Life Cycle Analysis for Different Energy Sources

Prof. Dr.-Ing. Alfred Voß

Institute of Energy Economics and the Rational Use of Energy (IER)
University of Stuttgart

Symposium Energy 2050

Stockholm 19-20 October 2009

The Brundtland Commission‘s Definition of Sustainable Development

"Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

“It’s a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potentials to meet human needs and aspirations.”

Sustainable energy provision?

- Sustainability and the use of finite (non-renewable) resources

- Efficient use of all scarce resources to provide energy services

Sustainable energy provision, if

- the potential for the economic provision of energy services increases (or does not decrease) for the next generation
- the environmental impact caused by substances released from the energy system does not exceed the assimilation capacity of the natural environment, and climate change is limited to a tolerable level
- the energy-related risk for human health is smaller than the natural risk avoided through the provision of energy services
- energy services are provided with the lowest possible input of resources, including environmental resources.

Life Cycle Assessment (LCA)

a conceptual framework for a detailed and comprehensive comparative evaluation of energy supply options with regard to environmental and resource impact

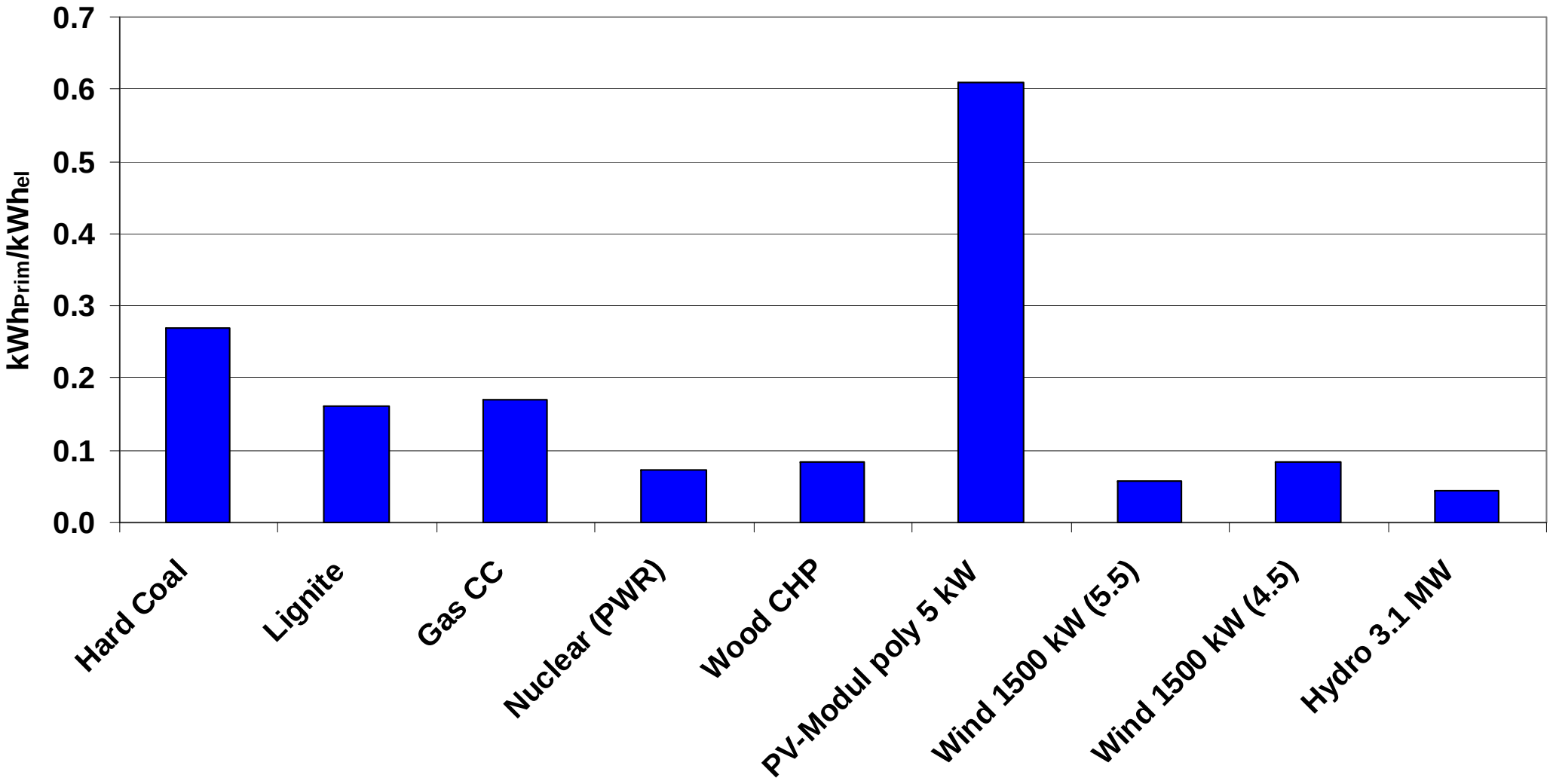
Reference Technologies for Electricity Generation

	Technology	Power installed (netto) [MWe]	Efficiency el [%]	Technical Life Time [Years]
Hard Coal	Pulverised Combustion	700	45.5	35
Lignite	Pulverised Combustion	800	43	35
Gas CC	Combined-Cycle	777.5	57.5	35
Nuclear (PWR)	actual PWR	1375	33	40
Wood CHP	Combined Heat and Power	20	24	35
PV-Modul poly 5 kW	polycristalline	0.005	12.5[1)]	25
Wind 1500 kW (5.5)[3)]	horizontal	1.5	2450 h/a [2)]	20
Wind 1500 kW (4.5)[3)]		1.5	1680 h/a [2)]	20
Hydro 3.1 MW	Run-of-River	3.1	90	60

[1)] system efficiency; full load hours: 880h/a; [2)] full load hours; [3)] average wind speed (in 10 m height)

Source: IER 2005/07

Specific Cumulative Energy Demand (CED)[1)]



[1)] production, dismantling and fuel supply

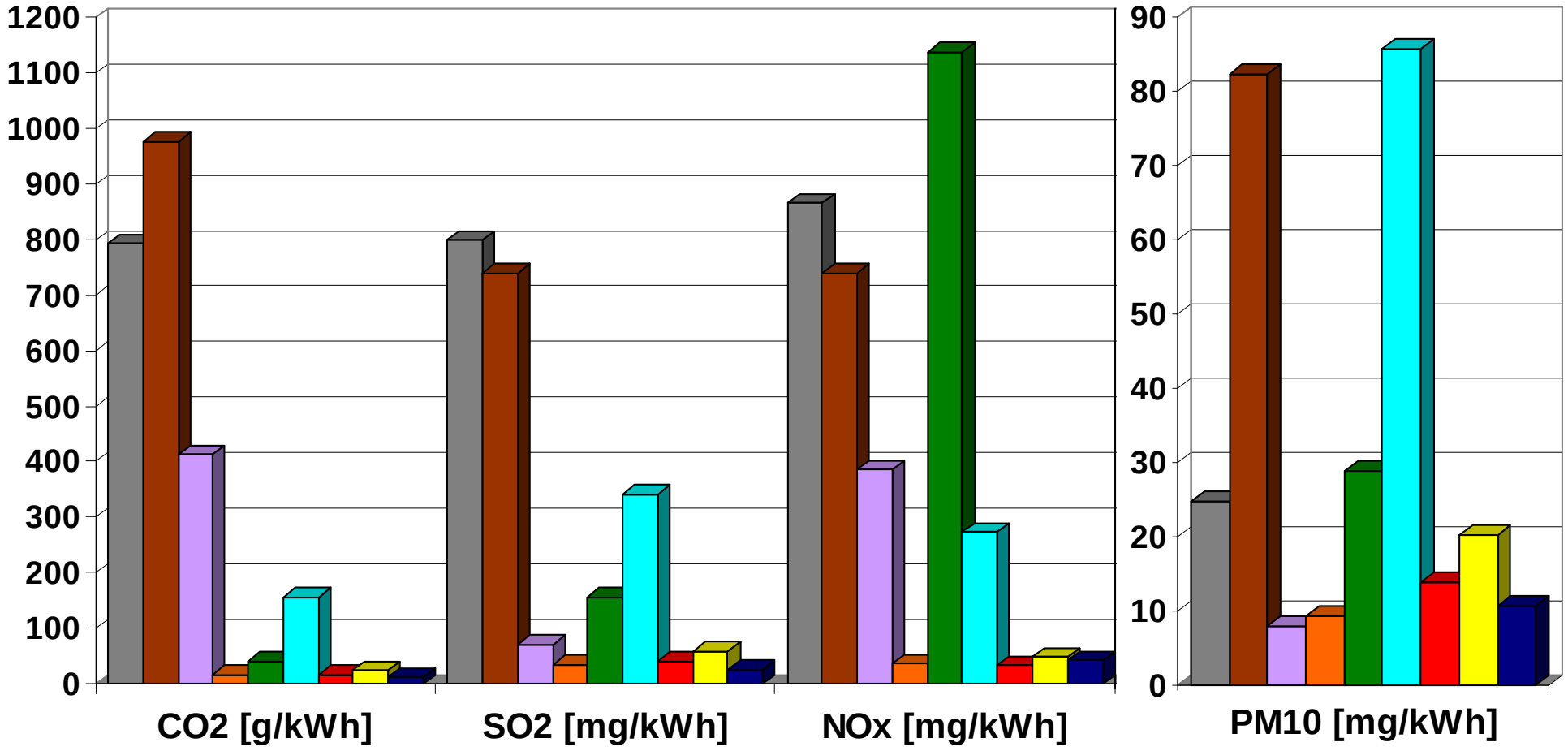
Source: IER 2005/07

Material and Resource Use

	Iron [kg/GWh$_{el}$]	Copper [kg/GWh$_{el}$]	Bauxite [kg/GWh$_{el}$]
Hard Coal	1700	8	30
Lignite	2134	8	19
Gas CC	1239	1	2
Nuclear, PWR	457	6	27
Wood CHP	934	4	18
PV poly 5 kW	4969	281	2189
Wind 1500 kW (5.5)	3066	52	35
Wind 1500 kW (4.5)	4471	75	51
Hydro 3.1 MW	2057	5	7

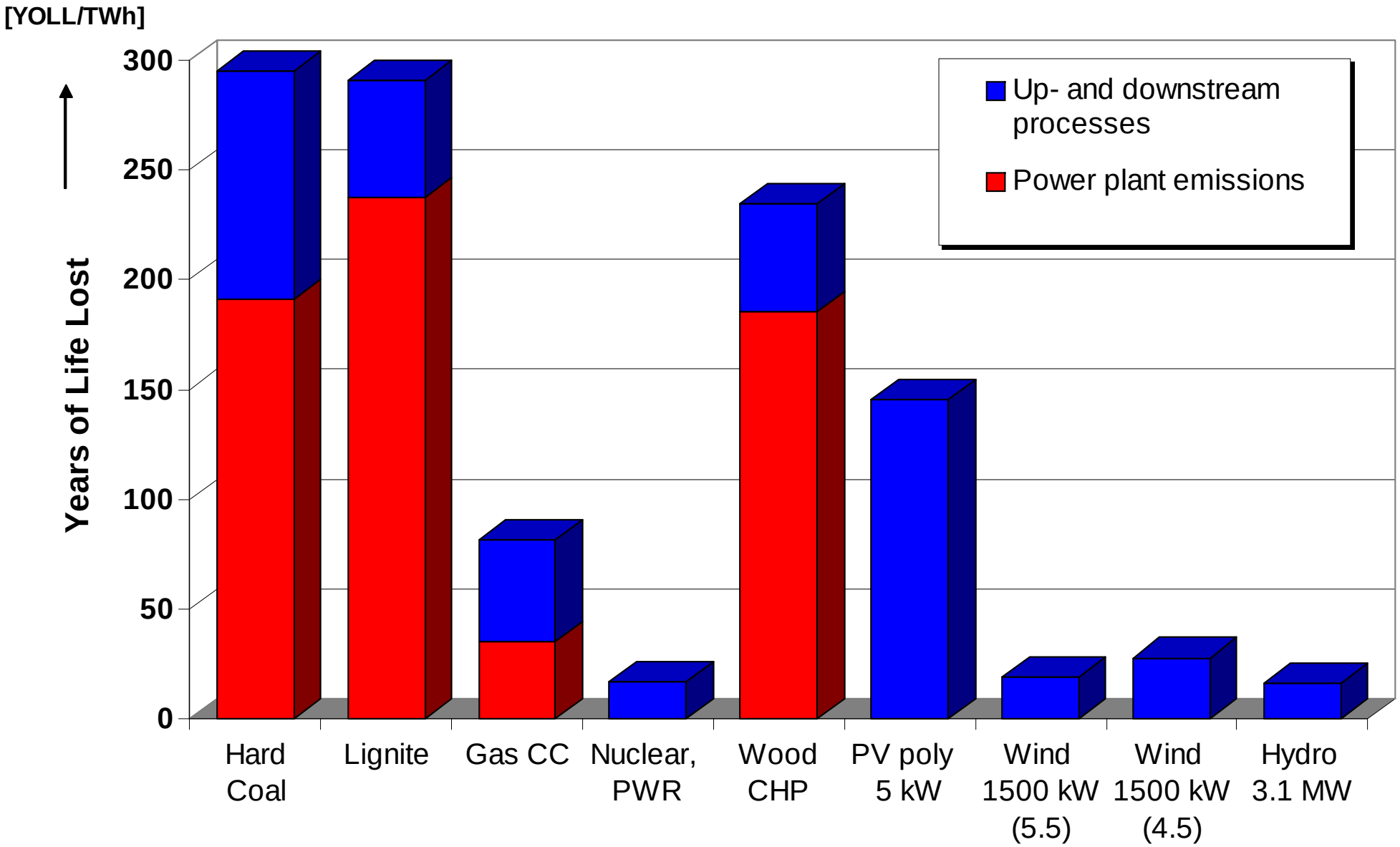
Source: IER 2005/07

Cumulative Emissions

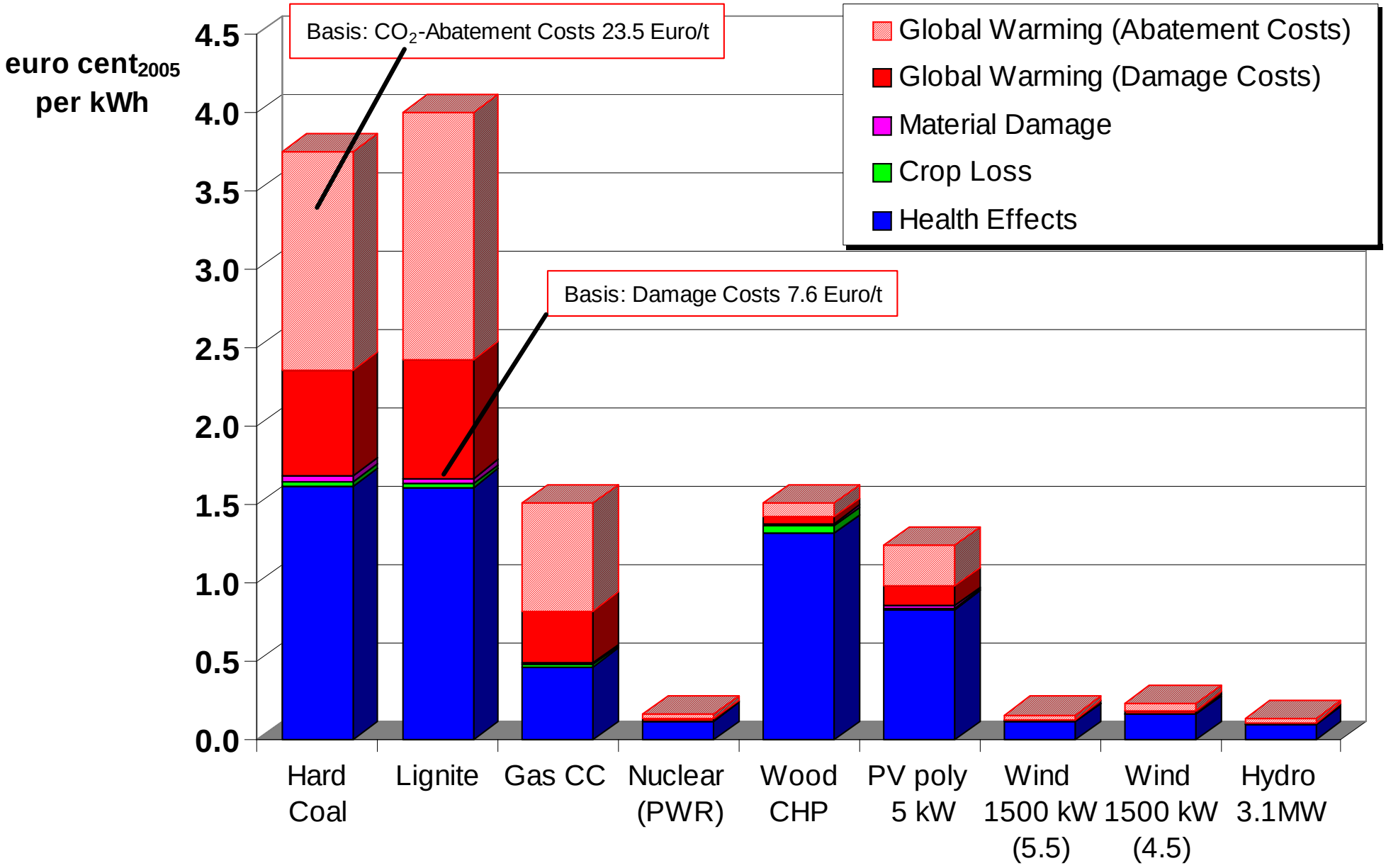


Source: IER 2005/07

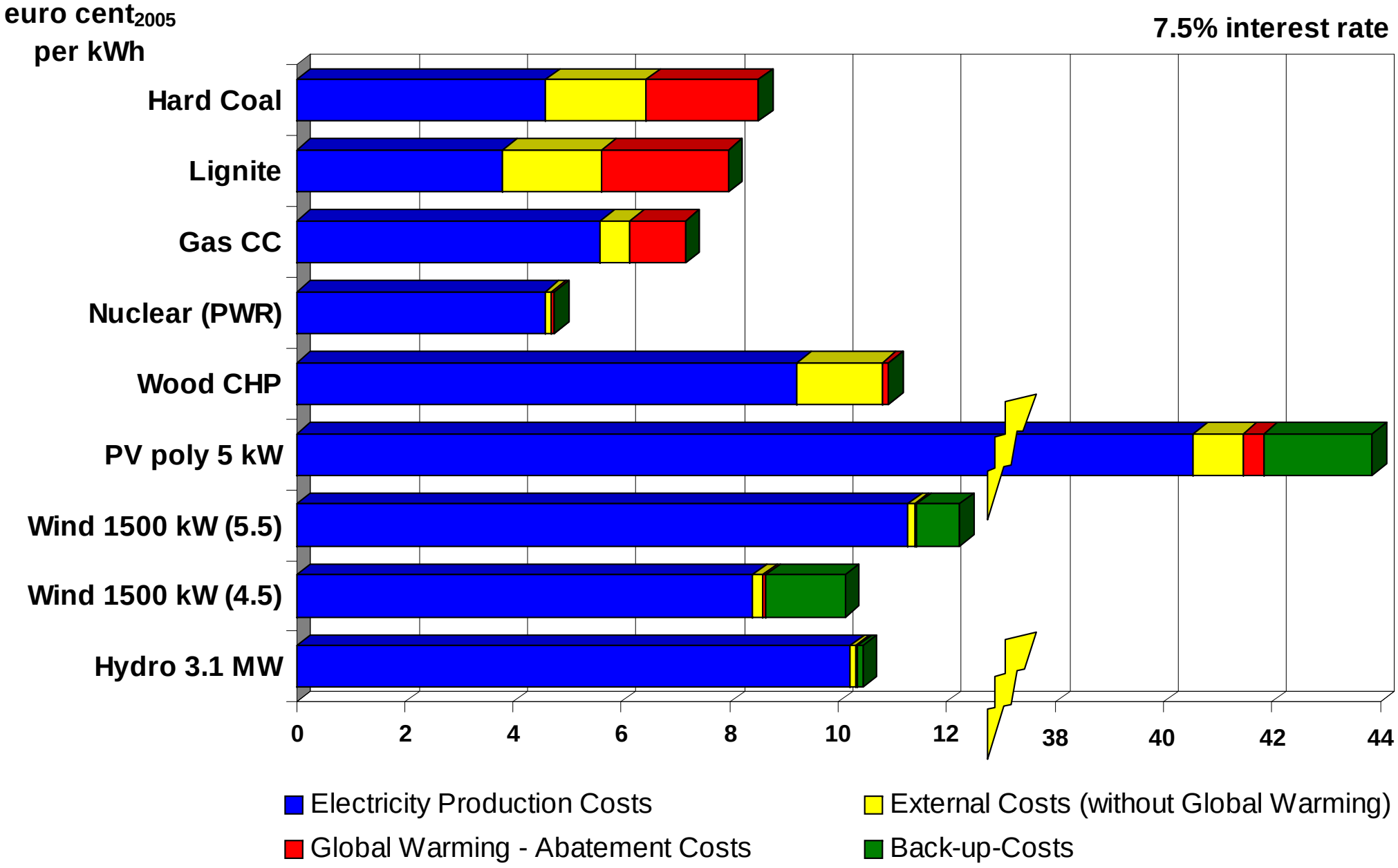
Health Risks



External Costs



Total Costs of Electricity Generation Technologies




Thank you very much for
your attention!