

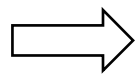
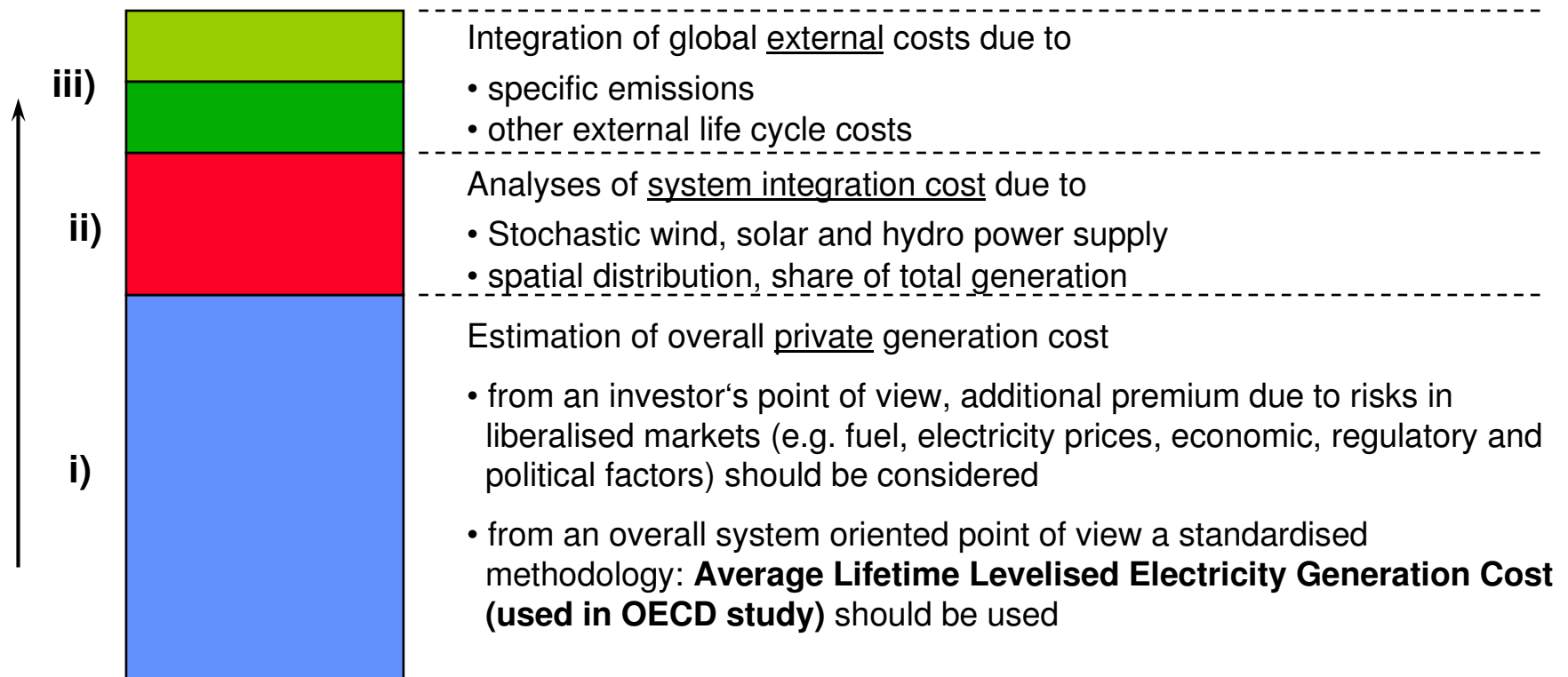
EUSUSTEL

***European Sustainable Electricity;
Comprehensive Analysis of Future European Demand and Generation
of European Electricity and its Security of Supply***

Half Year and Consultative Committee Meeting

Institute of Energy Economics and the Rational Use of Energy (IER)
University of Stuttgart
www.ier.uni-stuttgart.de

Calculation of the Overall Levelised Social Cost for Electricity Generation technologies (WP5.1)



Cost computation for various electricity generation technologies based on technology description in WP3.

I) Average Lifetime Levelised Generation Cost – Private Cost

Approach for calculation of the Average Lifetime Levelised Electricity Generation Cost based on data compiled in WP2 and WP3

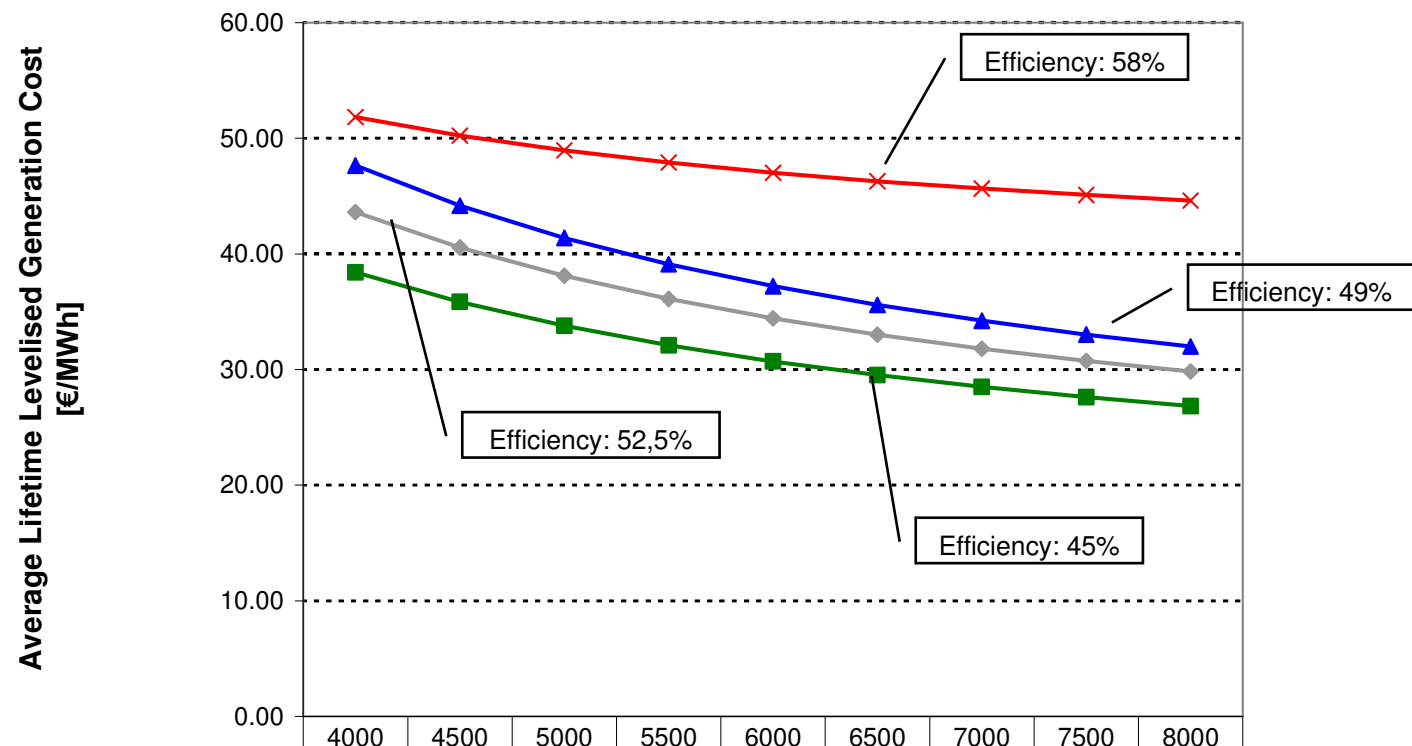
$$\sum_{t=0}^T \frac{\bar{p} \times E_t}{(1+r)^t} - \sum_{t=0}^T \frac{[I_t + M_t + F_t]}{(1+r)^t} = 0$$

$$\bar{p} = \frac{\sum_{t=0}^T \frac{[I_t + M_t + F_t]}{(1+r)^t}}{\sum_{t=0}^T \frac{[E_t]}{(1+r)^t}}$$

I_t = Investment expenditures in the year t
 M_t = Operations and maintenance expenditures in the year t
 F_t = Fuel expenditures in the year t
 E_t = Electricity generation in the year t
 r = Discount rate

I) Average Lifetime Levelised Generation Cost – Private Cost

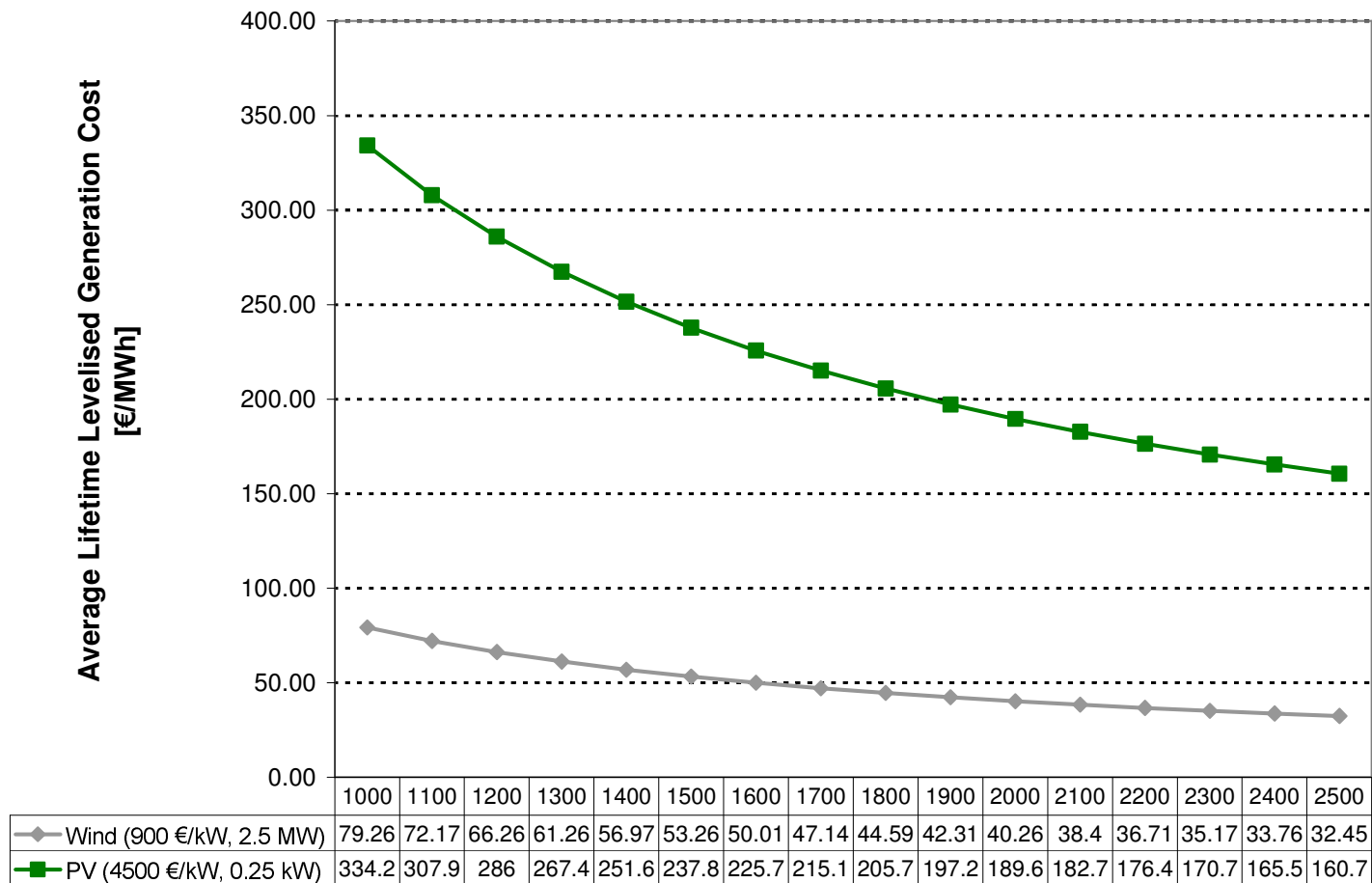
Examples of private generation cost: Advanced technologies in 2010, 5% discount rate.



	4000	4500	5000	5500	6000	6500	7000	7500	8000
◆ Advanced Pulverised Coal (AD700)	43.62	40.55	38.10	36.10	34.43	33.01	31.80	30.75	29.83
■ Advanced Lignite ST	38.41	35.84	33.79	32.11	30.70	29.52	28.50	27.62	26.85
▲ Lignite IGCC	47.64	44.16	41.38	39.10	37.20	35.60	34.22	33.03	31.98
× Gas CCGT	51.83	50.22	48.94	47.89	47.02	46.28	45.65	45.10	44.62

I) Average Lifetime Levelised Generation Cost – Private Cost

Examples cont. – RES without consideration of integration cost



II) System integration cost

Analysis of integration cost and estimation of cost range for various technologies, especially RES technologies

Information on stochastic wind, solar and hydro supply and distributed generation. Range of integration costs for typical technology by region:

- Back-up cost
- Grid extension
- etc.

III) Global external costs

- Results from the calculations:
External Costs / tonne of emitted substance
- for:
 - **direct emissions** from the plant
(height release, not including fuel supply etc.)
 - **indirect emissions** of up- and down-stream processes
- by using annuities these values will be aggregated as
Average External Costs / kWh

External costs: Examples for average values for the EU-25

External cost calculations per tonne of emitted substance based on approach used in ExternE.

[€ ₂₀₀₀ /tonne]	Inside EU25	Outside EU25	Total (rounded)
Primary Particles	9200	820	10100
SO₂	2800	440	3300
NO_x	2900	400	3300
NMVOC	800	80	870

C₁₄ will also be considered for external cost calculation.

III) Global external costs

Approach for external cost calculation when data are missing

Approach for projecting missing data on emission for advanced technologies:

- Direct emissions based on efficiency developmen
- Indirect emissions based on development of specific investment cost

Models and Scenario outline (WP5.3)

EUSUSTEL – Models and Scenarios

- PRIMES - Energy System Model
- TIMES-EG - Electricity and Gas Market Model

Scenario 1: Baseline (BL)

Scenario 2: Post-Kyoto (PK)

Scenario 3: Economic Optimum (EO)

Scenario 4: Security of Supply (SoS)

Scenario outline

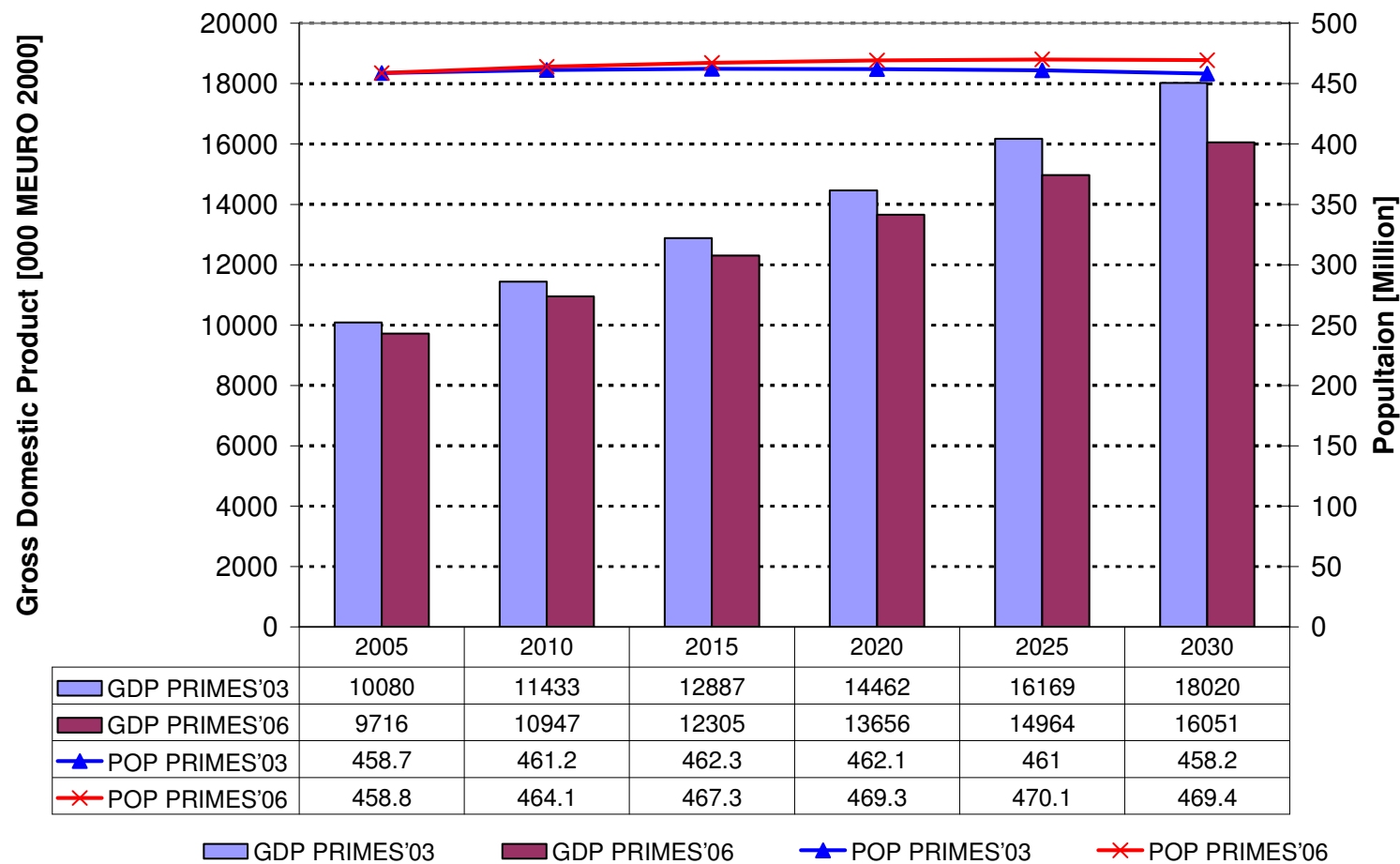
Scenario 1: Baseline (BL)

„Business as usual development for the EU-25 until 2030 considering current European policies and using improved technology data gathered in WP3 for the model runs“

- Fuel prices and other common assumptions based on WP2
- Kyoto target for EU-25: 8% reduction of CO₂ until 2012
- No further emission reduction targets after 2012
- Carbon tax calculated by PRIMES results
- Electricity generation by nuclear: No new nuclear power plants in EU-25, premature phase out e.g. in Germany
- RES support schemes as currently implemented in EU-25
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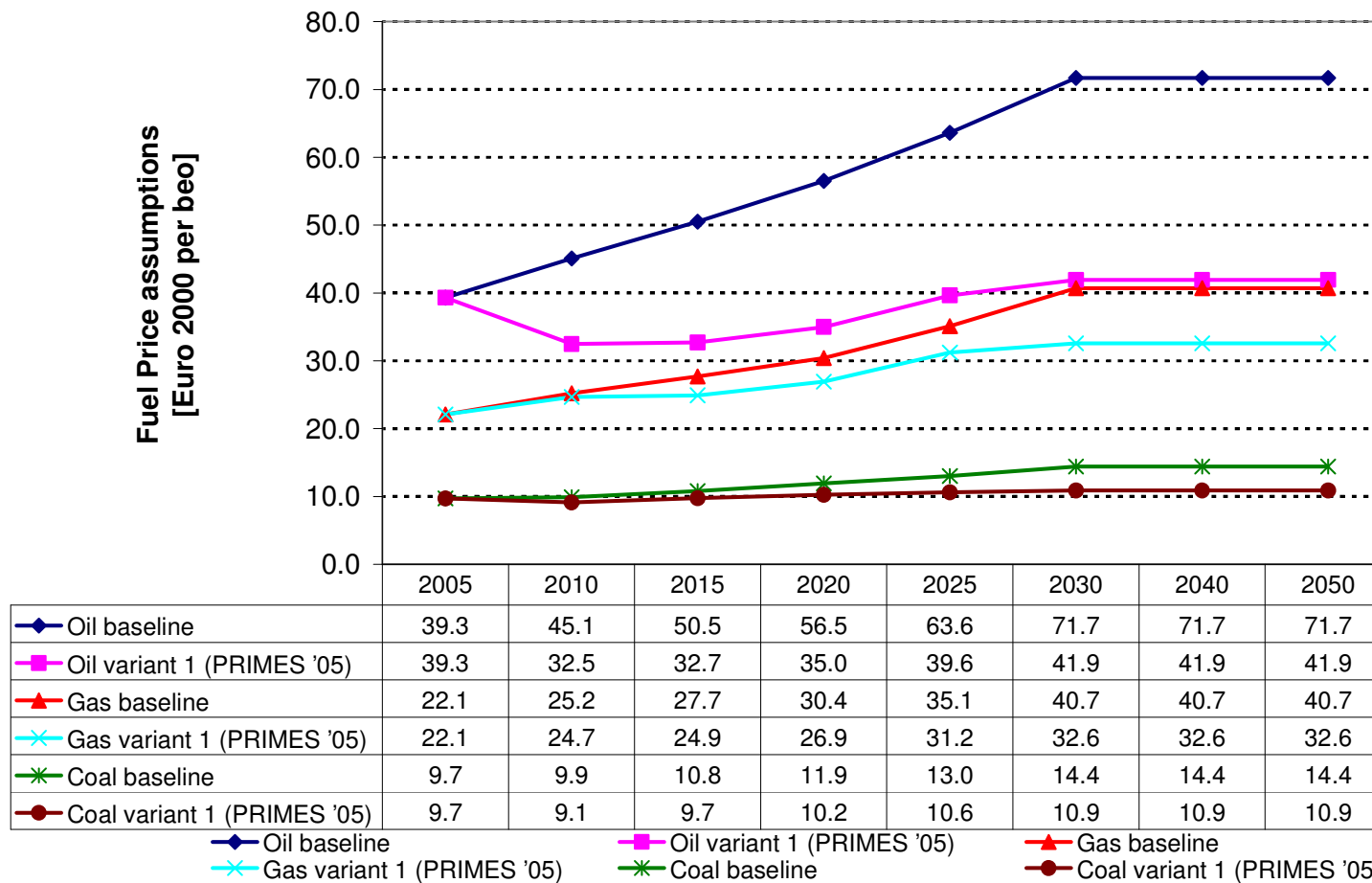
Common assumptions on input data: GDP and population

Development of Gross Domestic Product and population as assumed in PRIMES (2003) baseline scenario.



Common assumptions on input data: Fuel prices

High oil price scenario for baseline, gas price is uncoupled to oil price.
 Fuel price variant can be performed if needed for sensitivity.



Scenario outline

Scenario 2: Post-Kyoto (PK)

„Emission reduction according to a Post-Kyoto target of -16 % CO₂-emissions until 2030 applying a trading scheme within the EU-25“

- Kyoto target for EU-25: 8% reduction of CO₂ until 2012
- Post-Kyoto target for EU-25: 16% reduction until 2030
- Carbon tax calculated by PRIMES serves as input in TIMES-EG
- Electricity generation by nuclear: As in baseline
- RES support schemes: As in baseline
-

Scenario outline

Scenario 3: Economic Optimum (EO)

„Calculation of an economically optimal solution for the assumed Post-Kyoto target of -16 % CO₂-emissions until 2030, allowing for free technological choice within the optimisation models“

- Electricity generation by nuclear: No phase-out, no restrictions for new investments
- RES support schemes: No specific targets for renewables
- Kyoto target for EU-25: 8% reduction of CO₂ until 2012
- Post-Kyoto target for EU-25: 16% reduction until 2030
- Carbon tax calculated by PRIMES serves as input in TIMES-EG
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Scenario outline

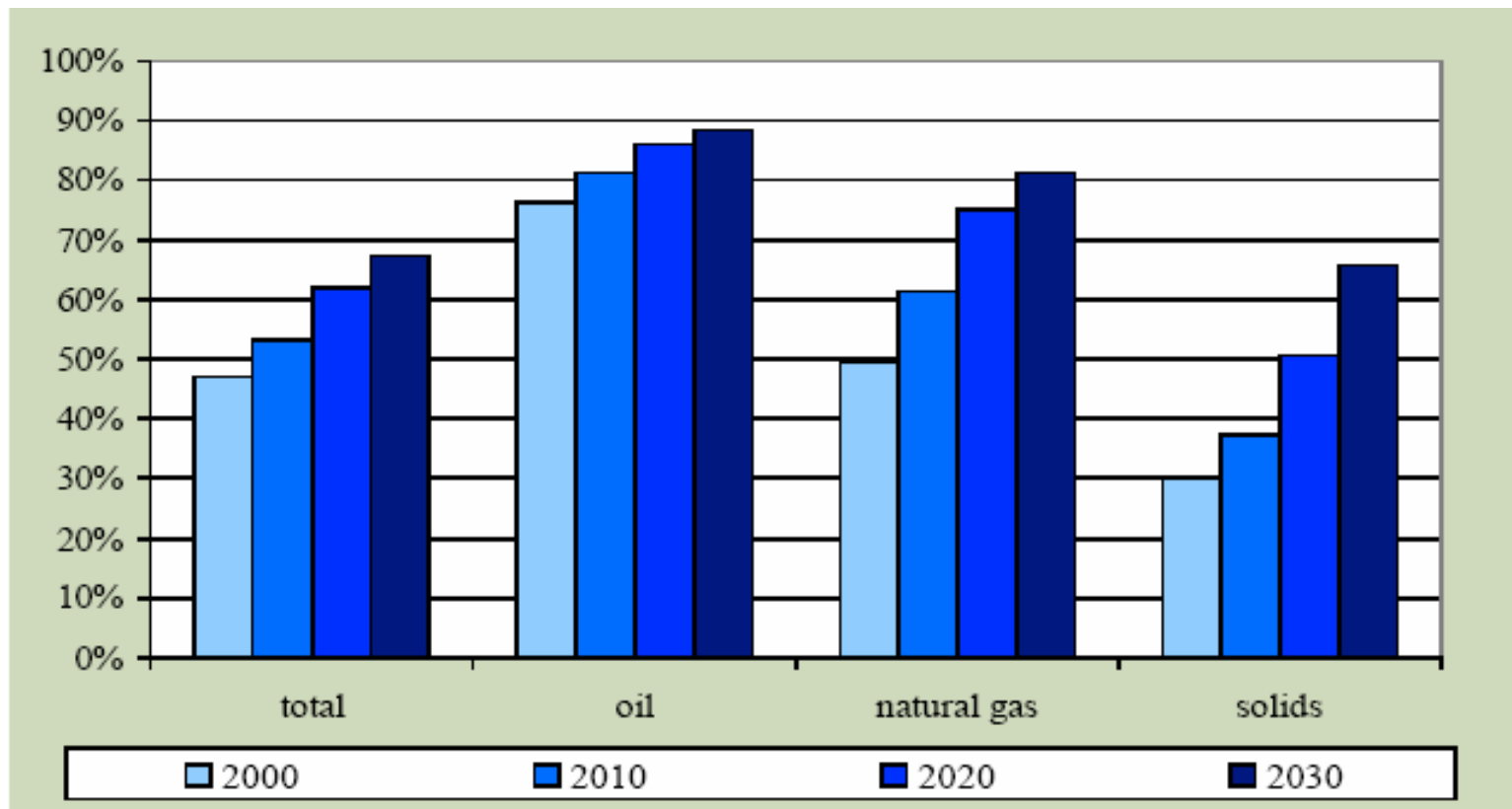
Scenario 4: Security of Supply (SoS)

„Improving security of supply by forcing the energy system to be more energy efficient and less import dependent“

- Improved energy efficiency and lower import dependency by increased domestic primary energy usage
- Kyoto target for EU-25: 8% reduction of CO₂ until 2012
- Post-Kyoto target for EU-25: 16% reduction until 2030
- Carbon tax calculated by PRIMES serves as input in TIMES-EG
- Electricity generation by nuclear: As in baseline
- RES support schemes: As in baseline
-

Scenario outline

Development of import dependency on fossil fuels between 2000 and 2030 in the EU-25.



Source: DG Energy and Transport, „Green Paper on a European Strategy for Secure, Competitive & Sustainable Energy“