

## INFORSE Vision 2050

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International Network for Sustainable Energy - Europe

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## World Vision 2050

The world energy system

- ✦ is beyond the environmental limits
- ✦ does not provide basic energy needs as light and healthy cooking facilities to 1/4 of the world's population
- ✦ Environmental imperative: keep global warming to 1°C in 21. century (1.6°C above pre-industrial)
- ✦ Social imperative: provide all with basic energy needs and allow developing countries to develop, including use of cheap energy supply



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## Environmental Imperative

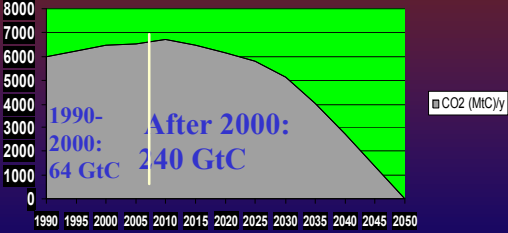
- ✦ To be sure to keep global warming below 1 °C during the 21. century, we must limit global CO<sub>2</sub> emissions to 225 Gigaton of Carbon in this century = 35 years of current consumption (assumed climate sensitivity of 3.5°C)




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## A Global Sustainable Scenario

CO<sub>2</sub> (MtC/y)

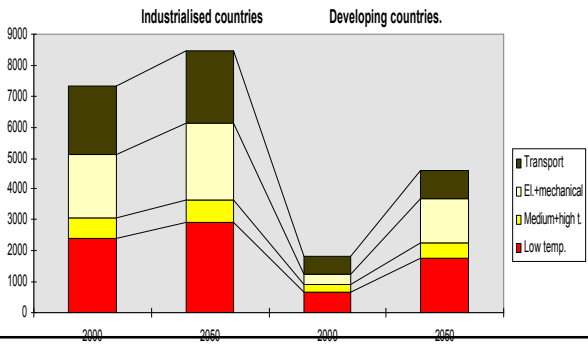


1990-2000: 64 GtC  
After 2000: 240 GtC

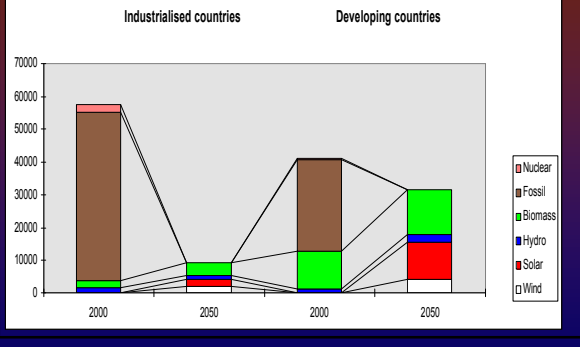


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## Energy Services per capita



## Primary Energy (TWh/y)



### Energy Supply

**Wind:** Follow Windforce10/12 growth from 15,000 MW in 2000 to reach 3.000.000 MW in 2040, then maybe less afterwards

Large windpower development programs are cost-effective: extra costs today will be paid back with future cost reductions due to technology learning. Some sites give cost-effective electricity today.

**Solar:** PV has reached the critical 500 MWp/year, and the growth around 25% pr. year follows this vision

**Biomass and hydro:** Increase 30-50% in total

**Biomass can be used as transport fuel**



### Energy Demand

❖ Most energy consuming equipment will be replaced any times before 2050: new generations of equipment should maximize efficiency. Technology learning drives prices down.

❖ One exception is houses. In EU houses could use only 1/7 of today's heat demand in 2050. This will require renovation/re-building of 2% p.a. / heat consumption 20-40 kWh/year per m<sup>2</sup>

❖ For transport is expected increase in conversion efficiency from today's 15-20% to 50%, and re-gain of "break energy": factor 4 efficiency increase

❖ Energy service demand will increase, also in industrialized countries



### Scenario Effects

- ❖ Electric grid remains
- ❖ Increase in energy storage demand
- ❖ Nuclear phase-out 2010-2030
- ❖ Fossil phase out until 2050
- ❖ Because of large learning rates for the new technologies, costs can be minimal.
- ❖ Energy service demand decoupled from GNP



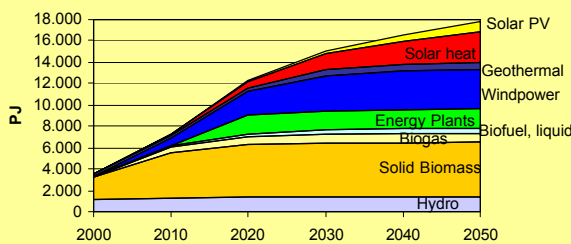
### A Vision for Europe

- ❖ White Paper for RE + more wind, less biomass, less solar
- ❖ Biomass follow WBGU sustainability limits
- ❖ of agricultural land 7% for solid biomass crops, 7% for extensive (1t/ha) liquid biofuels
- ❖ solar thermal + electric (mainly PV): 10 m<sup>2</sup>/person
- ❖ Factor 4 energy efficiency in transport, industry, electrical appliances
- ❖ 57% reduction in specific space heating
- ❖ CHP, flexible el.use: heat pumps, hydrogen for transport
- ❖ sustainable transport system



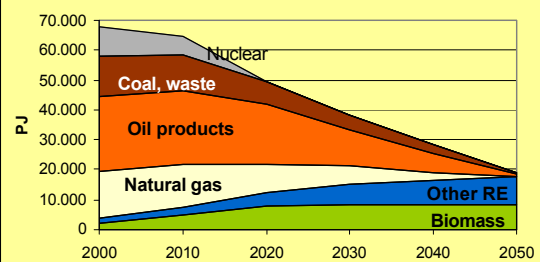
### EU-25 Vision

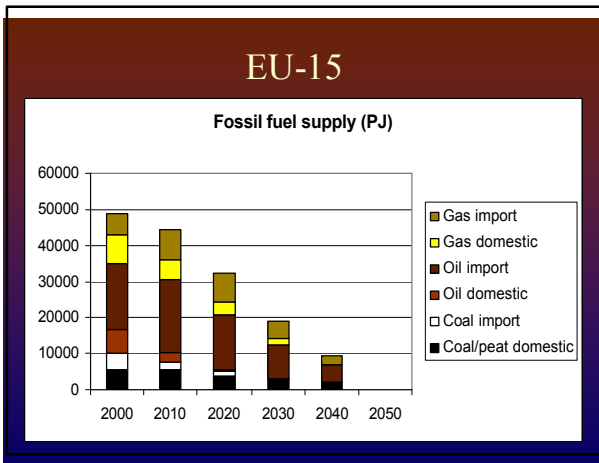
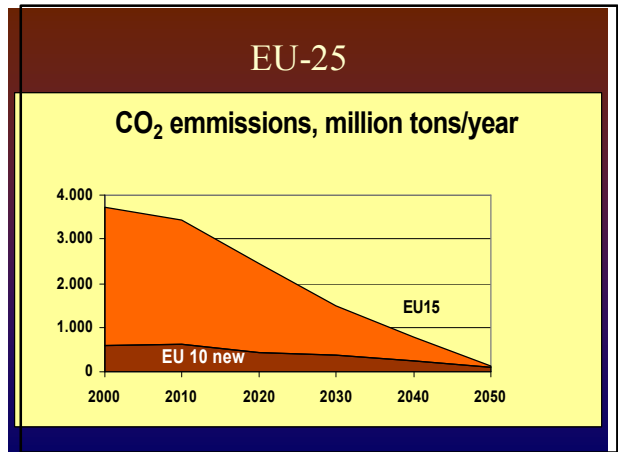
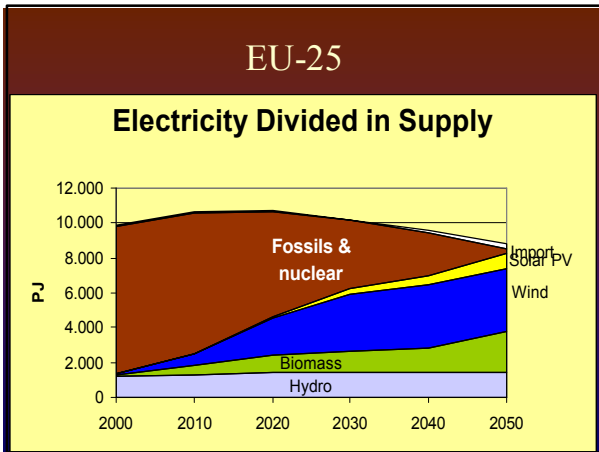
Renewable Energy



### EU-25

Total Primary Energy Supply





### Vision for Denmark (OVE'05)

- ❖ Strong growth in windpower until 2030
- ❖ Half specific building consumption 2005-2025
- ❖ Flexible electricity use: heat pumps and hydrogen
- ❖ Sustainable transport system by 2030 (33% reduction in car use)
- ❖ el-storages from 2030

