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 1ºC, global CO_2 emissions to 250 Gigatons of Carbon in 21st century
- Social imperative: provide all with basic energy needs and allow developing countries to develop, including use of cheap energy supply

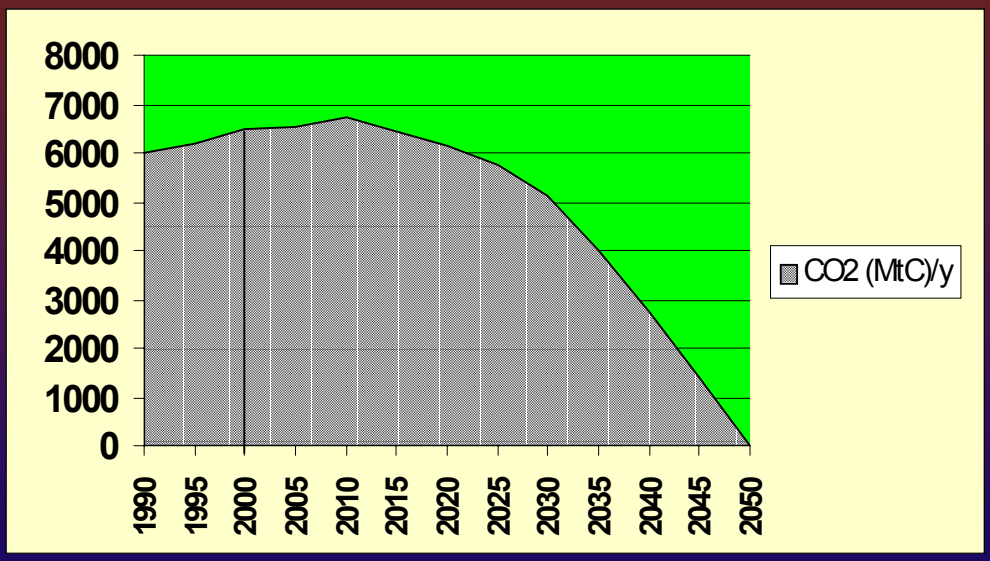
Existing scenarios

IPCC and many other scenarios are analysing emission-reduction paths that are not fast enough to reach this environmental imperative

A number of researchers have suggested scenarios with the necessary reductions:

- A Global Renewable Energy Scenario (Soerensen et.al.)
- Scenario for a Sustainable Future Energy System (Lehmann, Wuppertal Institute et.al.)
- Fossil-Free Energy Future (Lazarus, SEI/Greenpeace)

A Sustainable Scenario



Energy Demand

- Most energy consuming equipment will be replaced many 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^2
- For transport it is assumed an increase in conversion efficiency from today's 15-20% to 50%, and re-gain of "break energy".
- Energy service demand will increase, also in industrialized countries, but energy demand should decrease.

Energy Supply

Wind: Follow Windforce10 growth from today's 15,000 MW to reach 3.000.000 MW in 2040, then maybe decrease afterwards

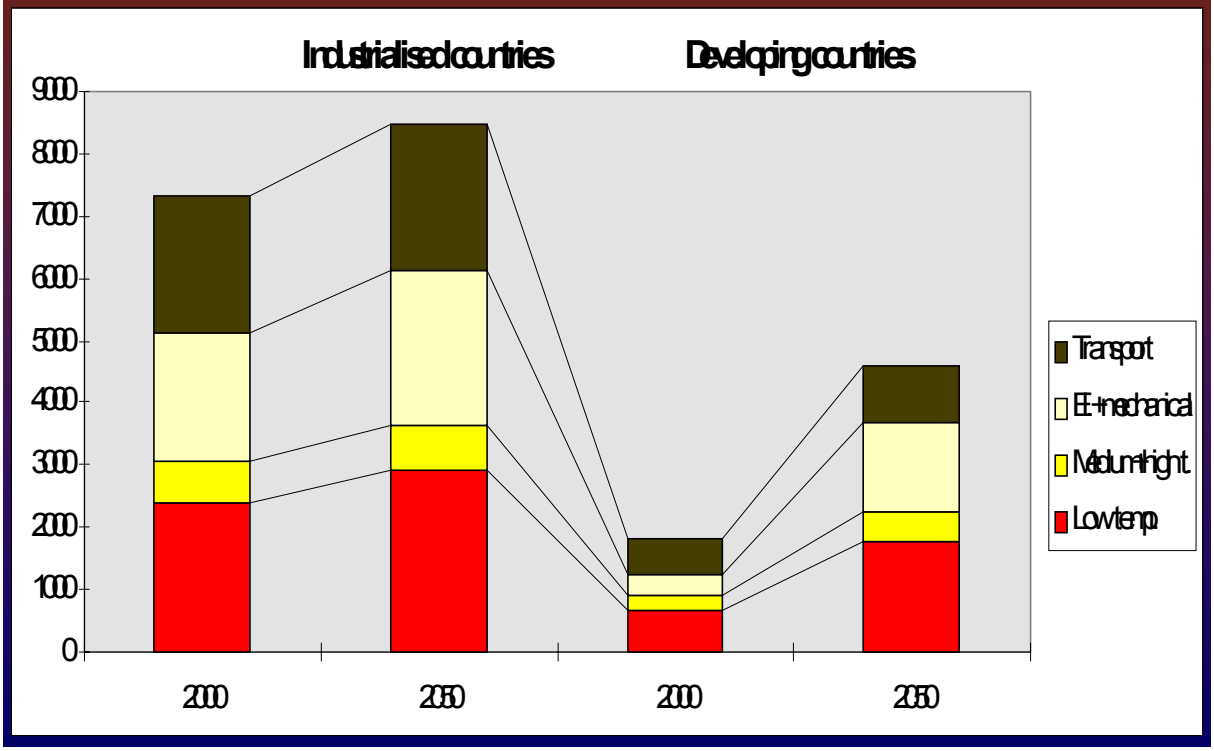
Large windpower development programs can be cost-effective: extra costs today can be paid back with future cost reductions due to technology learning. Some sites give cost-effective electricity today.

Solar: PV could reach 500 MWpeak in 2003, and then grow 25% pr. year

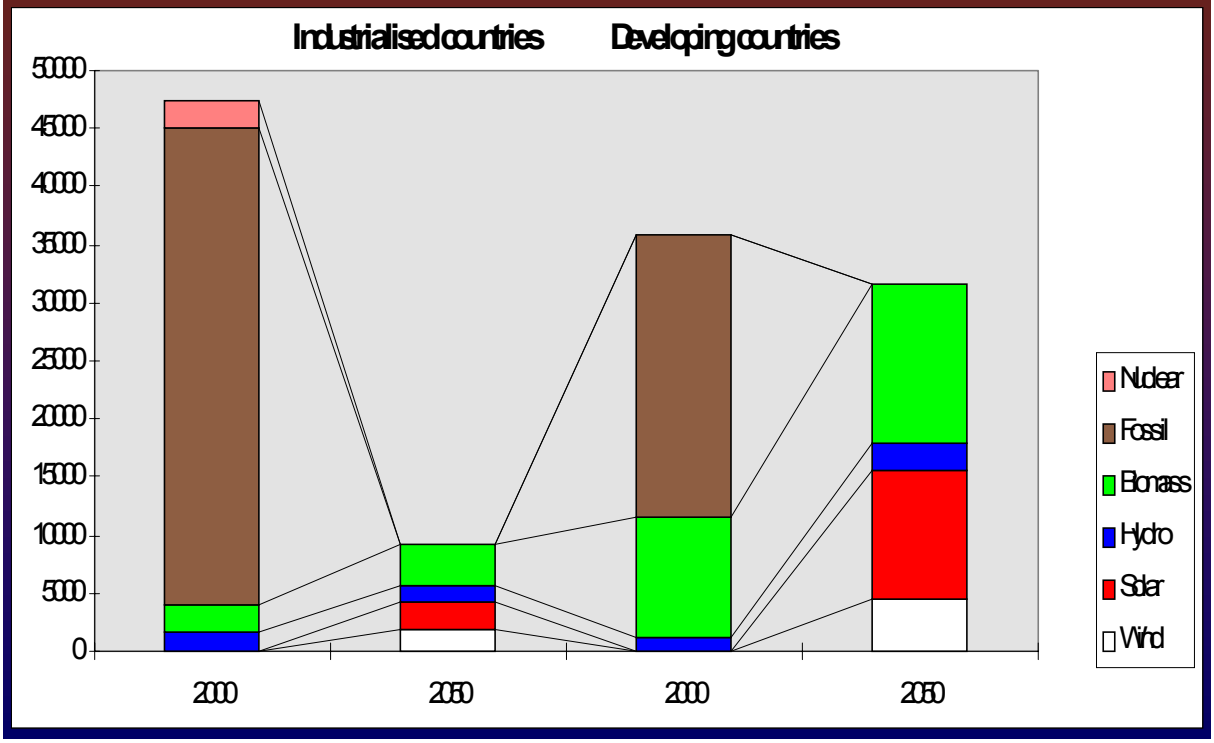
Biomass and hydro: Increase 30-50% in total

Biomass can be used as transport fuel

Energy Services per capita



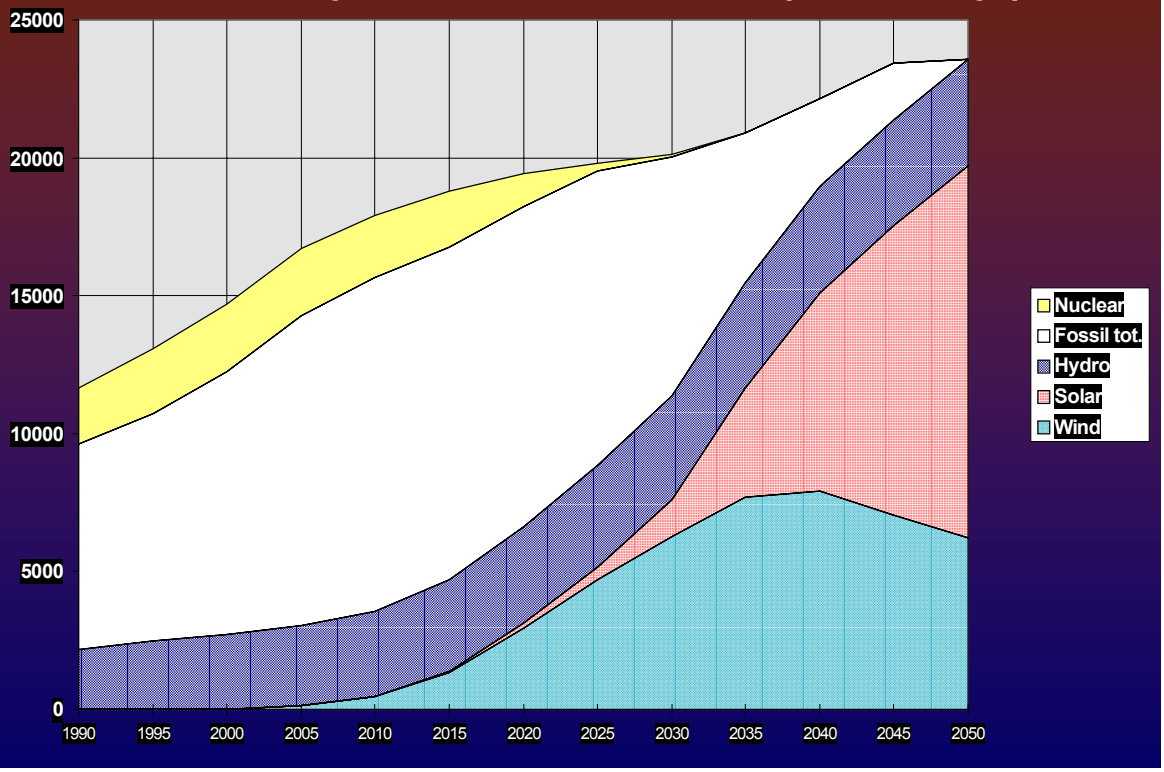
Primary Energy (TWh/y)



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 must decouple from GNP: small increase in industrialised countries, high in developing countries

Electricity, Worldwide (TWh/y)



How to make it happen

- refocus energy R&D
- develop mass-markets with political decisions, such as RE-portfolie, feed-in tariffs, inclusion of environmental costs in energy prices, energy efficiency standards
- abolish environmental harmful subsidies
- special efforts needed to supply basic energy needs
- re-focus of international energy co-operation, assistance, and organisations, maybe new org.

Conclusion

- The change to a sustainable system can be possible in 50 years
- It will have many co-benefits in addition to environmental gains
- Costs to the society can be small, if the change is well planned
- Need for initial investments and long-term strategies
- Need for additional analysis of economics of sustainable path, compared with business-as-usual paths.