



European Energy and CO₂ Emissions trends to 2020



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Athens, June 1999

Scope of the study

To present a consistent EU energy and energy related emissions outlook for the period to 2020:

Baseline scenario

CO2 Emissions reduction scenarios

Study carried out in the context of the «Shared Analysis Project», EU - DG XVII

Use of PRIMES model, ver. 2

Baseline Scenario

Moderate increase of Final Energy Demand

- Market share of electricity increases by 4% in 2020
- Tertiary is the faster growing sector
- Modest growth of energy demand in households
 - reflecting lack of growth of EU population
 - small increase in the number of households
- Transports account for 1/3 of final energy demand
- Industry restructuring, stagnation of energy-intensive sectors in the EU

Energy Intensity Improves

1.5% per annum in 1995-2020

Baseline Scenario

Electricity and Steam Generation liberalises and improves

- Higher thermal efficiency
- Lower capital costs
- Natural gas plants dominate in new investment decisions
- Small-scale producers get close to 20% of the market in 2020
- The share of cogeneration in steam production increase to 70% in 2020

Baseline Scenario

CO2 Emissions increase

+7.2% in 2010

+14% in 2020

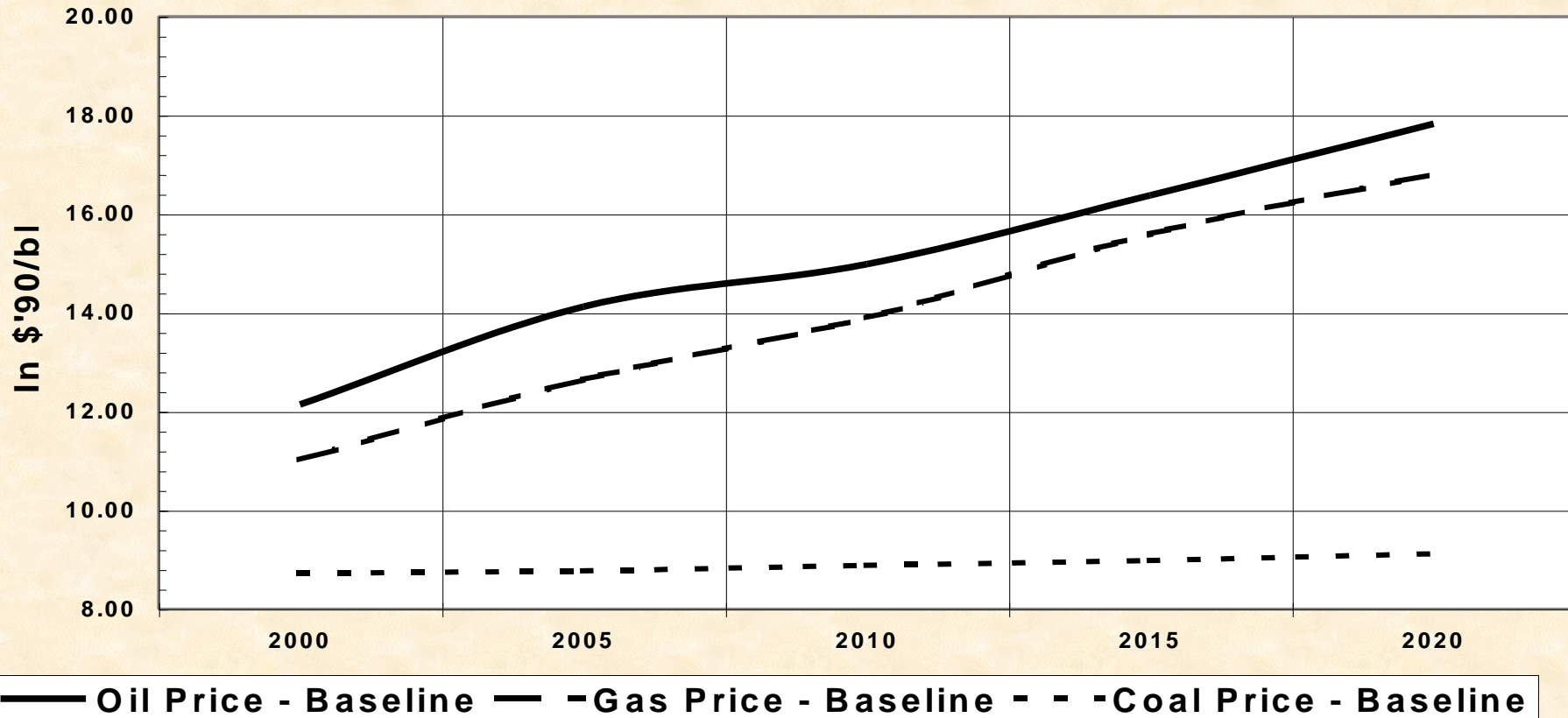
	1990-2010	1990-2020
Economic Growth	43.5%	61.7%
Energy Intensity	-26.9%	-41.5%
Fossil Fuel Intensity	-2.0%	0.2%
Fuel Mix in Fossils	-7.7%	-7.2%
Total Emission Change	7.0%	13.2%

- Transports sector responsible for the bulk of emissions increase (+35% in 2010, +40% in 2020) Emissions in power and steam generation remain stable in 2010, increase significantly afterwards due to decommissioning of nuclear plants (+17% in 2020)
- Emissions of households remain stable
- Emissions in tertiary increase by 15% in 2010 decrease afterwards (+5% in 2020)
- Emissions in industry decrease by 12% in 2010, 18% in 2020

Baseline Scenario

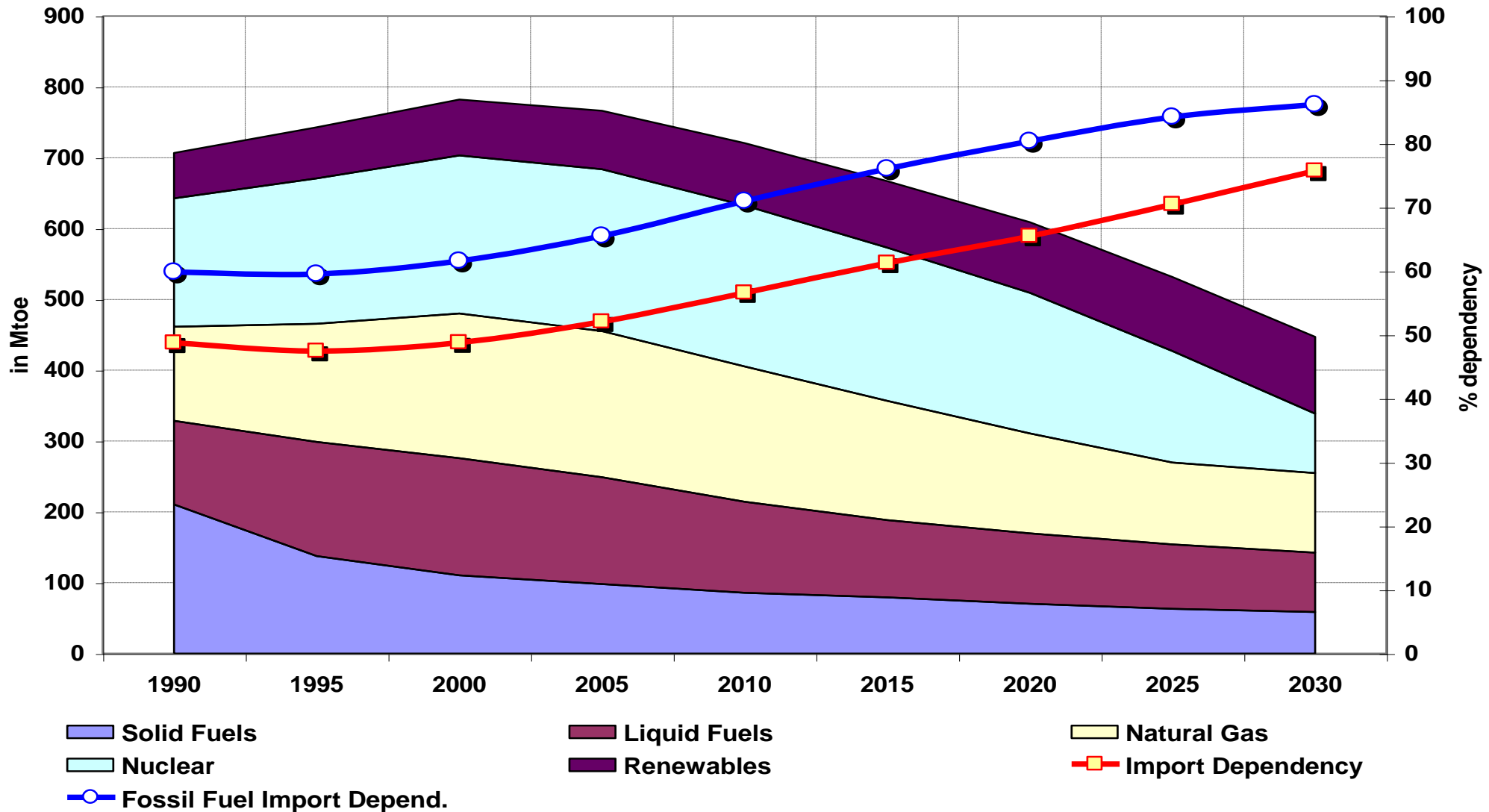
Primary fuel prices assumption

Energy Prices (Border to EU-15)



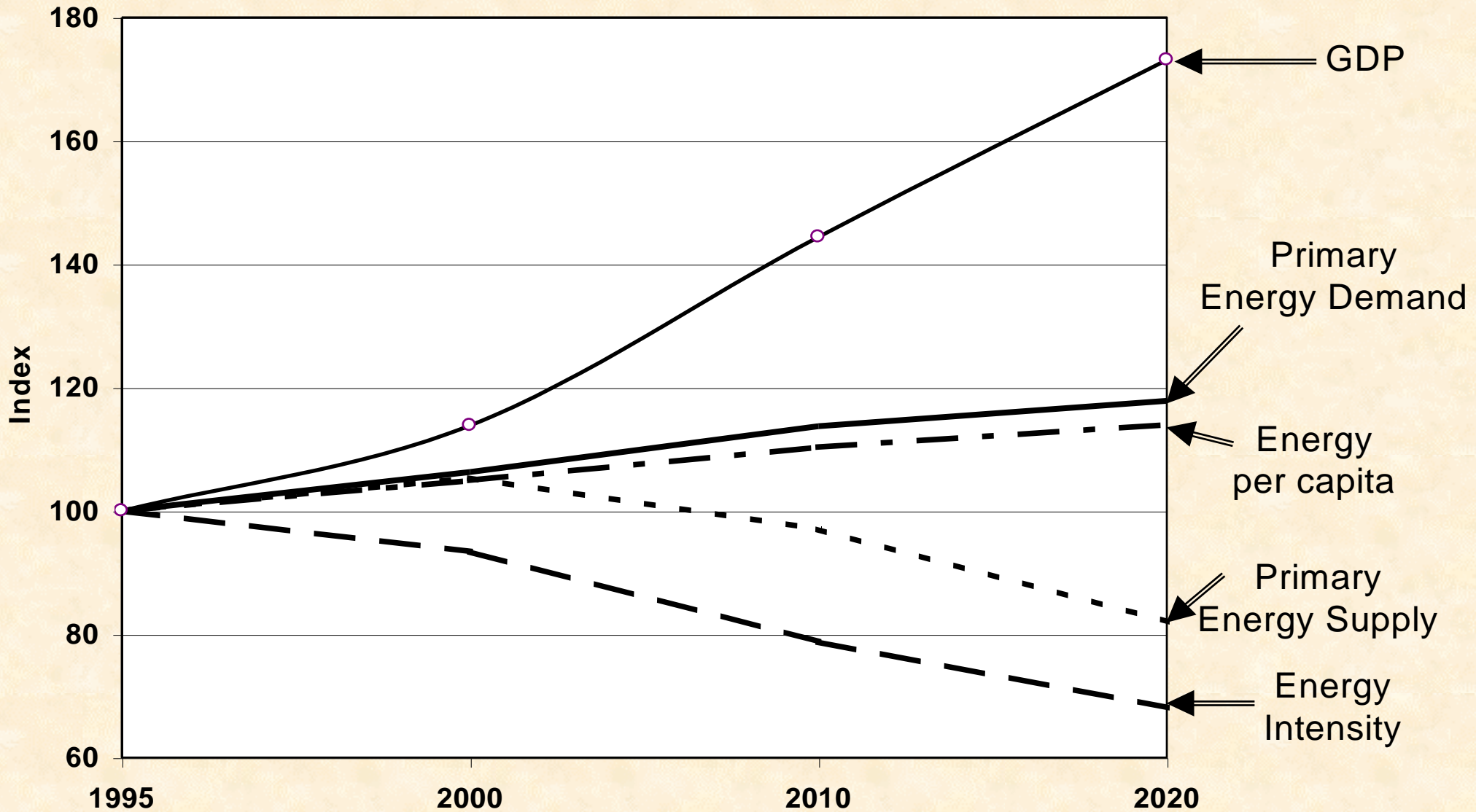
Baseline Scenario - Primes model

EU15 - Primary energy Production



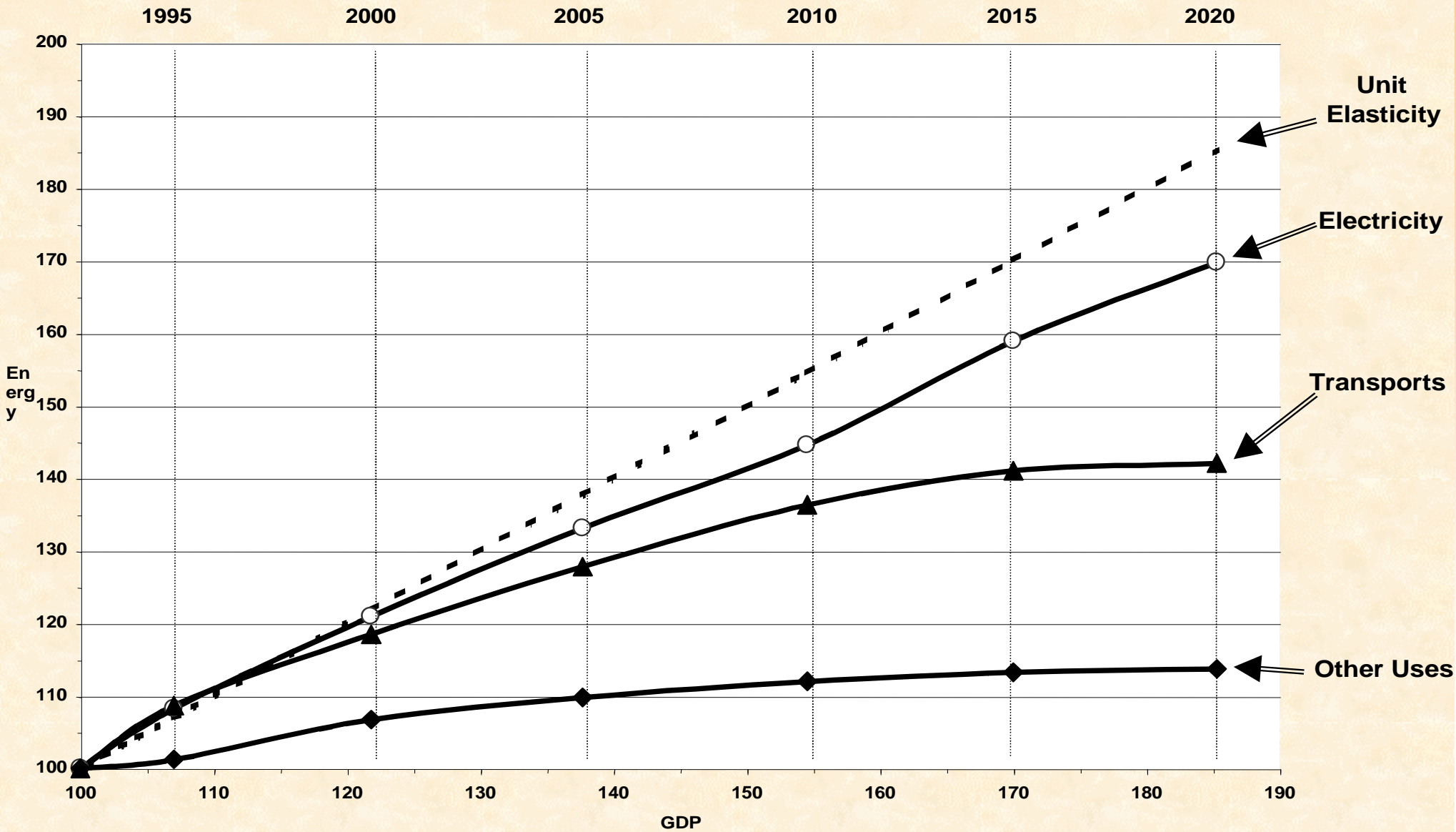
Baseline Scenario - Primes model

EU primary energy indicators, 1995-2020



Baseline Scenario - Primes model

Energy as a function of GDP (index 100 in 1990), 1995-2020

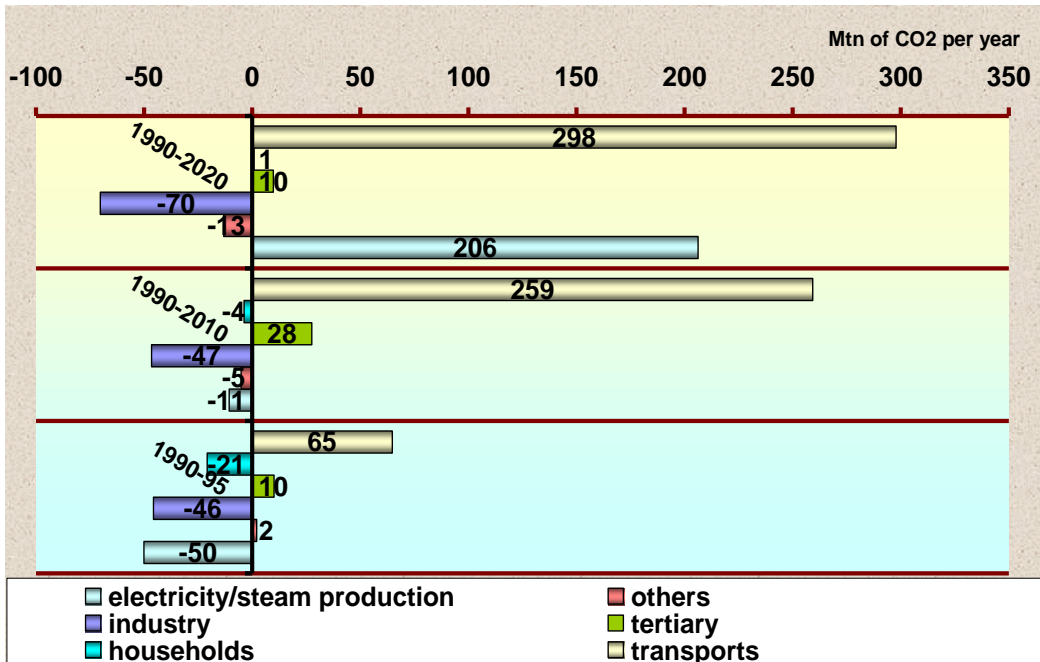


Baseline Scenario - Primes model

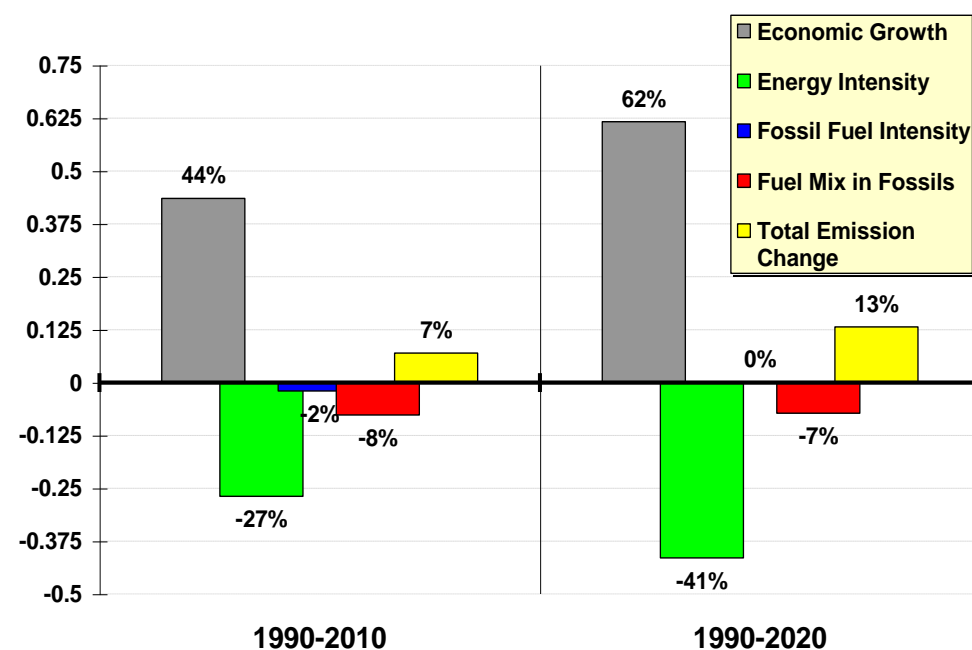
- The Kyoto target is not met under baseline conditions
- The baseline could be worse in energy efficiency

	1990	2010	2020	2030
CO2 emissions (Mtn CO2)	3068	3289	3500	3807
% Change from 1990 level		7%	14%	24%

Change of CO2 emissions by sector



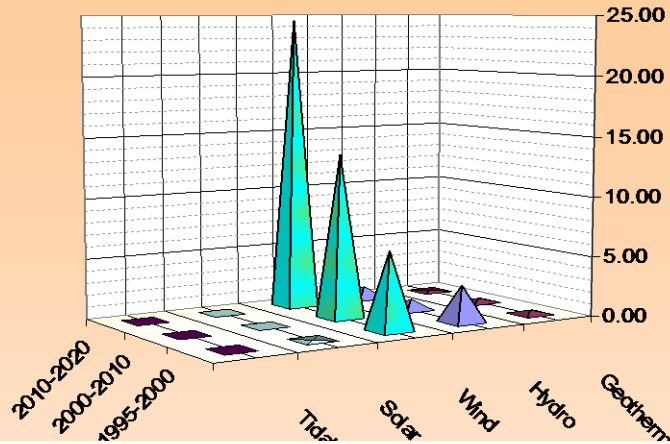
Decomposition of CO2 emission change



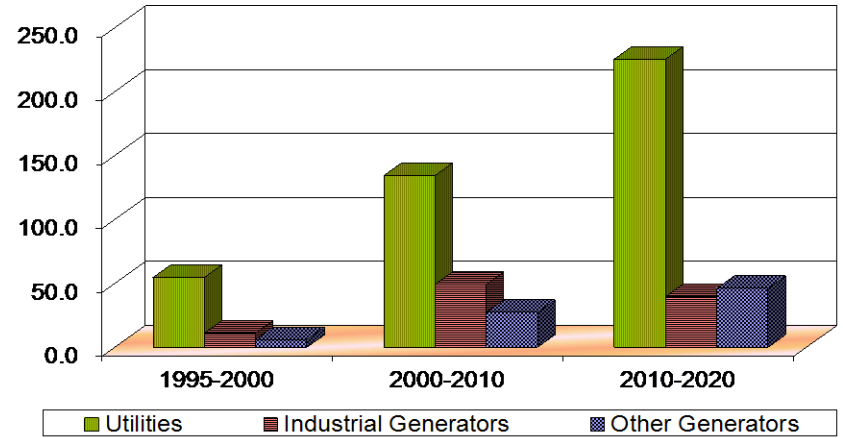
Baseline Scenario - PRIMES model

Electricity production

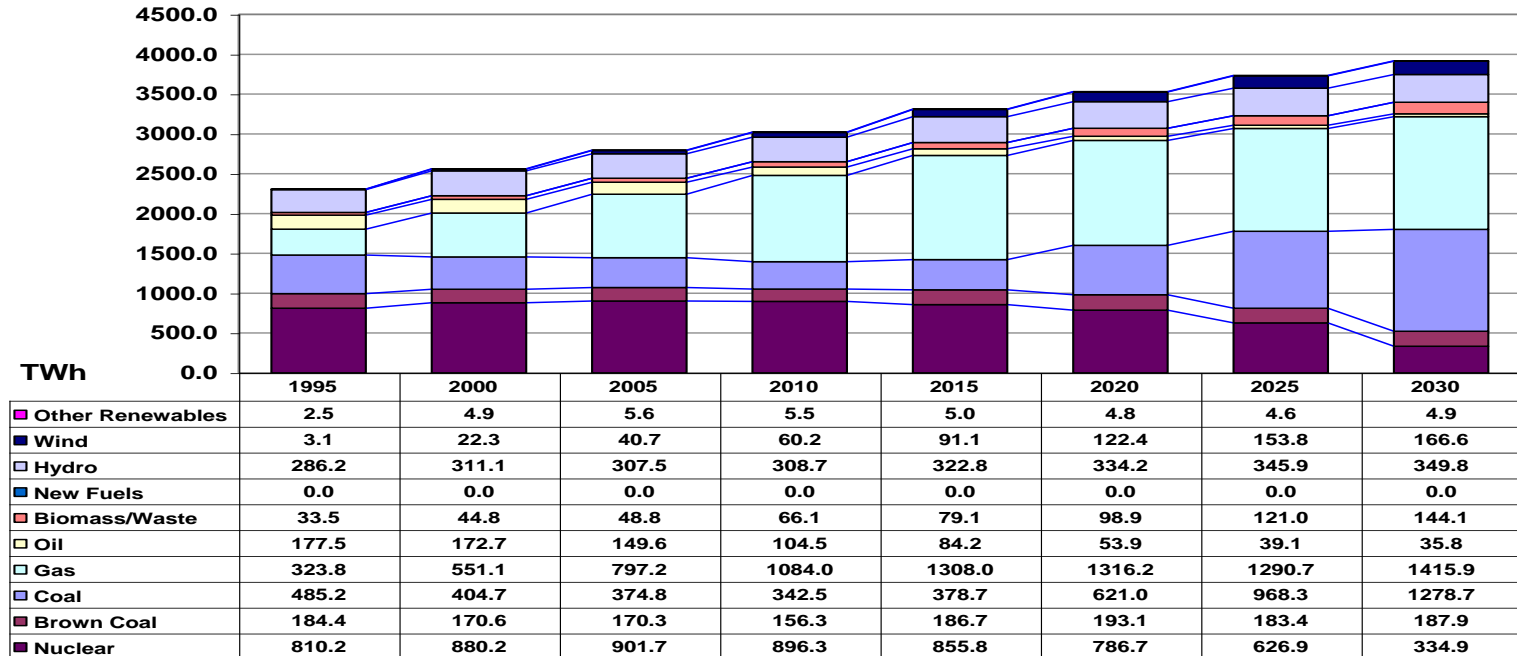
EU-14 Baseline: Investments in Renewables in GW



EU-14 Baseline: Capacity Expansion for Power in GW



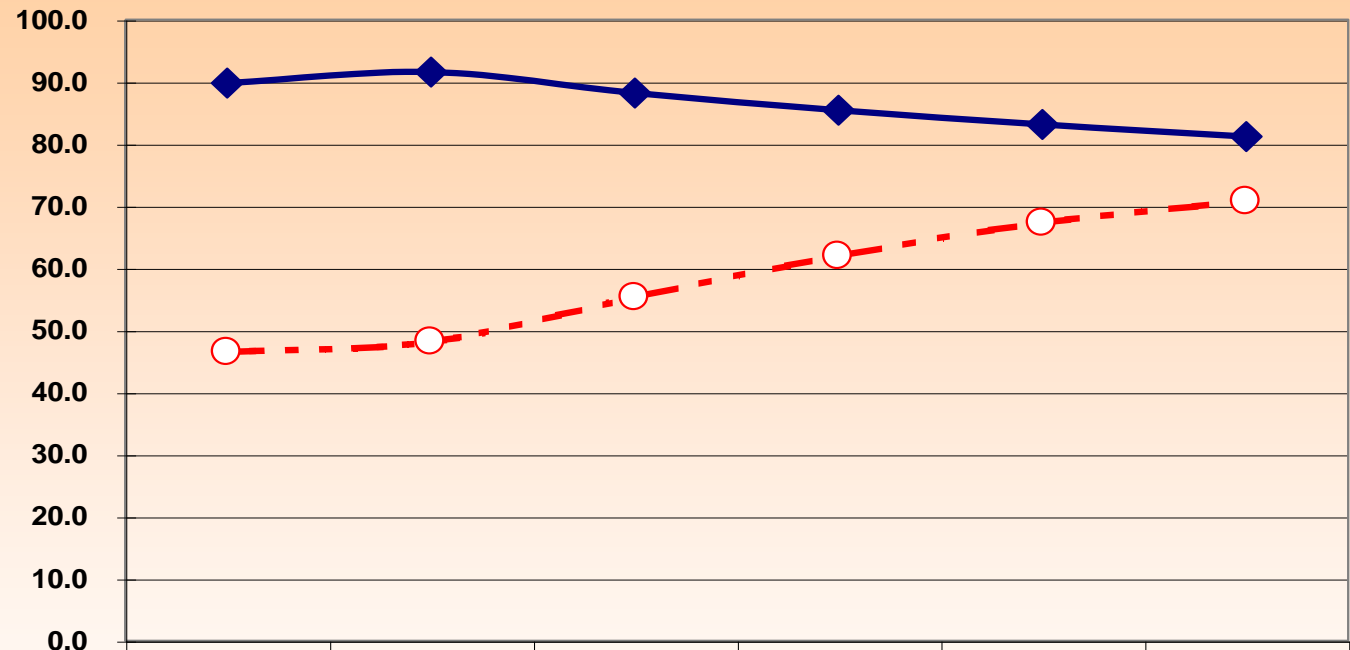
EU-14 Baseline: Electricity Production per Energy Form



Baseline Scenario - Primes model

Share of utilities in generation and the share of cogeneration

Market Structure (%)



	1995	2000	2005	2010	2015	2020
◆ Share of Utilities in Power Generation	89.8	91.6	88.2	85.4	83.1	81.2
○ Share of CHP in Steam Generation	46.5	48.1	55.3	61.9	67.3	70.7

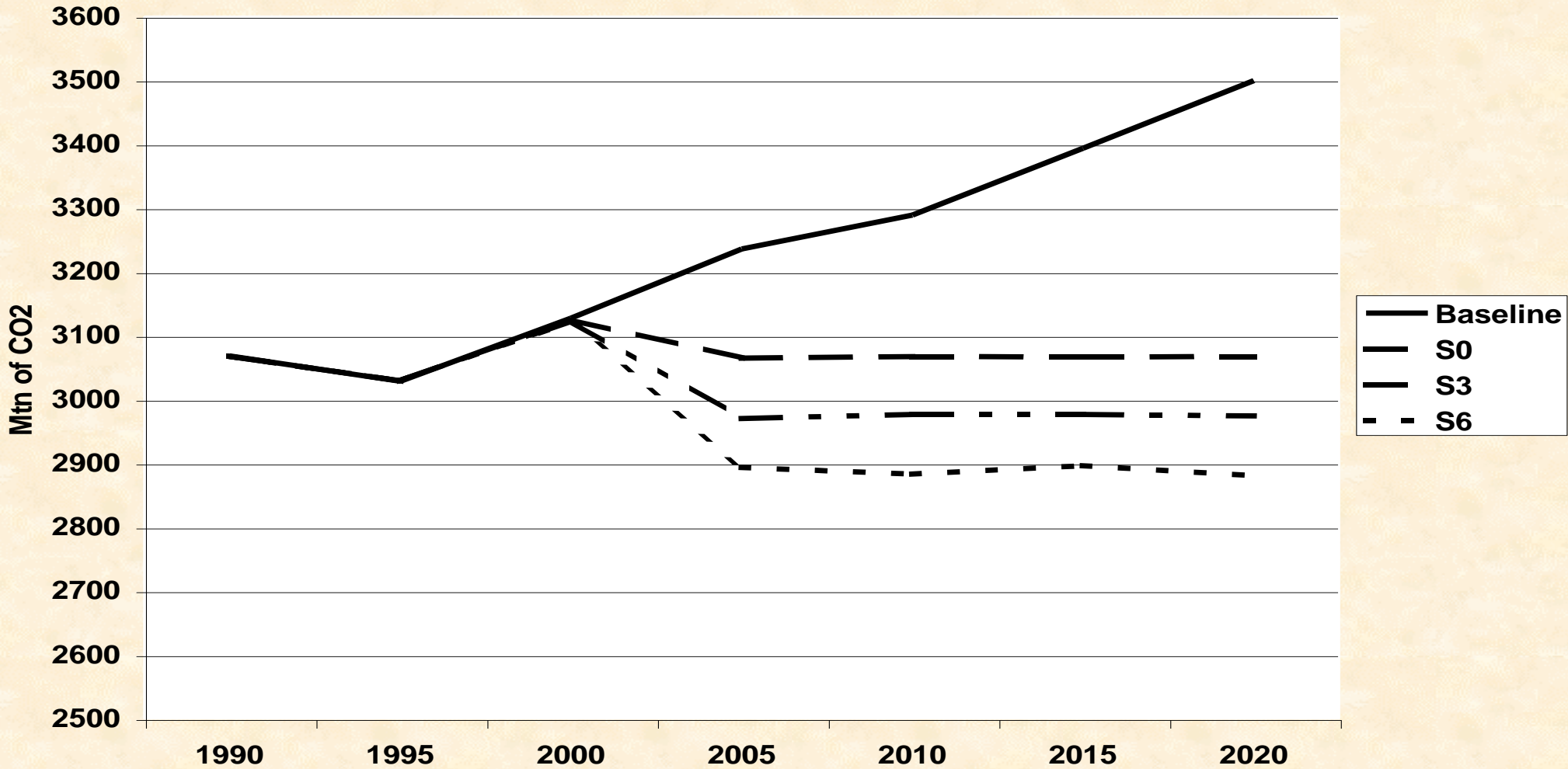
Emission Reduction Scenarios

- Three scenarios defined
 - Stabilisation of CO2 emissions to 1990 levels
 - 3% emission reduction scenario from 1990 levels
 - 6% emission reduction scenario from 1990 levels
- and several sensitivity analysis runs
 - nuclear
 - energy prices
 - transports
 - high emission targets

	1990	2010				2020			
		Baseline	S0	S3	S6	Baseline	S0	S3	S6
CO2 Emissions (Mtn CO2)	3068	3289	3067	2977	2883	3500	3067	2974	2880
Reduction from Baseline (Mtn CO2)			-222	-312	-406		-432	-525	-619
% of 1990 level			100	97	94		100	97	94
Carbon value (EUR90/tn carbon avoided)		0	50	78	102	0	59	81	115

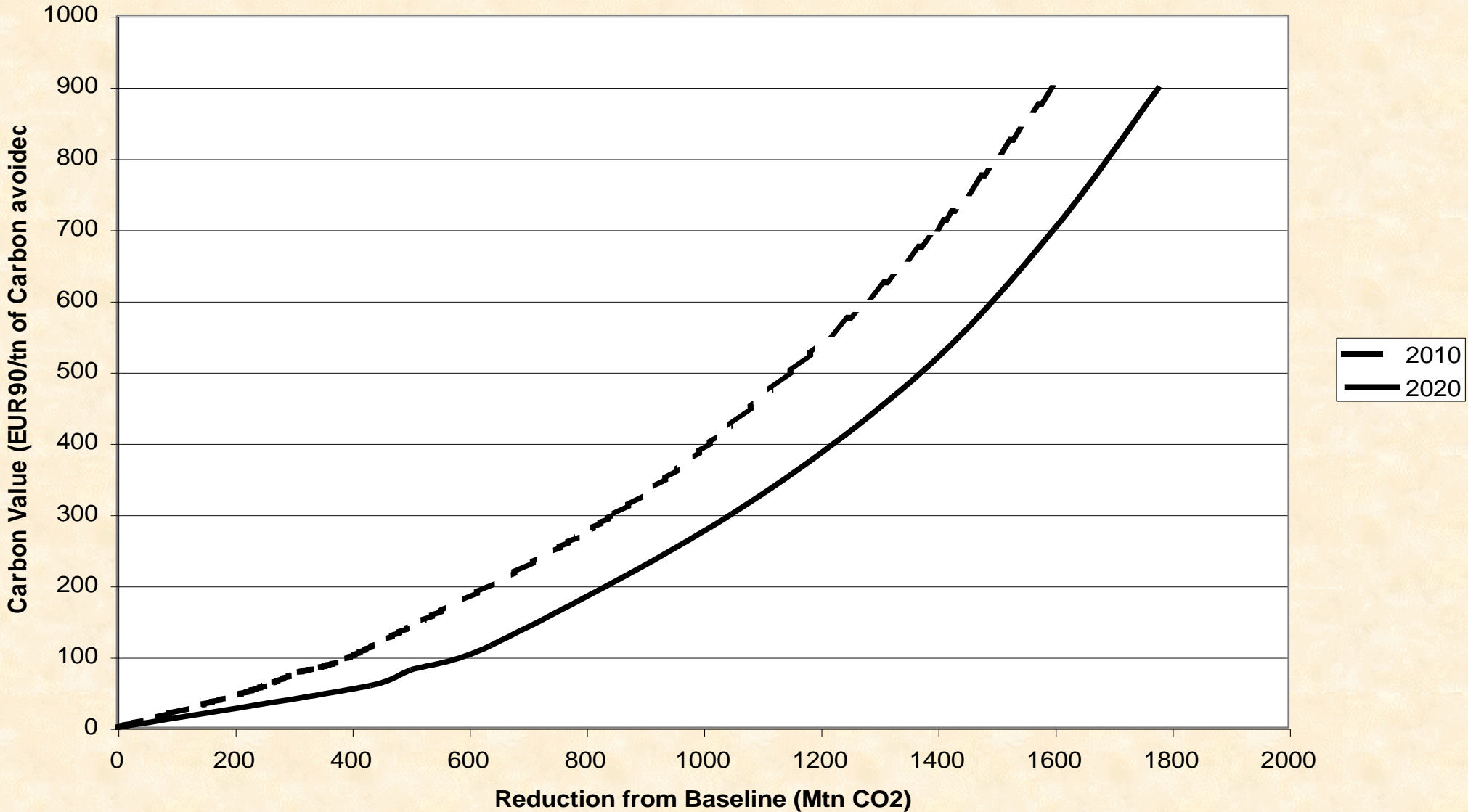
Emission reduction scenarios - Primes model

EU Emissions under baseline and the three scenarios



Emission reduction scenarios - Primes model

Marginal Abatement Costs for 2010 and 2020



Emission Reduction Scenarios

Primary consumption of fuels

- Consumption of solid fuels diminishes
- Demand for natural gas and renewable energy forms increases
- In the long-run substitution between fuels (improving carbon intensity) becomes more cost effective than reducing overall energy use (reducing energy intensity)

	1990	2010	%Difference from baseline in 2010			2020	%Difference from baseline in 2020		
		Baseline	S0	S3	S6	Baseline	S0	S3	S6
Gross Inland Consumption (Mtoe)	1314	1552	-3%	-4%	-6%	1609	-4%	-5%	-6%
Solid Fuels	301	182	-23%	-31%	-40%	218	-53%	-62%	-67%
Liquid Fuels	544	653	-4%	-6%	-8%	660	-3%	-4%	-7%
Natural Gas	222	400	3%	3%	5%	430	9%	10%	10%
Nuclear	181	227	-1%	0%	-1%	199	12%	12%	12%
Electricity	2	2	-2%	-3%	-4%	2	-3%	-4%	-5%
Renewable Energy Sources	64	88	9%	15%	21%	100	17%	22%	27%
Total CO2 (Mtn CO2)	3068	3289	-7%	-9%	-12%	3500	-12%	-15%	-18%

Emission Reduction Scenarios

Final Energy Demand sectors

- Industry acts on the basis of restructuring
 - shift towards less energy intensive processes
 - adoption of improved electrical technologies and heat pumps
 - limited flexibility for further emission reduction due to already achieved emissions reduction in the baseline
- Tertiary and households have large potential for emission reduction
 - use of more efficient appliances
 - reduction of their energy needs by
 - improving buildings insulation
 - redefining comfort standards
 - more rational use of energy

Emission Reduction Scenarios

Final Energy Demand sectors

- Small contribution from transports
 - efficiency improves in air and train transports
 - behavioural changes in road transports
 - shift towards train transports
- Adoption of best available technologies is low
 - increases if higher emission reduction targets are set

	1990	2010	%Difference from baseline in 2010			2020	%Difference from baseline in 2020		
		Baseline	S0	S3	S6	Baseline	S0	S3	S6
Total Energy (Mtoe)	852	1053	-3%	-4%	-6%	1108	-3%	-5%	-6%
Industry	257	282	-2%	-3%	-4%	290	-3%	-4%	-5%
Tertiary	110	159	-7%	-10%	-12%	177	-6%	-8%	-10%
Households	232	267	-2%	-4%	-5%	282	-2%	-4%	-5%
Transports	253	344	-2%	-4%	-5%	359	-3%	-4%	-5%
CO2 Emissions (Mtn CO2)	1800	2036	-4%	-6%	-8%	2038	-4%	-6%	-8%
Industry	424	378	-5%	-7%	-8%	354	-5%	-6%	-10%
Tertiary	193	220	-12%	-16%	-20%	203	-11%	-14%	-18%
Households	447	444	-4%	-6%	-8%	448	-4%	-6%	-8%
Transports	735	994	-2%	-4%	-5%	1033	-3%	-4%	-5%

Emission Reduction Scenarios

Final Energy Demand sectors

Potential Emission reduction in MT CO₂ equivalent

Sector/measures	Average cost < 50€ / ton CO ₂ equiv.	Of which Av. Cost < 25€ / ton CO ₂ equiv.	Of which Av. Cost < 5€ / ton. CO ₂ .equiv
CO₂			
· Industry (direct energy uses)	80	40	5
· Transport			
under conventional technology	130	60	10
under ACEA Agreement (2)	170	170	80
· Tertiary and households (energy efficiency and insulation)	230	140	35
· CHP (in industry and district heating)	70	40	15
· Renewables in power generation	160	80	30
· Fuel switching & efficiency in power generation	150	140	50
EU total CO₂	820 to 860	500 to 610	145 to 215

Emission Reduction Scenarios

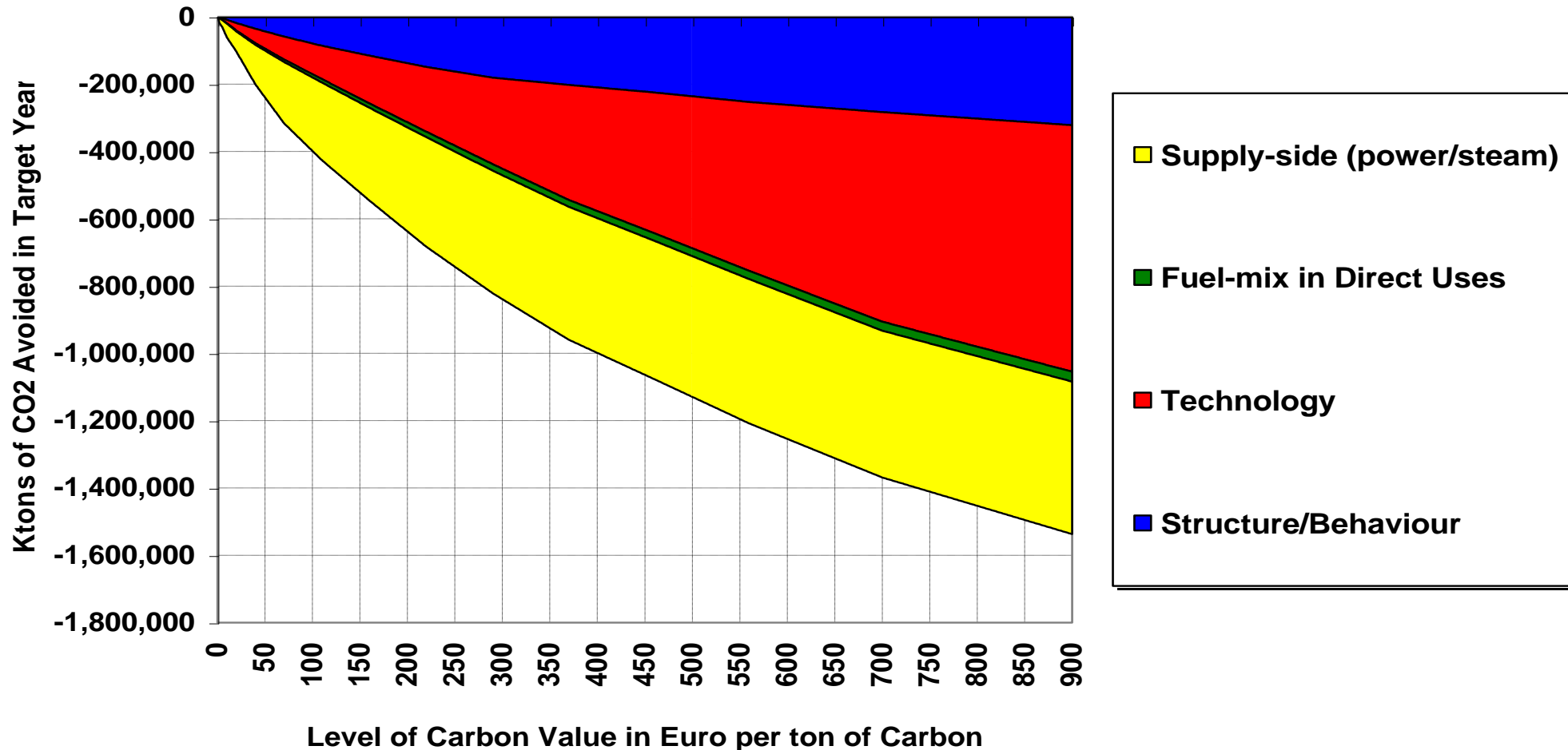
Power and steam generation system

- adjusts in the most cost effective way to emission reductions
 - shift towards non-fossil fuels
 - substantial expansion of nuclear in the long run (2020)
 - increase for renewable energy forms
 - change of fuel mix in fossil fuel plants
 - the come back of solids after 2010 in the baseline is cancelled
 - more use of gas also for cogeneration
 - improvement of plant efficiency
- accounts for 60% of emissions reduction in 2010 and around 75% of emissions reduction in 2020
- higher emissions reduction targets result in saturation of power and steam generation system potential

Emission reduction scenarios - Primes model

Decomposition of CO2 Emission Reduction into 4 categories for 2010

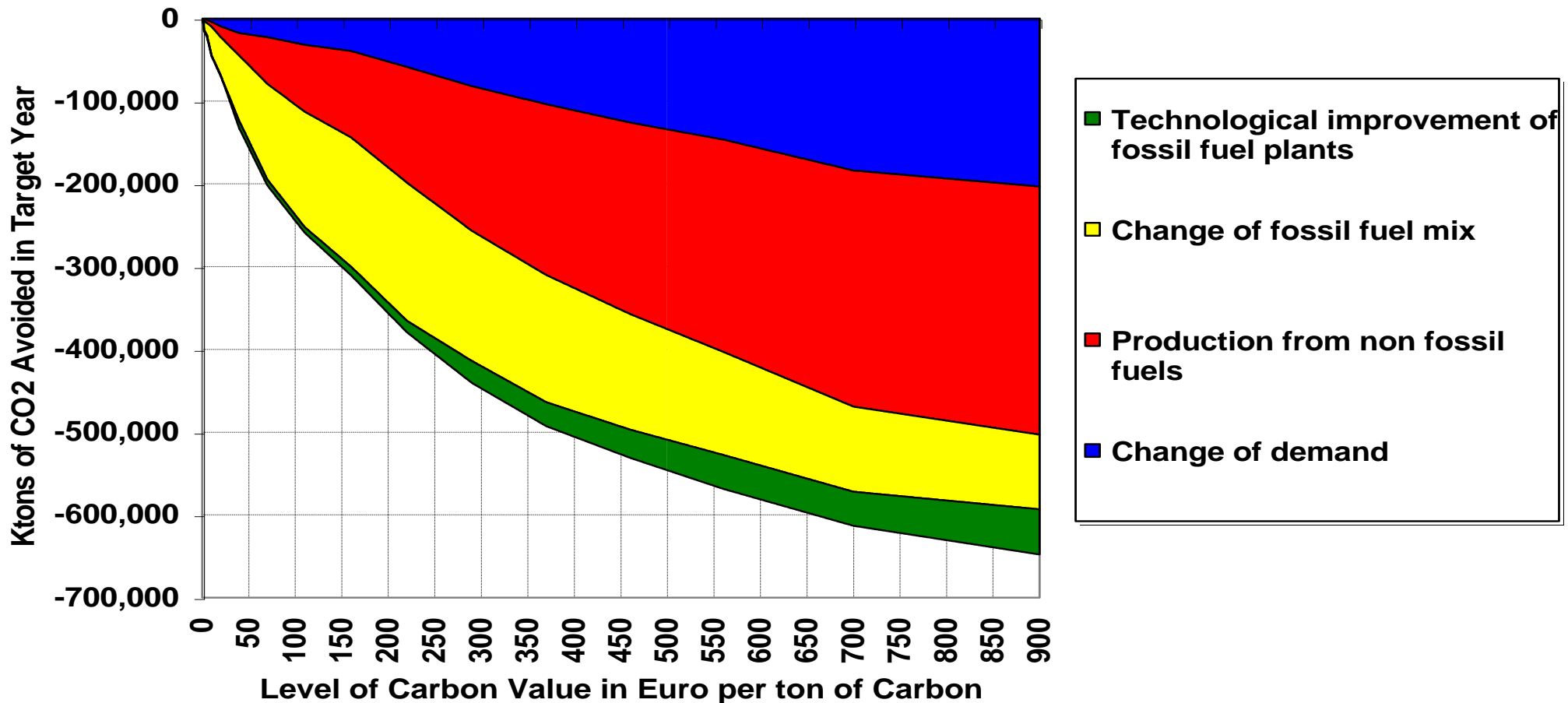
EUROPE - 14: CO2 Emission Reduction - Decomposition



Emission reduction scenarios - Primes model

Decomposition of changes in power and steam generation into 4 categories for 2010

EUROPE - 14: CO2 Emission Reduction in Power and Steam Generation - Decomposition



Economic Implications

- Costs of CO₂ emission reductions different across EU countries
 - Due to different structures of their electricity and steam generation systems and fuel mix technology choices
- Relatively low cost of reaching the emission targets (0.02%-0.07% of GDP) for the EU
 - Due to the low cost of switching between gas and coal in electricity and steam generation
- Different costs among sectors
 - Energy intensive industrial sectors most severely affected
 - Electricity and steam generation cost increases
 - higher capital expenditures, costs from stranded capital, higher fuel costs
 - Electricity tariffs increases
 - for industry by 20% (in the -6% emission reduction scenario)
 - for households by close to 10% (in the -6% emission reduction scenario)
- Cost for average EU household 50-150 Euro per year, depending on the scenario (or less than 0.5% of average household income)

Uncertainties

- Replacement of nuclear capacity to be decommissioned between 2015-2030
- Price of gas
 - small price increase in the longer term may lead to significant come back of solids in electricity and steam generation
- The role of transports sector
 - significant emissions reduction can be achieved through voluntary agreements
- Adoption of BAT technologies
 - need for policies to promote BAT technologies at the range of emission reduction targets examined
- The current range of targets for the EU can be accommodated through Power Generation, mostly
 - demand-side efficiency become significant at higher emission targets

Policy Implications

- Resolve uncertainties on non-CO2 GHG and Flexibility
- Demand-side actions
 - Priority on efficiency of transports (e.g. 1998 voluntary agreement)
 - Promote B.A.T. technologies (appliances, heat pumps, motor drives, processes, insulation)
- Supply-side actions
 - Regulate the liberalised electricity markets
 - non-fossil fuel obligations (renewables, preserve present stock of nuclear)
 - protect small producers, fair tariffs for cogeneration
 - funds for R&D on new generation technologies
 - Ensure low prices for natural gas and security of supply to Europe, hedge against uncertainties of the 2015-2030 period
- Timing: clarify long-run targets for the EU regarding global warming