Umwelt
Bundes
Amt

Für Mensch und Umwelt

Scenarios for a low carbon energy system in Germany

Christoph Erdmenger

Head of Section I 4.2
Energy Policy and Supply Technologies

UNEP Workshop, Dessau, 19.4.06

Introduction and Overview

- Overview
- Philosophy of scenario work
- Overview: Long term energy scenarios in Germany
- Longterm energy scenario Germany - one example
  - Targets
  - Methodology
  - Necessary steps
  - Major findings
  - Open questions and necessary in depth analysis
- Conclusions

Selected Current Scenario Studies For Germany

Long experience of long term energy in scenarios in Germany
First scenarios in the early 1980's (nuclear extension path)

Business as usual projections (no GHG-reduction goals):

- Ministry of Trade: Energy Predictions (by Prognos/EWI, 1999, 2002, 2005)

Climate protection scenarios (GHG reduction by 40%/2050 and 80%/2050):

- Parliamentary Commission : Long term energy scenarios for the German „Sustainable Energy supply“ (Prognos/Wuppertal Institut/IER, 2002)
- Environmental Agency: Climate Policy scenarios for 2020/2030 (ÖI/DIW/FZJ/ISI: 2003)
- Environmental Ministry/Environmental Agency: Increasing the share of renewable energies within an overall climate protection scenario (DLR/Wuppertal Institut/ifeu 2004)
- Scientific network group „Modelling experiments“ (1999-2005) - different tasks

Umwelt Bundes Amt
Für Mensch und Umwelt

Institutes working on Scenario presented here

Key partners

•DLR-Institute for Technical Thermodynamics, Stuttgart
Department System Analysis und Technology Assessment;

• IFEU-Institute for Energy- and Environmental Research, Heidelberg;

• Wuppertal-Institute for Climate, Environment and Energy;

• Centre of Solar Energy and Hydrogen Research, Stuttgart

Framework

•Based on work for the Parliamentary Commission

•Backbone is a energy system simulation model (not a energy economics model), based on expert input rather than on optimisation calculations

•Multiple research projects on restrictions and potentials for renewable energy in Germany

Philosophy of Scenario Work

- Different from predictions
- Ask “what happens if ….”
- Based on a consistent set of assumptions which should be outlined transparently
- Purposes:

  - to deal with future uncertainties

  - to identify the range of future paths (including the branching points)

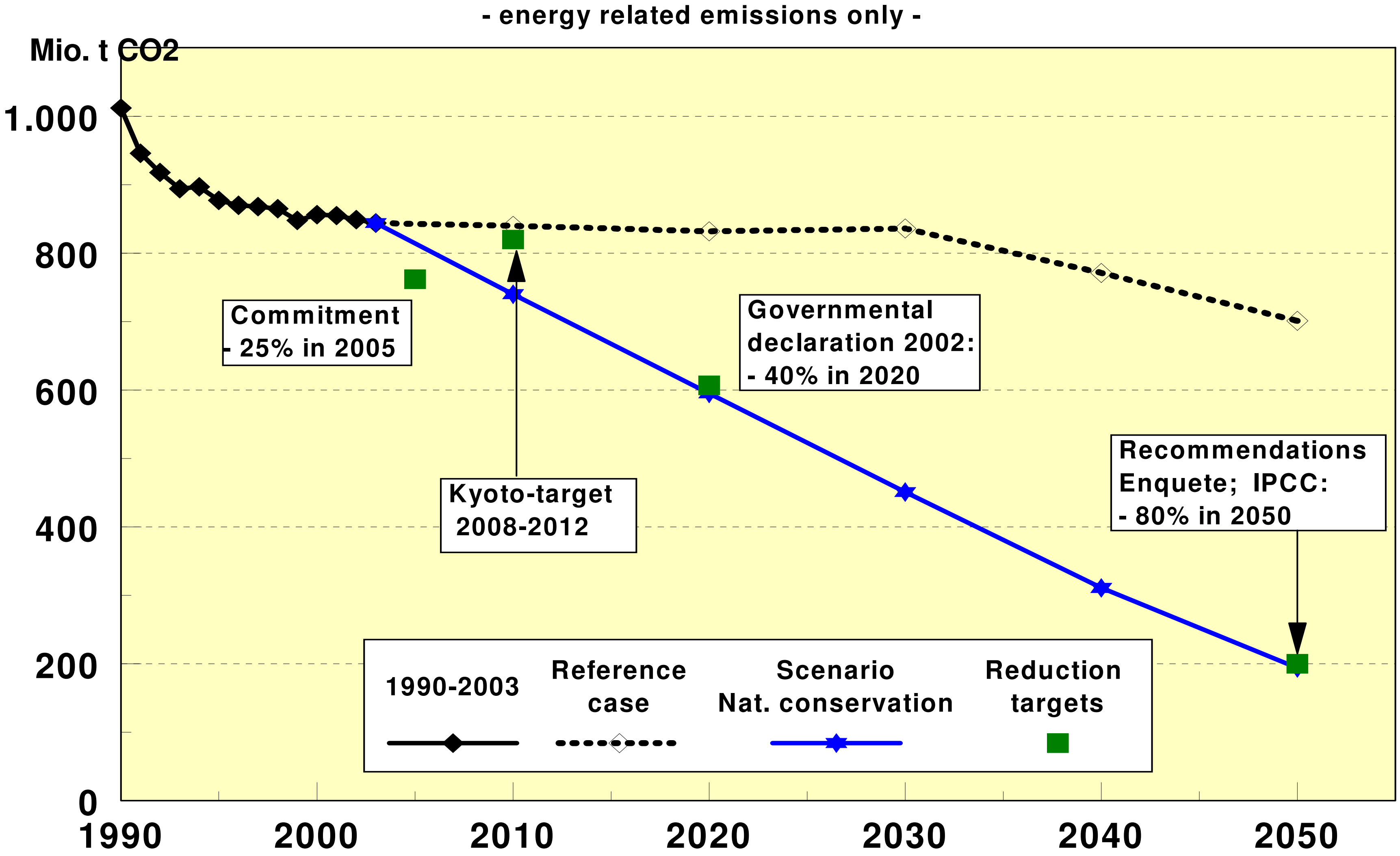
  - to describe the major impacts and dangers of those paths

  - to gain more experience about the various interactions in the system

  - to enable an elaborate discussion about suitable policy and technology strategies following defined targets

Overview on results

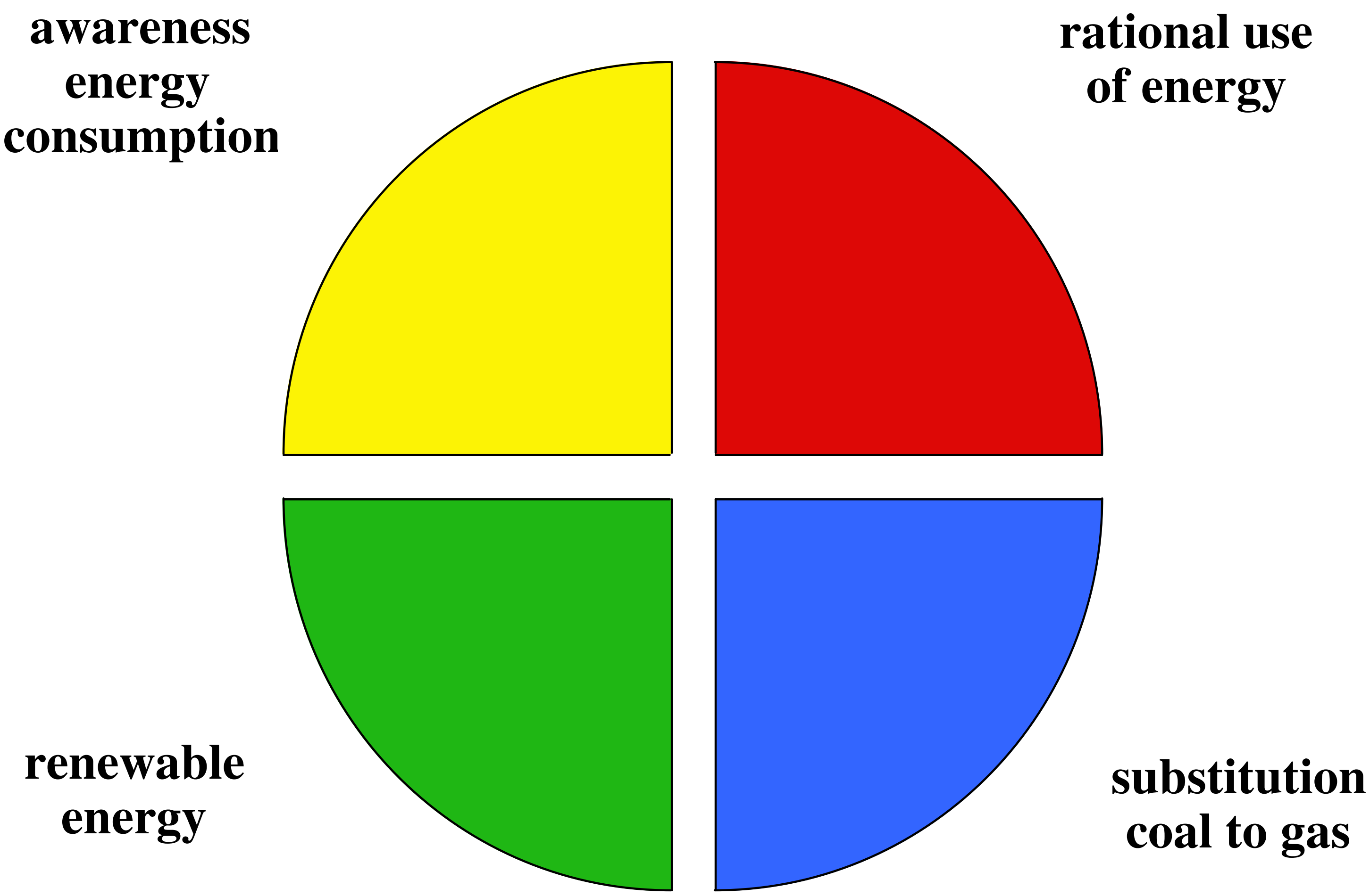
Umwelt Bundes Amt
Für Mensch und Umwelt



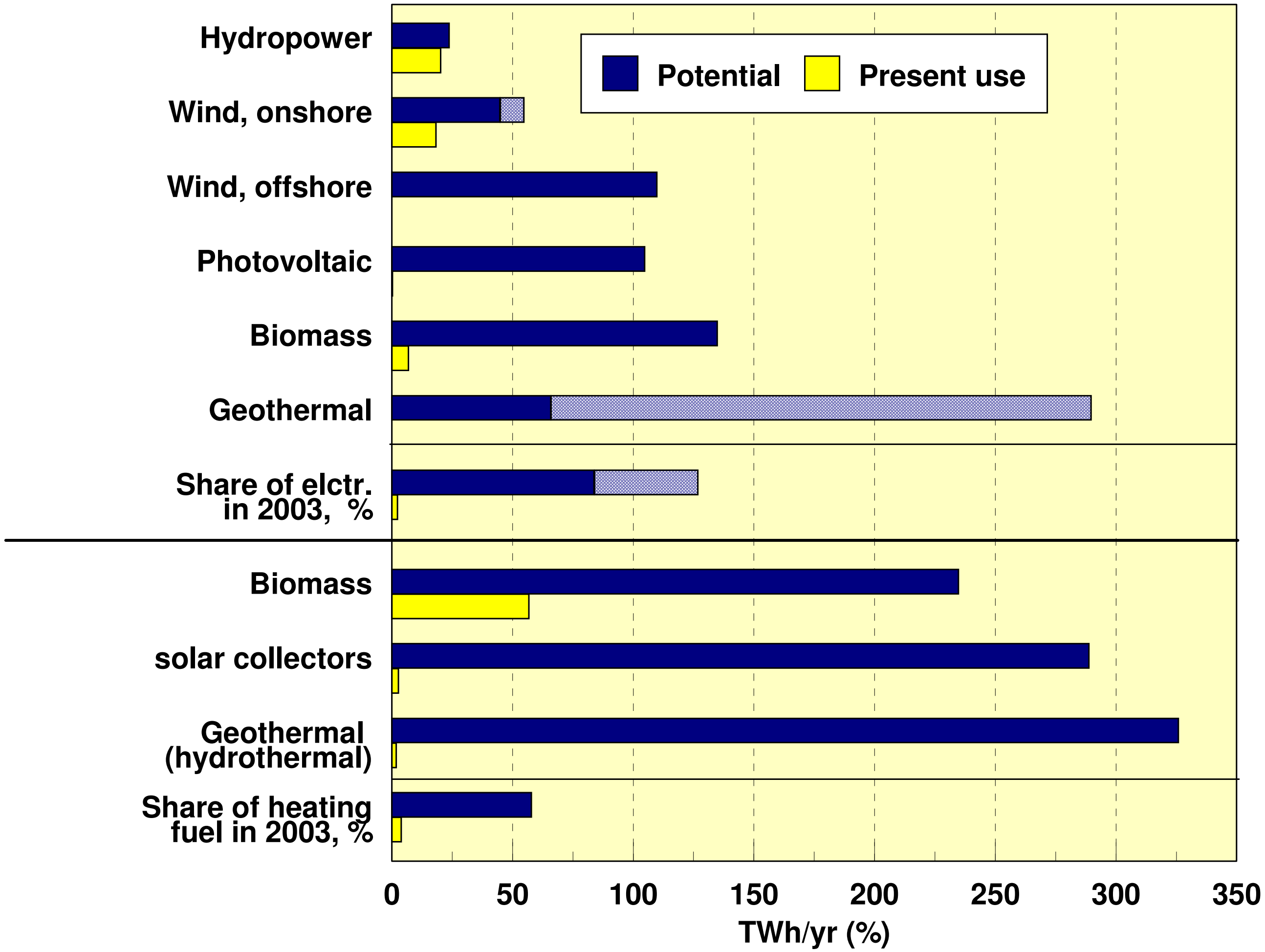
urces: DIW-report 10/2004; reduction path: BMU 2004

oeko\co2deu.pre;3.1.04

Strategy elements for climate protection



Determination of technical potentials of renewable energy



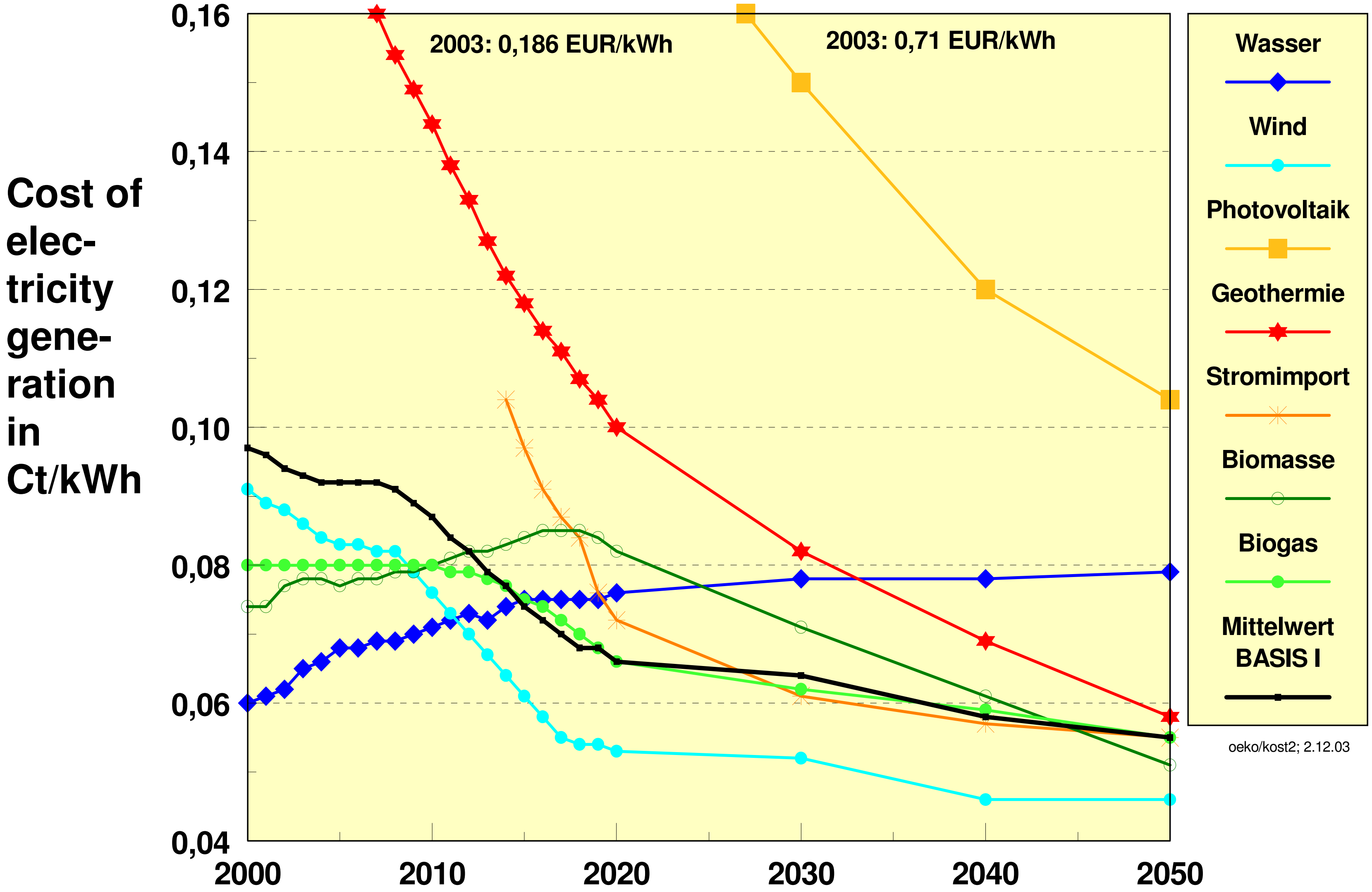
Assumptions:

Biomass:
100 % stationary use with 75% cogeneration. (optional 210 TWh/yr biofuels = 27% of present consumption)

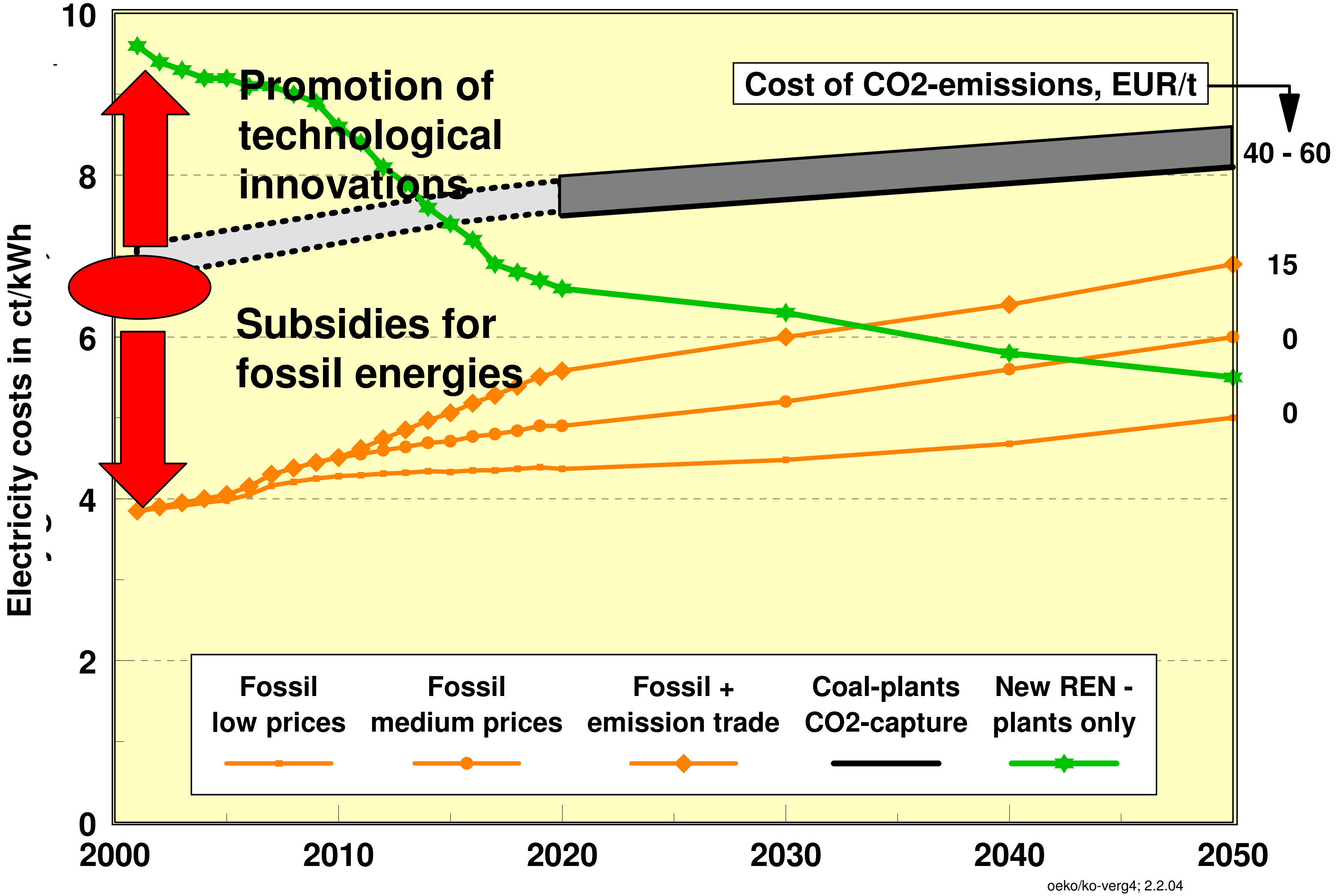
Geothermal electricity:
Lower value with heat use in cogeneration, upper value without restrictions

Learning curves are crucial for long term scenarios

Umwelt Bundes Amt
Für Mensch und Umwelt



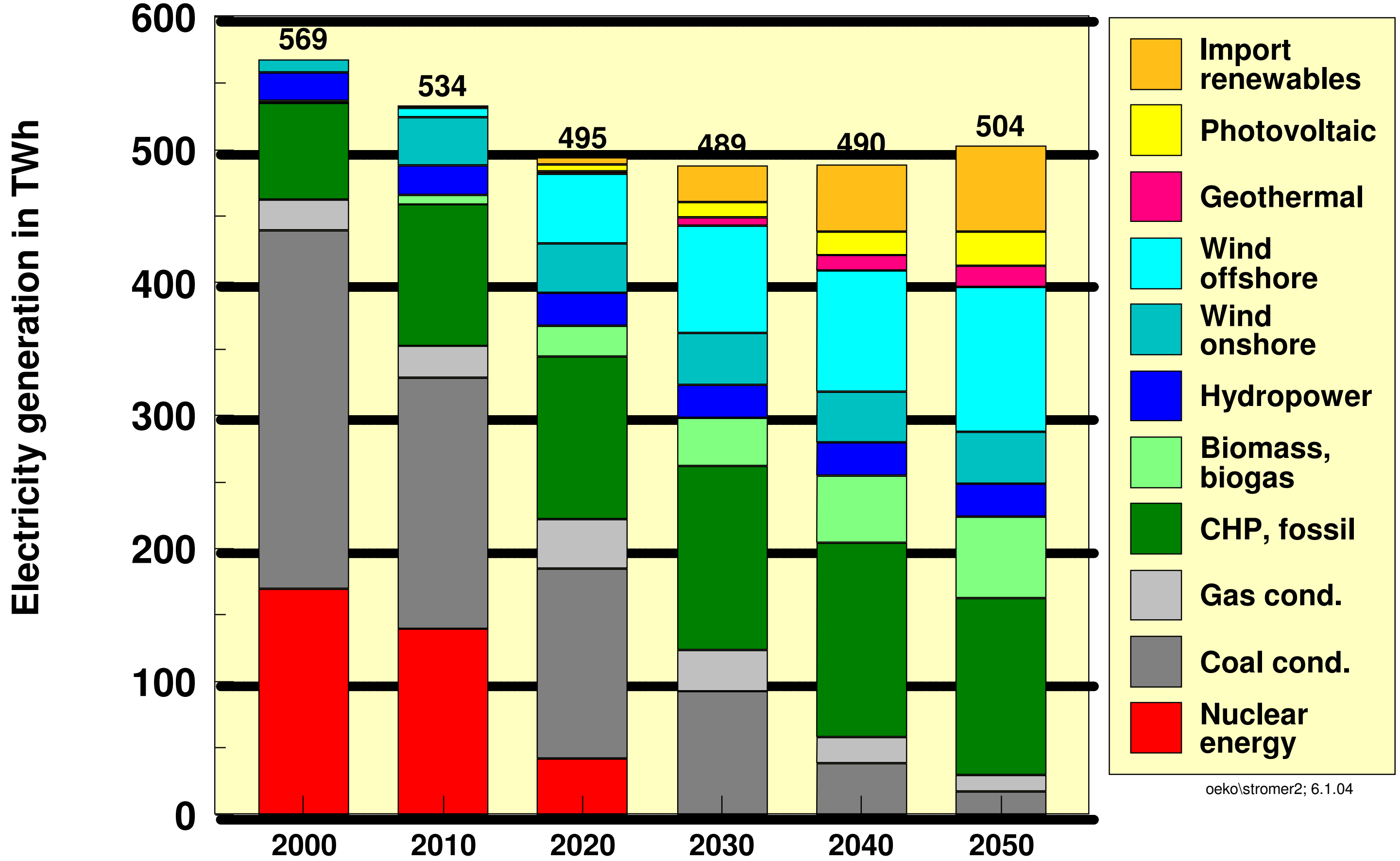
Comparison of technological options in the time scale



Electricity generation - substantial system changes needed

Umwelt Bundes Amt
Für Mensch und Umwelt

- Scenario NatureConservationPlus I -



14,3	21,2	29,5	35,9	40,2	39,9 %	CHP incl. biomass
5,7	12,8	25,7	40,0	48,1	55,6 %	REN excl. biomasse-CHP

5-step strategy for implementing REN

Umwelt Bundes Amt
Für Mensch und Umwelt

Up to 2010: „ENTRY“ supported by energy policy measures, based on target specifications and specific instruments (e.g. REN Energy Rescources Act)

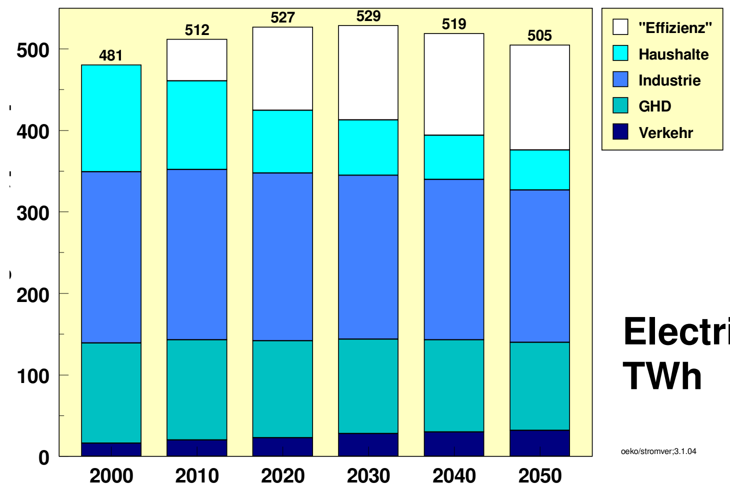
2010 – 2020: „STABILIZATION“ of growth with gradual incorporation of REN in general climate protection instruments (emission trade; CO_2-taxes etc.)

2020 – 2030: Complete „ESTABLISHMENT“ of all REN technologies and incip use of low-cost REN potentials throughout Europe and the Mediterranean region

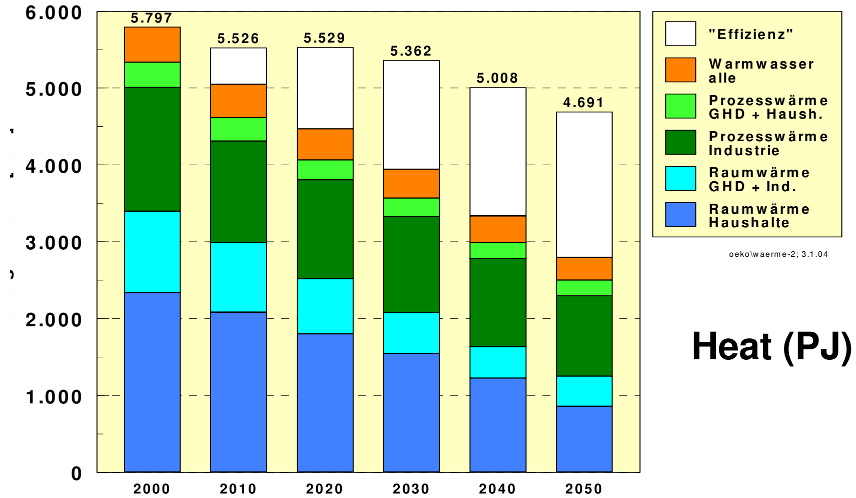
2030 – 2050: Gradual „DOMINANCE“ of REN in all energy supply sectors and starting use of hydrogen from renewables

After 2050: Progressive „REPLACEMENT“ of fossil energy sources an establishment of an energy economy entirely based on renewable energy source

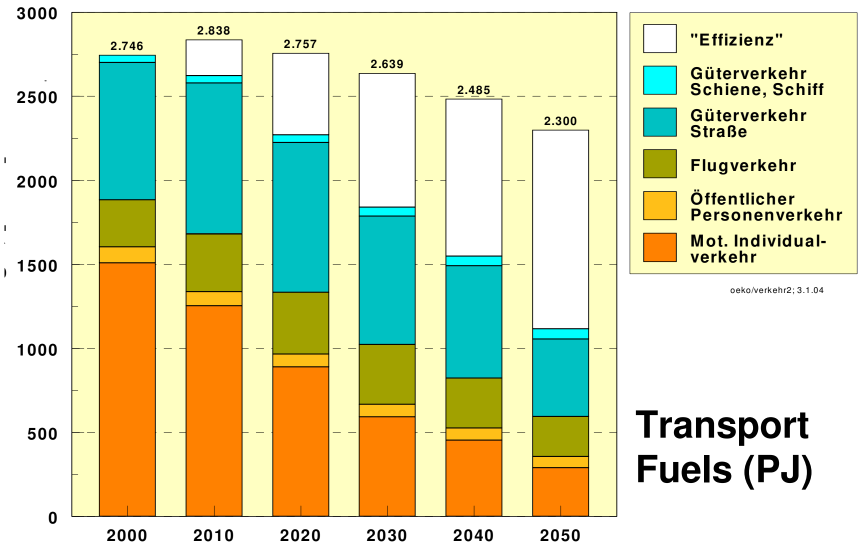
Energy Efficiency improvements



Electricity TWh



Heat (PJ)

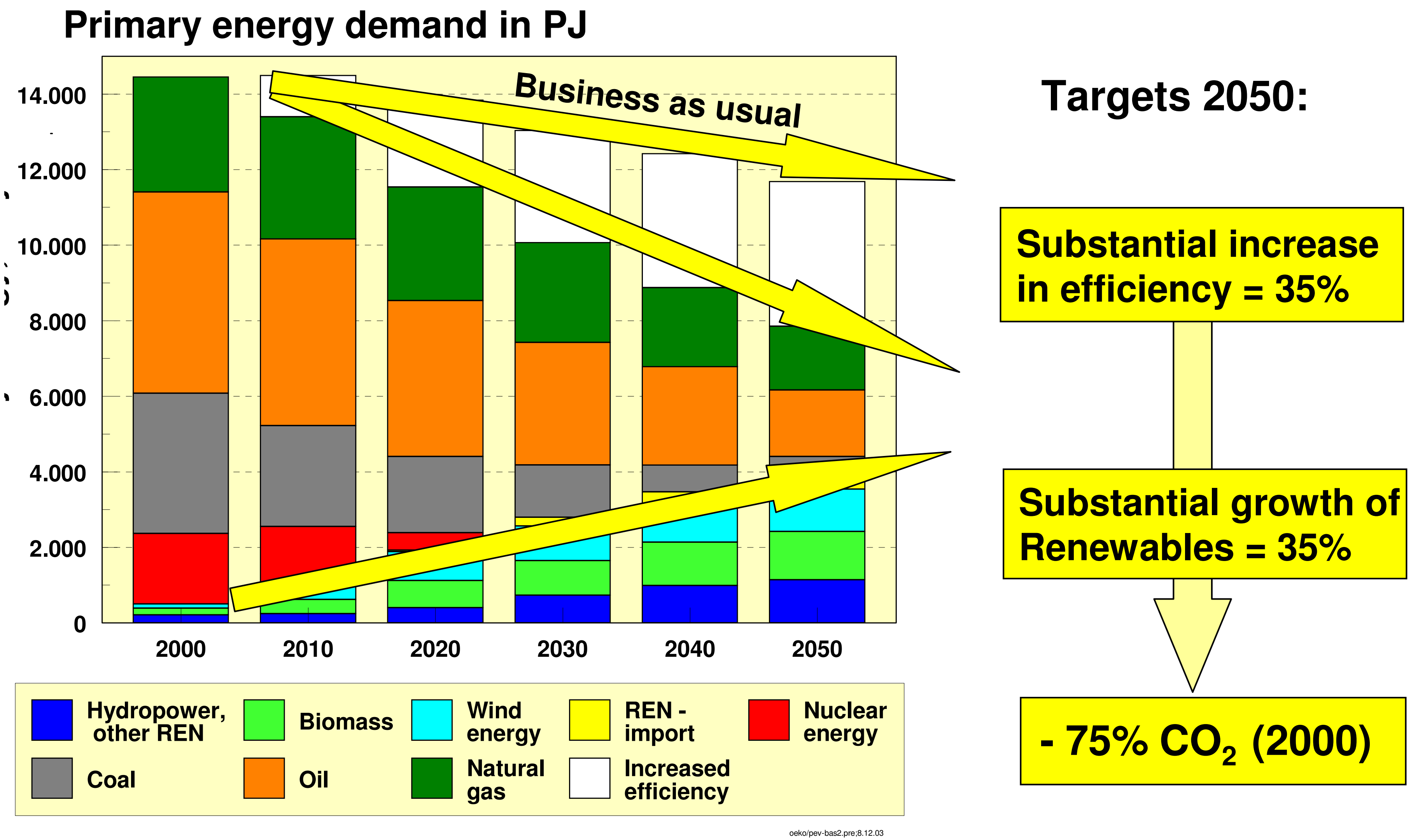


Transport Fuels (PJ)

„Efficiency“compared to Ref.: (in % to 2000)

Electr. = - 450 PJ (26%)
Heat = - 1680 PJ (36%)
Transp. = - 1170 PJ (41%)
Final Energy = - 3300 PJ (36%)

Development of primary energy demand



Additional costs seem to be acceptable

- Cost is hard to predict, because depends on various factors
    - Fossil fuel and CO2 prices
    - Price estimates for technologies implemented
    - Learning curves of technologies
    - Assumptions on profitability requirements for investments
    - Assumptions on non-monetary hurdles
    - Assumptions on economic development, mobility needs, etc
- Overall result for 80% scenario: appr. 4 Bio €/year (average 2001-2050)

- 0,2-0,6 Trillion€/50 years compared to 19,2 Trillion €/ 50 years

Conclusions

- Climate protection is feasible from technology side of view and implementation can be realized by acceptable costs
- Adaptation is no alternative but due to already caused damages of the climate to a certain extent unavoidable
- Climate protection can be accompanied in particular in "first mover" countries with side benefits (e.g. new innovations, employment effects)
- Climate protection is connected with significant structural changes and requires a sophisticated and reliable long term energy and climate policy
- Policy makers should be aware of the high time constants for structural changes in the energy sector (operation time of power plants, creation of new infrastructures) - starting right now with actions is without alternative
- Energy scenarios can help to find the right way for action

Umwelt Bundes Amt
Für Mensch und Umwelt

Heading for a sustainable energy system in Germany

christoph.erdmenger@uba.de

Thank you for your attention!