



The role of technologies and structural changes in the energy system of the EU 27 to achieve the 450 ppm target

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Characterization of the Pan-European TIMES model

- **30 region model (EU 27, No, CH, IS)**
- **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: CO₂, CH₄, N₂O, SF₆ /Others pollutants: SO₂, NO_x, CO, NMVOC, PM_{2.5}, PM₁₀**



Regional Coverage Pan-European TIMES model





Scenario analysis

1. **Baseline** case (REF)

Continuation of the support of renewable on a minimum level, nuclear phase out and limited use of nuclear in the countries they have used nuclear in the past.

2. **Post-Kyoto** climate policy to stabilize CO₂e concentrations at 450 ppmv (450PPM)

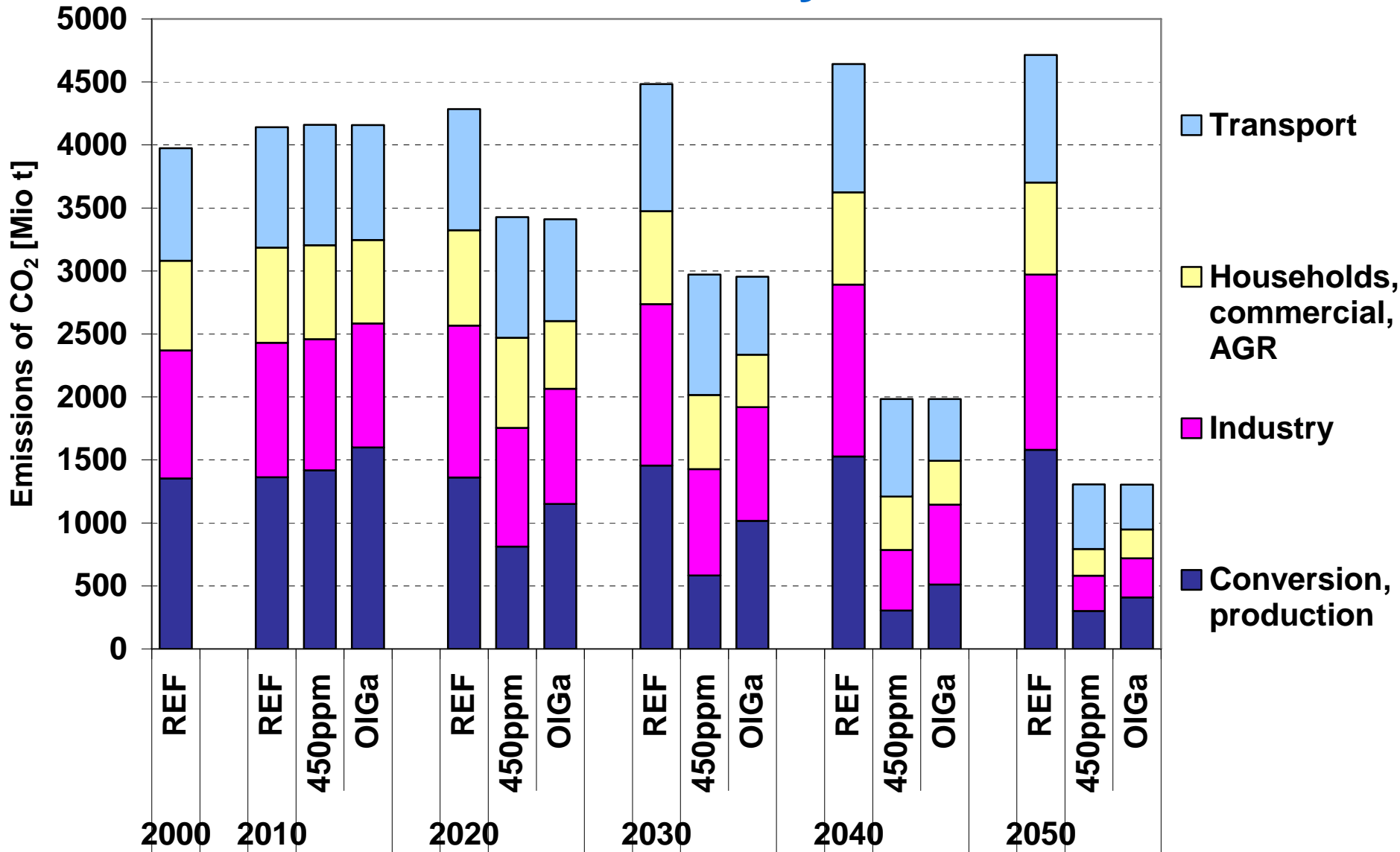
Constrain the CO₂ emissions till 2050 on a level of 71 % compared to 1990. Continuation of the support of renewable on a minimum level, nuclear phase out and limited use of nuclear in the countries they have used nuclear in the past.

3. **Enhancement of endogenous energy resources**, (constraining imports of fossil fuels to foster the use of renewables, efficiency standards and new nuclear)

(450PPM + (OIL and GAS Limitation) = OLGA)

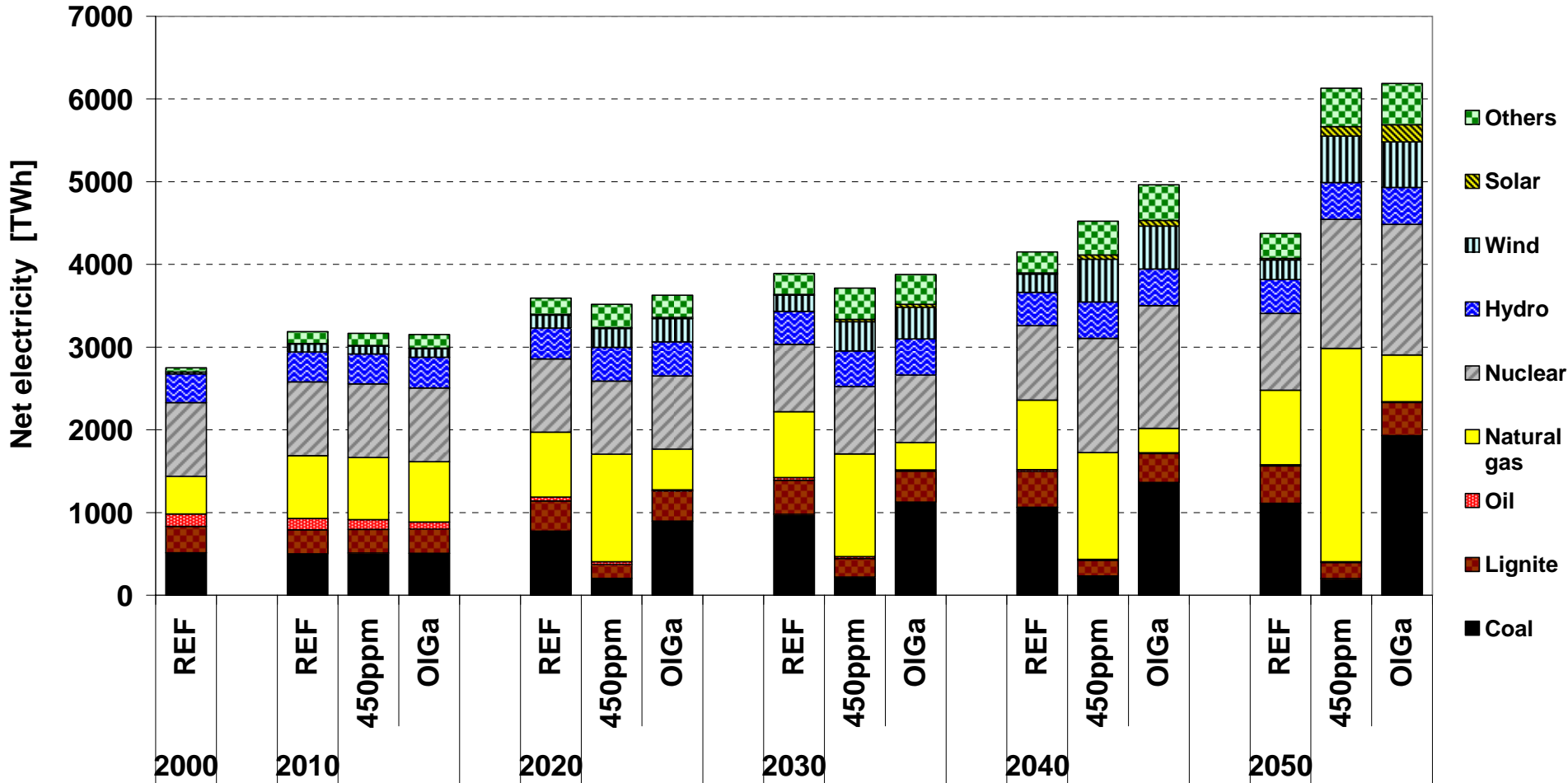


Carbon Emissions in Mt CO₂/yr



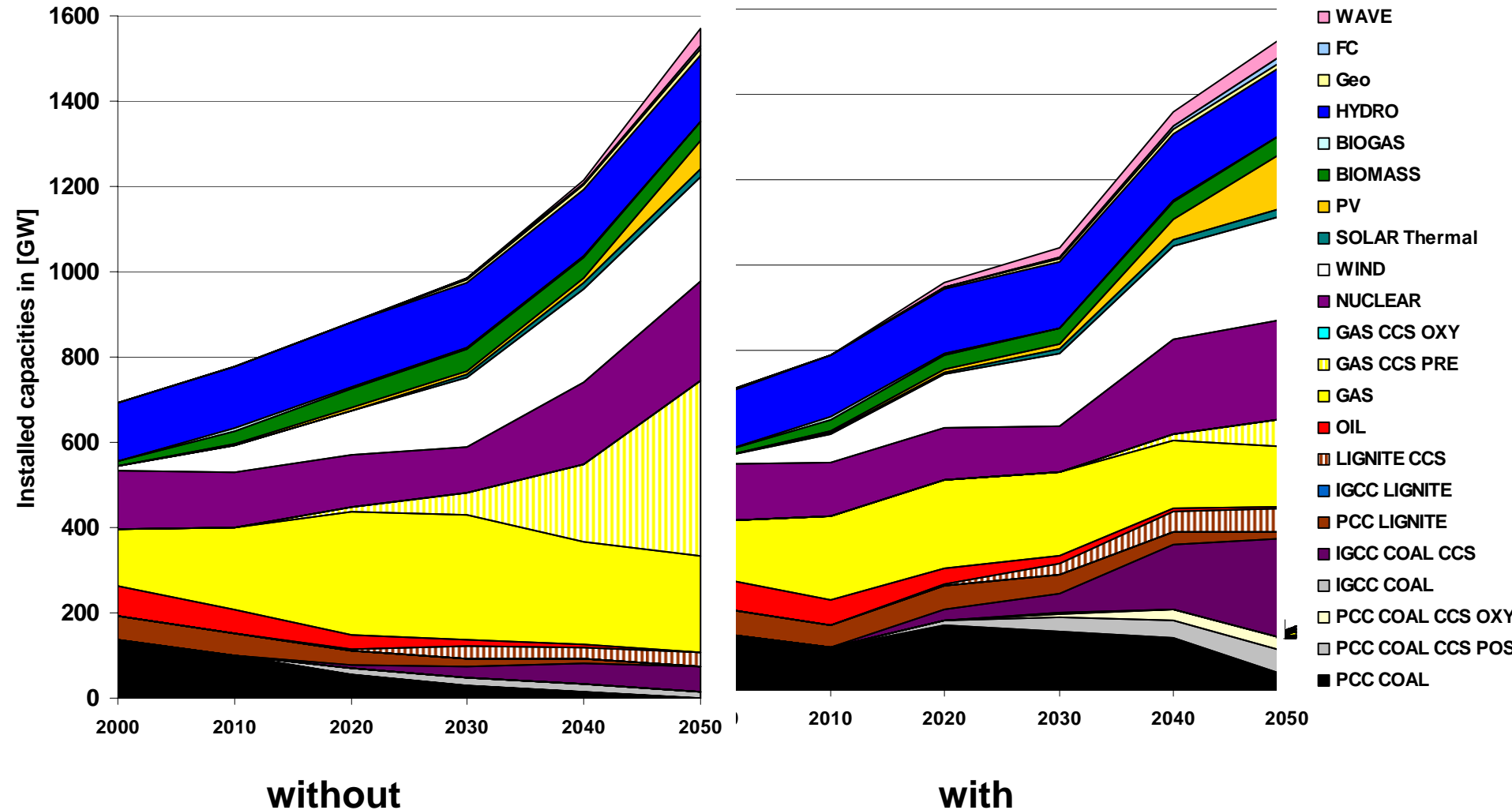


Scenario Comparison, EU27: Net Electricity Production



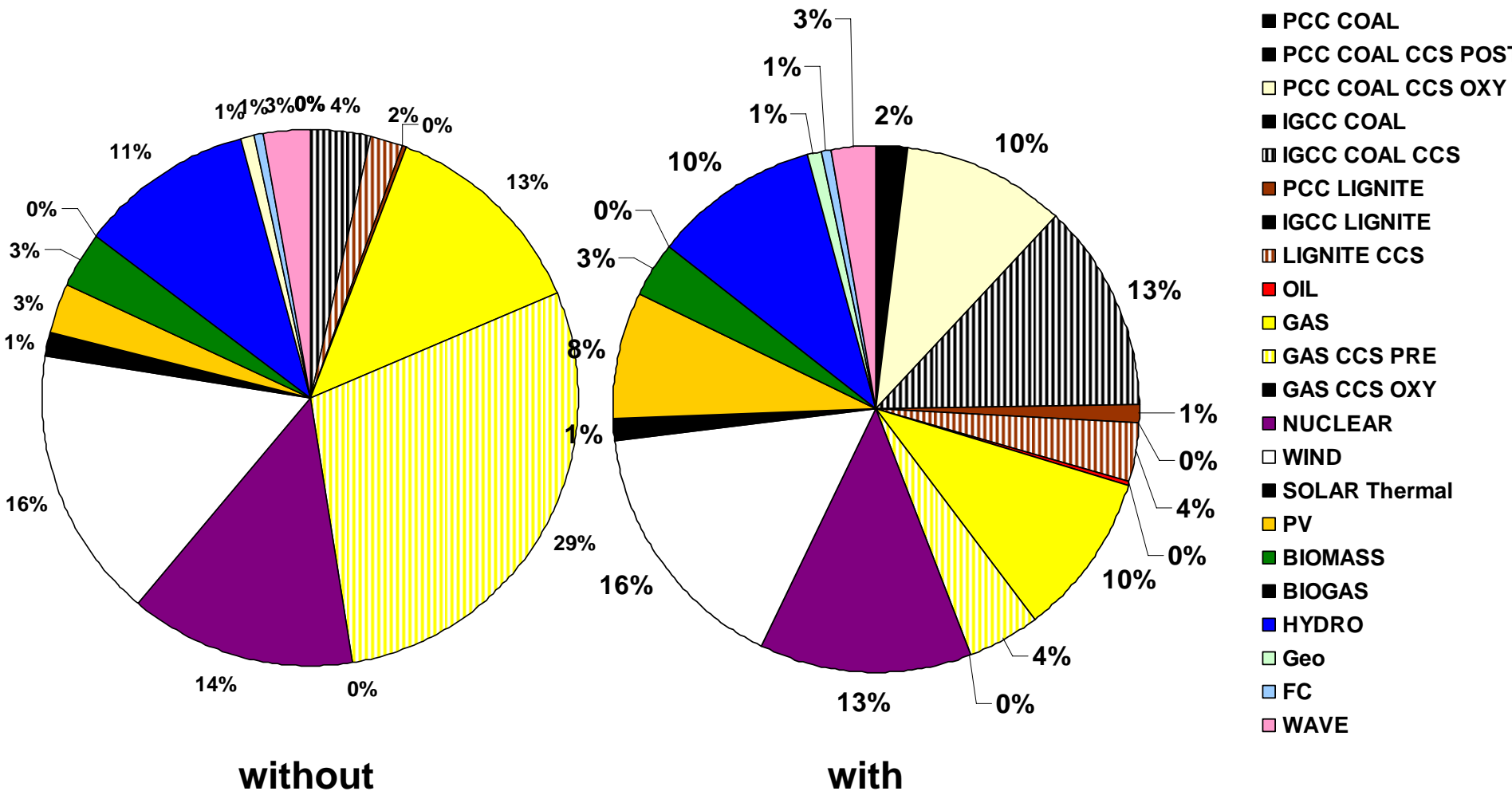


Scenario Comparison 450 PMM wi/wo security of supply EU27: By Electrical Capacity and Technology in GW



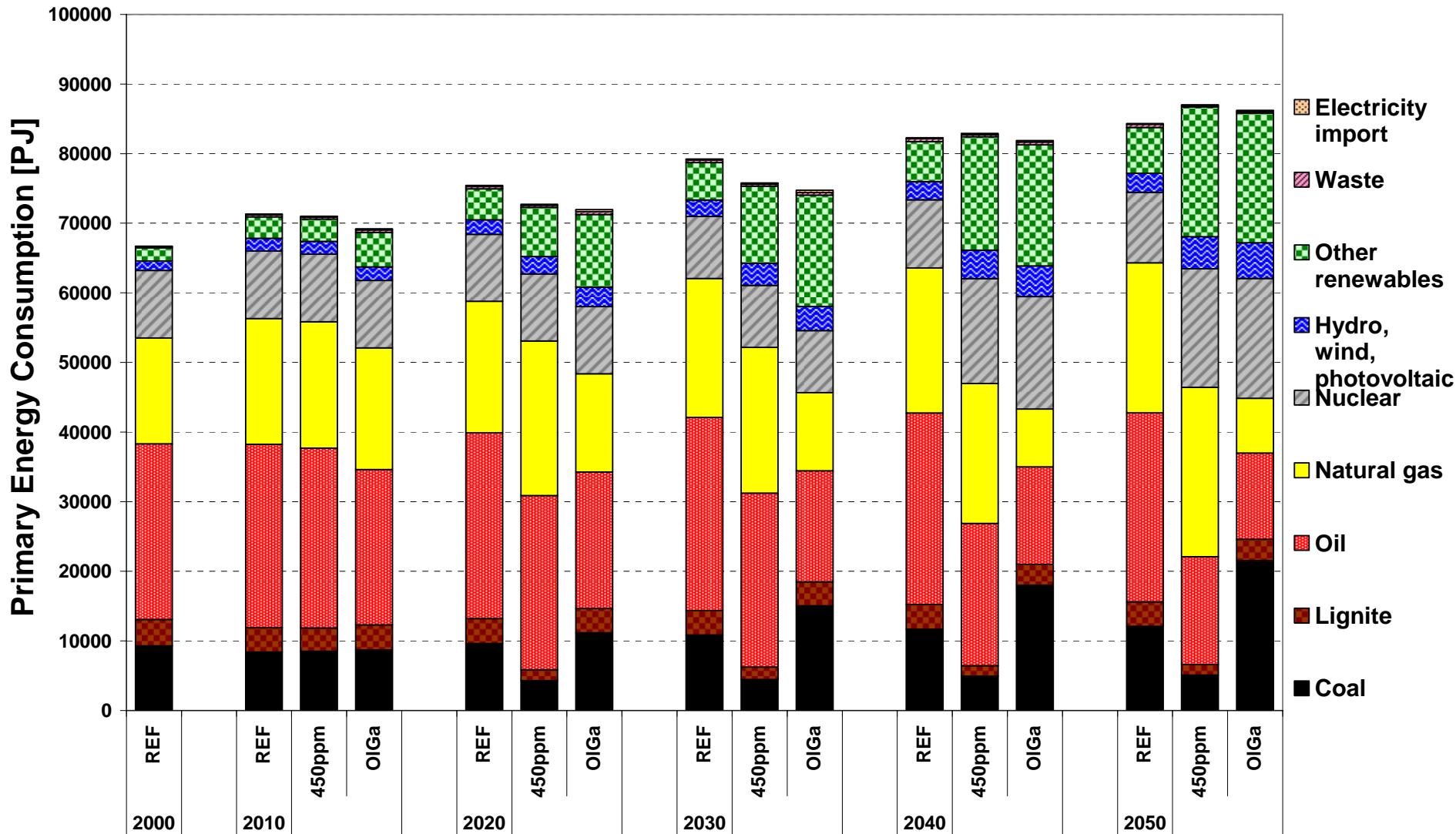


Scenario Comparison 450 PMM wi/wo security of supply EU27: Share of Technology in 2050



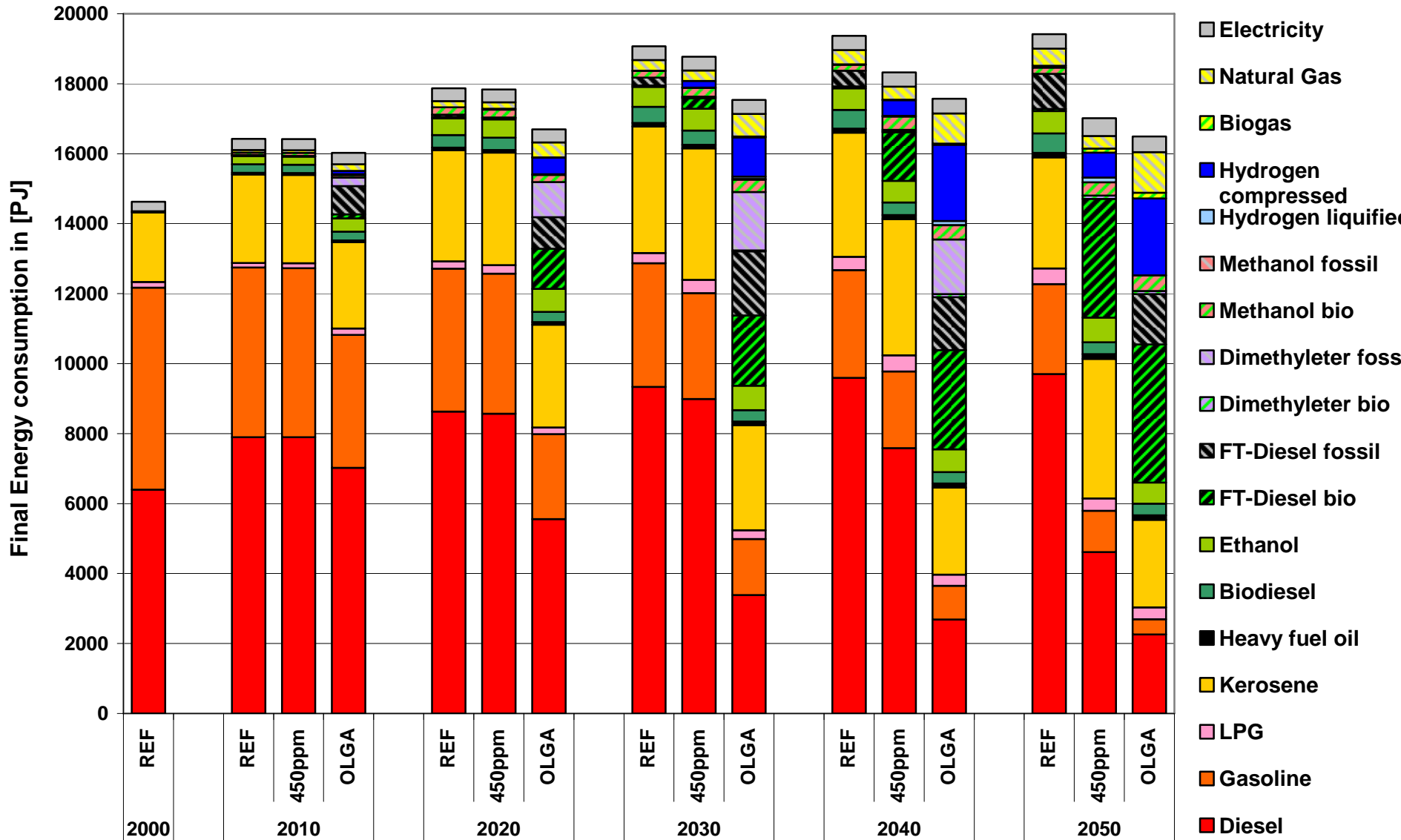


Primary Energy consumption EU27 in PJ/yr





Final energy consumption transport EU27(PJ/yr)



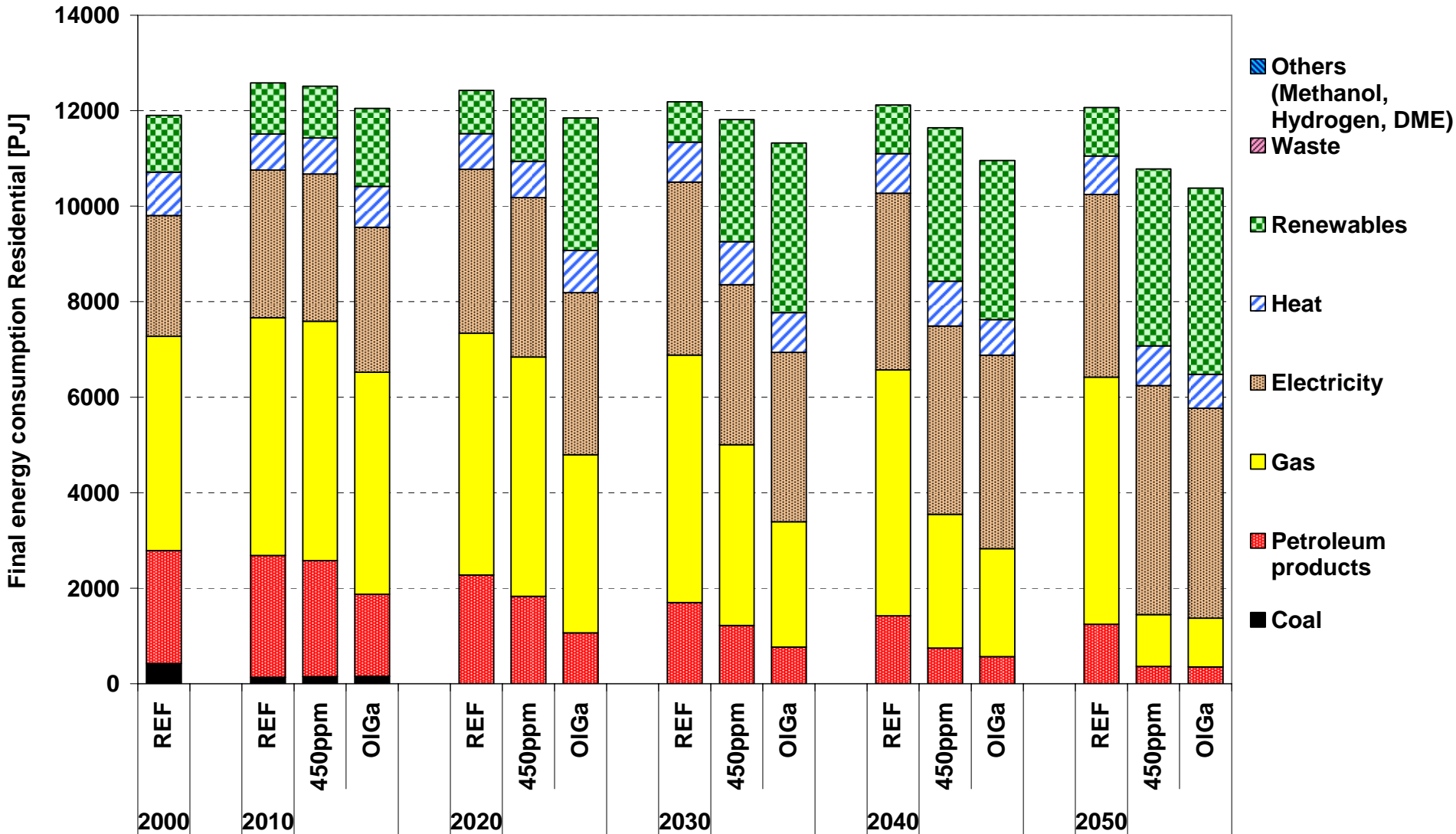


Technologies used by private car transport in 2050

	REF	450 ppm	OLGA
Diesel	++	++	+
Gasoline	++	++	+
Hybrid	++	++	+++
LPG	++	+	o
Biodiesel	-	o	-
Biodiesel Blended	o	o	-
Ethanol	++	+	+
Sunfuel	-	++	+++
Synfuel	+	o	+++
Dimethyleter bio	-	+	+
Dimethyleter fos	-	-	-
Methanol bio	+	++	+++
Methanol fossil	o	-	-
Hydrogen liq	-	o	-
Hydrogen compressed	-	+	+++
Biogas	-	o	o
Natural Gas	+	+	+++
Electric	-	+	o
Pulv-In Hybrid	-	+	o



Final energy Consumption Residential EU27 (PJ/yr)





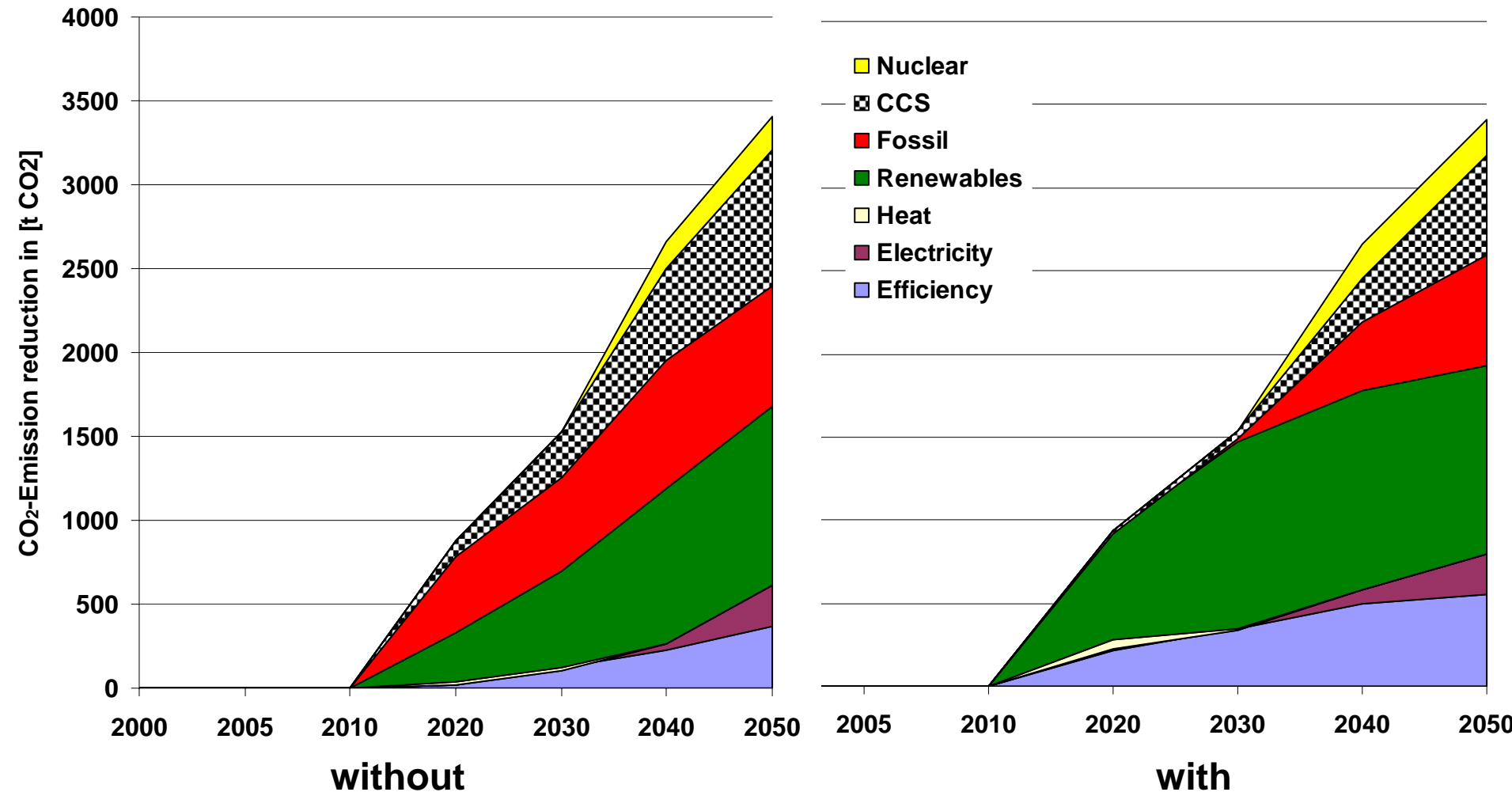
Technologies in Residential in 2050

	REF	450 ppm	OLGA
High efficient Isulations / heating	-	++	++
High efficient Isulations / Cooling	-	++	++
Oil Boilers	++	0	-
Oil Cond. Boilers	0	+	+
Gas Boilers	++	0	-
Cond. Gas Boilers	++	++	+
Gas Heat Pump	0	++	+
Heat Exchanger	++	+	+
Absorption Heatpump	-	+	+
Ele. Groundwater Heatpump	0	++	++
Ele. Air Heatpump	++	+	+
Ele. Heating	+	0	0
Compress Heatpump Cooling	++	++	++
Absorption Heatpump Cooling	-	0	0
Woodchips boilers	+	++	++
Wood pellets boilers	+	++	++
Solar thermal	+	++	++
Advatage Electr. Appliance	+	++	++



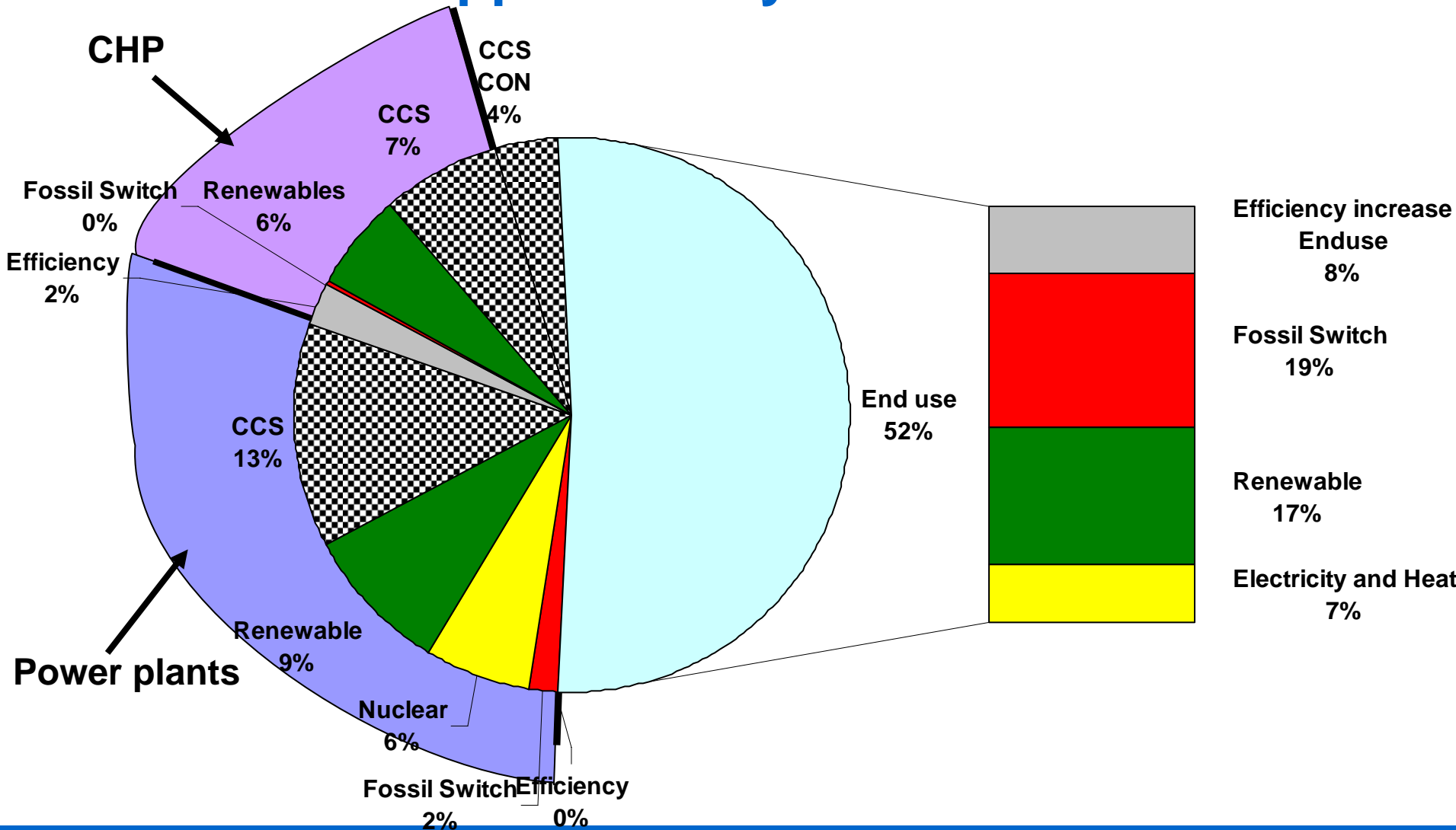
Carbon Emissions by reduction reason in Mt CO₂/yr

Scenario – 450 ppm wi/wo security of supply



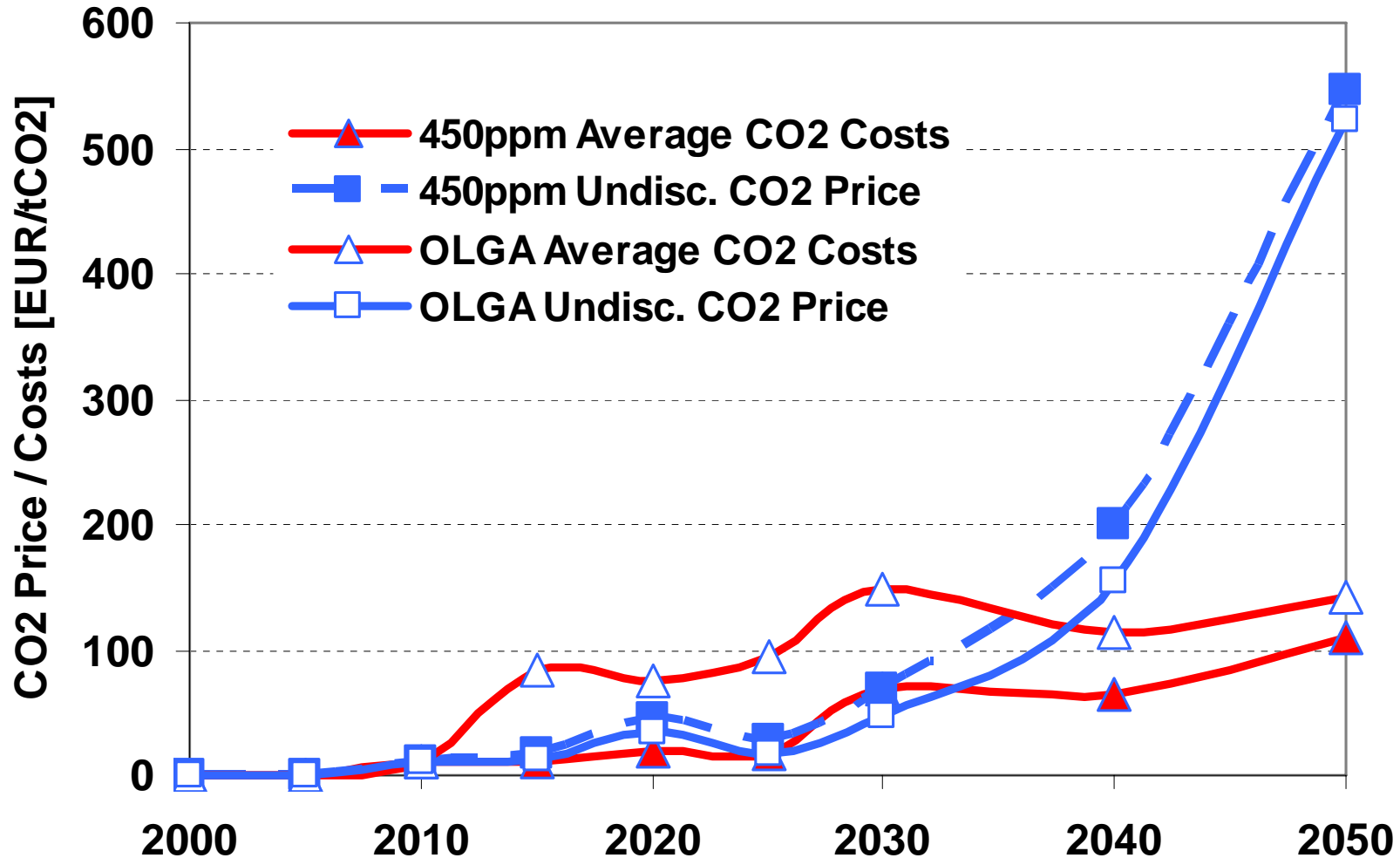


Carbon Emissions by reduction reason in Mt CO₂/yr Scenario – 450 ppm in the year 2050






CO₂ Prices and CO₂ costs in the different scenarios





Conclusions

- **The role of technologies and structural changes in the energy system of the EU27 are more influenced by policies than of the technologies them self.**
- **A strong reduction of the import-dependence on oil and gas is only possible if the technology development will be successful in all parts of the energy system.**
- **In case of CO₂ emission reduction with a limitation on the further use of nuclear, renewable, CCS , fossil fuel switch and a increase of electricity in the final energy consumption plays a big rule.**
- **Only in case of security of supply efficiency improvement takes up an additional part.**



Thank you for your
attention !

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