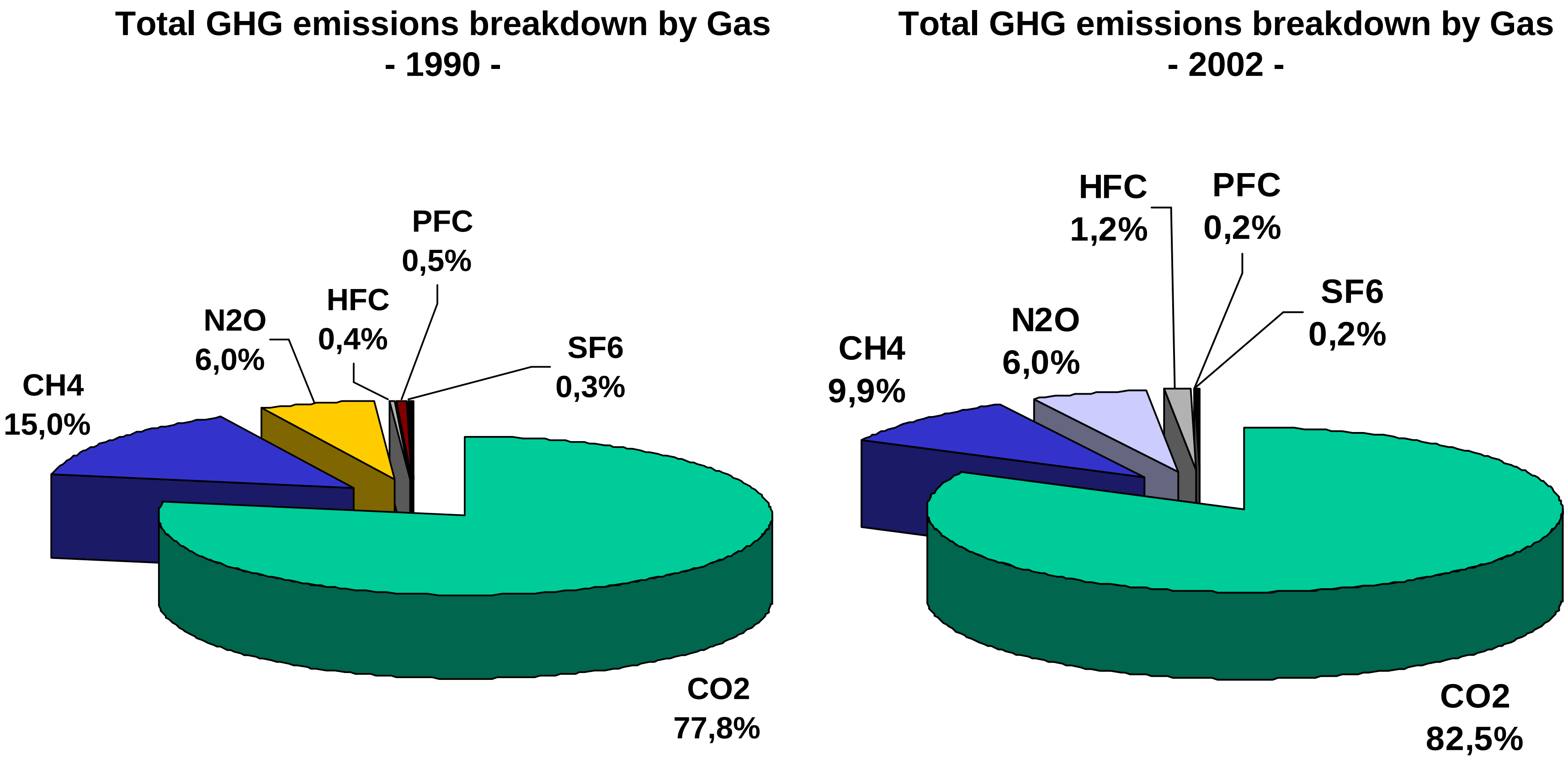
Paris, January 19th 2005

www.enerdata.fr

## Agenda

- Energy weight within total GHG emissions
- CO2-energy emissions in 2003
- What status vs. Kyoto commitments?
- Implications for the industry sector

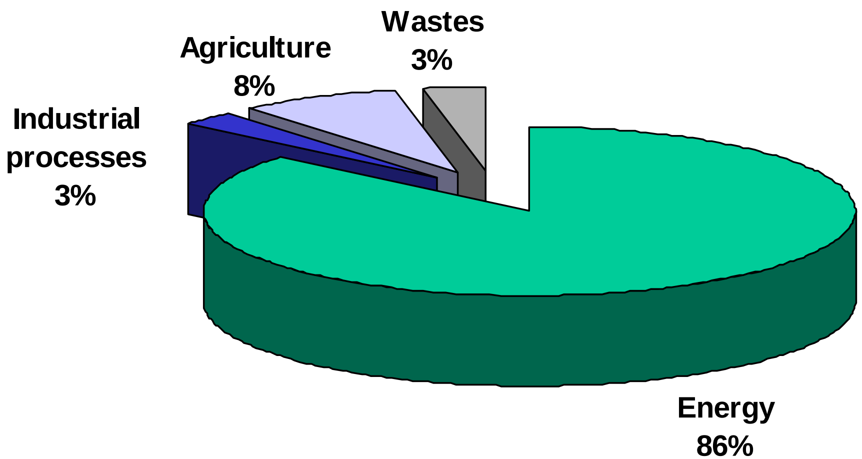
# CO2 represents more than 80% of all GHG emissions and it is increasing since 1990



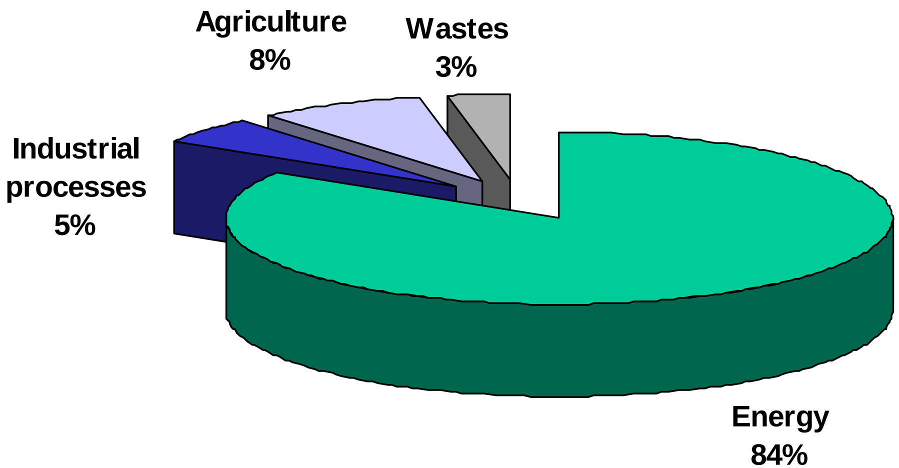

Source : Inventory UNFCCC, Annex B countries

# Energy accounts for 85% of all GHG emissions

**GHG Emission breakdown by Sector**
**- 1990 -**

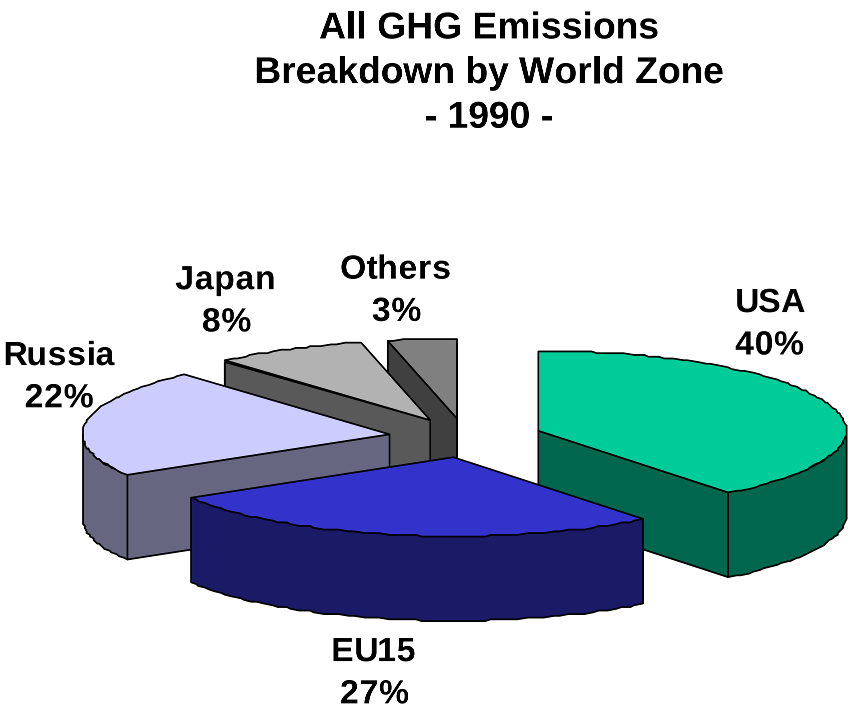


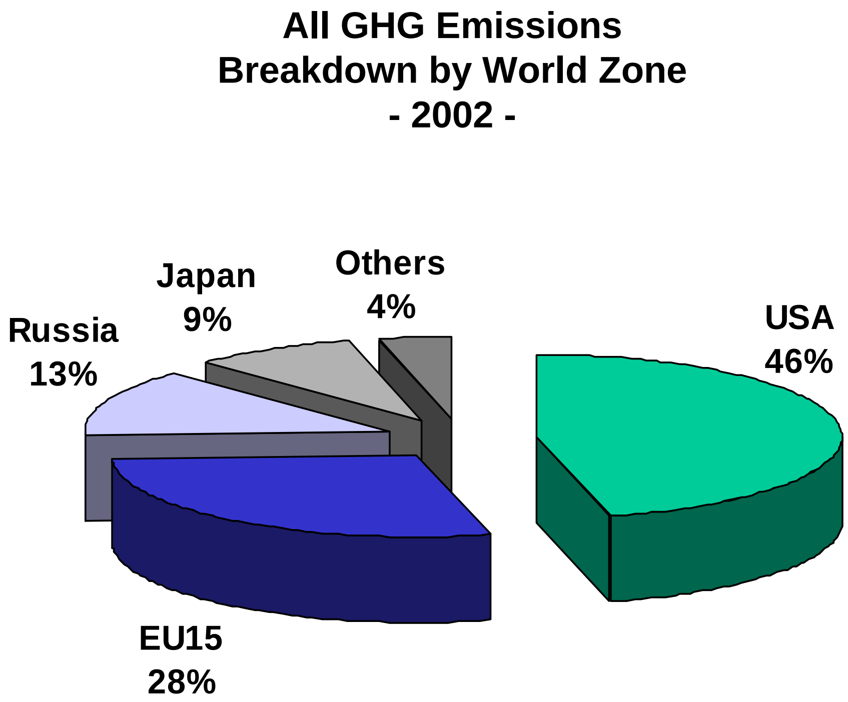

**GHG emission breakdown by Sector**
**- 2002 -**




Source : Inventory UNFCCC, Annex B countries

# The United States account for almost 50% of all GHG emissions from the countries of the Annex B

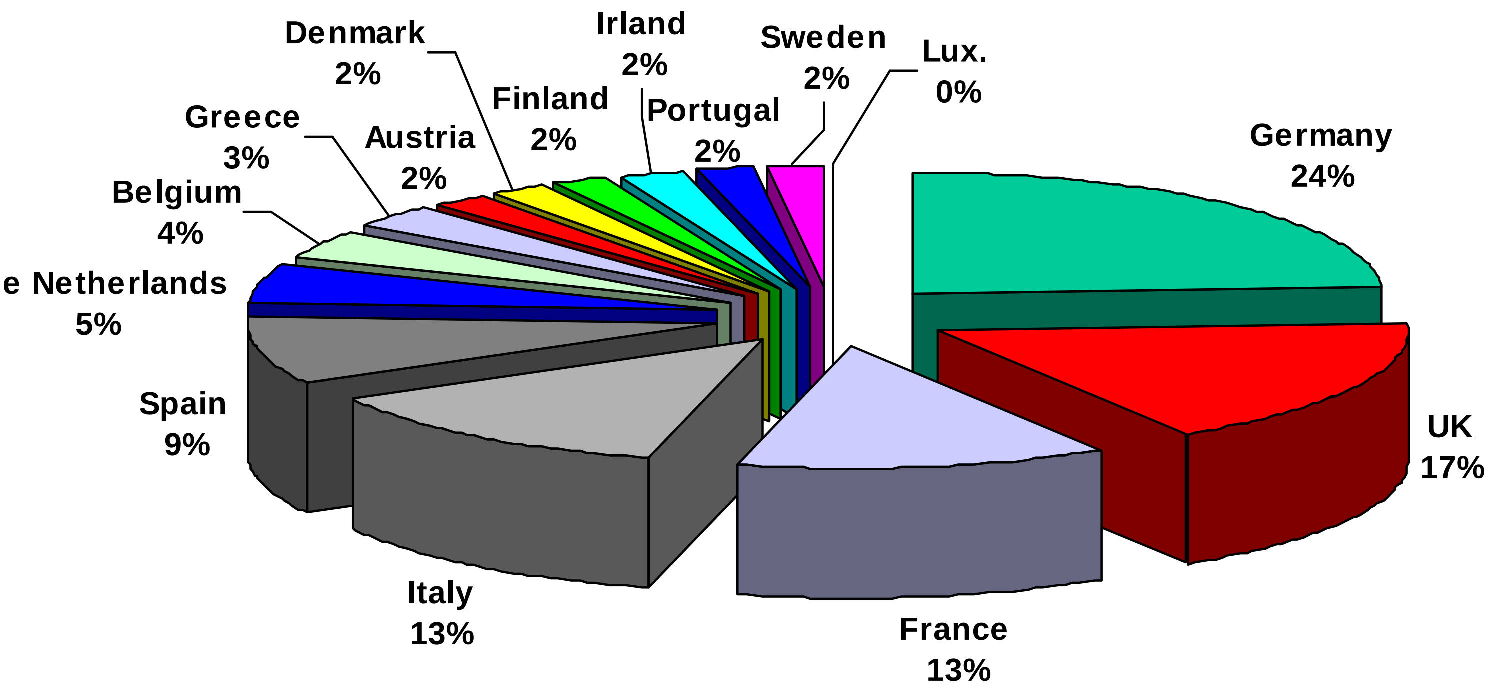



- Russian emissions have collapsed, from 22% to 13% of total emissions from Annex B countries between 1990 and 2002.
- The share of the United States has increased by 6 points since 1990, the EU-15's by one point

Source : Inventory UNFCCC, Annex B countries

## Germany, United Kingdom, France, Italy and Spain cover 75% of total GHG emissions from the EU-15 (2002)




Source : Inventory UNFCCC, Annex B countries

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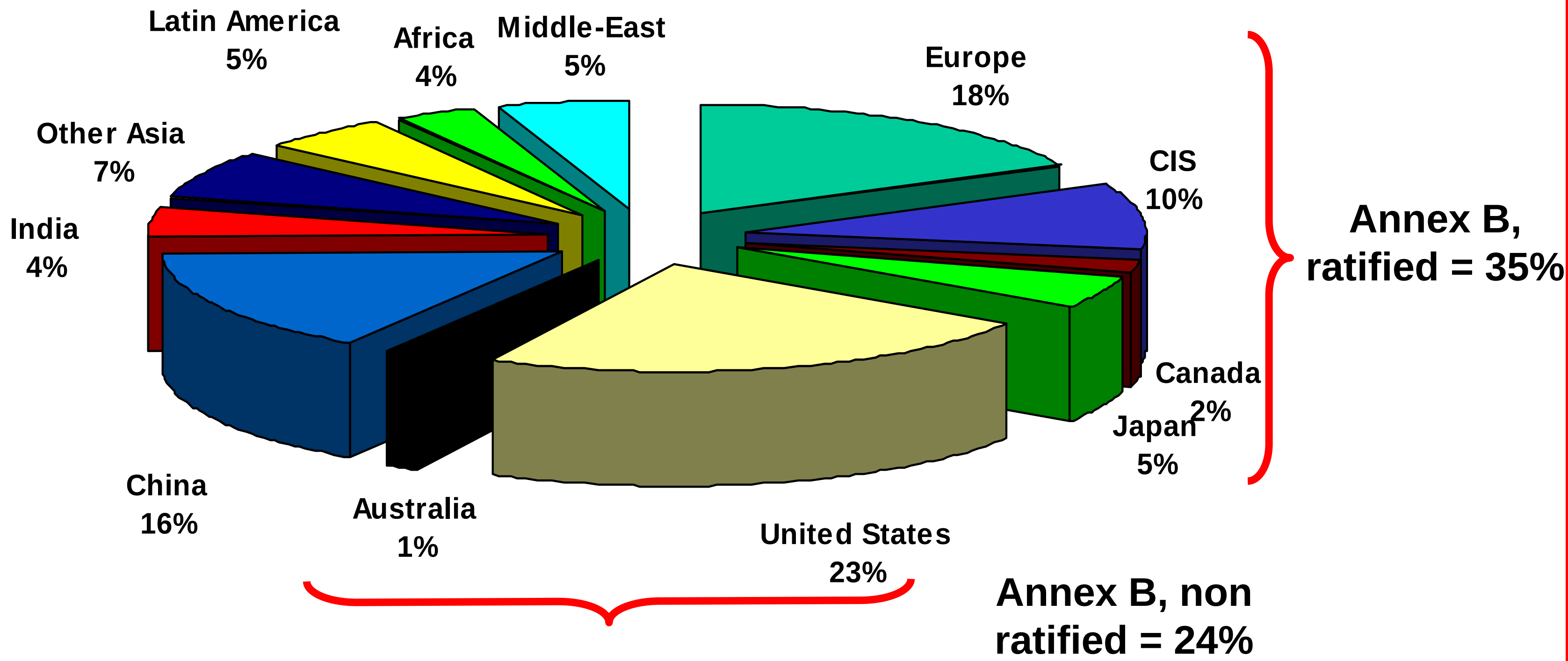
## 1990-2003 worldwide: Key data

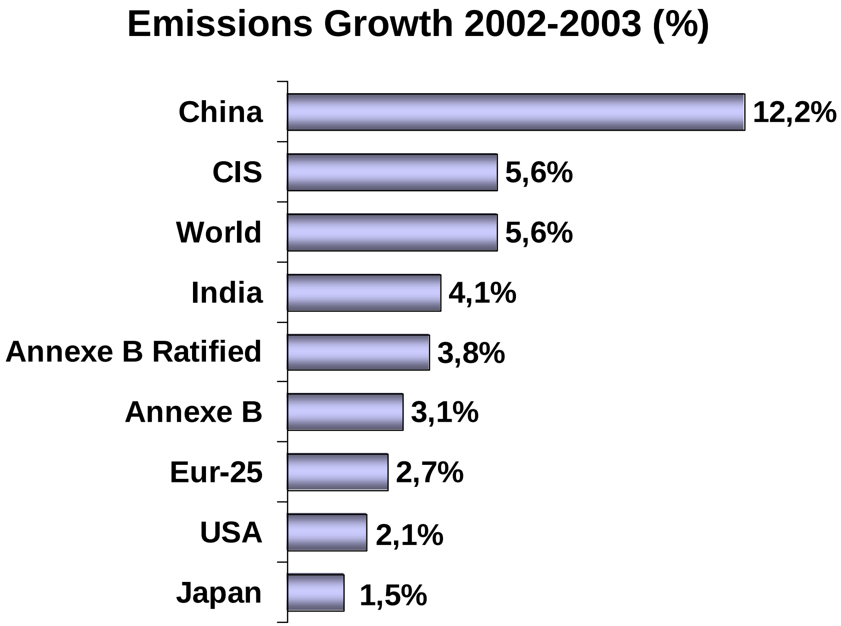
- GDP : +38 %
- Population : +19%
- $CO_2$-energy : +21%
- $CO_2$/inhabitant : +1,7%
- $CO_2$/GDP : -12%

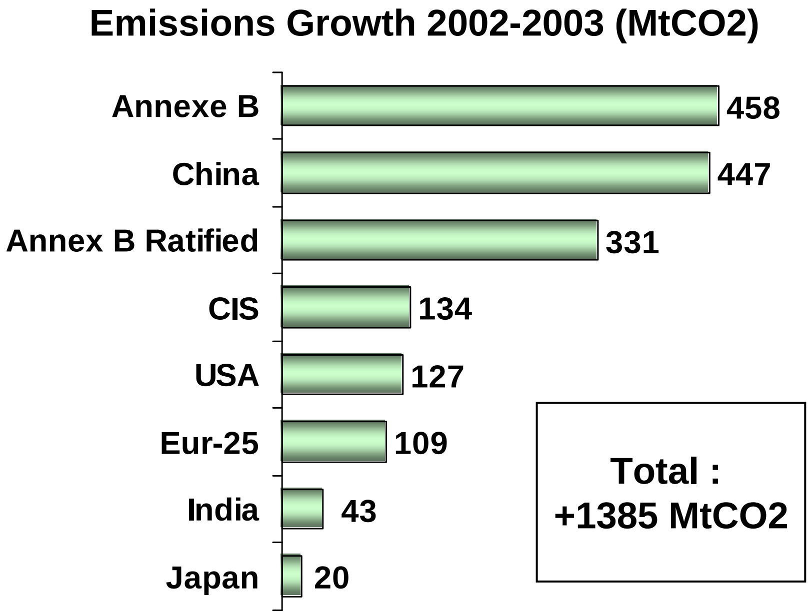
## CO2-energy emissions in the world : 26,3 GtCO2 in 2003




- Annex B's countries  account for around 60% of the world emissions
- Annex B's countries which have ratified the Kyoto Protocol represent around one third of all emissions
- China accounts for 16% of total emissions

# China, CEI, USA and the EU-25 drive world emissions in 2003

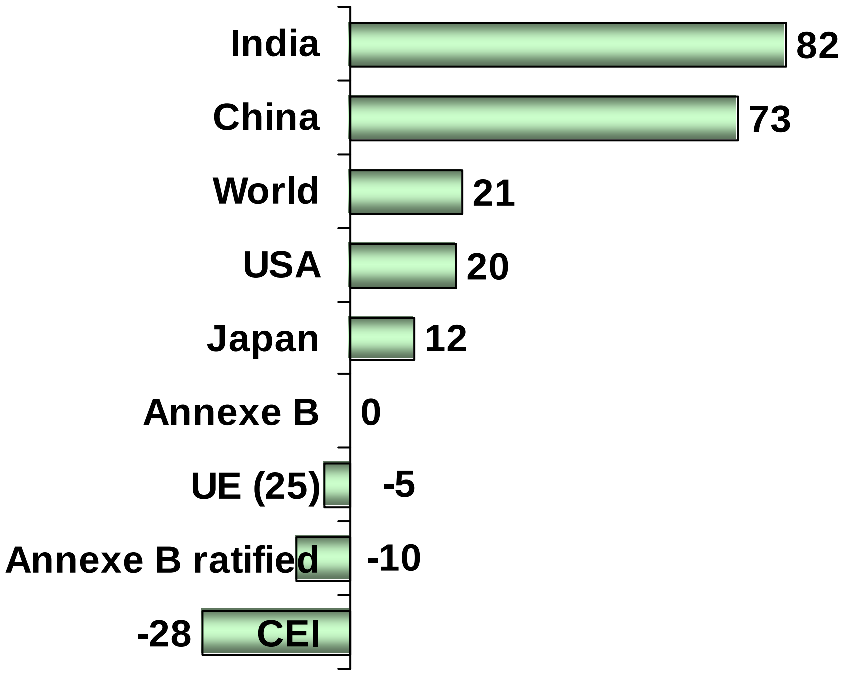



- Chinese emissions have risen by from 12% between 2002 and 2003
  - They account for one third of the world emissions increase
  - Chinese emissions have increased as much as all Annex B 's countries
- 25% of the world emissions increase come from the Annex B's countries which have ratified the Kyoto Protocol

# CO2-energy Emissions from the annex B's countries have been steady between 1990 and 2003

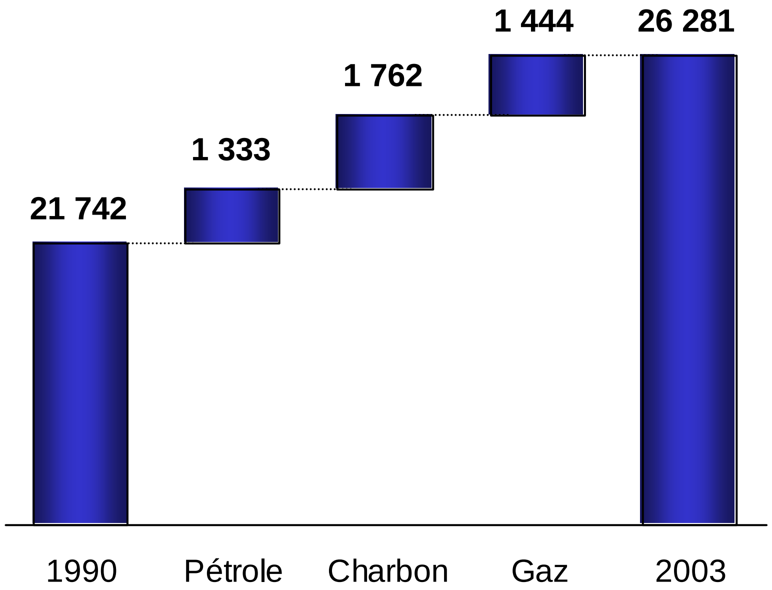
**Evolution of the CO2-Energy Emissions Energy – from 1990 to 2003 (1990 = Index 100)**



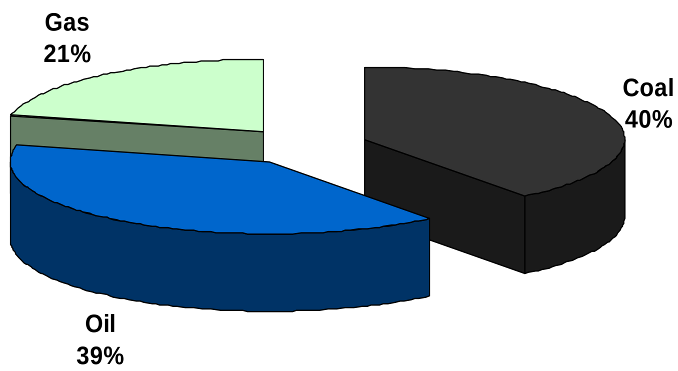

- The annex B's countries which have ratified Kyoto have decreased by 10% in 2003 compared to 1990
- US emissions increased sharply when those of the EU-25 decreased: +20% versus -5%
- The "hot air" of the CIS still represents 28% of 1990 CIS emissions
- Meanwhile, the weight of China and India has dramatically increased: +73% and 82%

# World CO2-energy emissions by energy source in 2003

**Evolution des Emissions de CO2-énergie par source (1990-2003; MtCO2)**

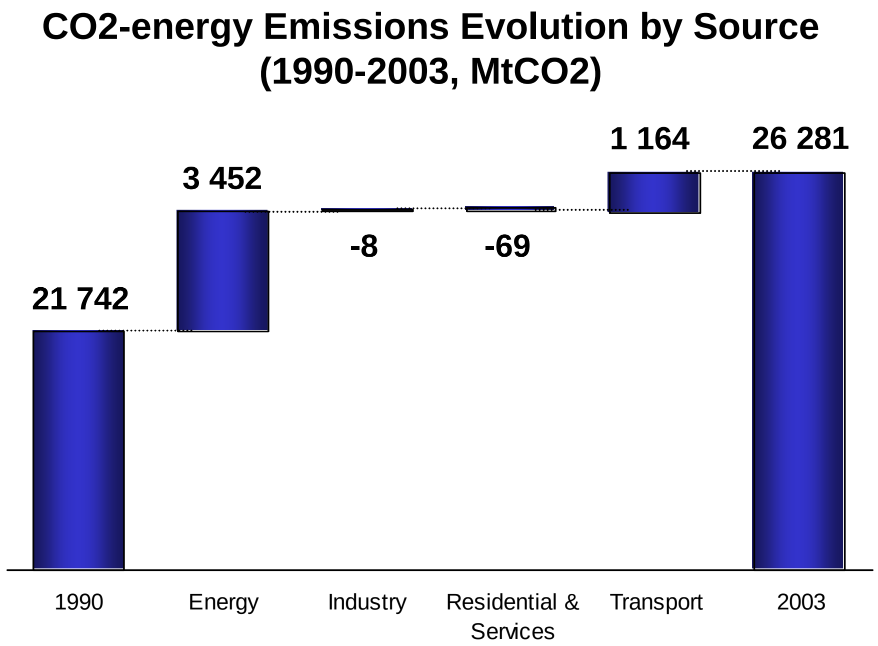


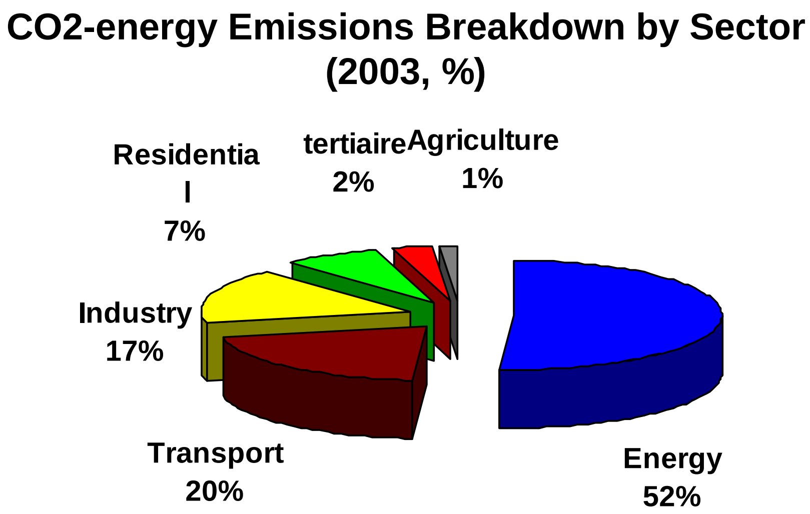

**Répartition des Emissions de CO2-énergie par Source (2003, en %)**




- Coal is the principal emission source in the world in 2003
- Since 1990, the emissions increase is principally due to coal
  - coal: 39%
  - gas: 32%
  - oil: 29%

# World CO2-energy emissions by sector in 2003




- The energy sector (power generation essentially) accounts for more than half of total CO2-energy emissions; the transport sector is the second largest emitter (20%)
- ¾ of the CO2-energy emissions increase is due to the energy sector, ¼ due to the transport sector
- The industrial sector and the other sectors do not emit more in 2003 than in 1990

# Agenda

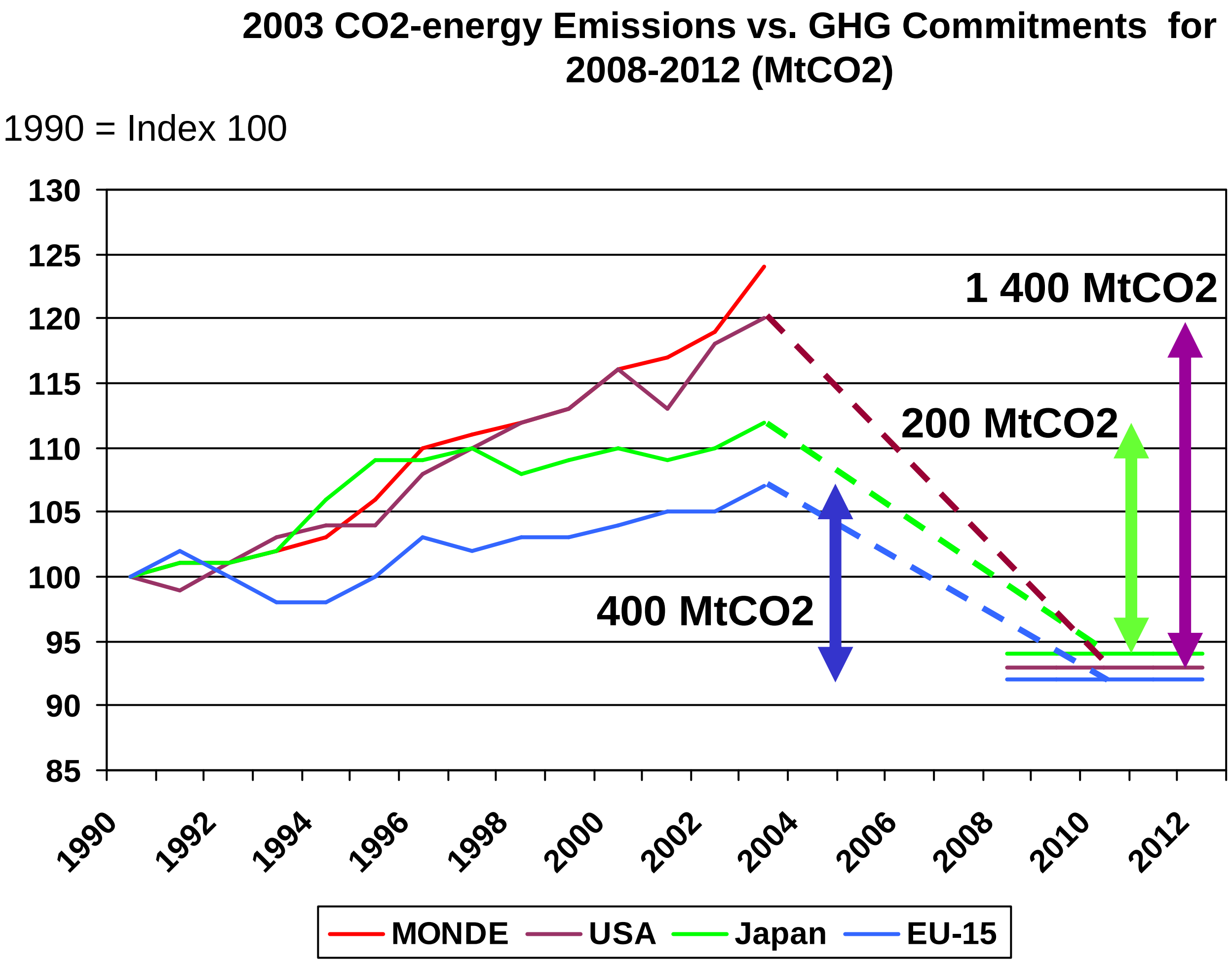
- Energy weight within total GHG emissions
- CO2-energy emissions in 2003
- What status vs. Kyoto commitments?
- Implications for the industry sector

# Countries commitments within the Kyoto protocol

- Kyoto Protocol implementation: February 16th, 2005
- 122 countries have ratified the protocol
- Missing countries:
  - Australia
  - USA
  - Indonesia
  - Croatia, Égypt, Kazakhstan, Liechtenstein, Monaco, Niger, St Vincent & Grenadines, and Zambia

| | **Objectives 2008-2012/1990** (%) |
|---|---|
| Germany | -21 |
| Austria | -13 |
| Belgium | -7,5 |
| Denmark | -21 |
| Spain | 15 |
| Finland | 0 |
| France | 0 |
| Greece | 25 |
| Ireland | 13 |
| Italy | -6,5 |
| Luxembourg | -28 |
| Netherlands | -6 |
| Portugal | 27 |
| United Kingdom | -12,5 |
| Sweden | 4 |
| **EU-15** | **-8** |

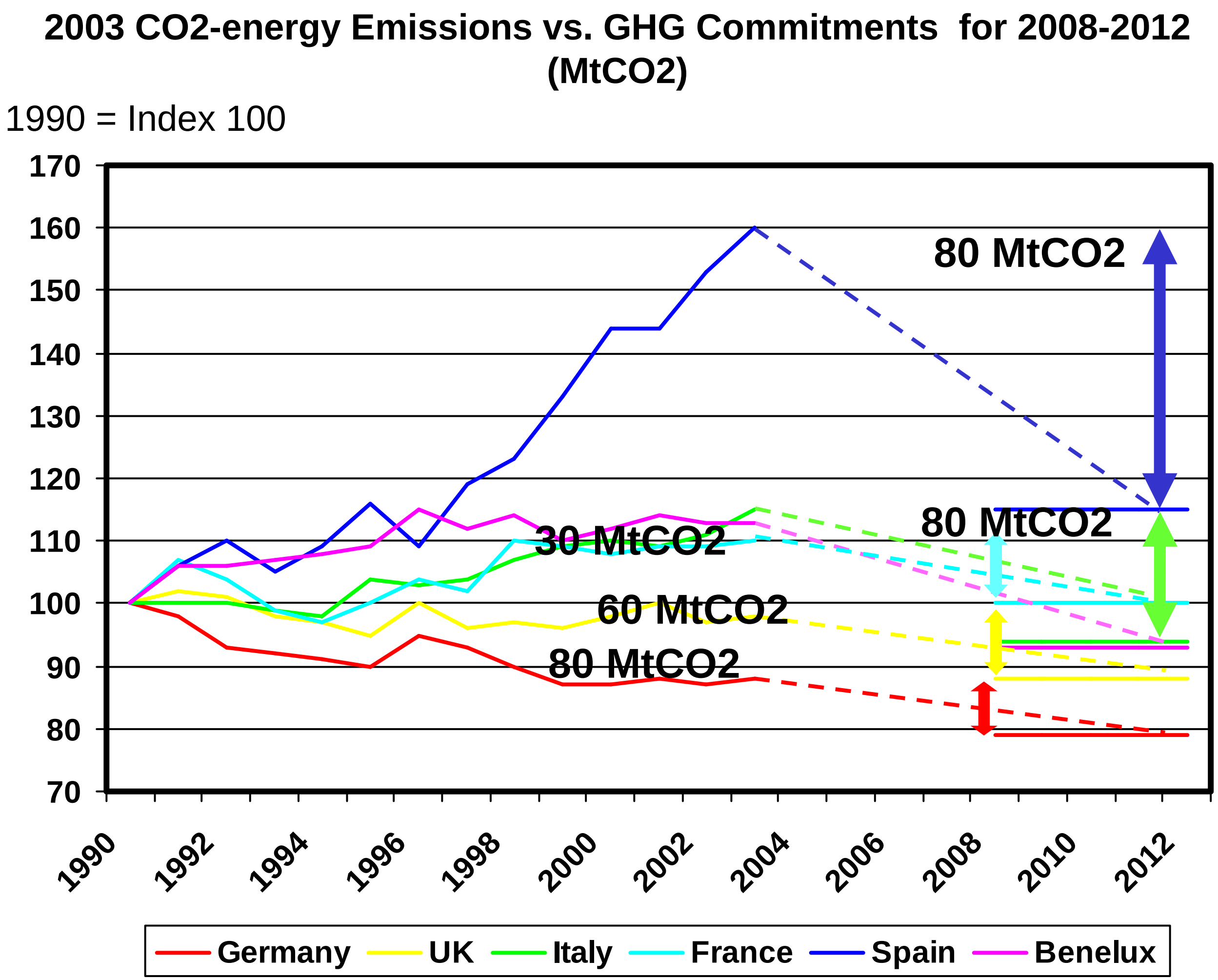
# What is the status as regards Kyoto commitments?
# a) Large countries / Annex B zone




- All large countries & zones of the Annex B, except the CIS and Eastern Europe countries, resolutely deviate from the Kyoto objectives; relatively, the UE-15 performs better than the other zones

- Despite the Russian hot air, global emissions from the Annex B countries are 1,5 $GtCO_2$ higher than the Kyoto objectives for 2003

# What is the status as regards Kyoto commitments? b) the European bubble



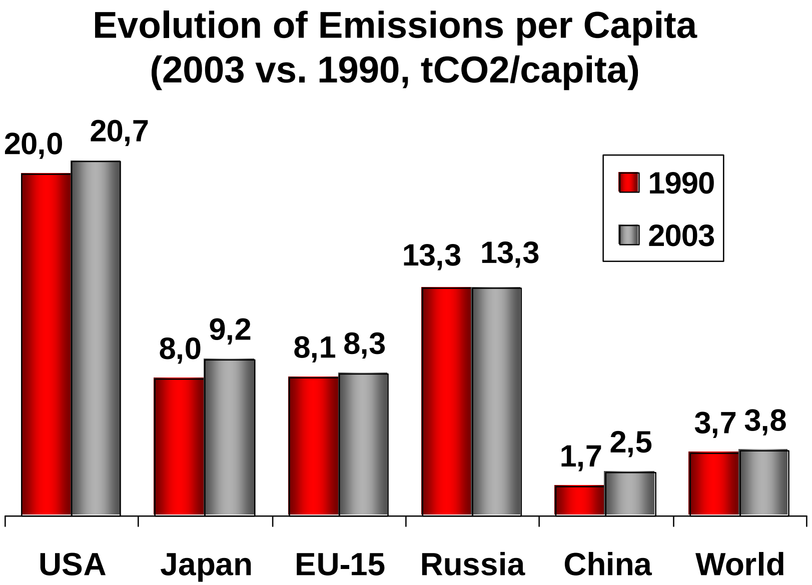

- Only 5 countries are less than 12% from the objective in 2003: Germany, France, Greece, UK, Sweden
- 4 countries are more than 35% higher from the objective: Austria, Spain, Ireland, Luxembourg

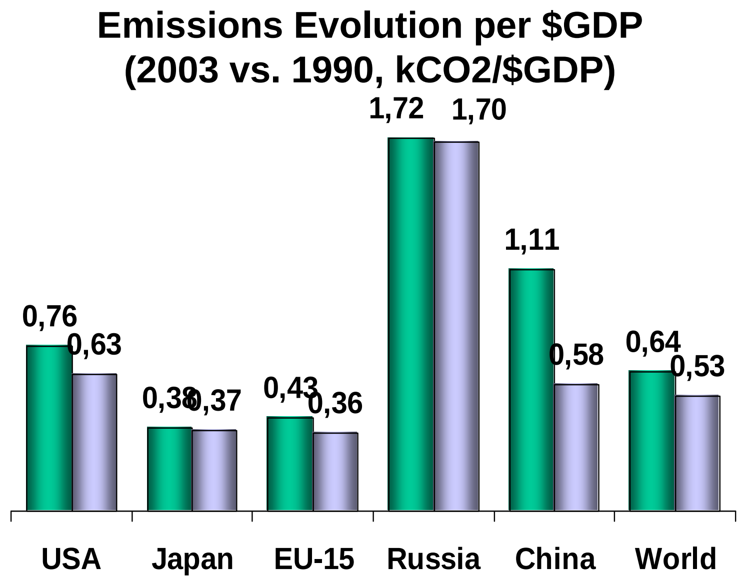
# There are 3 principal drivers explaining emissions dynamics

| | |
| --- | --- |
| Economy & Demography | Economic & demographic growths generate higher emissions |
| Fuel Mix | Emissions / capita disparities are also linked to energy fuel mix, in particular for electricity generation: this fuel mix evolution partly explains the differences among countries performance vs. Kyoto |
| Sectors | The various sectors emitting CO2-energy weight unequally within total emissions: differences in dynamics by sector partly explain the evolutions observed |

# The economy and the demography are driving emissions upwards

Large Countries / Zones

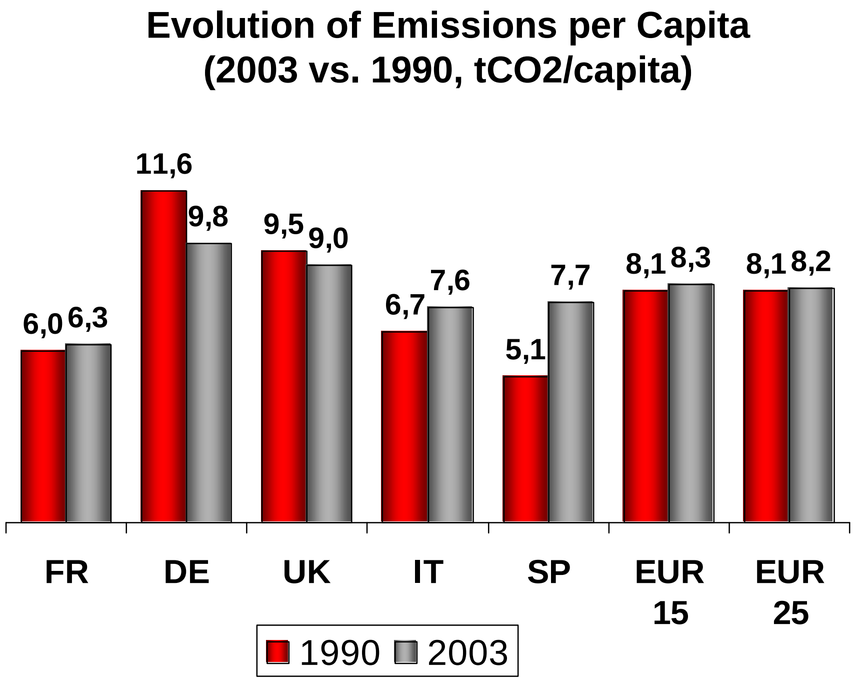


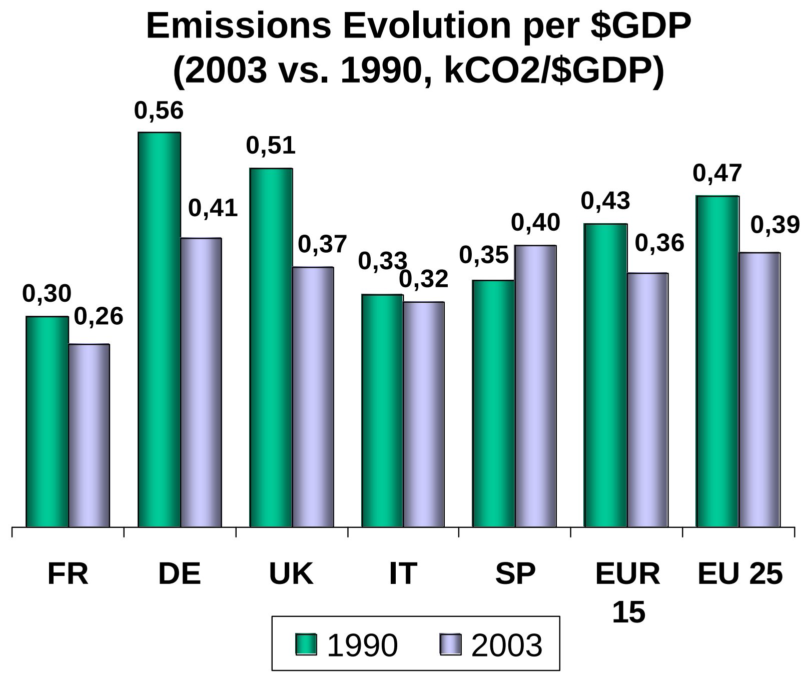




- A ratio of 1 to 2,5 for emissions per capita and of 1 to 4,5 per GNP $ in 1990 between countries of the Annex B: initial gaps do not reduce significantly
- Important gaps in GNP growth since 1990: 45% in the USA, 28% in the EU, 19% in Japan and -21% in Russia
- Unequal Energy efficiency improvements: 18% in the USA, 10% in the EU, 3% in Japan, 53% in China and 14% in Russia

# The economy and the demography are driving emissions upwards

## The European Bubble




- Initial gaps also appear within the European bubble: they partly explain the European « burden sharing »
- Countries with high economic growth are also those with highest increasing CO2 emissions: Spain, Ireland, …
- Differences in energy efficiency improvements evolutions, reflecting more or less voluntarist national policies

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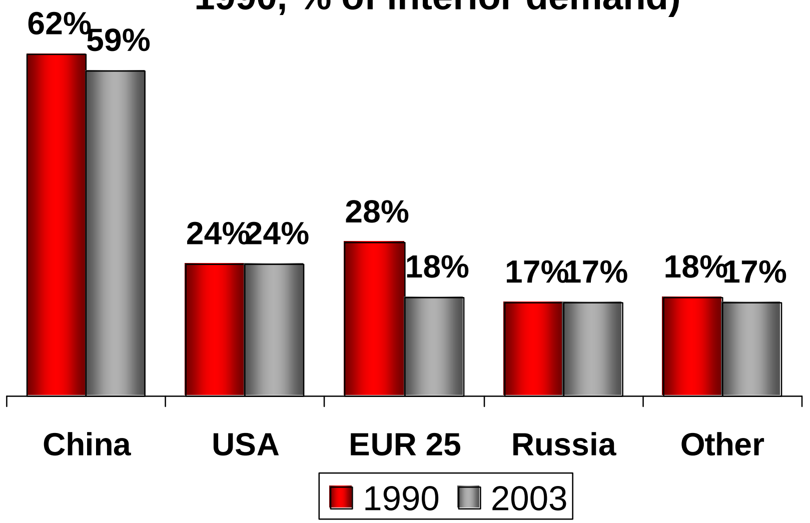
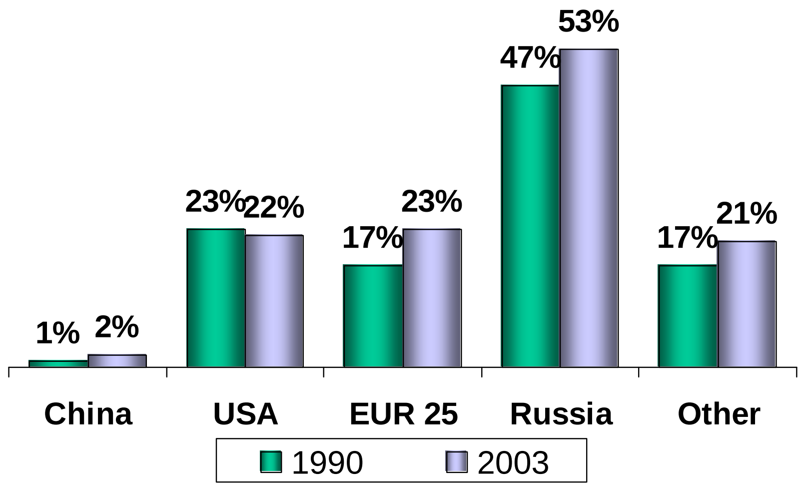
# The natural gas penetration and relative coal receding slow the emissions increase

Large Countries / Zones

**Evolution of the Coal Weight ( 2003 vs. 1990, % of interior demand)**



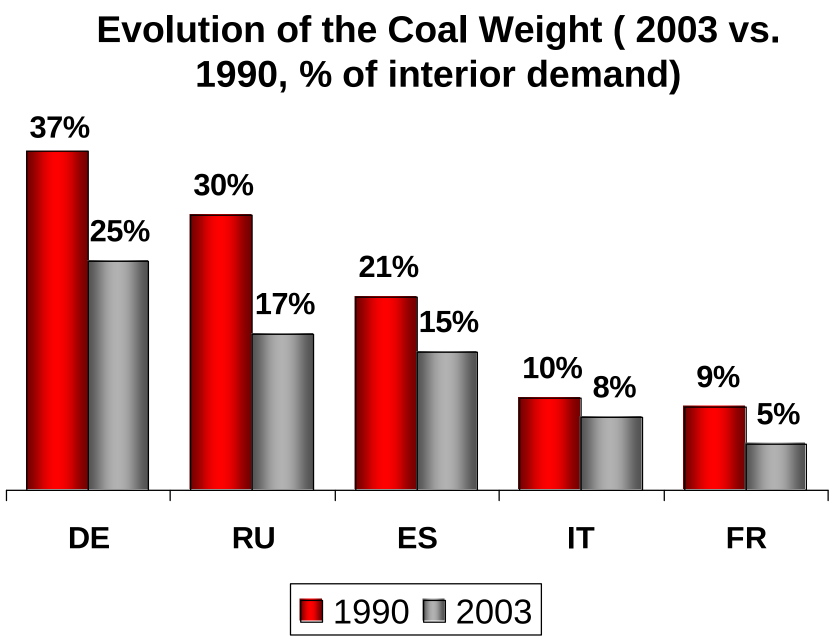

**Evolution of the Gas Weight (2003 vs. 1990, % of interior demand)**

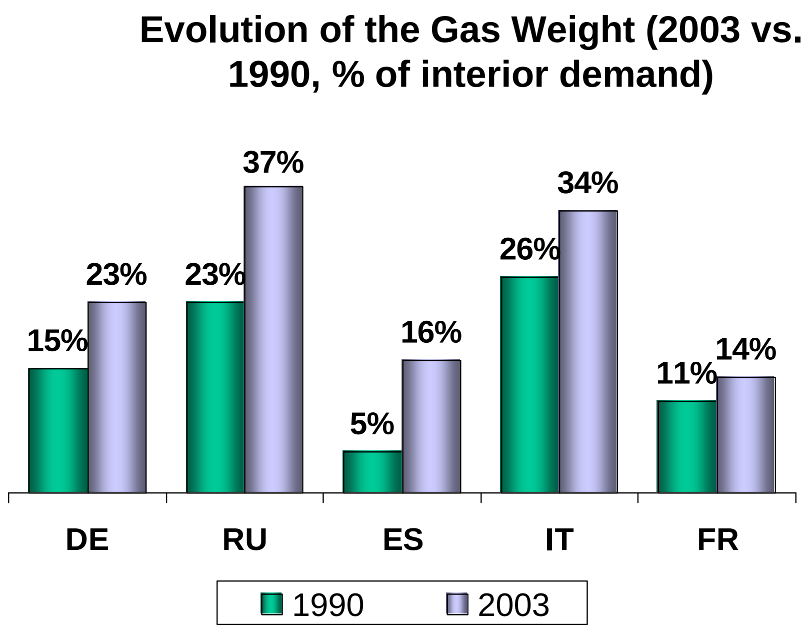



- The coal decline in Europe partly explains the good "CO2 performances" relatively to 1990; The situation in Japan and in the USA is the opposite
- Except for the USA, the switching to gas is general and contributes to improving CO2 performances
- The role of oil in CO2 performances is very weak, except in Japan

# The natural gas penetration and relative coal receding is even more accentuated in Europe

The European Bubble



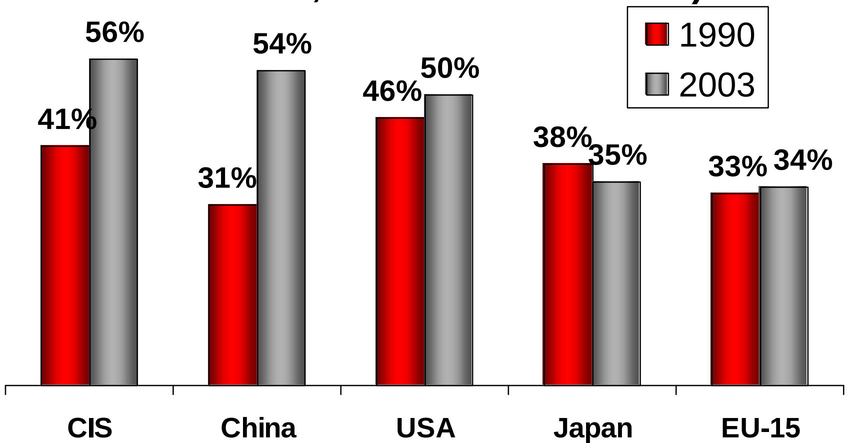

- The rapid switch from coal to gas, especially in the electricity generation, explains the relative good CO2 performances of Germany and the UK
- The important penetration of natural gas in all European countries has contributed to a limitation of the European emissions since 1990

Enerdata

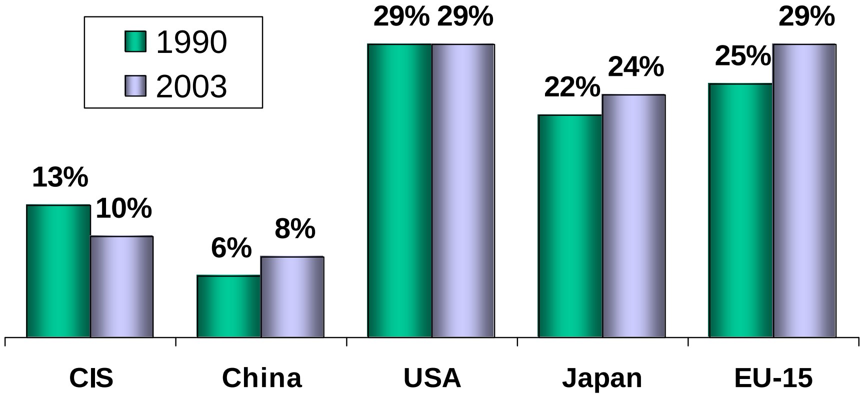
# The electric sector and transport, main drivers of world emissions increase

Large Countries / Zones

**Evolution of the Electric Sector Weight (2003 vs. 1990, % of total emissions)**



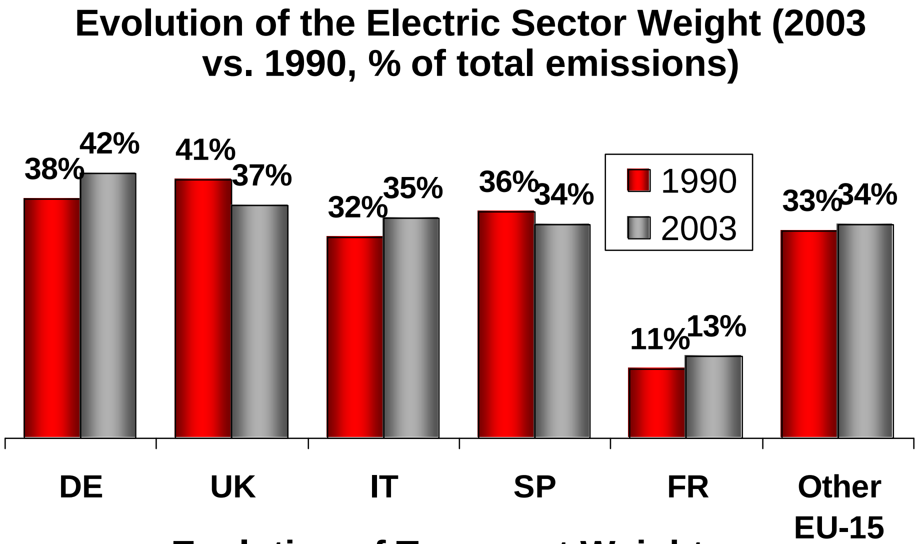

**Evolution of Transport Weight (2003 vs. 1990, % of total emissions)**

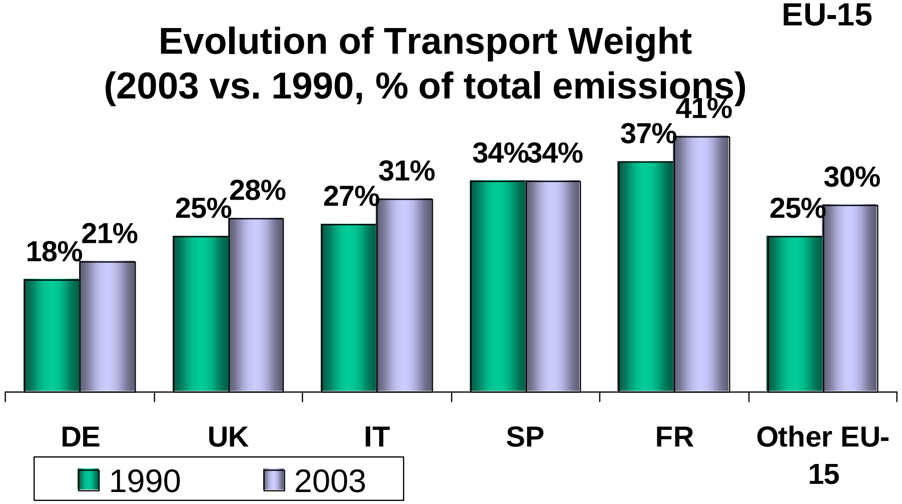



- The weight of electricity generation in $CO_2$ emissions has largely increased since 1990, except when gas substitutes for coal (EU-15, Japan)
- The weight of transport in total emissions has also increased in every country / zone (except for CIS)
- The weight of the industry sector is receding everywhere as regards $CO_2$ emissions

# Situations and evolutions are more contrasted in Europe for the energy sector

## The European Bubble




- The weight of the energy sector in Europe accounts for more than 1/3 of total CO2 emissions, except for France (nuclear); it accounts for 42% in Germany in 2003
- The weight of transport in total emissions increases in almost every country; (from 3 to 5 points depending on countries)
- The relative high weight of transport in France is explained by the small emissions of the energy sector

# Agenda

- Energy weight within total GHG emissions
- $CO_2$-energy emissions in 2003
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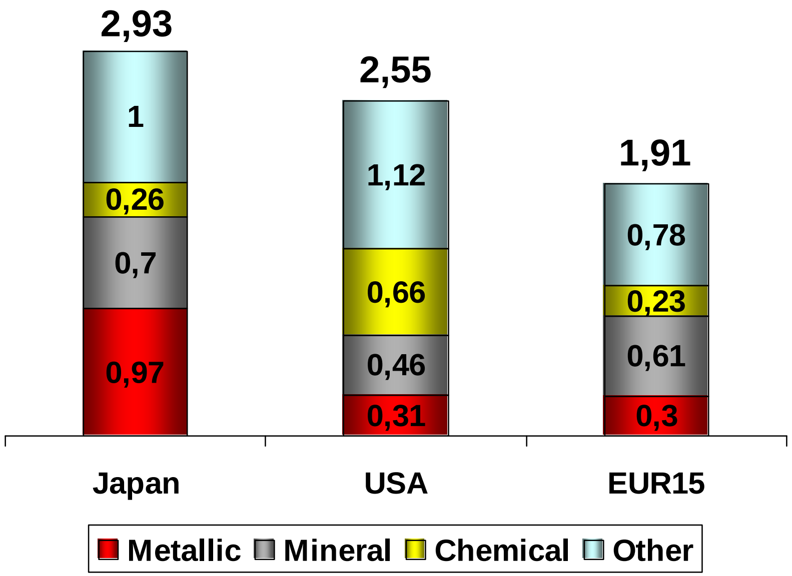
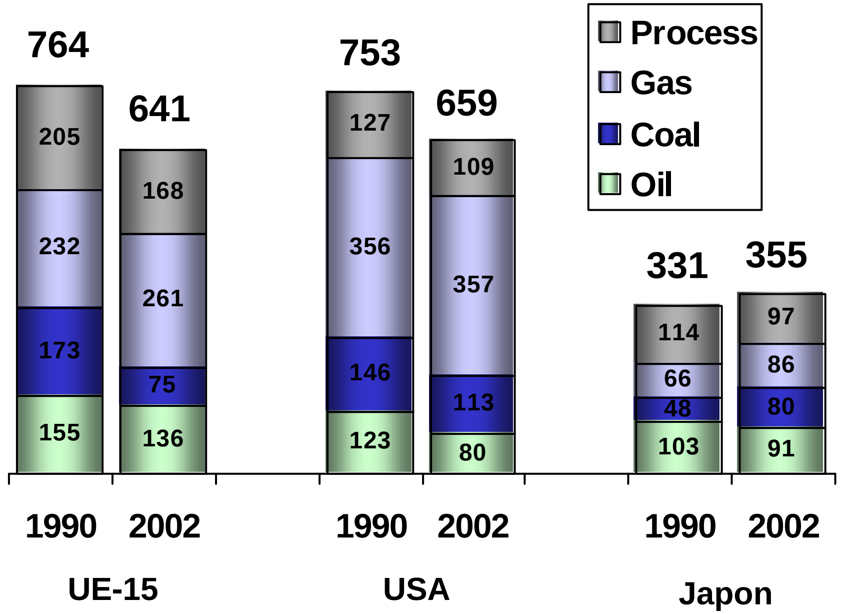
# Contrasted positions in the industry sector vs. CO2 emissions (including process) within the Annex B countries



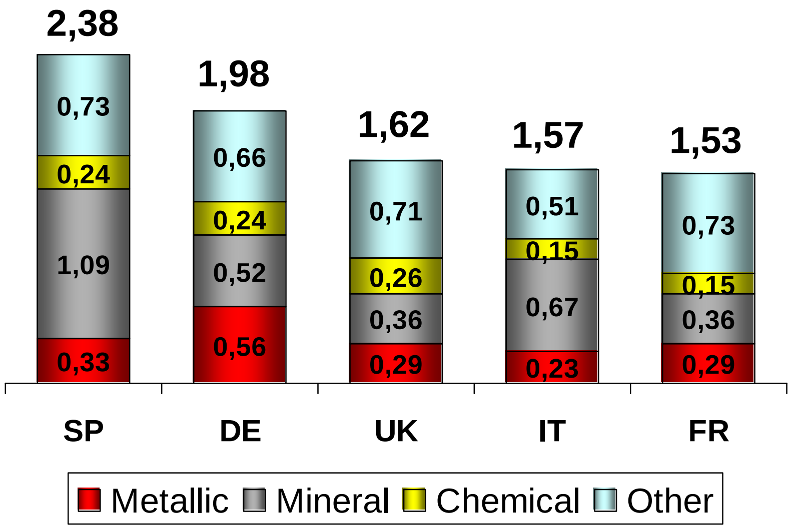

*Note : process emissions of 2002




- Strong discrepancies between sectors explain these differences in industry emissions levels
- The weight of steel industry in Japan and of chemical industry in the USA explain the high levels of these countries vs. Europe
- The switch coal ➔ gas explains the reduction of industrial emissions in Europe and in the USA; the opposite for Japan

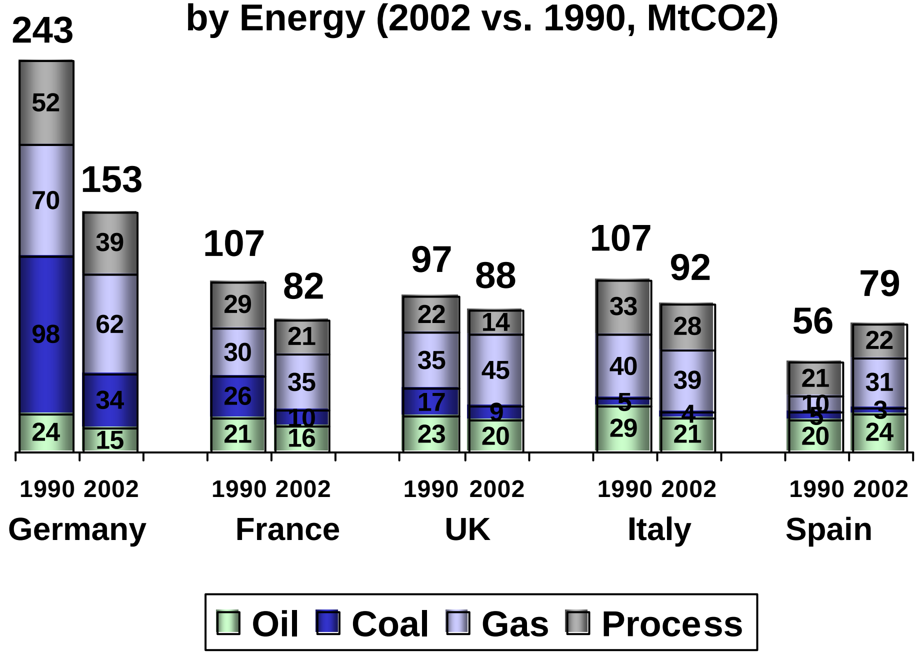
# A similar contrast is observed in the EU

**Industry Emissions Breakdown by Sector (2003*, tCO2 / capita)**




*Note : process emissions of 2002

**Evolution of Industrial Emissions Breakdown by Energy (2002 vs. 1990, MtCO2)**

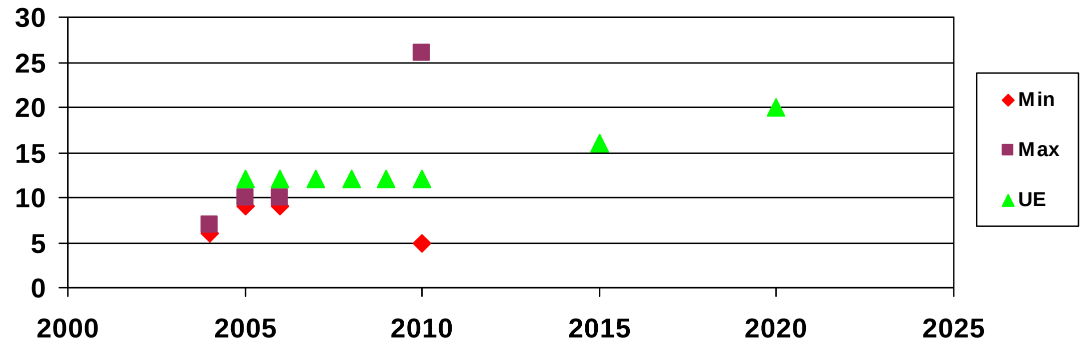



- Spain emissions are driven by the very important weight of non metallic activities; Germany by its steel industry
- The dramatic coal ➔ gas switch everywhere in Europe contributes to the reduction in industry emissions

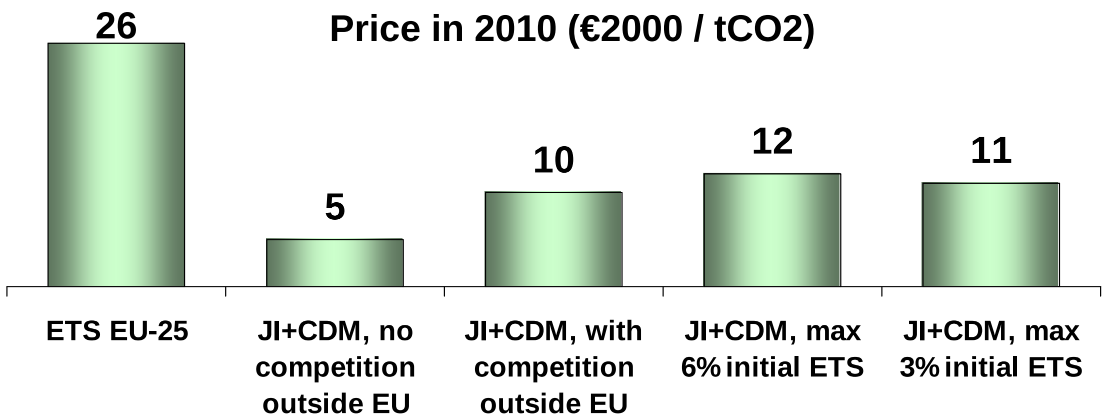
# Economic impact of carbon quotas : what carbon price, today and tomorrow?

**Principal Carbon Prices Hypothesis**

€ 2000 / tCO2




**POLES Simulations for Carbon Price in 2010 (€2000 / tCO2)**




Source : LEPII-EPE (POLES Model)

- Around 7€/t CO2 at the end of 2004 (Point Carbon), carbon term price reaches 9 to 10 €/tCO2 by the end of 2005
- The EU hypothesis on prices evolution for 2010-2020 give a maximum price of 20€/t by 2020
- POLES simulations with respect of Kyoto commitments, and according to CDM & JI contribution : 5 – 26 €/tCO2 in 2010
- Large uncertainties remain, due to the Russian « hot air »

# Anticipation of carbon prices: a market simulated by the POLES model, based on carbon supply and offer

**POLES - ASPEN-sd : Pronk's Package**

**INPUTS :**

| | | | | | |
|---|---|---|---|---|---|
| CDM Accessibility Factor | 10% | of Non Annex B reductions | | | |
| with | 20% | Transaction Cost | | | |
| Concrete Ceiling / Imports | 100% | (Ref-Assigned Amount)*x% | | | |
| / Exports | 100% | (Assigned Amount)*x% | | | |
| Allowable Sinks | 3% | of 1990 Base Emissions | | | |
| Hot Air Exclusion (HAE) | 0 | M tC | | | |
| | $90/tC | | or % of sales | | or % of permits |
| Share of Proceeds (SP) on IET | 0 | | 7.0% | | 0% |
| on CDM | 0 | | 2.0% | | |
| | $90/tC | E99/tC | E99/tCO2 | | |
| Voluntary Compliance Payment | 200 | 228 | 62 | (>200 $90 for no VCP) | |

**OUTPUTS :**

| CO2 Reductions Kyoto Target | | of which: Hot Air | IET | CDM | Domest | Missing | Missing - HAE |
|---|---|---|---|---|---|---|---|
| 798 | M tC | 324 | 68 | 46 | 360 | 0 | 0 |
| 2 926 | M tCO2 | 1 186 | 250 | 170 | 1 320 | 0 | 0 |

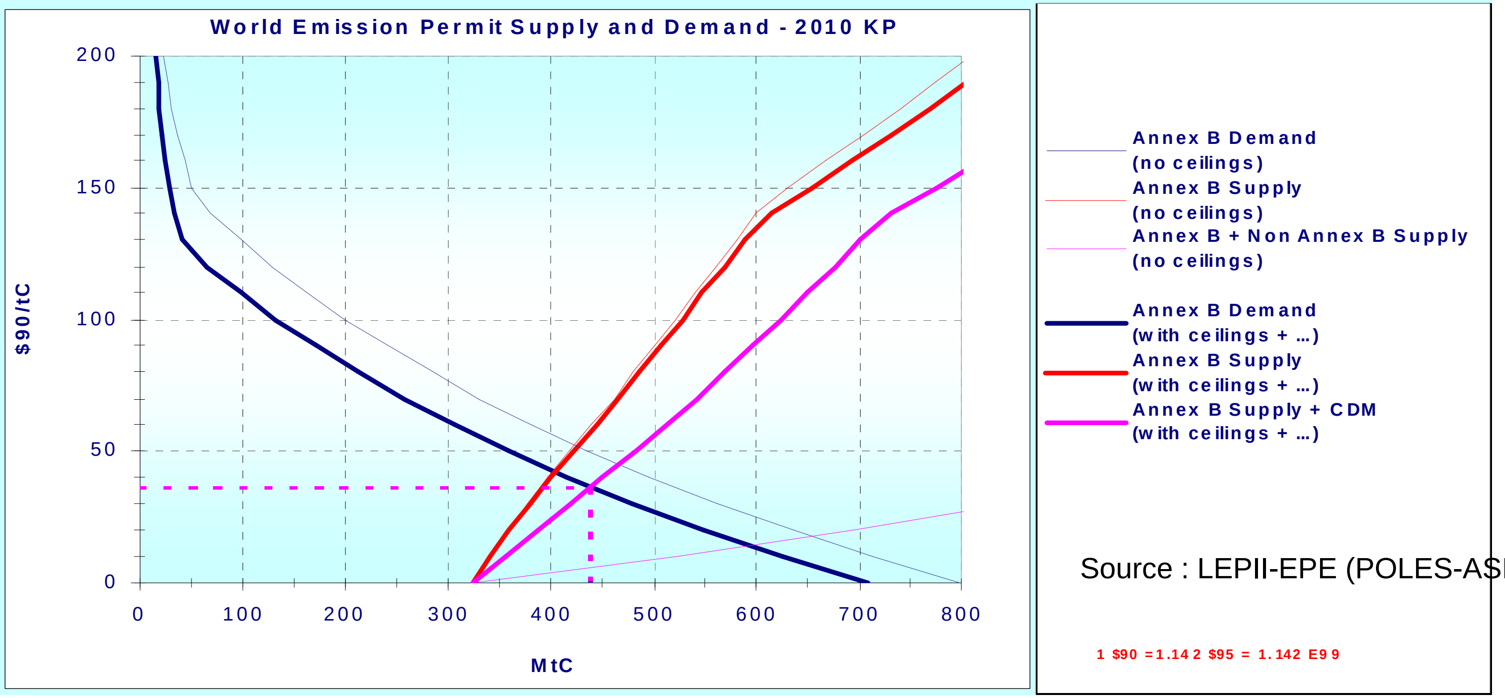
| Permit price | |
|---|---|
| 36.3 | $90/tC |
| 41.4 | E99/tC |
| 11.3 | E99/tCO2 |

| Fund from SP |
|---|
| 1 029 M$90 of which |
| 995 from IET |
| 34 from CDM |

| Permits from SP |
|---|
| 0 M tC |

| Reverse Auction | |
|---|---|
| 0 | $90/tC |
| 0 | E99/tC |
| 0 | E99/tCO2 |

| Fund from VCP |
|---|
| 0 M$90 of which |
| 0 to IET |
| 0 to CDM |




Source : LEPII-EPE (POLES-ASPEN Model)

1 $90 =1.142 $95 = 1.142 E99

# In particular, the POLES model assesses the effect of the USA withdrawal and Russian « hot air » on the carbon market

**POLES - ASPEN-sd : Pronk's Package**

**INPUTS :**

| | | |
|---|---|---|
| CDM Accessibility Factor | 10% | of Non Annex B reductions |
| with | 20% | Transaction Cost |
| Concrete Ceiling / Imports | 100% | (Ref-Assigned Amount)*x% |
| / Exports | 100% | (Assigned Amount)*x% |
| Allowable Sinks | 3% | of 1990 Base Emissions |
| Hot Air Exclusion (HAE) | 0 | MtC |

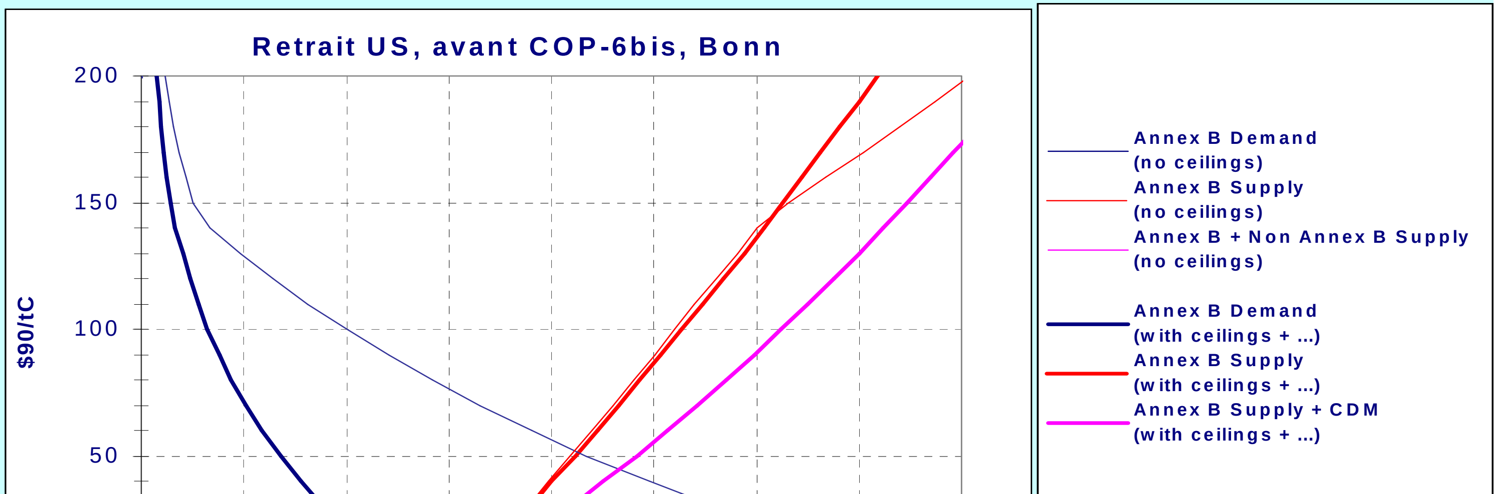
| | $90/tC | | or % of sales | or % of permits |
|---|---|---|---|---|
| Share of Proceeds (SP) on IET | 0 | | 7,0% | 0% |
| on CDM | 0 | | 2,0% | |
| | $90/tC | E99/tC | E99/tCO2 | |
| Voluntary Compliance Payment | 200 | 228 | 62 | (>200 $90 for no VCP) |

**OUTPUTS :**

| CO2 Reductions Kyoto Target | | of which: Hot Air | IET | CDM | Domest | Missing | Missing - HAE |
|---|---|---|---|---|---|---|---|
| 798 | MtC | 324 | 0 | 0 | 849 | -375 | -375 |
| 2 926 | MtCO2 | 1 186 | 0 | 0 | 3 114 | -1 374 | -1 374 |

| Permit price | | Fund from SP | Permits from SP |
|---|---|---|---|
| 0,0 | $90/tC | 0 M$90 of which | 375 MtC |
| 0,0 | E99/tC | 0 from IET | |
| 0,0 | E99/tCO2 | 0 from CDM | |

| Reverse Auction | | Fund from VCP |
|---|---|---|
| 0 | $90/tC | 0 M$90 of which |
| 0 | E99/tC | 0 to IET |
| 0 | E99/tCO2 | 0 to CDM |




Source : LEPII-EPE (POLES-ASPEN Model)

1 $90 =1.142 $95 = 1.142 E99

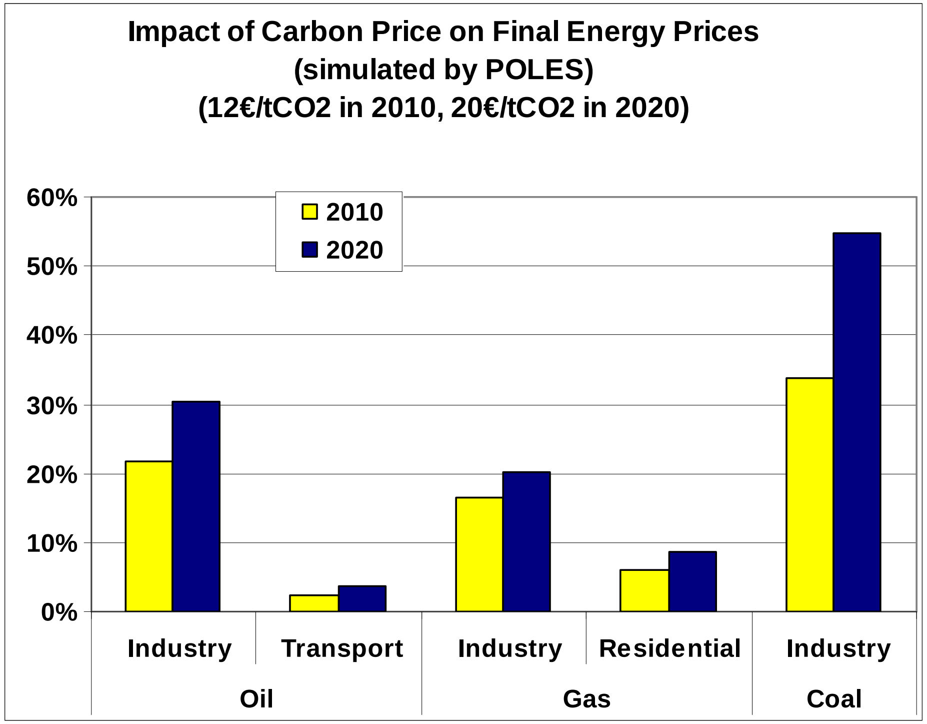
# The implementation of the EU ETS will lead to an increase in gas prices

- The EU ETS will lead to a switch coal ➔ gas, particularly in the electric sector

- The resulting higher increase in gas demand will create a tension on the gas market; the impact on prices will be a Russian affair in the first place

- The coal demand will lower, and competition between producers will increase : until where?

# Energy prices will be more affected by carbon price in the industry sector than in other sectors

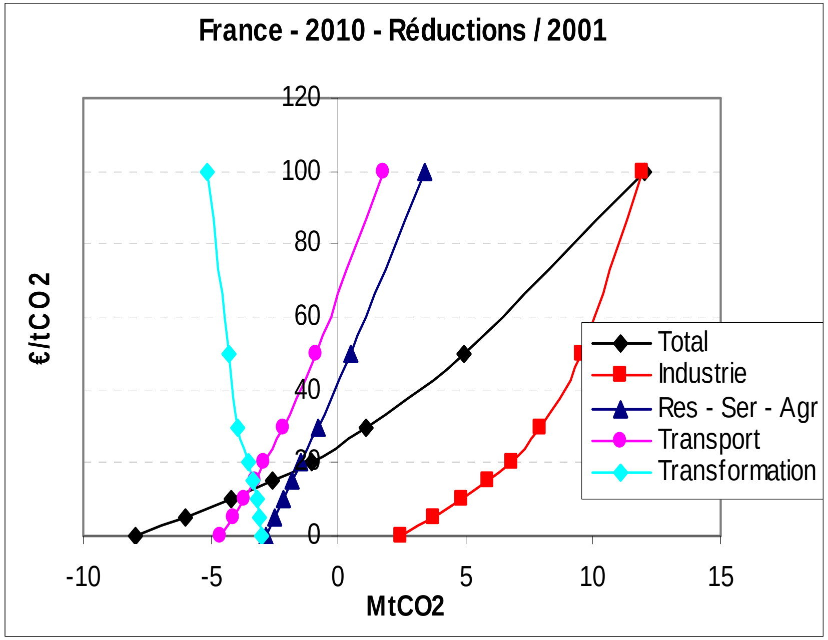



- Large incidence on the industry and electric sectors, especially for coal
- Small incidence on road transports (<4%)
- Relatively small influence on the residential sector (<8%)
- In theory, few directs impacts on electricity prices in France (nuclear)

Source : Enerdata (POLES Model)

# Which mechanisms for equal efforts between sectors?

**Carbon Marginal Abatement Cost Curves**




- Flexibility mechanisms for the industry: tradable permits, CDM, JI
- White certificates for households and small consumers
- « Policies & measures »: thermal regulation in construction, voluntary agreements for car producers, labels, etc.

Source : Enerdata (POLES Model)

## For further information… www.enerdata.fr

### EmissionStat™

- International Database on CD-Rom (English & French)
- GHG emissions data
- 185 countries
- 2003 emissions Data and annual data since 1990
- $CO_2$, $CH_4$ & N20 covered
- Emissions detailed by sector

### POLES Model

- Model used for EU energy demand projections references (WETO 2030)
- Projections to 2015, 2020, 2030
- Based on supply / demand equilibrium by world region
- Energy demand forecasts
- GHG Emissions forecasts
- Carbon prices valuation
- Carbon prices forecasts


- **Contact us**

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