CHP and district heat in the Europe under an emission reduction regime

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Motivation

- Climate change, melting of glaciers, rising up the average temperature become more and more a problem.
- If we want to stop this process a limitation of the worldwide GHG-emission is necessary.
- If we know how many GHG can be emitted, we can try to find out which are the optimal technology pathways to go on without any quality and lost of useful energy demand.
- Which are the technologies in the future in our energy system?
- What is the benefit of CHP and district heat and cooling in the future?

Characterization of the Pan-European TIMES model

- **30 region (EU 27 + NO, CH, IS) partial equilibrium energy systems, technology oriented bottom-up model.**
- **Energy system model**

  SUPPLY: reserves, resources, exploration and conversion Country specific renewable potential and availability (onshore wind, offshore wind, geothermal, biomass, biogas, hydro)

  Electricity: public electricity plants, CHP plants and heating plants

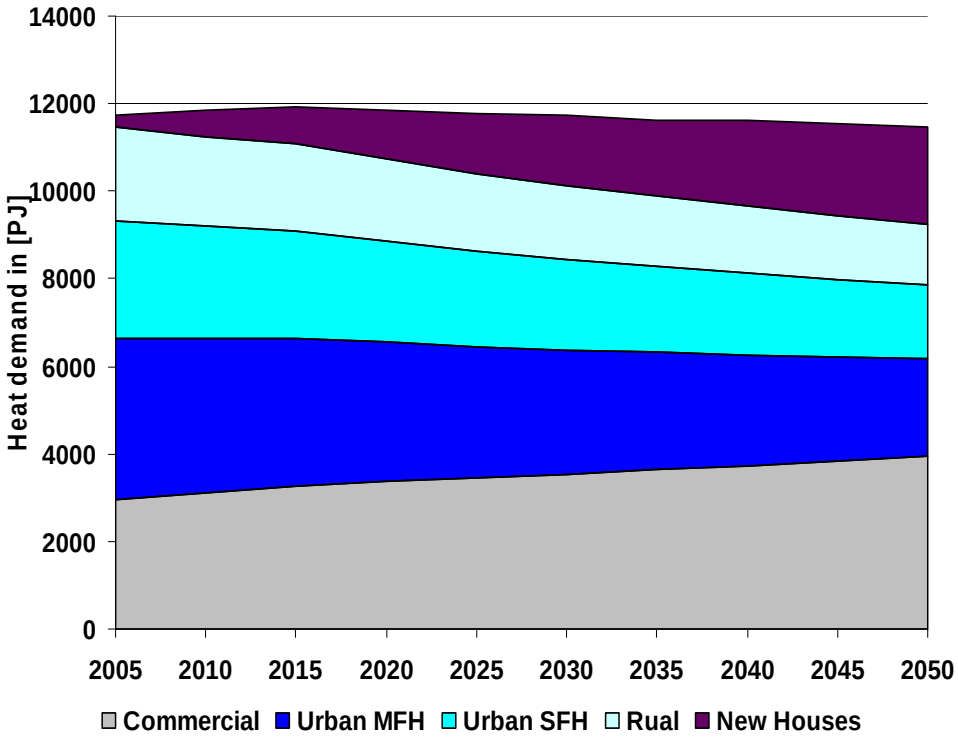
  Residential and Commercial: End use technologies (space heating, water heating, space cooling and others)

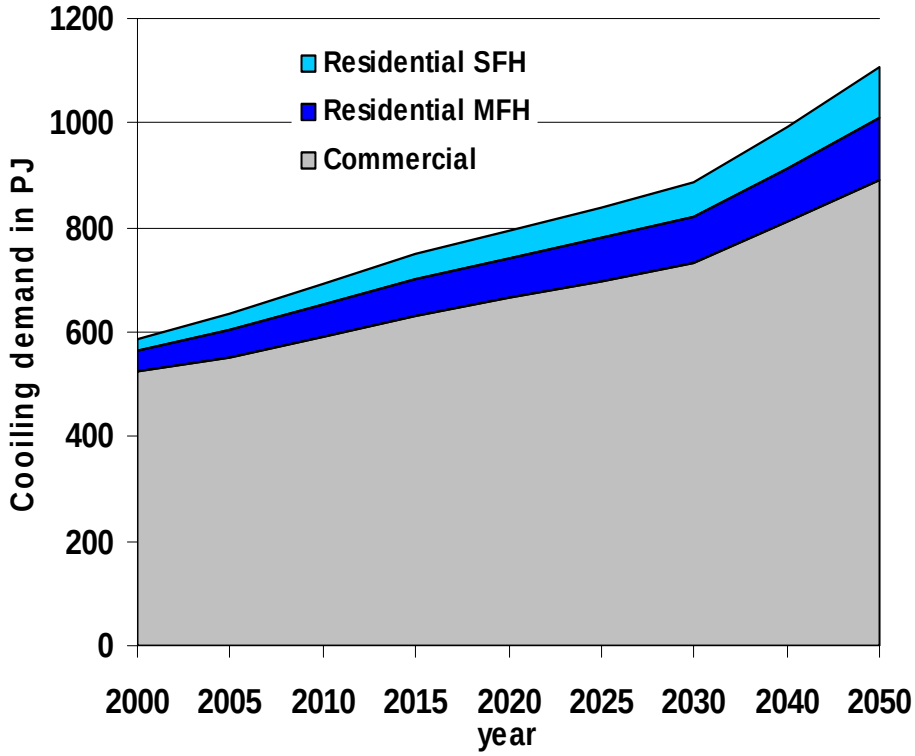
  Industry: Energy intensive industry (Iron and steel, aluminium copper ammonia and chlorine, cement, glass, lime, pulp and paper), other industries , autoproducer and boilers

  Transport: Different transport modes (cars, buses, motorcycles, trucks, passenger trains, freight trains), aviation and navigation
- **Country specific differences for characterisation of new conversion and end-use technologies**
- **Time horizon 2000 - 2050**
- **GHG: CO_2, CH_4, N_2O, SF_6 /Others pollutants: SO_2, NO_x, CO, NMVOC, $PM_{2.5}$, PM_{10}**

Regional Coverage Pan-European TIMES model

One driver of the future energy system - the energy demand in the EU27





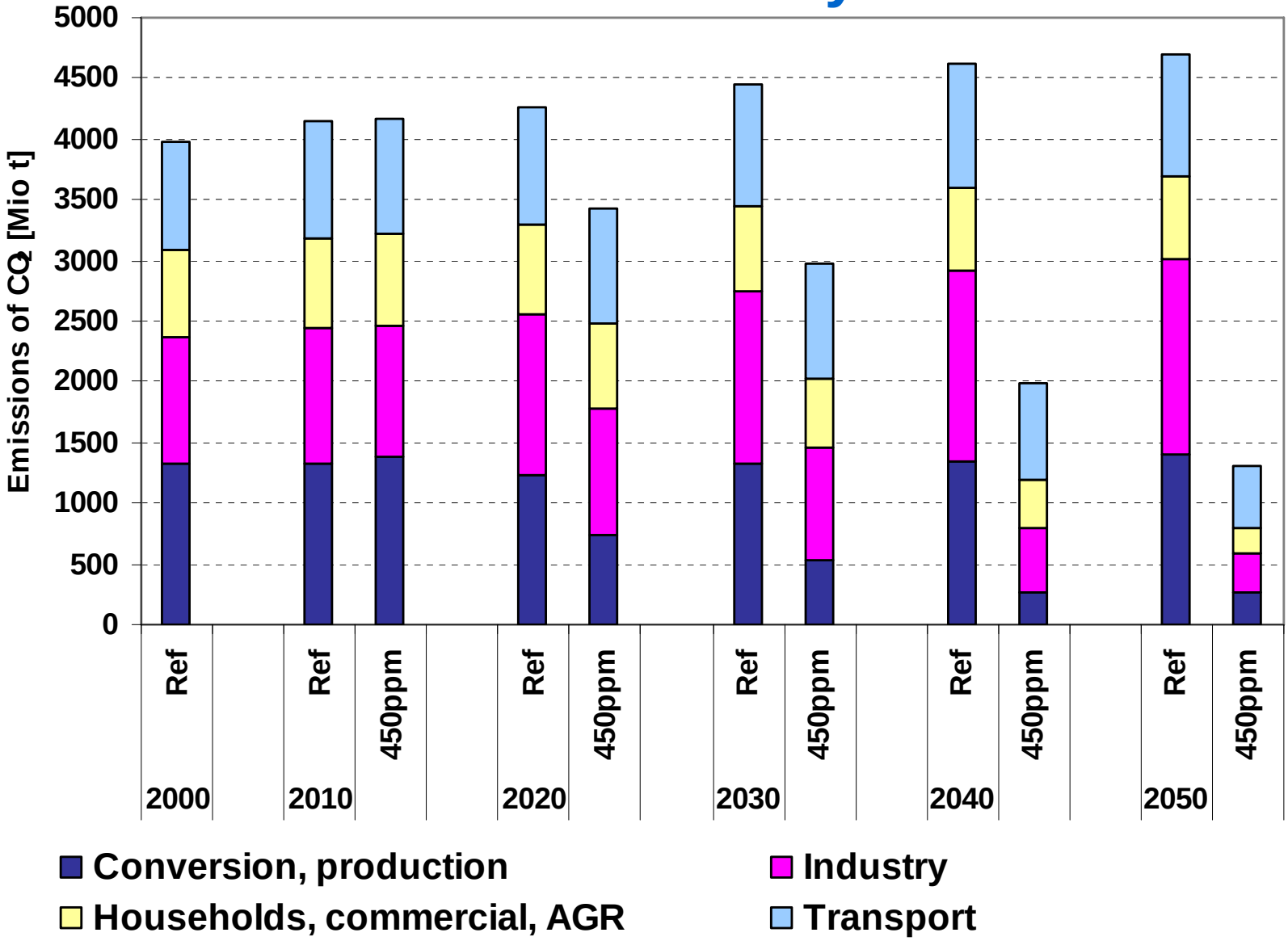
- **Heat demand will be influenced by insulation standards of, change in population and economic growth**
- **Cooling demand will growth driven by economical development**

Scenario analysis

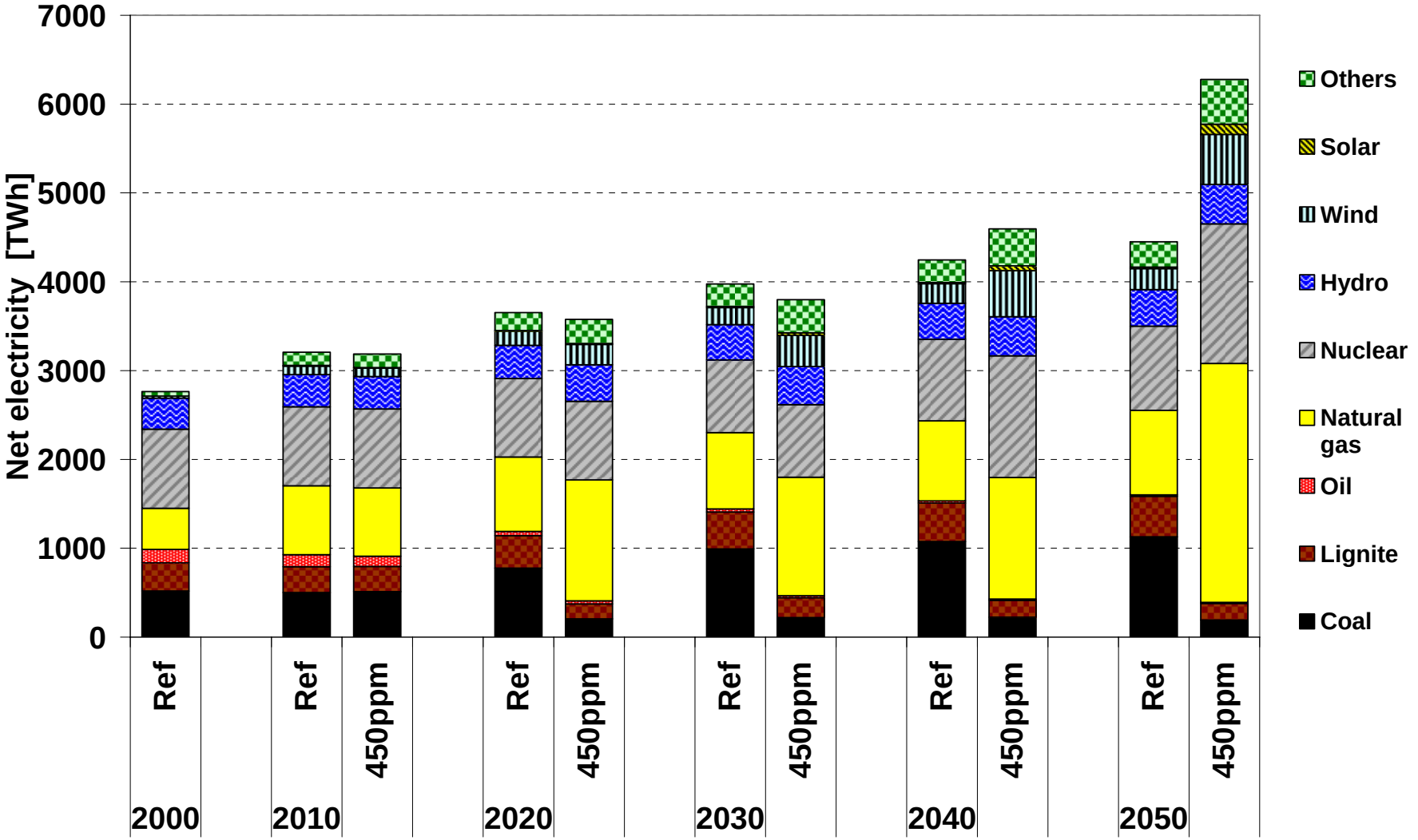
1. **Baseline case (REF)**
   - No emission reduction measures
   - Nuclear phase out according policy of respective EU countries
   - Minimum renewable energy use

2. **Post-Kyoto climate policy to stabilize CO2e concentrations at 450 ppmv (450PPM)**
   - GHG emission reduction -71% by 2050 (equivalent to max. GHG concentration in atmosphere of 450ppm = max 2°C)
   - Nuclear phase out according policy of respective EU countries
   - Minimum renewable energy use

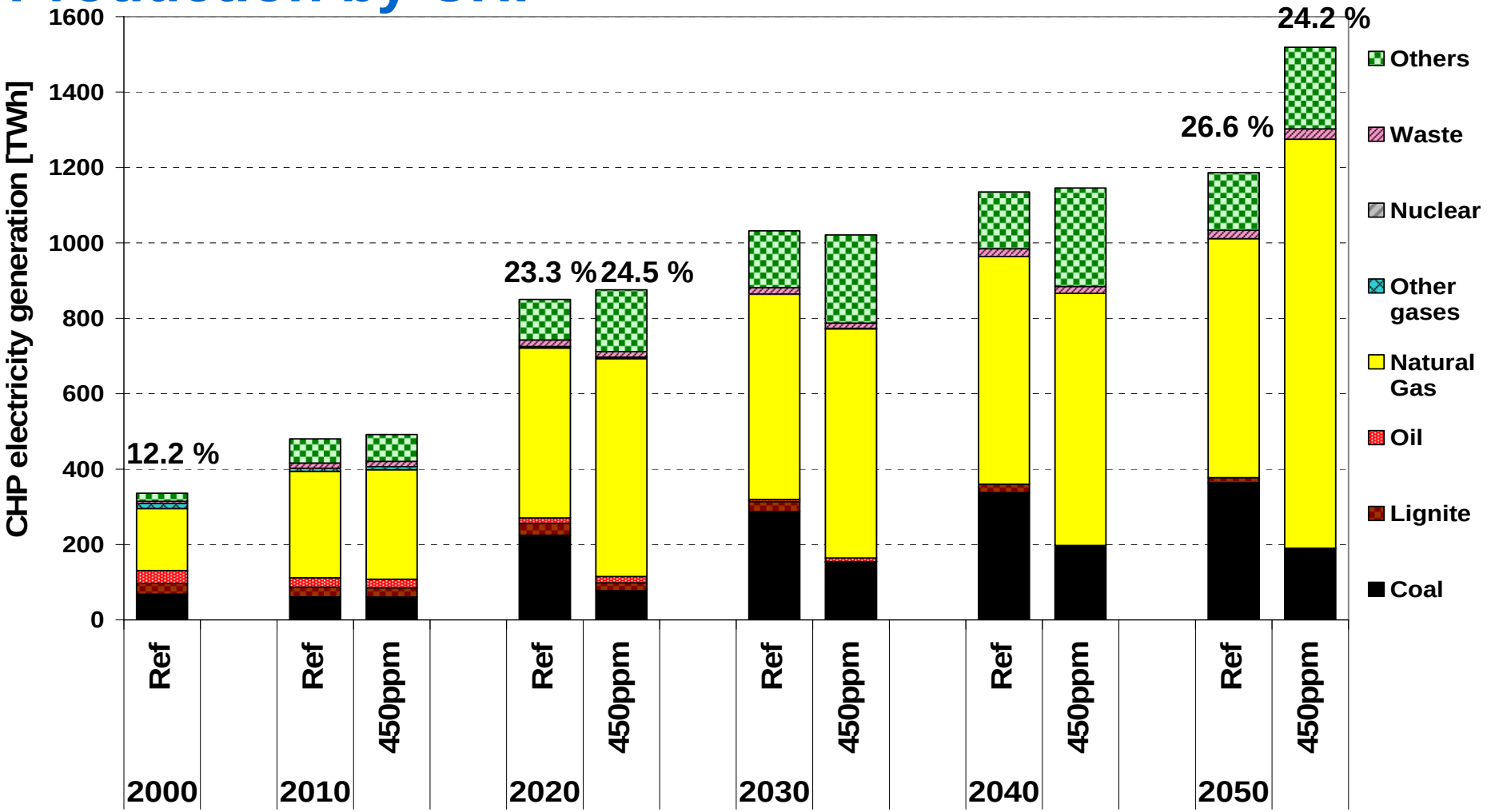
Carbon Emissions in Mt CO2/yr



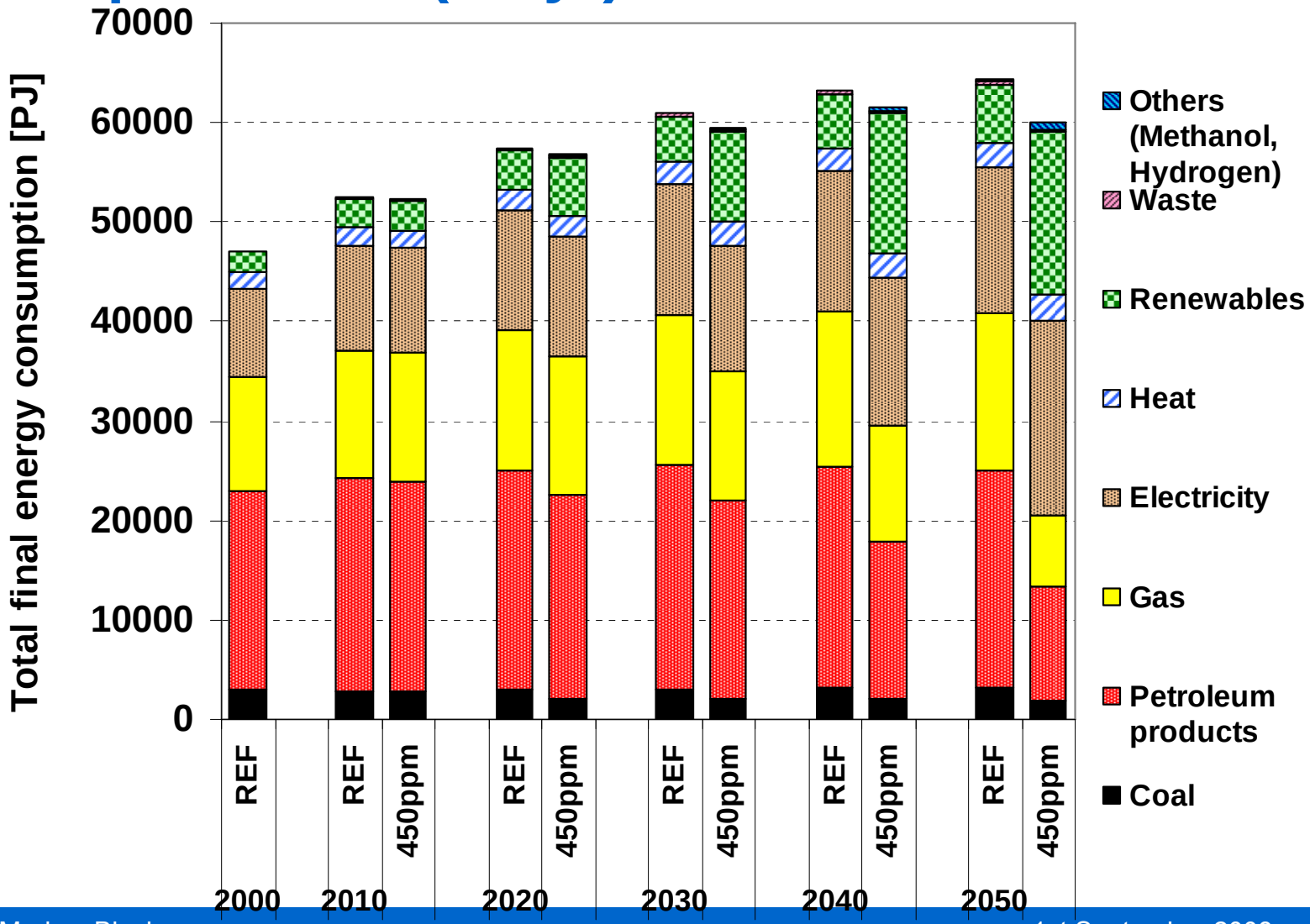
Scenario Comparison, EU27: Net Electricity Production



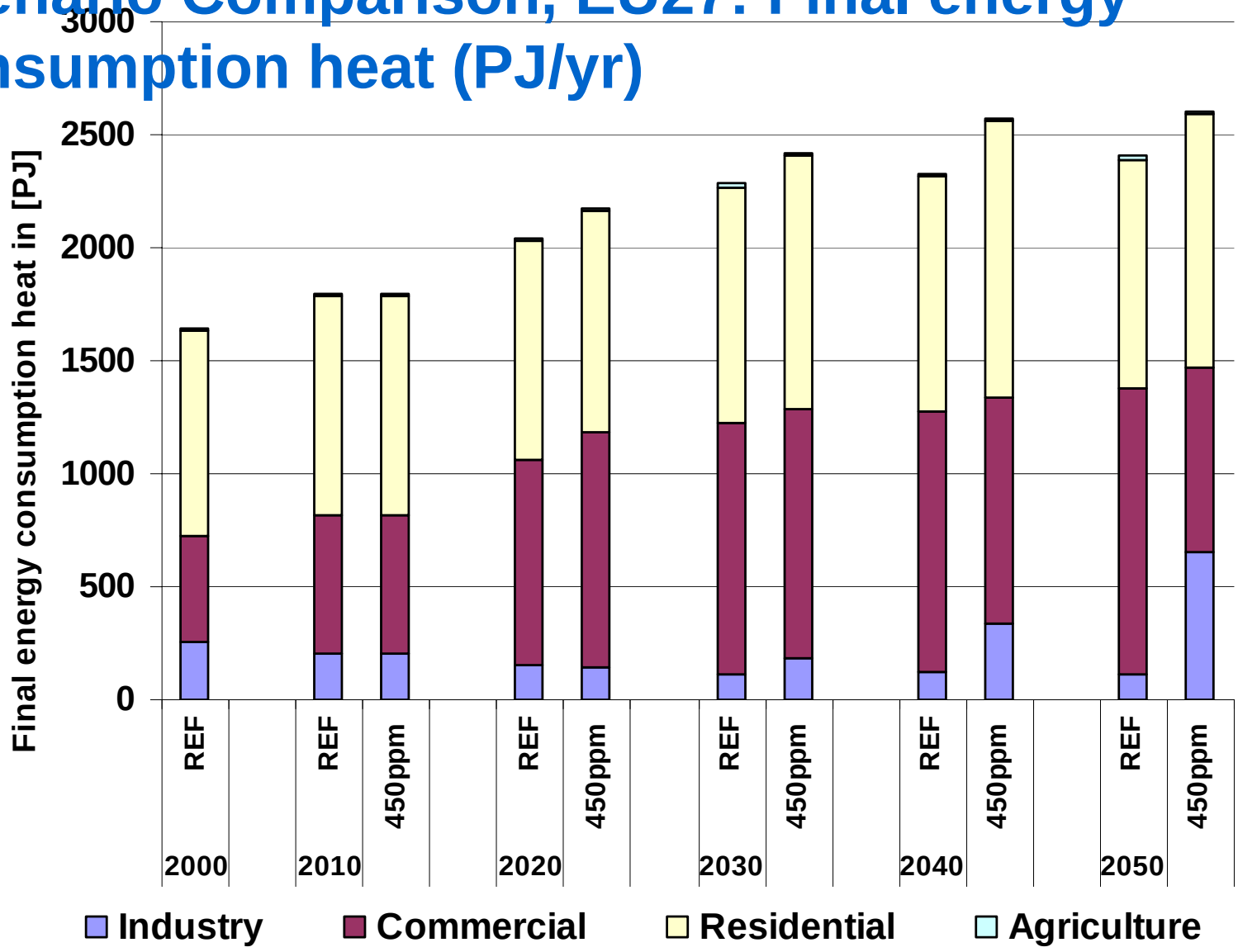
Scenario Comparison, EU27: Net Electricity Production by CHP



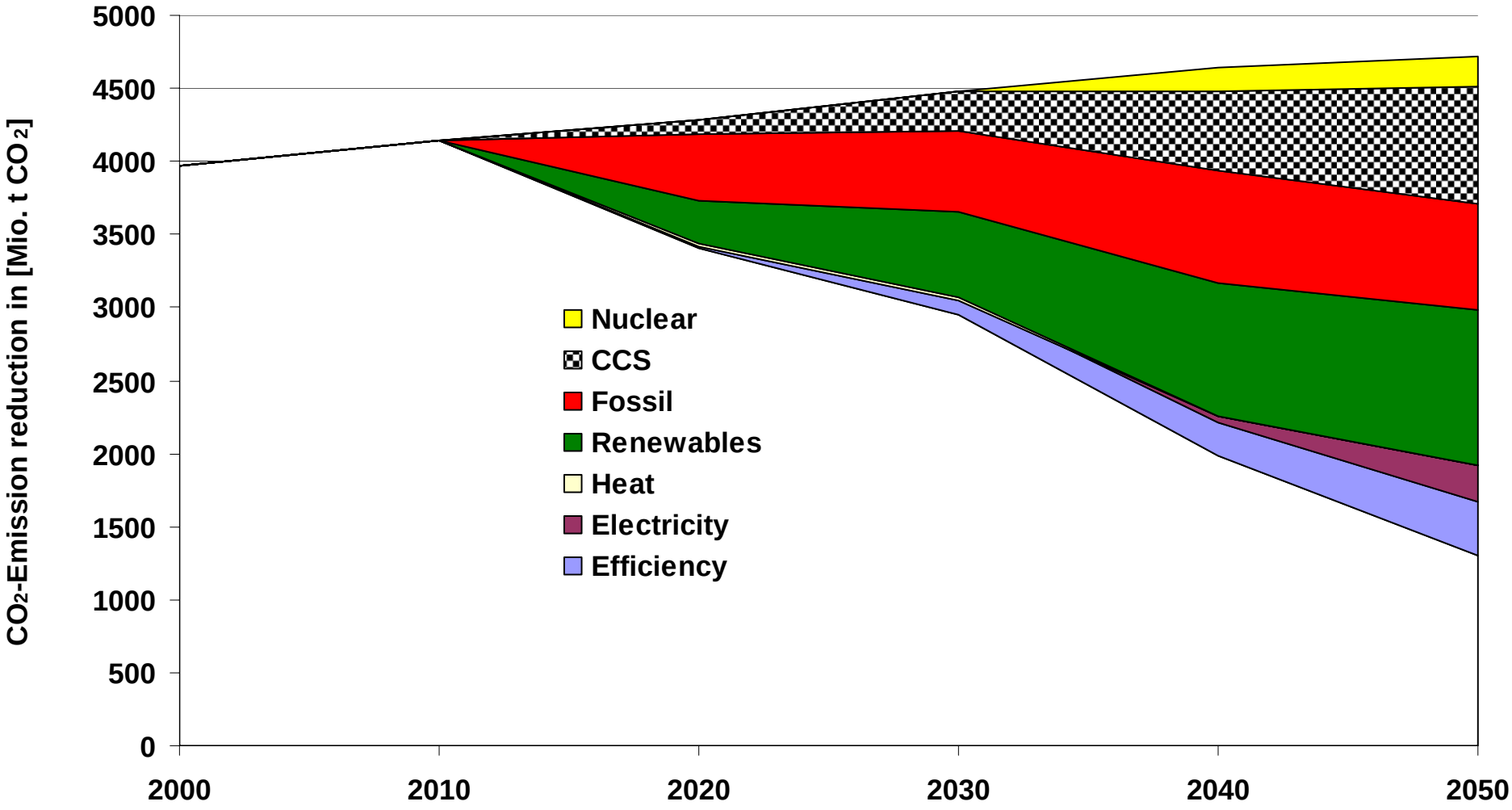
Scenario Comparison, EU27: Final energy consumption total (PJ/yr)



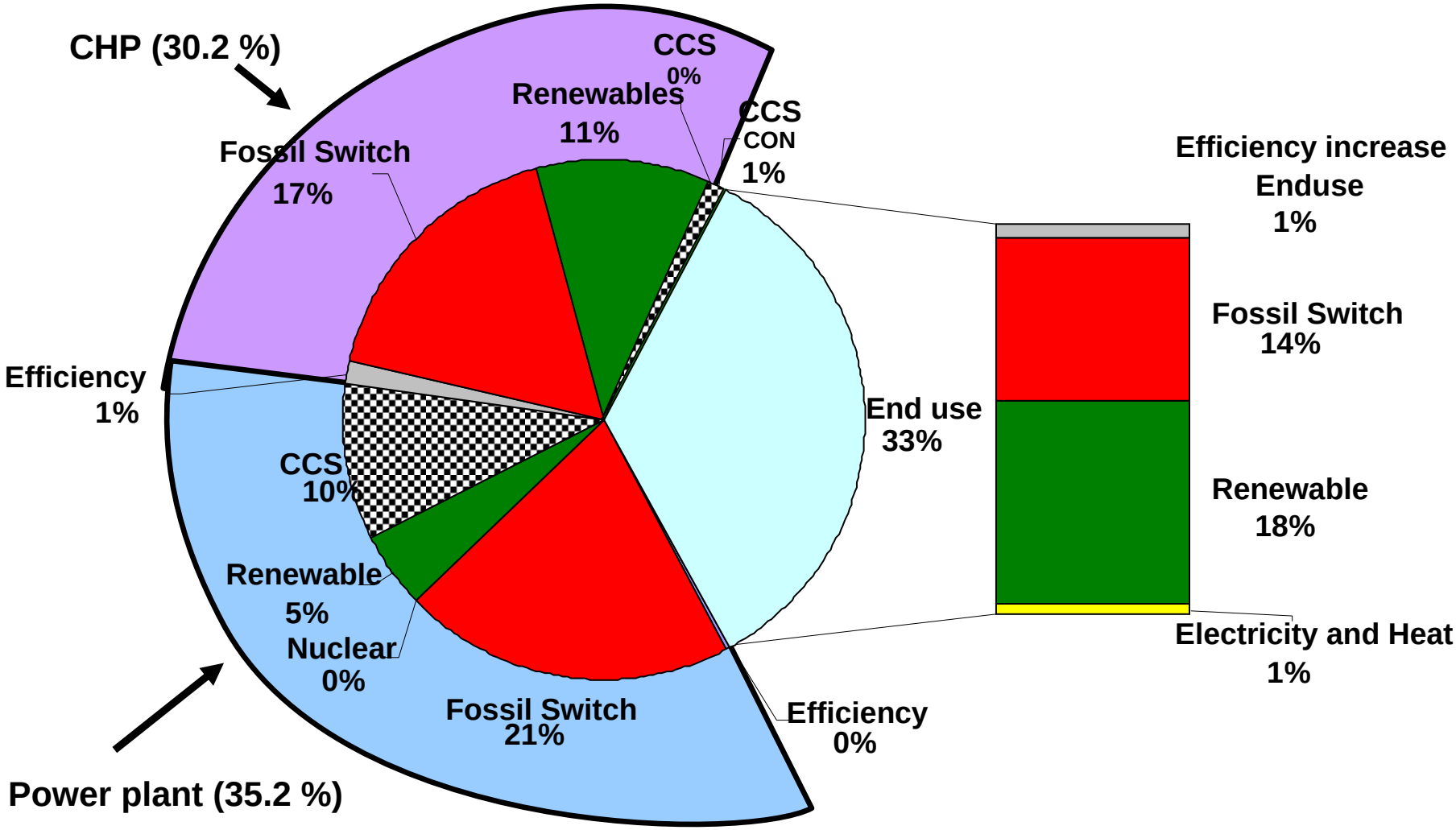
Scenario Comparison, EU27: Final energy consumption heat (PJ/yr)



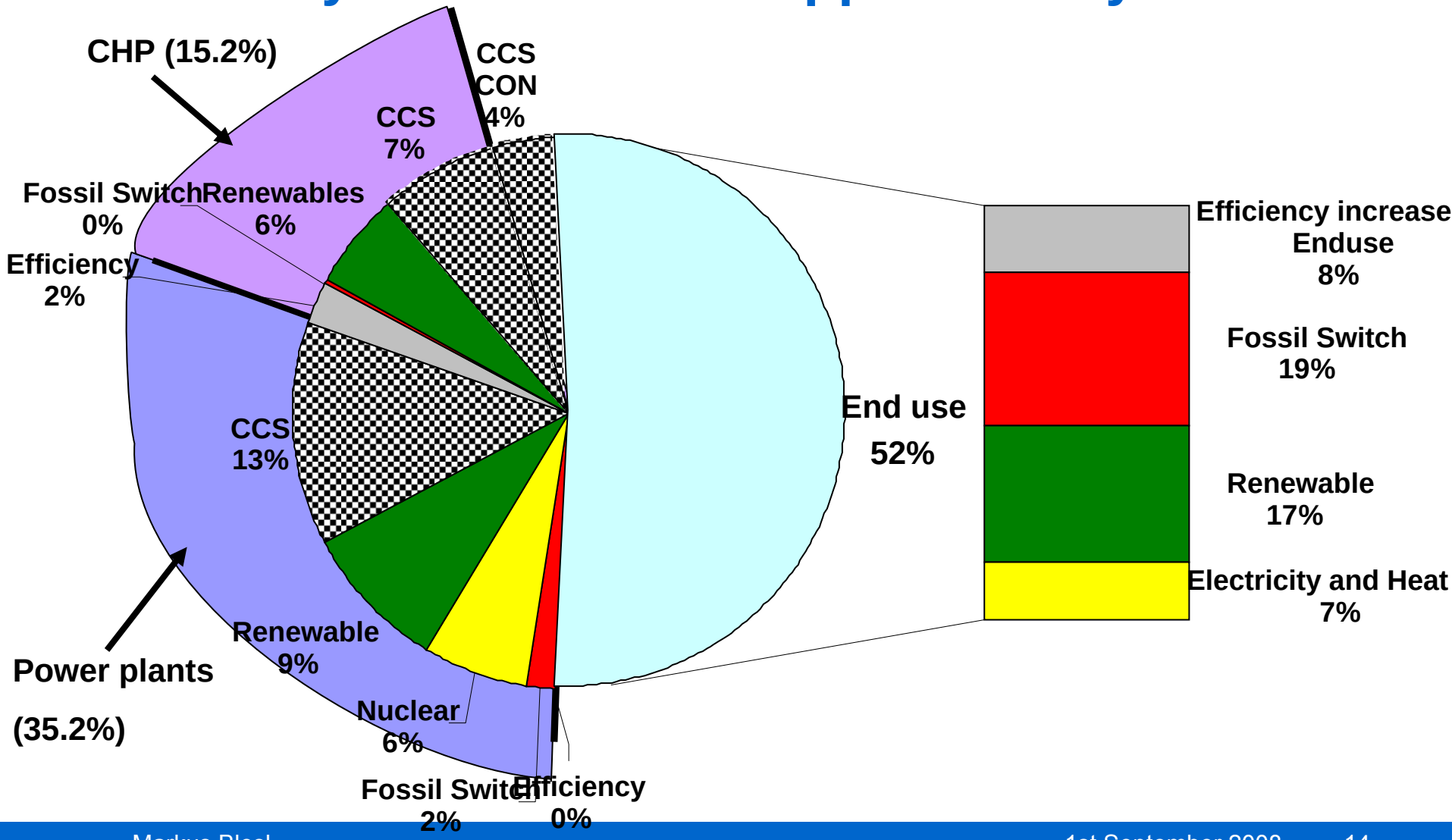
Attribution of CO2 emission reduction in the EU27



Attributes of CO2 emissions reductions in the EU27 in Mt CO2/yr Scenario – 450 ppm in the year 2020



Attributes of CO2 emissions reductions in the EU27 in Mt CO2/yr Scenario – 450 ppm in the year 2050



Conclusions

- District heating generation offers an economic potential for extension in the future. The share of CHP in the industry growth up more rapidly then in the residential sector.

  ➔ Combinations of different supply options becomes more and important.

- Moreover, the additional co-generated electric power to be produced tendency is for the out of natural gas and biomass. The possibility to install CCS influences the penetration of CHP more and more.

  ➔ Technology availability or the R&D investments at the right time becomes more and important.

- In general the progression of district heat crucially depends on the costs of opening up new district heating supply areas in the future. The efficiency of the whole district heat system is main issue in the long term.

  ➔ Technology integration in the whole system becomes more and important.

Thank you for your attention !

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