



Energy & Climate, Working Group Meeting



Montreux, Thursday October 27th

Directions to 2050: Introduction

- « Directions to 2050 » explores the « what if » case of a world in 2050 that emits no more than 9 GtC, which is roughly on a 550ppm stabilization pathway (F&T 2004).
- The options discussed are not a scenario nor do they recommend a target, but an illustrative hypothesis to gauge the extent of change needed in our energy infrastructure and the impact that might have on industry.





Directions to 2050: Introduction (contd.)

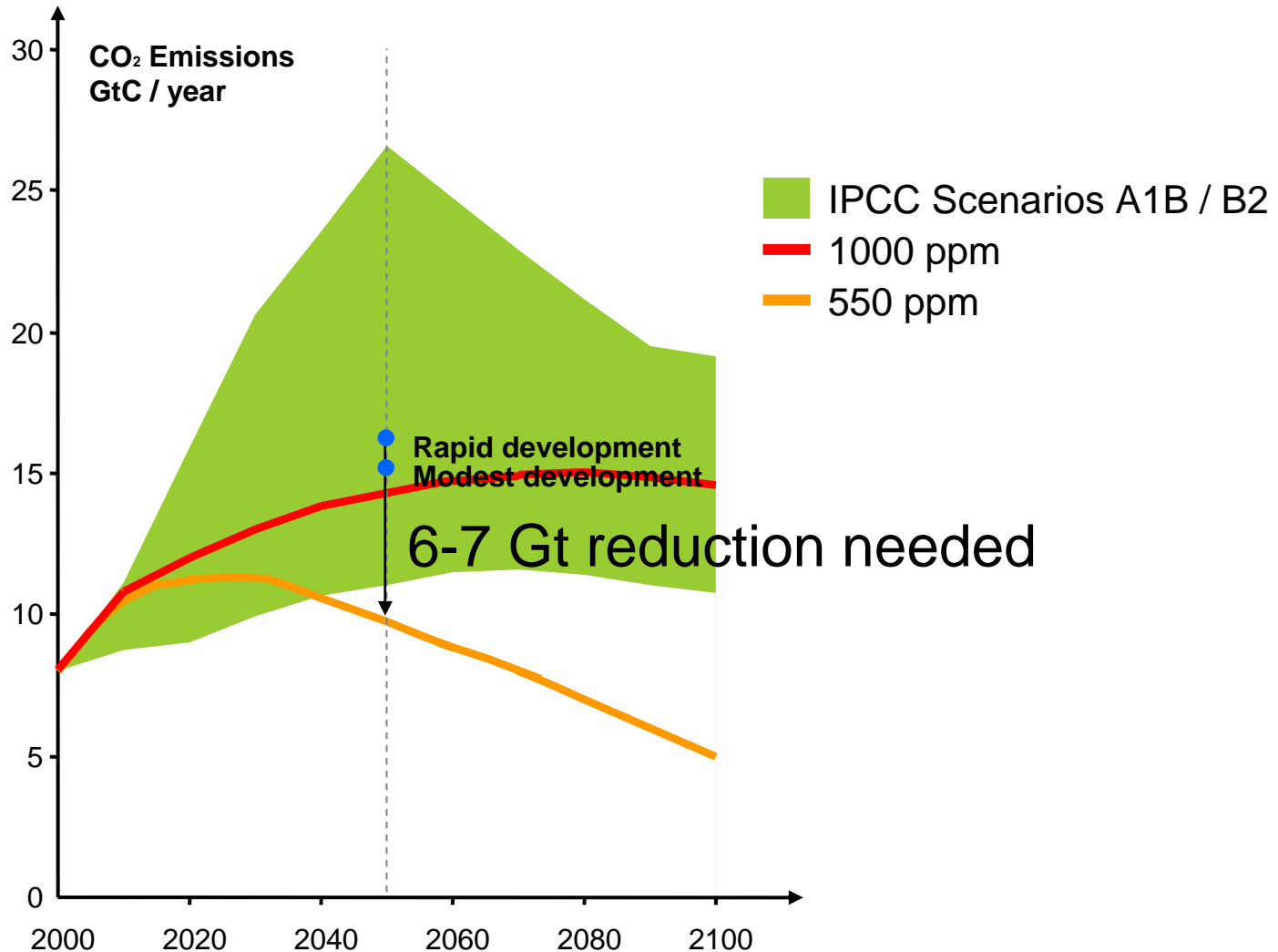
- The presentation is not an endorsement of any particular pathway, technology or specific atmospheric concentration target.
- The pathway chosen:
 - Illustrate the scale and complexity of change needed
 - The progress that has to be made through to 2050, with 2025 as a « checkpoint » providing a measure of progress
- This document does not discuss policy definitions or policy options



« Directions to 2050 »: Content

- Introduction
- Global Trends and Pathways
- Megatrends
 - Power Generation
 - Industry and Manufacturing
 - Mobility
 - Buildings
 - Consumer Choices
- Regions
 - US/Canada
 - EU-25
 - China
 - Japan

Achieving an acceptable CO₂ stabilization level

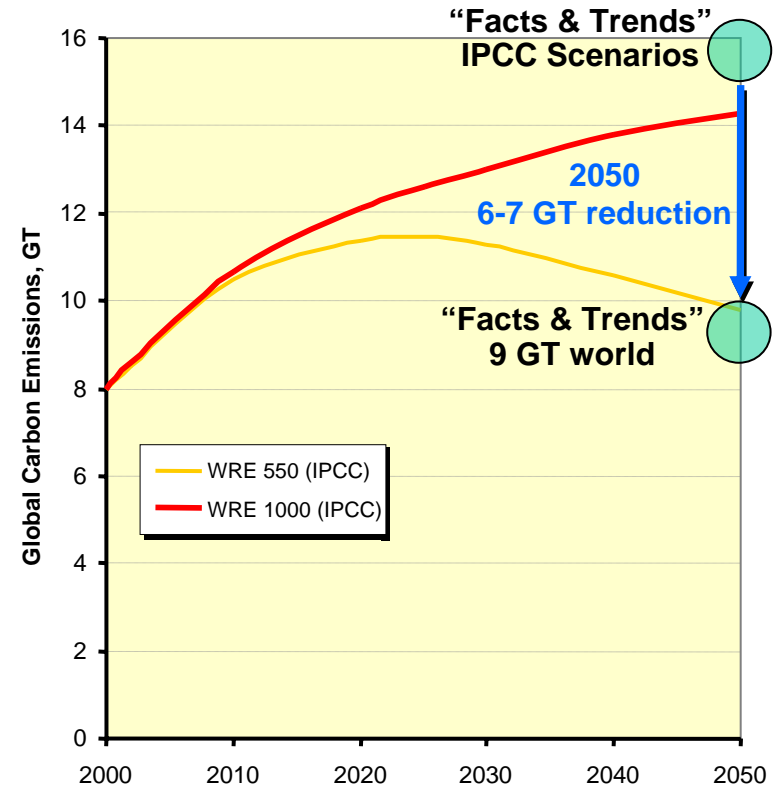


Directions to 2050 – Methodology

Premise is a ~9 GT 2050 world which is equivalent to a 550 ppm emissions trajectory. Create an infrastructure which corresponds to the following:

1. 9 GT carbon budget in 2050.
2. UN median population projections for 2050.
3. Standardised growth rates from 2002-2050, but in line with IEA WEO 2002-2030 rates
4. Energy efficiency improvement globally of 1.6% p.a. vs. 1.2% since 1971.
5. Utilise a reasonable balance between sequestration, bio-fuels, vehicle efficiency, renewables etc. – but many decisions “arbitrary”.

The end result is a more energy efficient 2050 than portrayed in F&T, but similar infrastructure spread between technologies.





The Kaya Identity

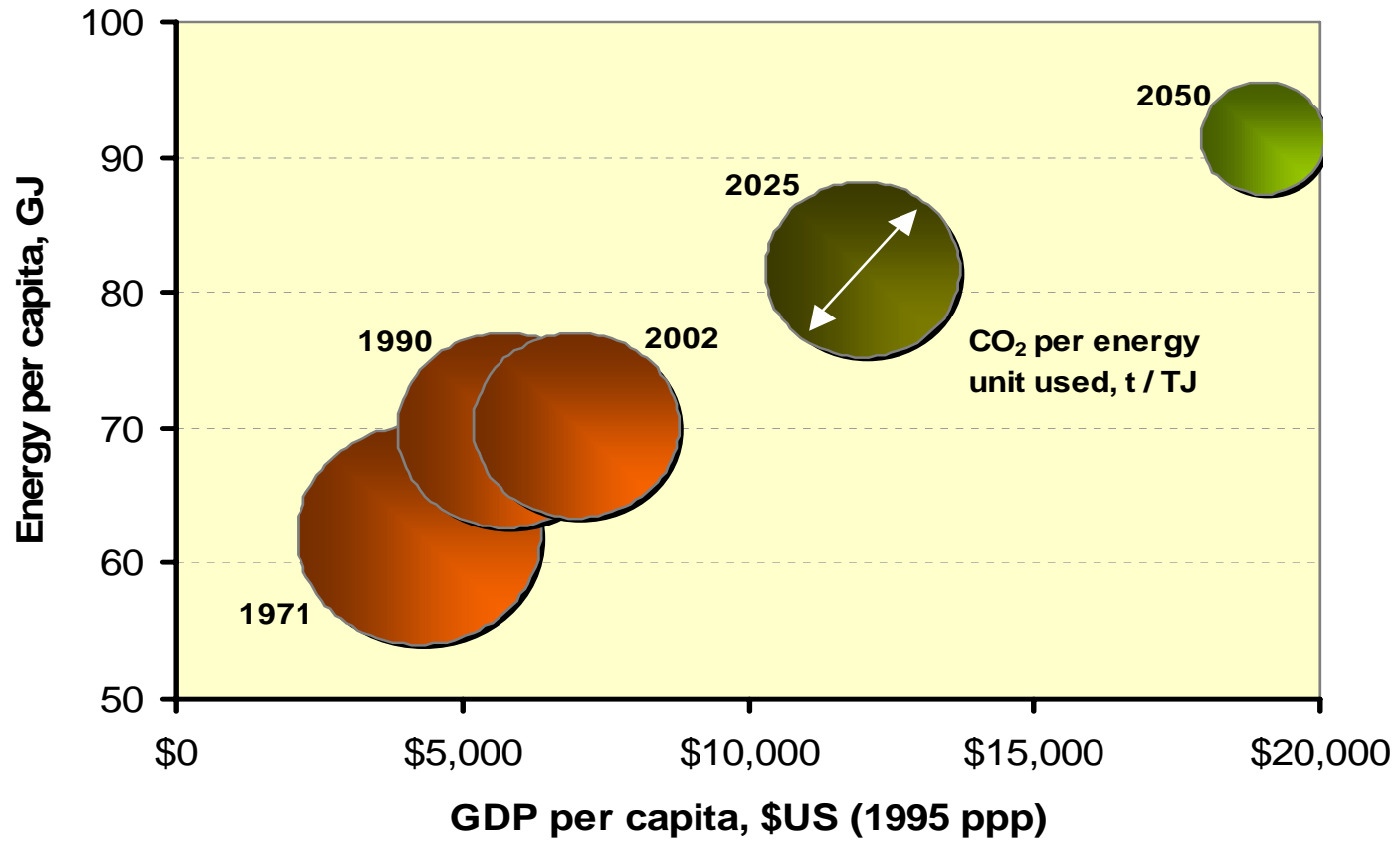
The *Kaya Identity* breaks down the main emissions driving forces as multiplicative factors on one side of an equation, against CO₂ emissions on the other, such that:

$$\text{CO}_2 \text{ emissions} = \cancel{\text{people}} \times \cancel{\frac{\text{GDP}}{\text{person}}} \times \frac{\text{energy}}{\text{unit GDP}} \times \frac{\text{CO}_2}{\text{unit energy}}$$

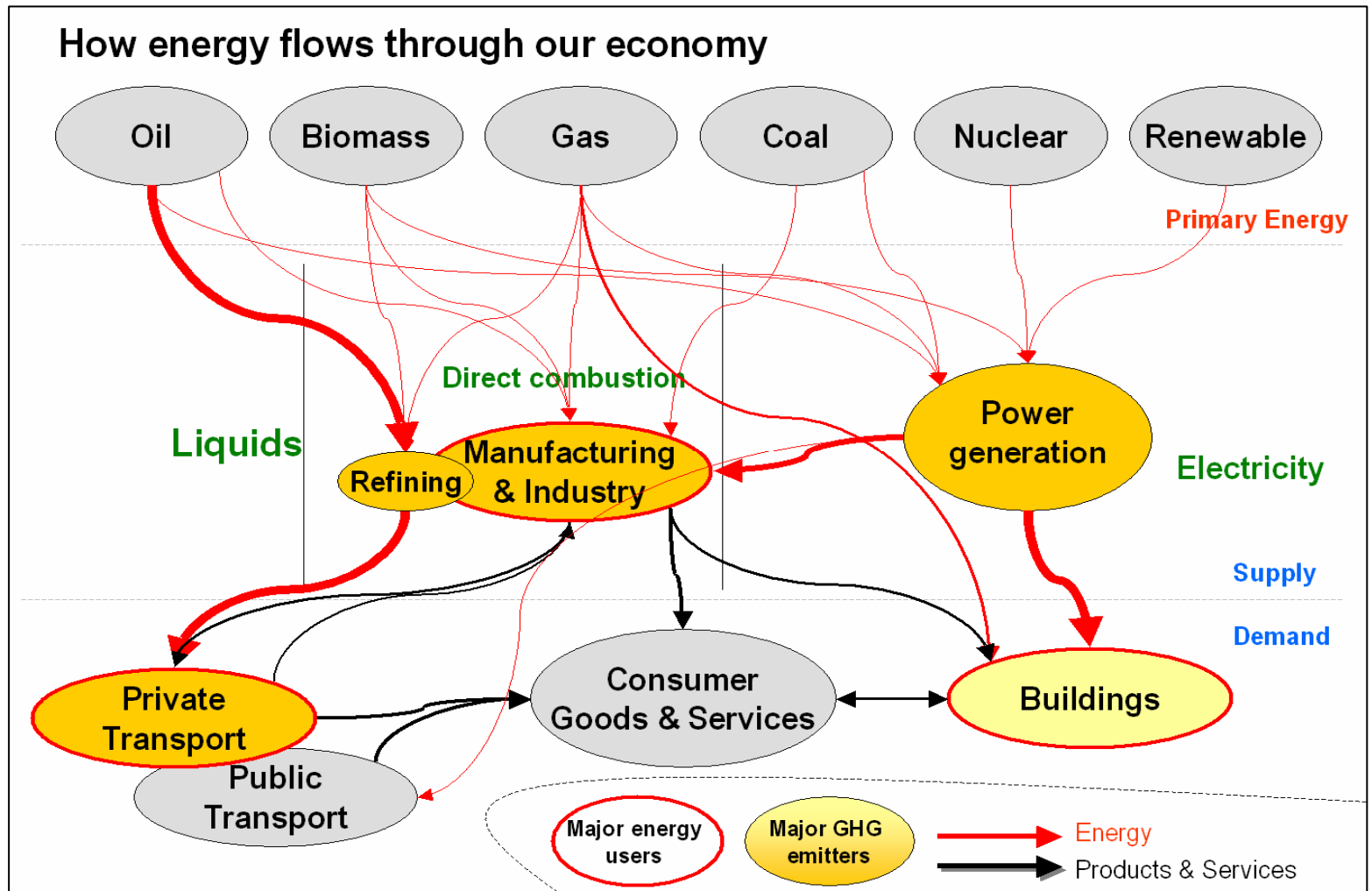
Only four factors govern the outcome, being:

- Population Number of people
- Standard of Living GDP per person
- Energy Intensity Energy per unit of GDP (efficiency of the economy)
- Carbon Intensity CO₂ per unit of energy (reflects the energy source)

Growth, energy, and carbon emissions – global



Sectors and Megatrends

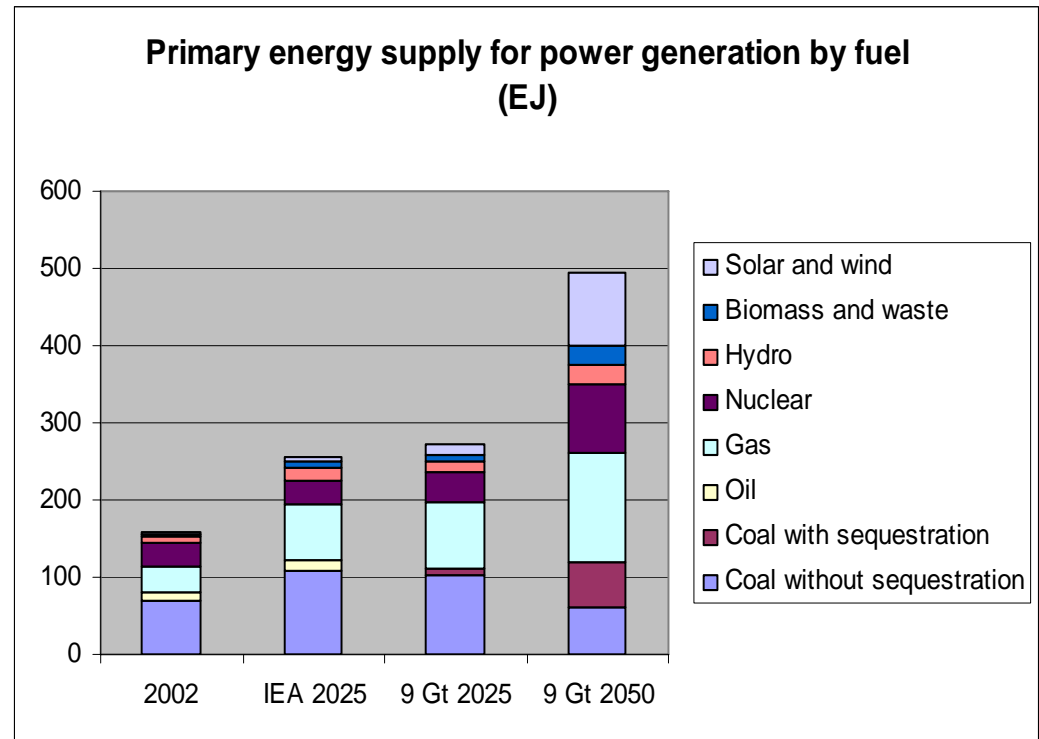
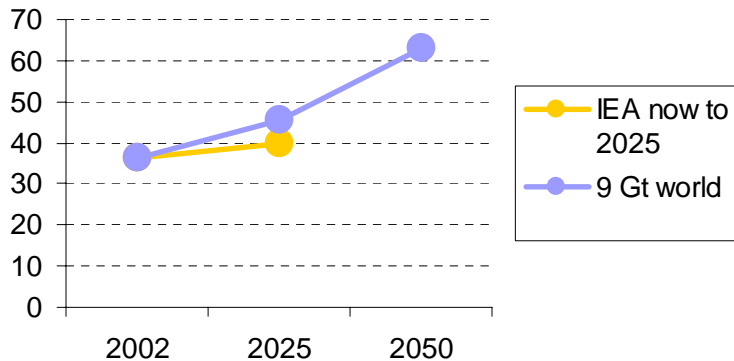


Power generation (2.8->3.5GtC)

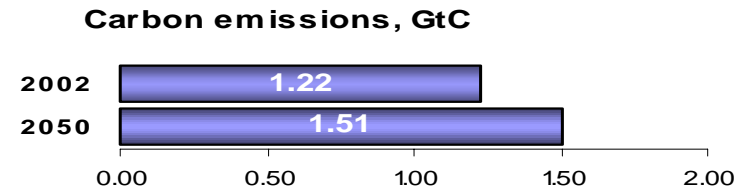
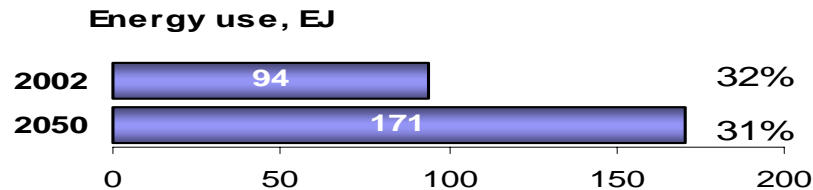
•2050

- 50% CCS in coal generation (100 plants by 2025)
- Wind and others (e.g. wave, tidal) has to increase 70 fold
- 3 times more gas than today
- 3 times more nuclear

Share of power generation in primary energy



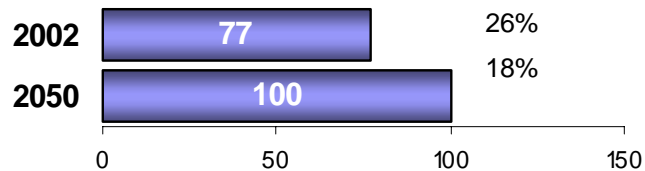
Industry and Manufacturing



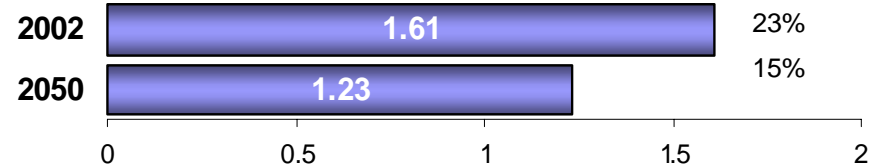
- Emission reduction measures:
 - Shift towards electricity and bio fuels
 - Increase the deployment of currently best available technologies (BATs) especially to developing countries
 - Improve energy efficiency and fuel conservation
 - Develop new low energy and low carbon intensive technologies
- Examples
 - Cement
 - Pulp and paper
 - Electric motors

Mobility

Energy use, EJ

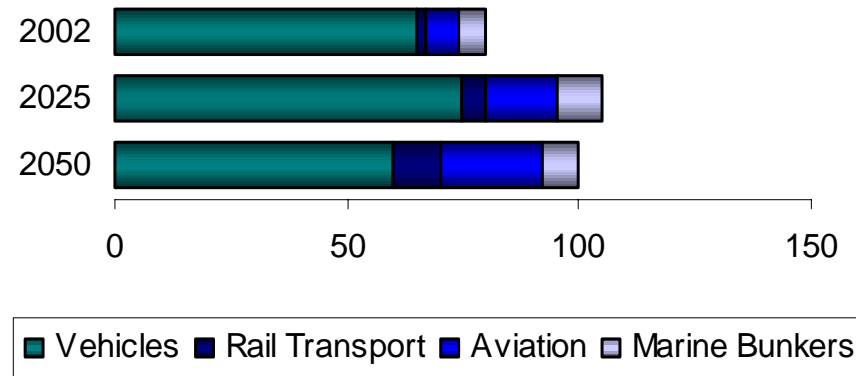


Carbon emissions, GtC

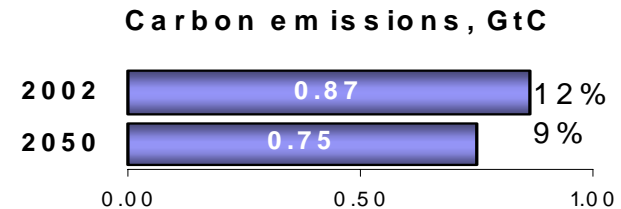
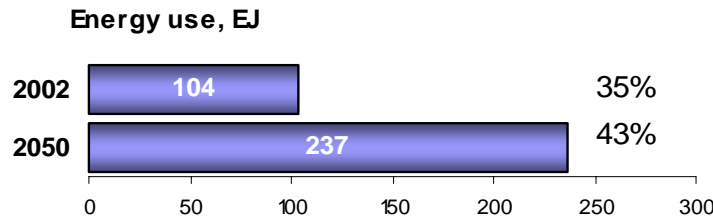


- Road Transport 2050
 - Vehicle-kms double
 - Fuel mix: bio fuels 20%, renewable hydrogen 23%
 - More than half the fleet is high efficiency hybrids or diesel
- Shift towards mass transportation, rising energy share of aviation

Energy Consumption in the Mobility Sector (2002-2050)

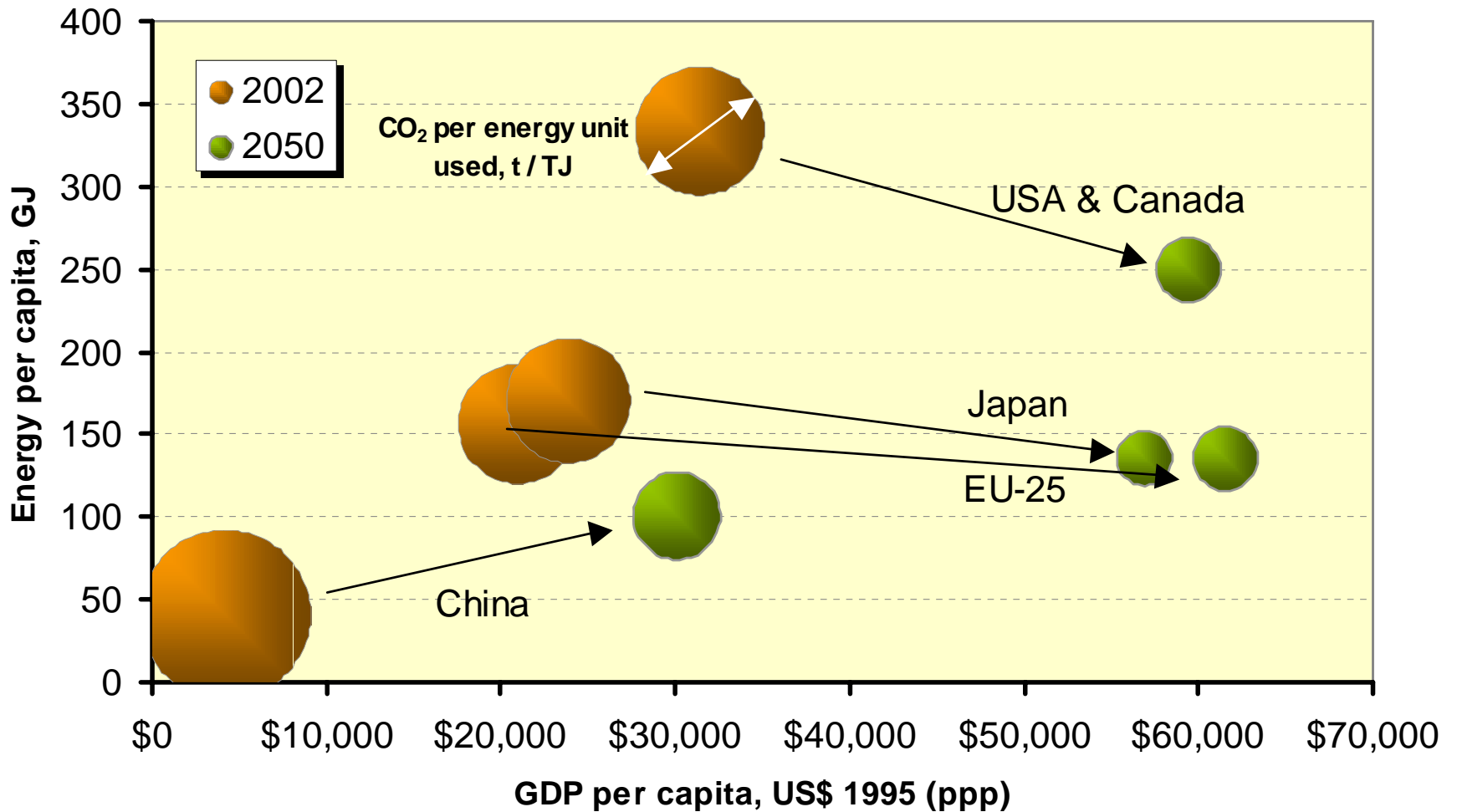


Buildings and Consumer Choice

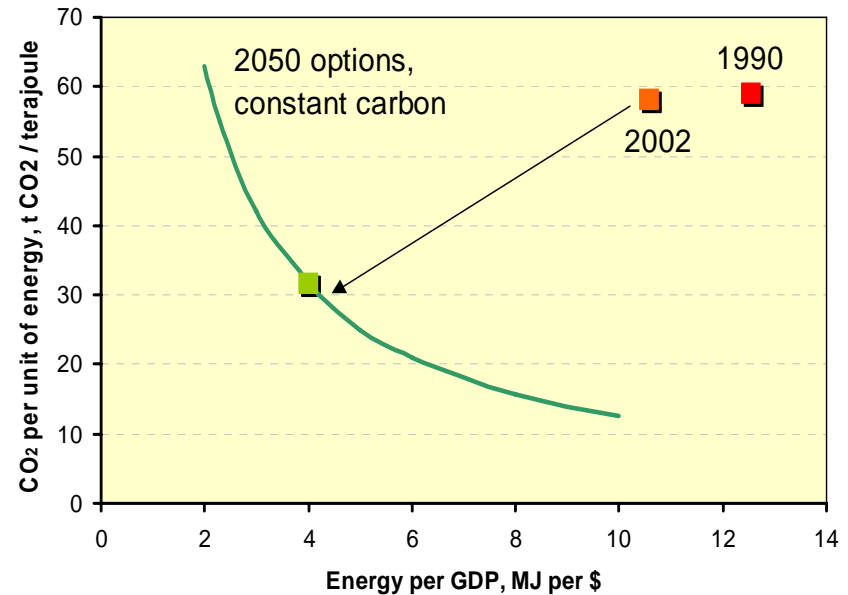


- **Buildings (residential and commercial)**
 - Improve energy efficiency in buildings and appliances, but:
 - Switch to electricity (more appliances, comfort etc.)
 - Buildings = Growing service sector (incl. information economy)
 - Development from rural to urban habitat
- **Consumer Choice**
 - Doing things differently

Key countries



USA and Canada – efficient and growing



- Primary energy demand has to remain close to flat
- By 2050:
 - The share of nuclear power has increased
 - 75% use of CCS in coal generation
 - Large-scale use of renewables, especially wind and solar (e.g. wind increases 50 fold)

EU25 – broad based energy infrastructure



- Energy efficiency has to improve at a higher rate than in the last 25 years
- By 2050:
 - Electricity becomes the main end-use energy source
 - Renewable energy (wind and solar) will need to grow substantially, with wind power alone being some 10-15 times today's levels across the EU-25.
 - Bio fuels and hydrogen fuel over 55% of road transport



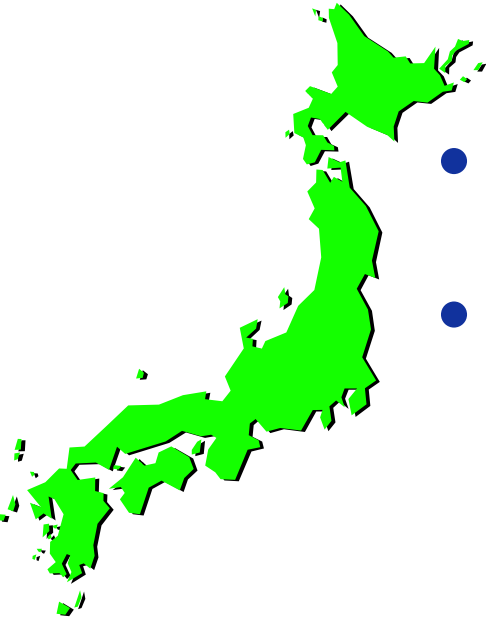
China – a low carbon, coal based economy



- Establish a highly energy efficient economy (e.g. same level as top developed countries)
- By 2050:
 - Half of all coal power plants need to apply CCS (e.g. coal gasification)
 - Wind power is established as the largest renewable source (about 200,000 5 MW turbines)
 - Vehicle efficiency doubles



Japan – A sustainable « showcase » economy



- Japan becomes one of the most energy efficient economies
- By 2050:
 - Road transport to be a 100% Hydrogen based
 - The phasing out of coal power plants is completed
 - Development of a large scale renewable base, especially solar
 - Doubling of nuclear power generation