LCA and External Costs in Comparative Assessment of Electricity Chains.

Decision Support for Sustainable Electricity Provision?

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Characterisation of the reference electricity production technologies

	Technology	Power installed	Efficiency	Life
Coal	Pulverised Fuel Firing	600 MW	43,0 %	35 a
Lignite	Pulverised Fuel Firing	800 MW	40,1 %	35 a
Gas Combined-cycle	Combined-cycle	777.5 MW	57,6 %	35 a
Nuclear (PWR)	actual PWR	1375 MW	34,0 %	40 a
PV (poly) **PV (amorphous)**	poly-crystalline amorphous	5 kW 5 kW	9,5 % [1)] 4,5 % [1)]	25 a 25 a
Wind	5.5 m/s [2)]	1.5 MW	-	20 a
Hydro	Run-of-River	3.1 MW	90 % [3)]	60 a

1) System-efficiency
2) Average windspeed p.a.
3) Efficiency of turbines

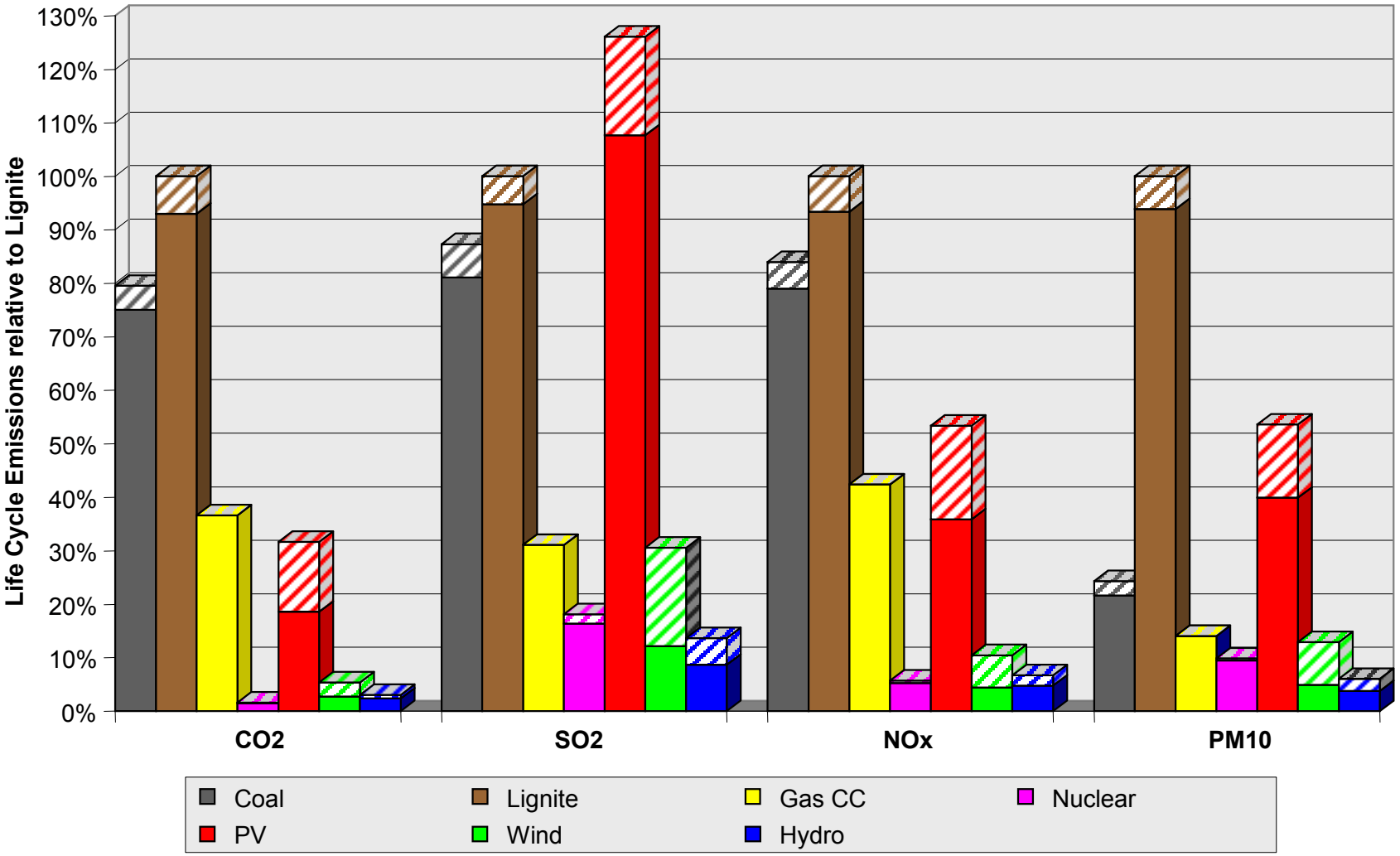
Cumulative energy requirements and energy payback periods

	CER (without fuel) [kWh_{Prim} / $kWh_{el.}$]	EPP [months]
Coal (43 %)	0.3	3.6
Lignite (40 %)	0.17	2.7
Gas CC (57.6 %)	0.17	0.8
Nuclear (PWR)	0.07	2.9
PV (poly) **PV** (amorph)	1.24 0.67	141 76
Wind (5.5 m/s)	0.07	6.4
Hydro (3.1 MW)	0.04	10.9

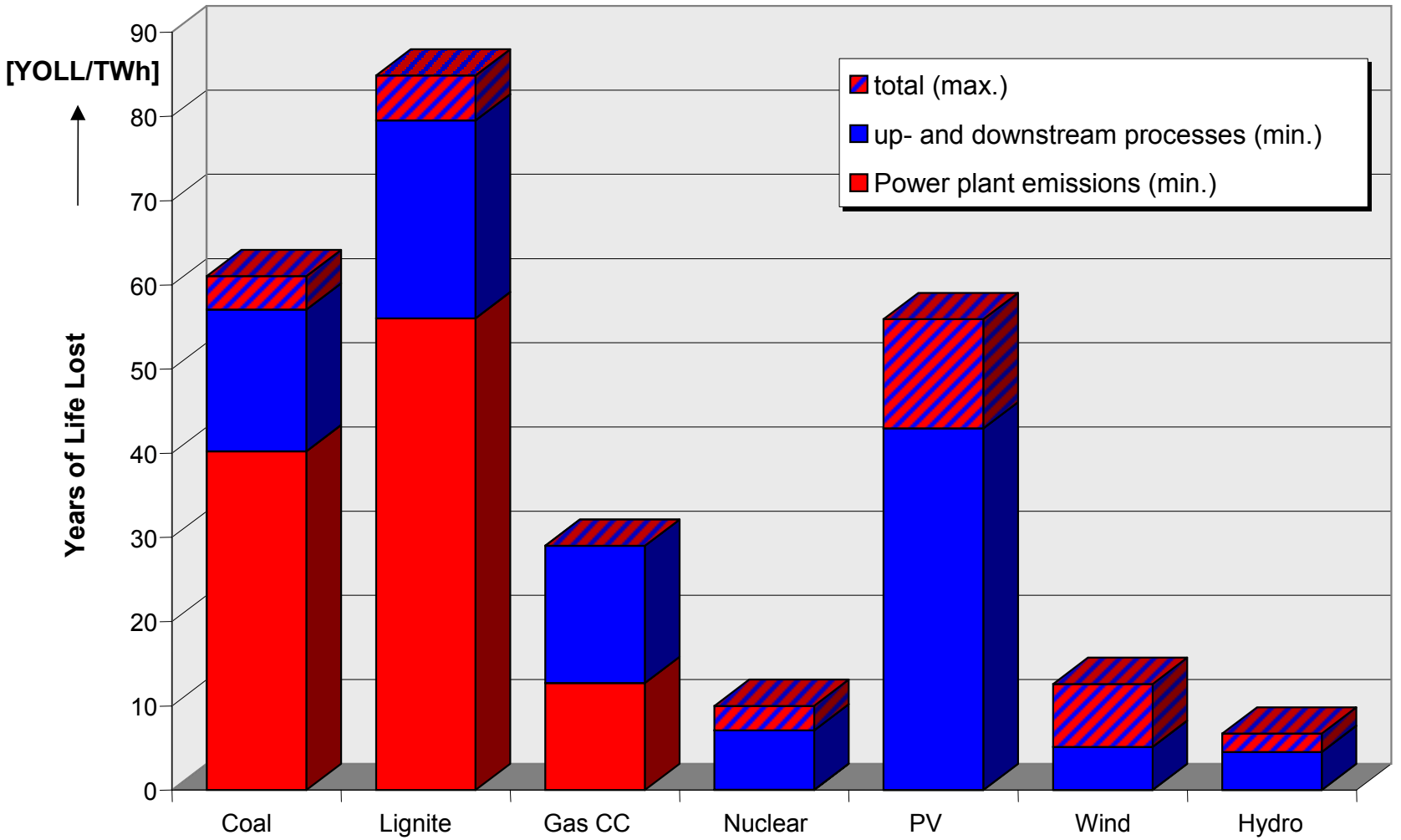
Total life cycle raw material requirements

	Iron [kg / $GWh_{el.}$]	Copper [kg / $GWh_{el.}$]	Bauxite [kg / $GWh_{el.}$]
Coal (43 %)	2310	2	20
Lignite (40 %)	2100	8	19
Gas CC (57.6 %)	1207	3	28
Nuclear (PWR)	420 - 445	6	27
PV (poly) / **PV** (amorph)	5350 – 7300	240 - 330	2040 - 2750
Wind (5.5 m/s)	3700	50	32
Hydro (3.1 MW)	2400	5	4

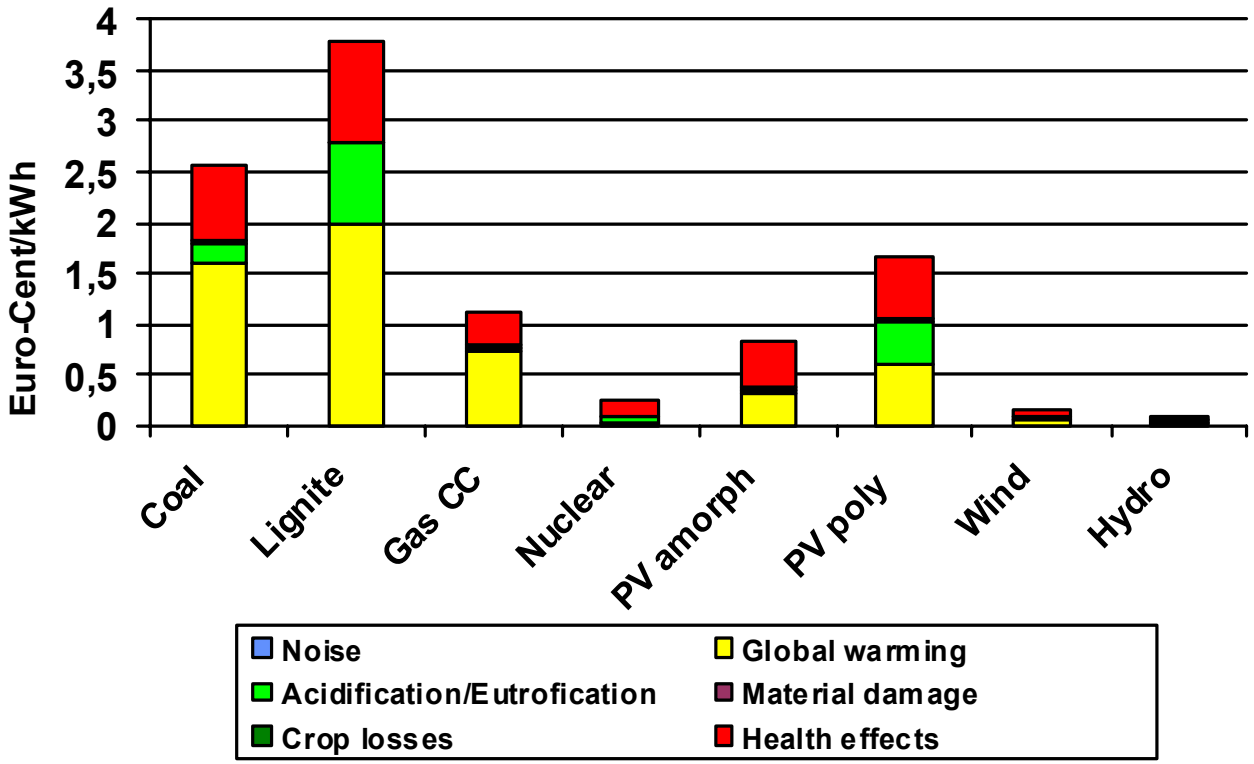
Life Cycle Emissions



Health Risks

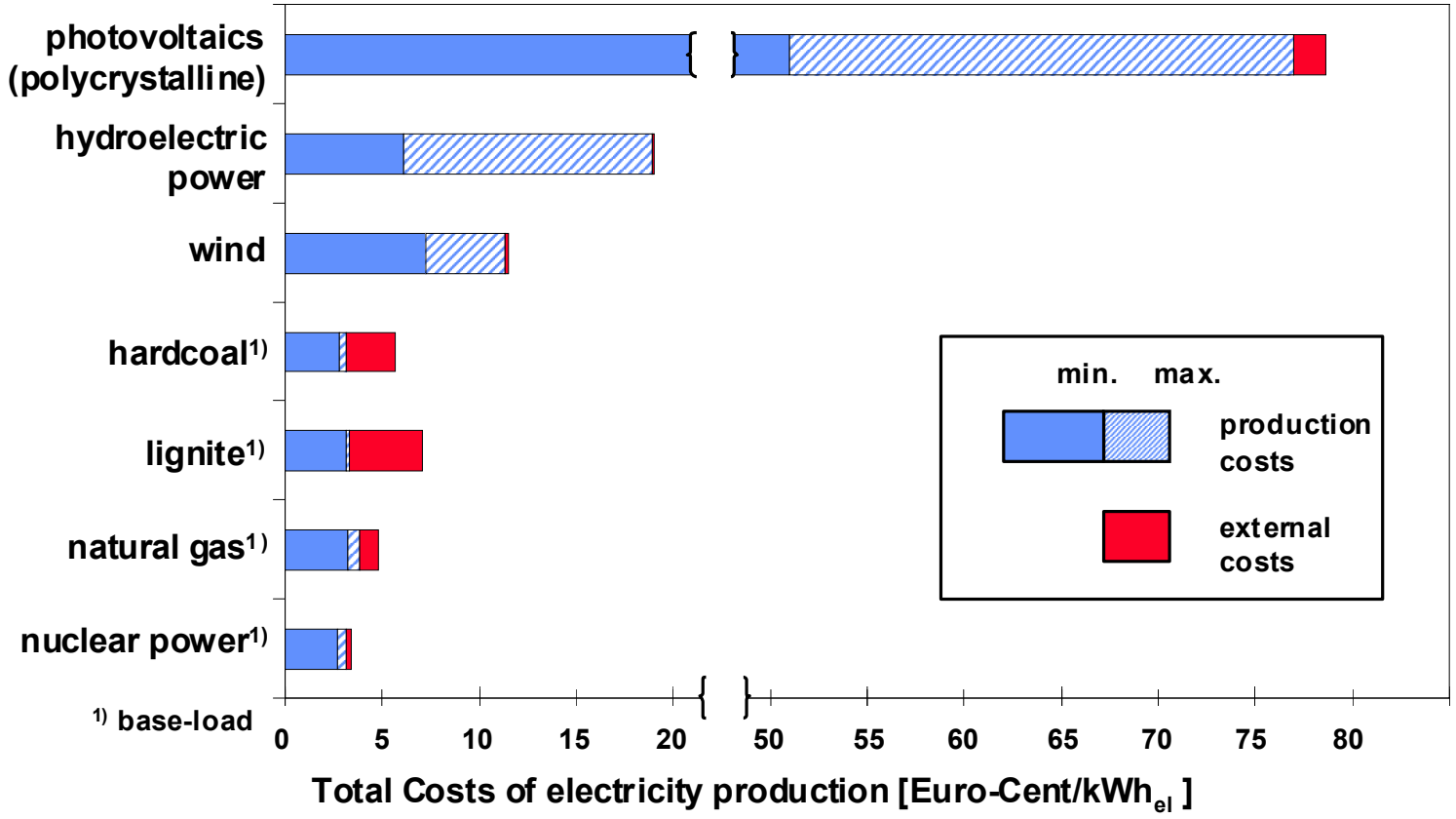


External costs from different electricity generation technologies operated in Germany



Acidification/Eutrofication: Valuation based on marginal abatement costs required to achieve the EU "50%- Gap Closure" target to reduce acidification in Europe
Global warming: Valuation based on marginal CO_2-abatement costs required to reduce CO_2-emissions in Germany by 25% in 2010 (19 Euro/tCO_2) 16.1.2001

Total costs of various electricity generation technologies operated in Germany



Uncertainties and open problems

- Climate change: Lack of knowledge results in large uncertainties of climate change damage-costs ➔ abatement costs
- Valuation of health risks: Exposure-response functions and Value of Life Year Lost are uncertain
- Nuclear: valuation of low probability events with large consequences remains controversial

LCA and external costs for policy support

- Assessment of technologies to identify deficiencies and potentials for improvement and corresponding research issues
- Cost-benefit-analysis of environmental policy measures
- Comparison of current and future energy supply options with respect to health and environmental impacts, resource requirements and sustainable energy provision.
- Internalising externalities by means of technology-specific price adders has some drawbacks

  ➔ pollutant-specific damage costs

Specific damage costs in € per tonne of pollutant emitted in Germany (reference year 1998)

	€ per tonne emitted
SO_2	5650
NO_x	5030
PM_{10}	8700
NMVOC	1770