Presentation of Ch 4 Energy Supply of IPCC AR4/WG3 Report Mitigation

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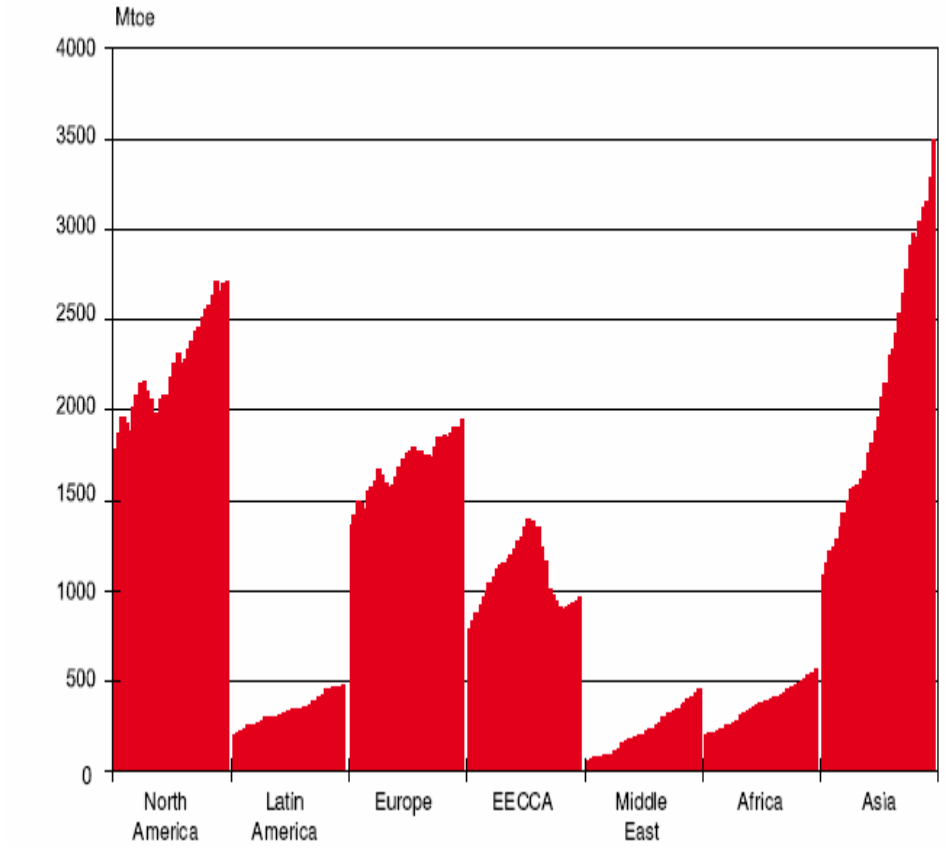
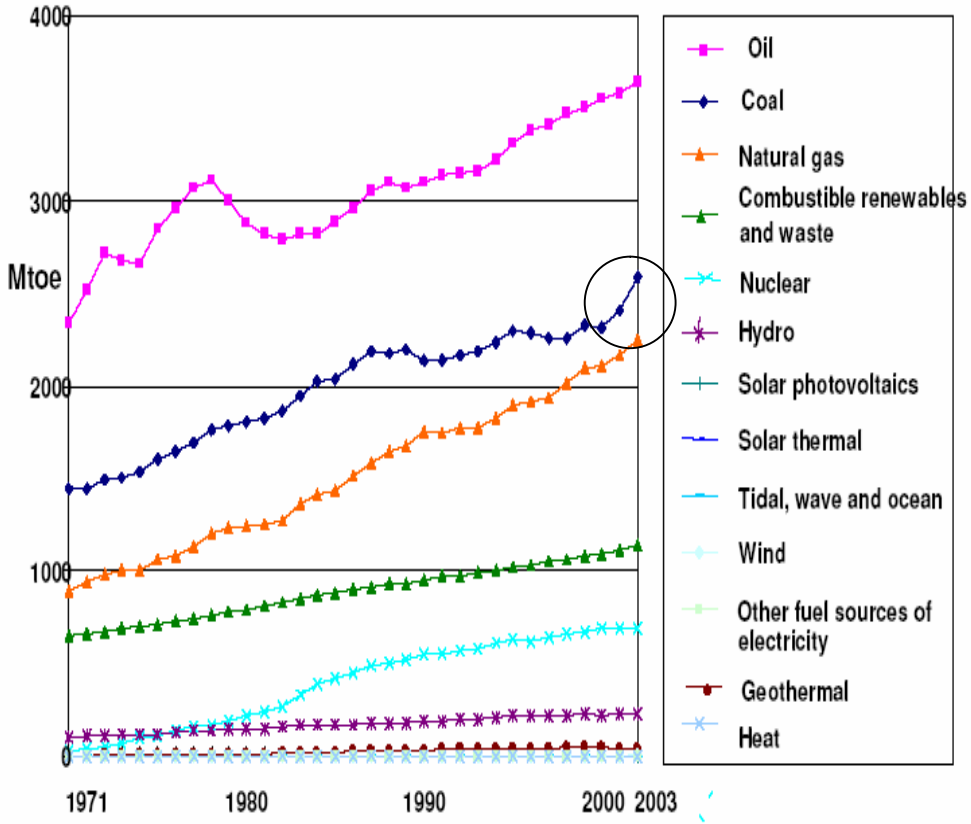
Business from technology

Primary energy consumption has continued to rise in all regions

Global annual primary energy demand (including traditional biomass), 1971 – 2003 by region.

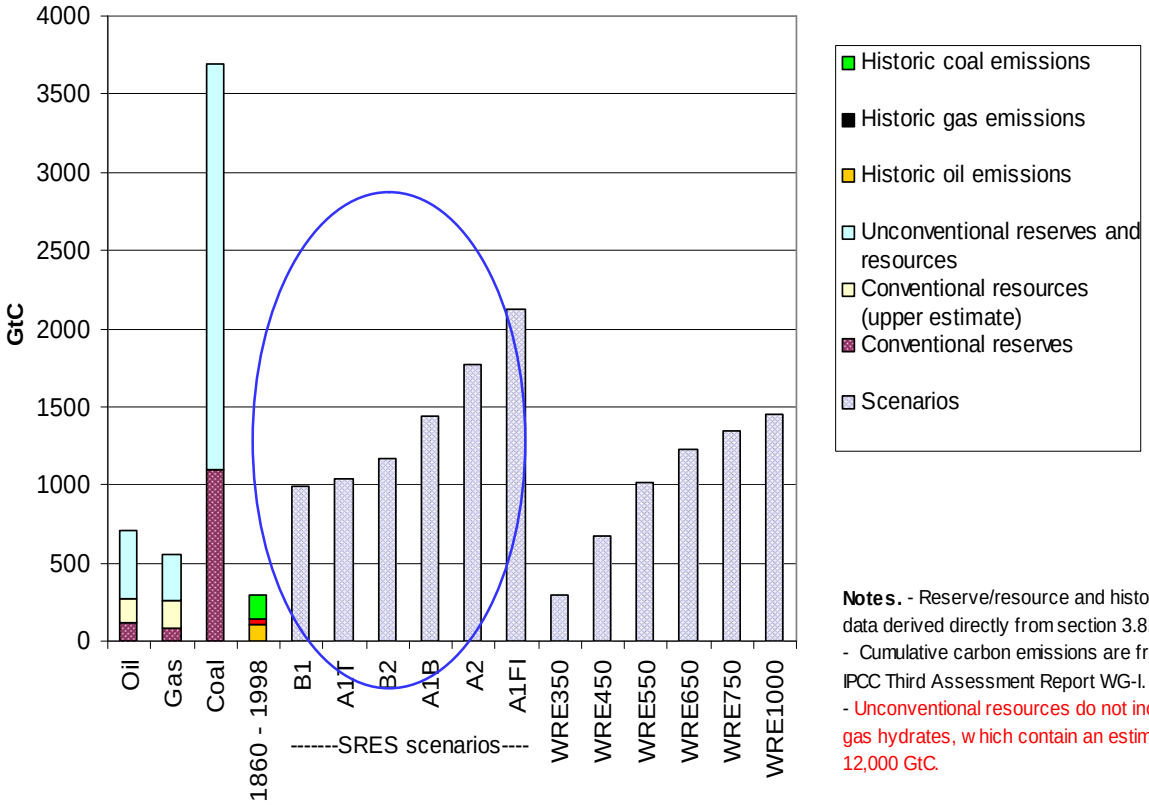


World primary energy consumption in the period 1971 – 2003 by fuel type/energy sources



Future energy supply

- Strong increase in energy demand projected (upto 100% by 2030)
- Increase in oil/gas price: both low and high carbon alternatives attractive
- Price volatility important barrier against investments
- Shortage of fossil fuel is not going to help to stabilise CO2 concentrations (IPCC TAR)

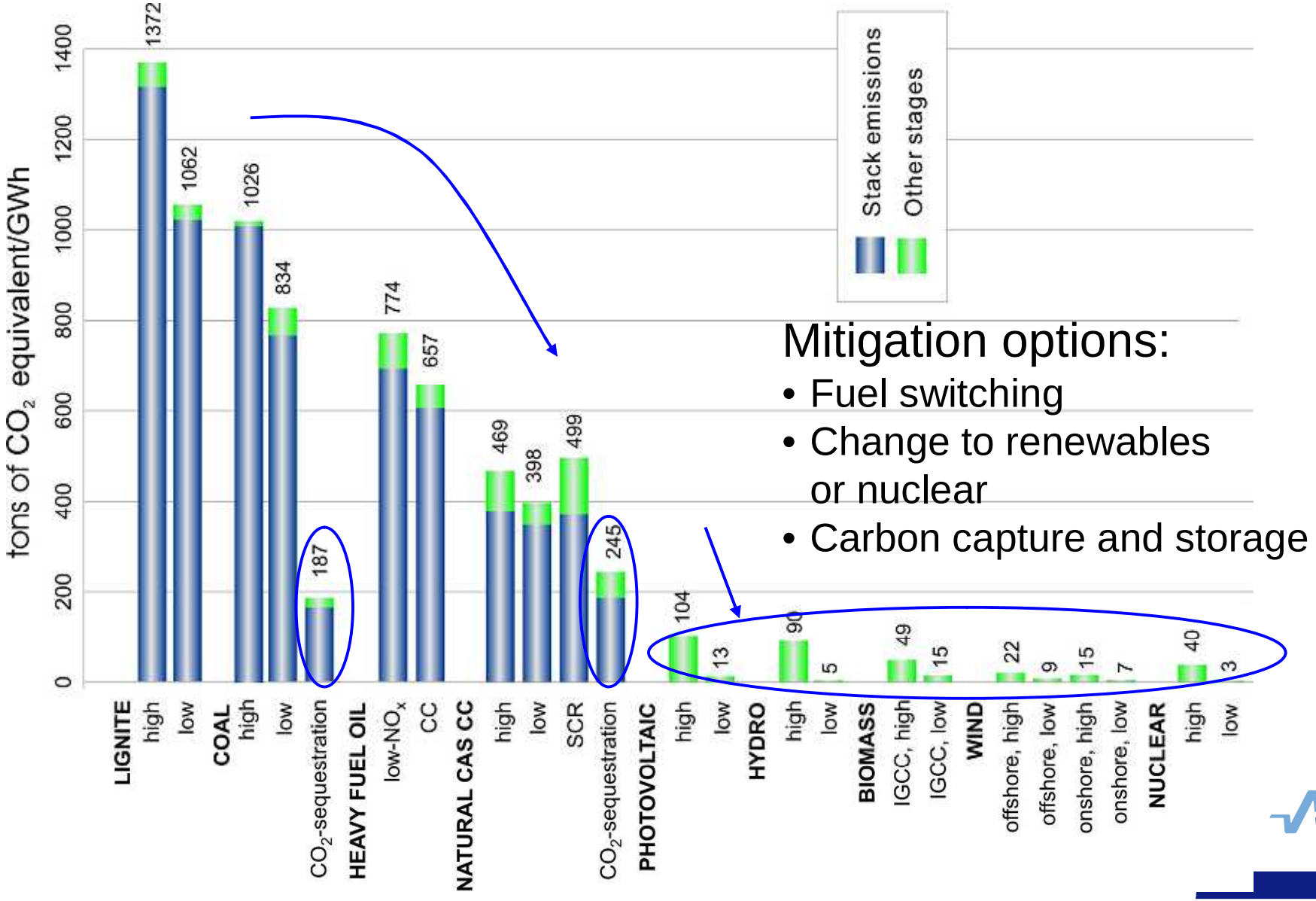


Notes. - Reserve/resource and historic use data derived directly from section 3.8.1.
- Cumulative carbon emissions are from the IPCC Third Assessment Report WG-I.
- Unconventional resources do not include gas hydrates, which contain an estimated 12,000 GtC.

The development of CO2 emissions by combustion of fossil fuels without emission reduction measures

- According to various information sources in the ”business as usual” scenario
  - Global energy related carbon dioxide emissions would rise from the year 2000 level of 26 $GtCO_2eq$/year by 40% minimum ie. to the level of 37 – 40 $GtCO_2eq$/year by the year 2030
  - Solely the emissions from power and heat production were 12,7 $GtCO_2eq$ in 2004 (26% total emissions)
  - These emissionss are assumed (World Energy Outlook 2004, baseline) to rise up to the level 15,8 $GtCO_2eq$ (increase + 25%)

Specific GHG emissions for alternative electricity-generation systems (tonnes CO_2eq/GWh)



Mitigation options:

- Fuel switching
- Change to renewables or nuclear
- Carbon capture and storage

Potential GHG emissions avoided by 2030 for selected, electricity generation mitigation technologies

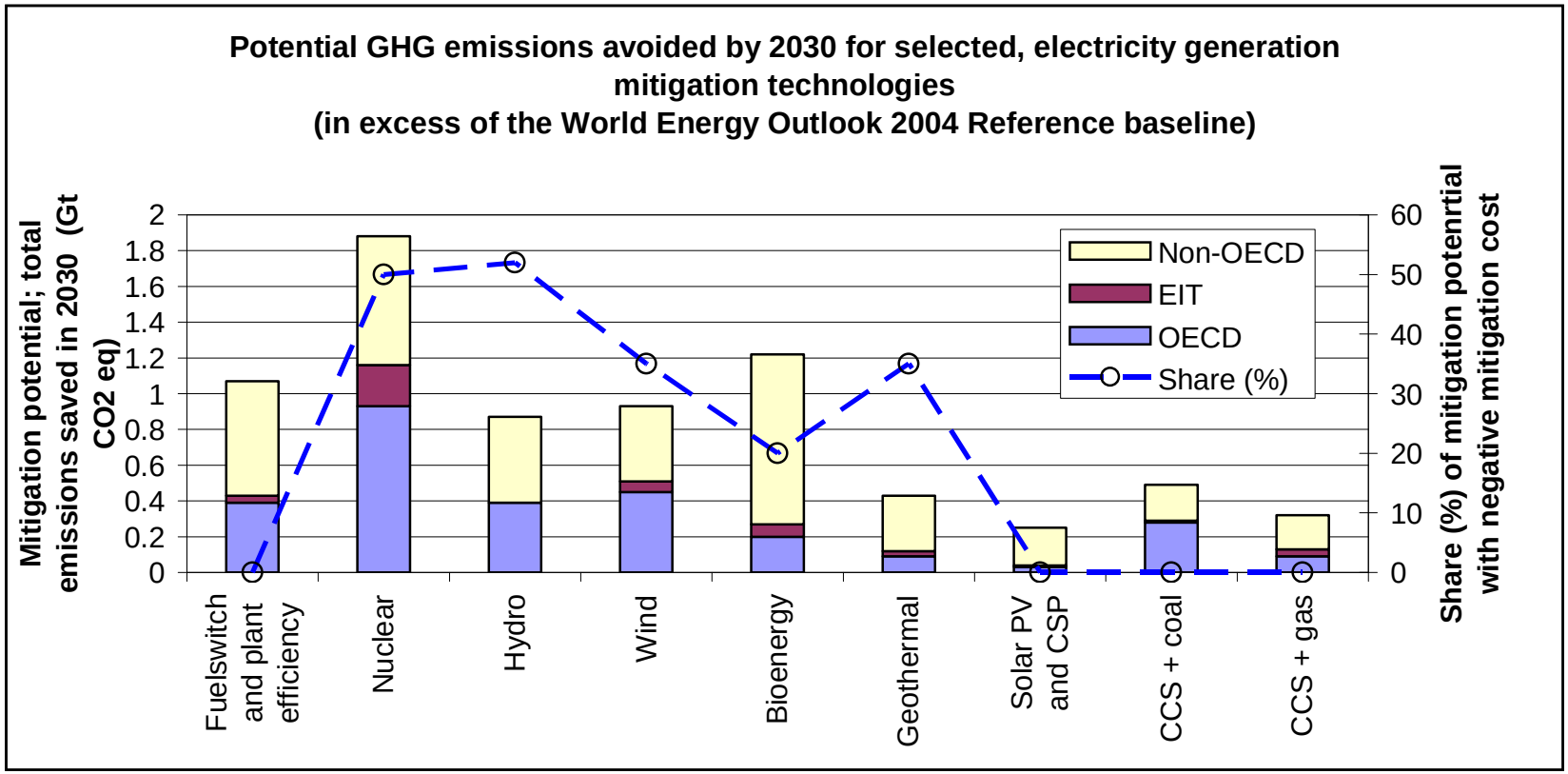
	Regional groupings	Mitigation potential; total emissions saved in 2030 (Gt CO_2-eq)
Fuelswitch and plant efficiency	OECD	0.39
	EIT	0.04
	Non-OECD	0.64
	World	**1.07**
Nuclear	OECD	0.93
	EIT	0.23
	Non-OECD	0.72
	World	**1.88**
Hydro	OECD	0.39
	EIT	0.00
	Non-OECD	0.48
	World	**0.87**
Wind	OECD	0.45
	EIT	0.06
	Non-OECD	0.42
	World	**0.93**
Bioenergy	OECD	0.20
	EIT	0.07
	Non-OECD	0.95
	World	**1.22**

	Regional groupings	Mitigation potential; total emissions saved in 2030 (Gt CO_2-eq)
Geothermal	OECD	0.09
	EIT	0.03
	Non-OECD	0.31
	World	**0.43**
Solar PV and CSP	OECD	0.03
	EIT	0.01
	Non-OECD	0.21
	World	**0.25**
CCS + coal	OECD	0.28
	EIT	0.01
	Non-OECD	0.20
	World	**0.49**
CCS + gas	OECD	0.09
	EIT	0.04
	Non-OECD	0.19
	World	**0.22**

Potentials are in excess of the World Energy Outlook 2004 Reference baseline

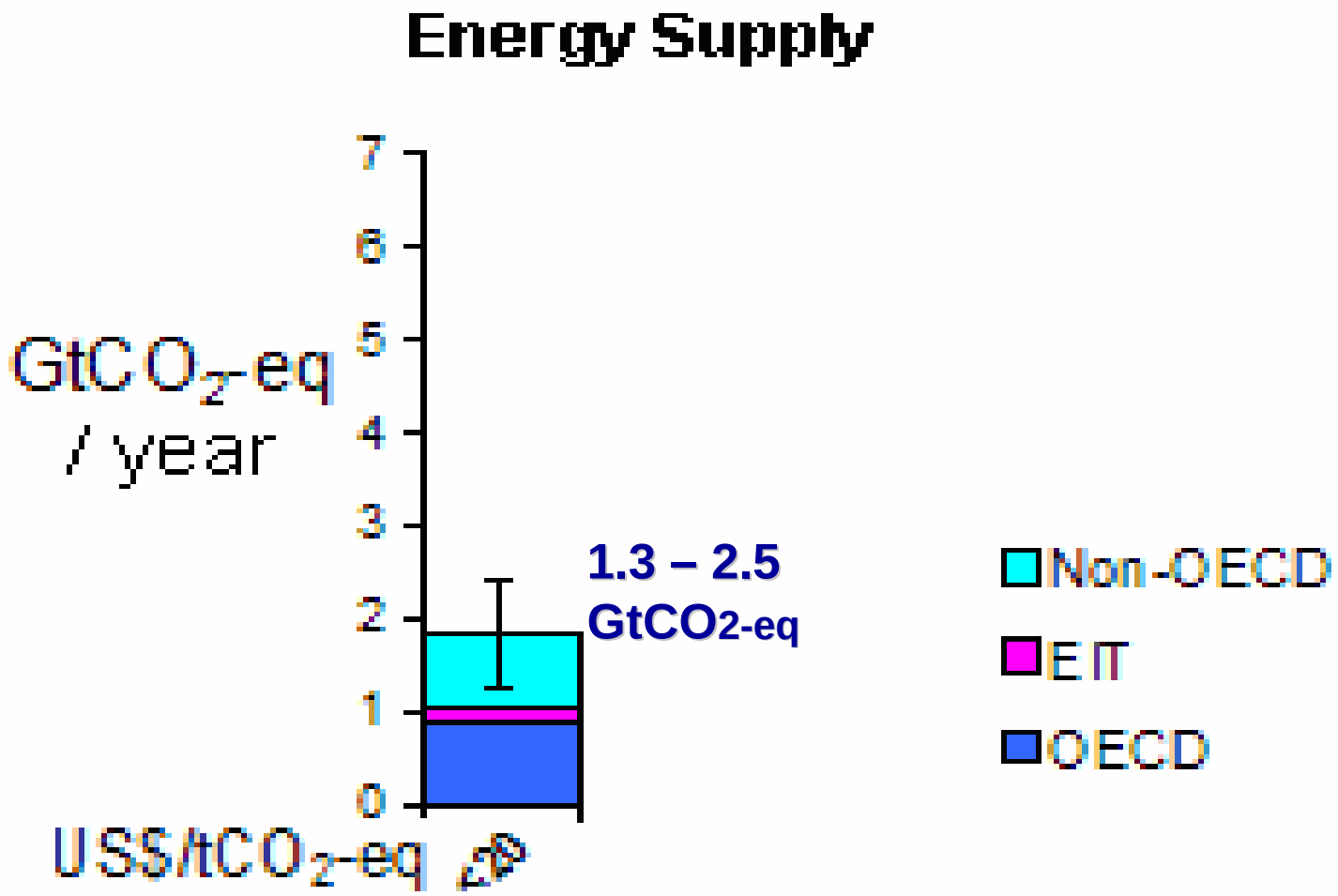
Assumption:
Options developed in isolation and with the estimated mitigation potential shares spread across each cost range (2006 US$/tCO2-eq) for each region

Potential GHG emissions avoided by 2030 for selected, electricity generation mitigation technologies

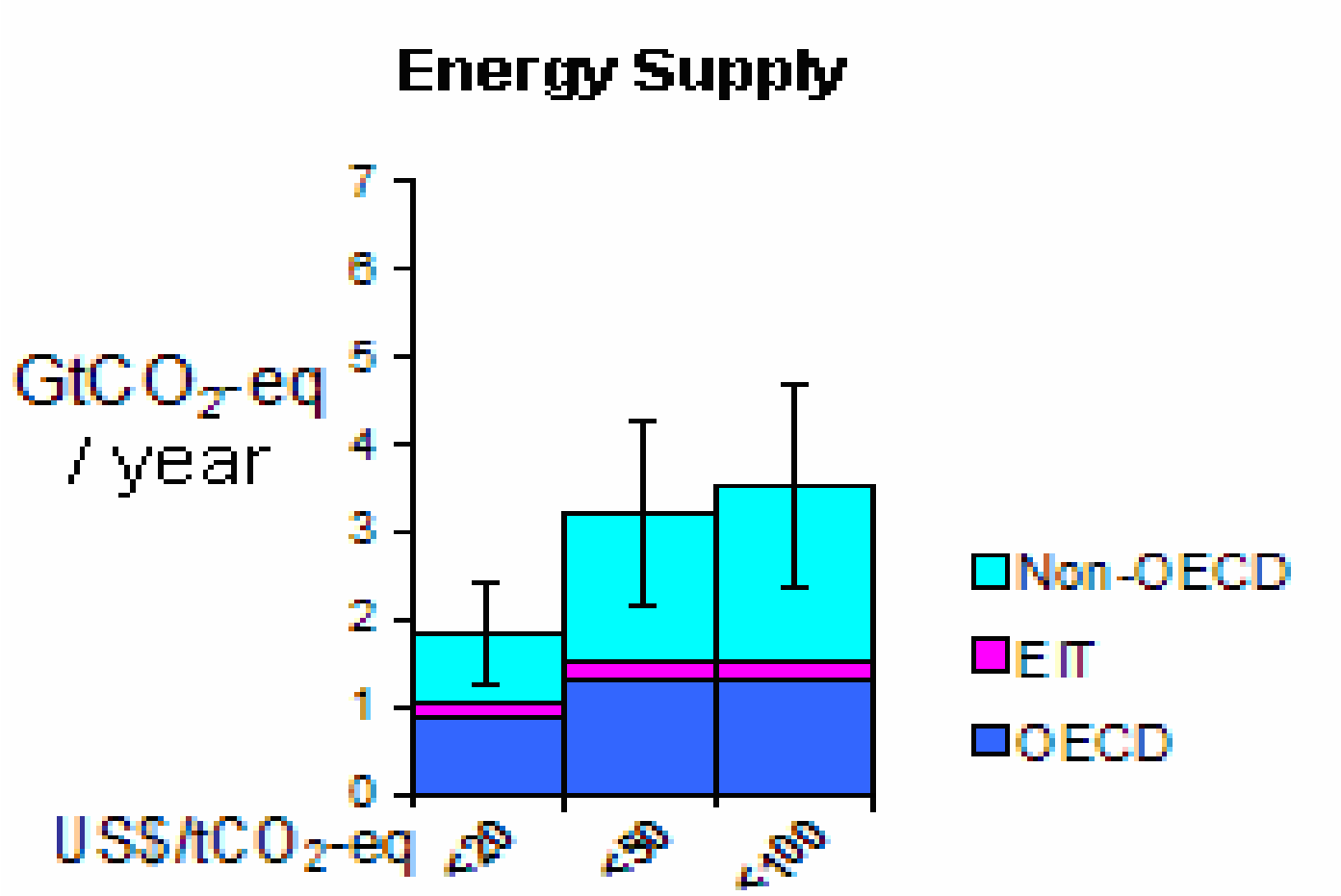


NOTE: The potentials of mitigations are individually encouraged. and cannot be added together.

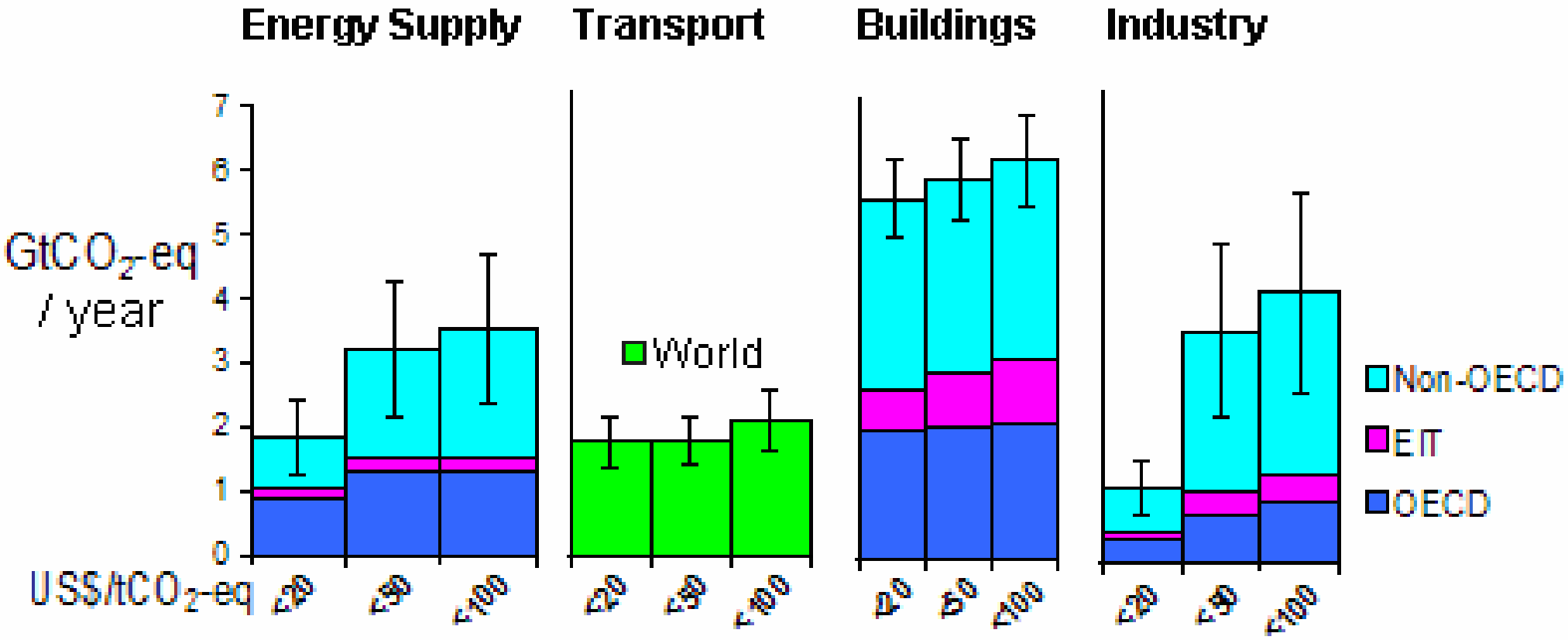
Range of energy supply economic potentials above the baseline by 2030 as a function of carbon price up to US$ <20 / t CO2 -eq.



Economic potentials above the baseline by 2030 as a function of carbon prices of US$ <20, 50 and 100 / t CO2 -eq.



Sectoral economic potentials above the baseline by 2030 as a function of carbon prices of US$20, 50 and 100 / t CO2 -eq.



<$100/tCO2eq **2.4 - 4.7** **1.6 – 2.5** **5.3 – 6.7** **2.5 – 5.5**

Notes: Emissions from electricity use are counted in the end-use sectors.
Transport not split into regions because of international aviation fuel.

Projected power generating levelized costs for coal (C), gas (G), nuclear (N), wind (W) and hydro (H) power plants with assumed capital interest rates of 5 or 10%

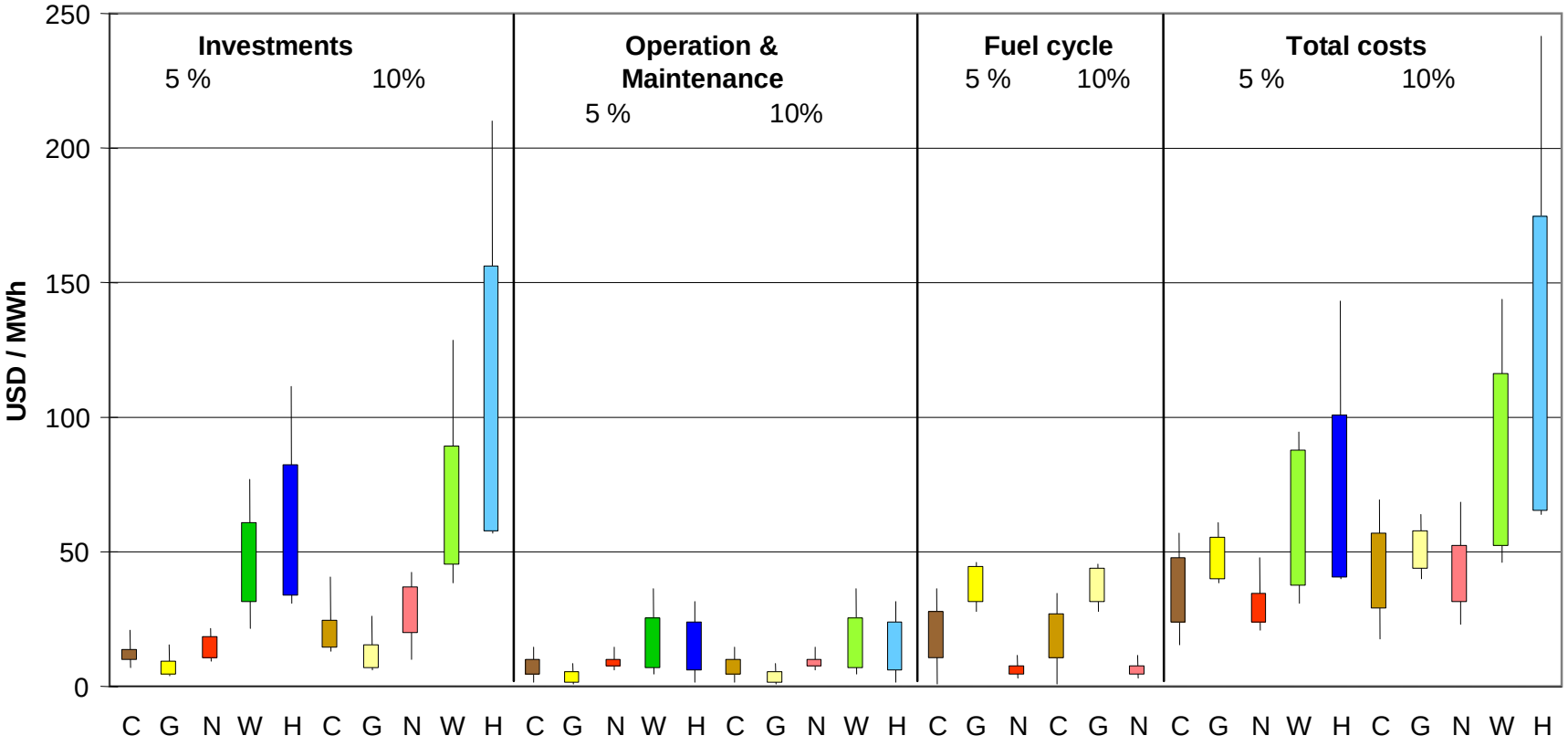
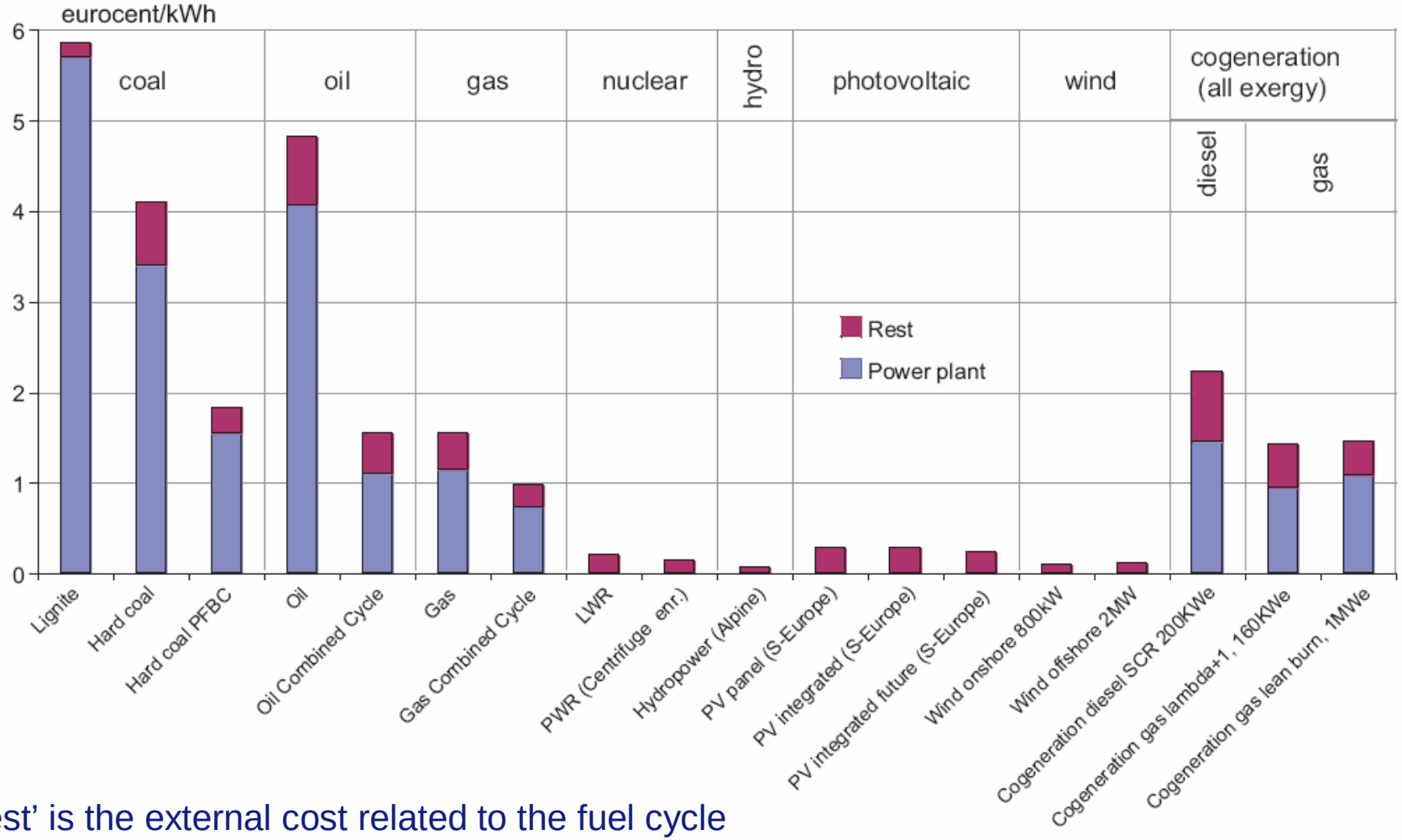


Figure 4.26: Projected power-generating levelized costs for actual and planned coal (C), gas (G) nuclear (N), wind (W) and hydro (H) power plants with assumed capital interest rates of 5 or 10%.
Notes: Bars depict 10 and 90 percentiles and lines extend to show minimum and maximum estimates.
Other analyses provide different cost ranges (Table 4.7) exemplifying the uncertainties resulting from the discount rates and other underlying assumptions used.
Source: IEA/NEA (2005)

External costs (€/MWh) of current and more advanced electricity systems (EU, 2005).



'Rest' is the external cost related to the fuel cycle
(1 € = 1.4 US$ approximately).

Projected power demand increase from 2010 to 2030 as met by new, more efficient additional and replacement plants.
The potential mitigation above the baseline of GHG avoided for <20 US$/t, <50 US$/t and <100 US$/tCO2-eq

	Existing mix of power generation in 2010 TWh	Share of mix of generation of total new and replacement plant built by 2030 including CCS at various costs of US$/$tCO_2$-eq avoided[b]			Total $GtCO_2$-eq avoided by fuel switching, CCS and displacing some fossil fuel generation with low carbon options of wind, solar, geothermal, hydro, nuclear and biomass		
		<20 US$ TWh	<50 US$ TWh	<100 US$ TWh	<20 US$/t	<50 US$/t	<100 US$/t
OECD	**11302**		**7463**		**1.58**	**2.58**	**2.66**
Coal	4079	899	121	0	%	%	%
Oil	472	13	2	0	%	%	%
Gas	2374	1793	637	458	%	%	%
Nuclear	2462	2084	2084	1777	%	%	%
Hydro	1402	1295	1295	1111	%	%	%
Biomass	237	263	499	509	%	%	%
Other renewables	276	1116	1544	1526	%	%	%
CCS		0	1282	2082	%		
EIT	**1746**		**1420**		**0.32**	**0.42**	**0.49**
Non OECD/EIT	**7137**		**10662**		**2.06**	**3.44**	**4.08**
TOTAL	**20185**		**19545**		**3.95**	**6.44**	**7.22**

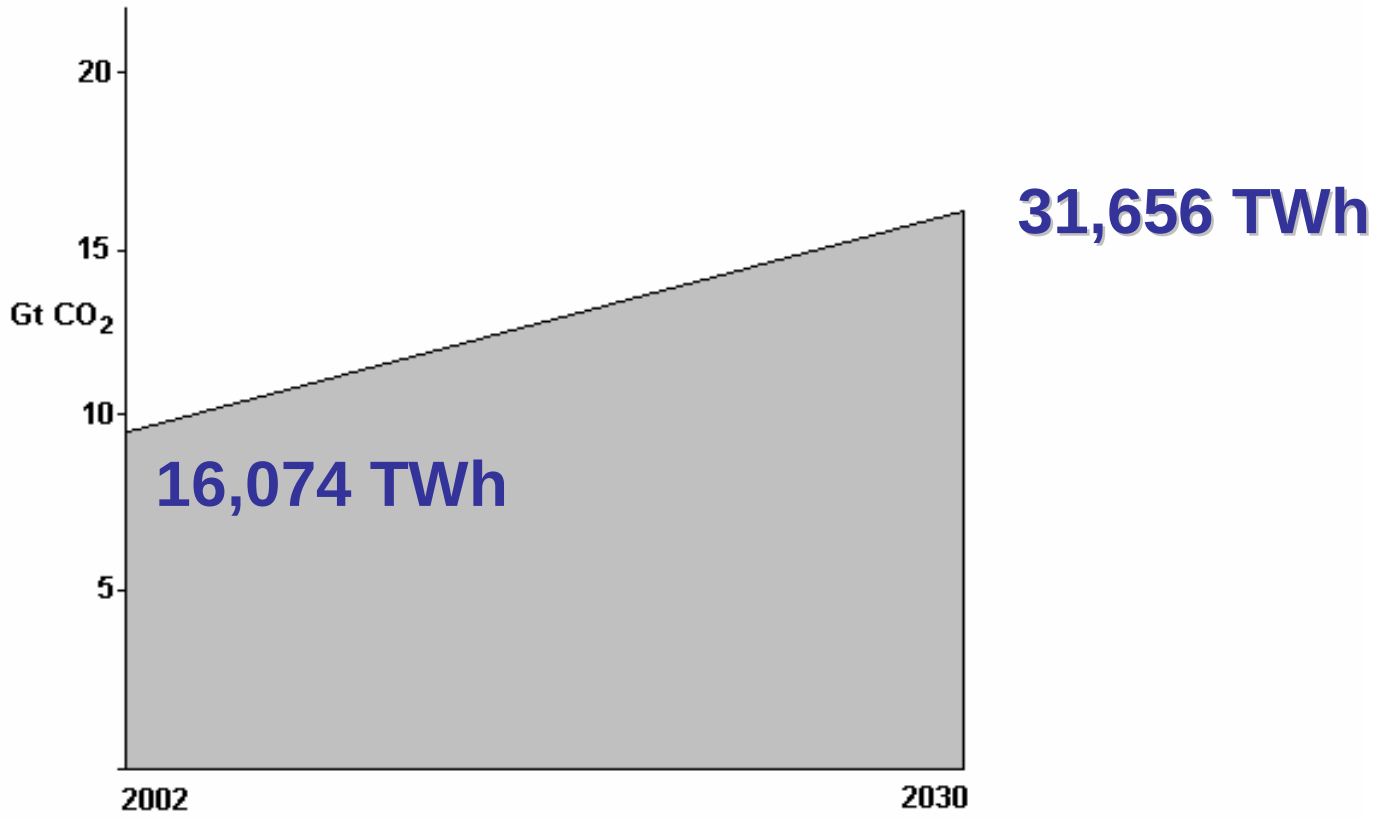
Key mitigation technologies and practices
a) currently commercially available and
b) projected to be commercialized by 2030.

Energy Supply

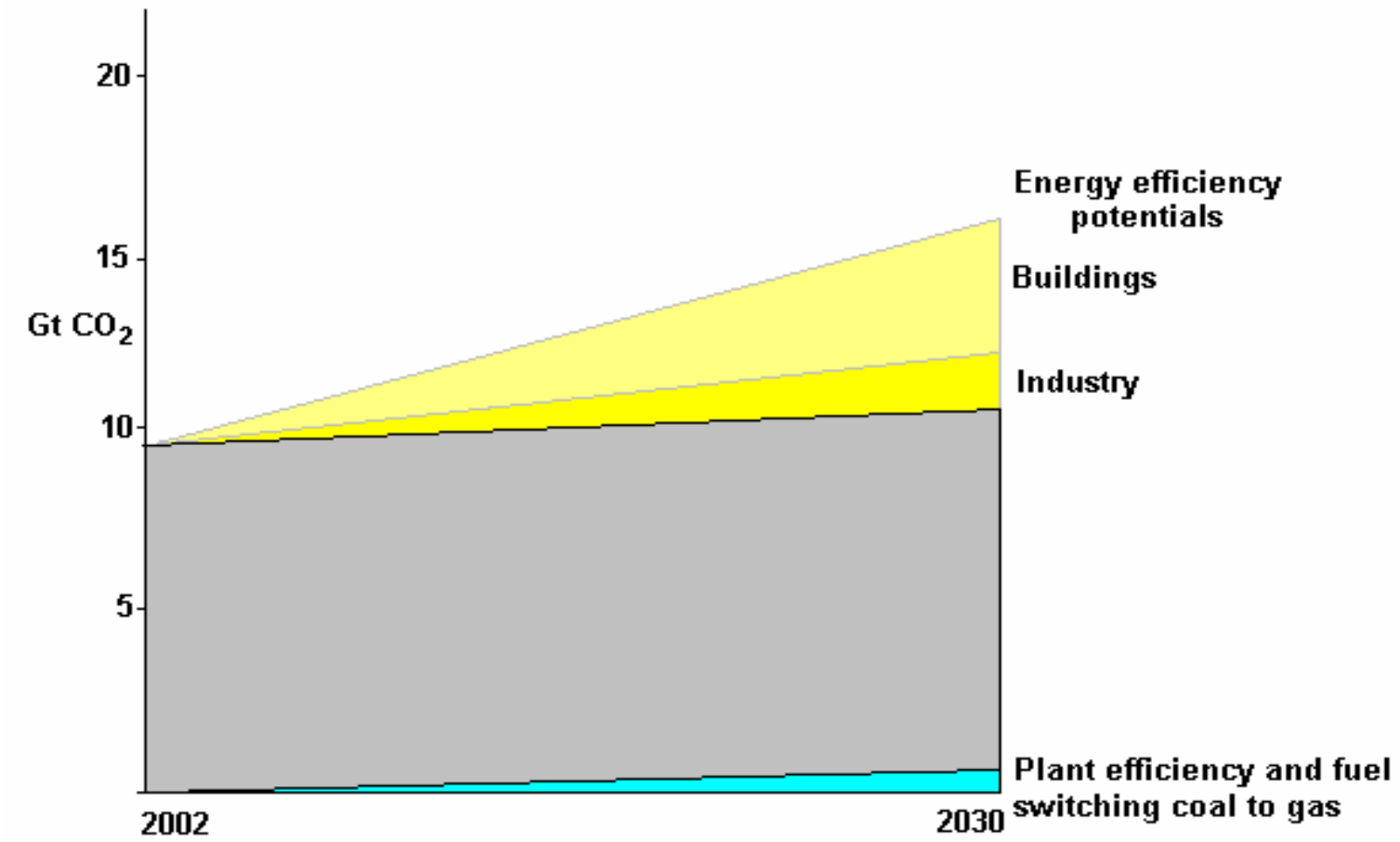
a) * Improved supply and distribution efficiency;
* Fuel switching from coal to gas;
* Nuclear power;
* Renewable heat and power
(hydropower, solar, wind, geothermal and bioenergy).

a) * Carbon capture and storage (CCS) for gas, biomass and coal-fired electricity;
* Advanced nuclear power;
* Advanced renewable energy, including ocean energy, concentrating solar, and solar PV.

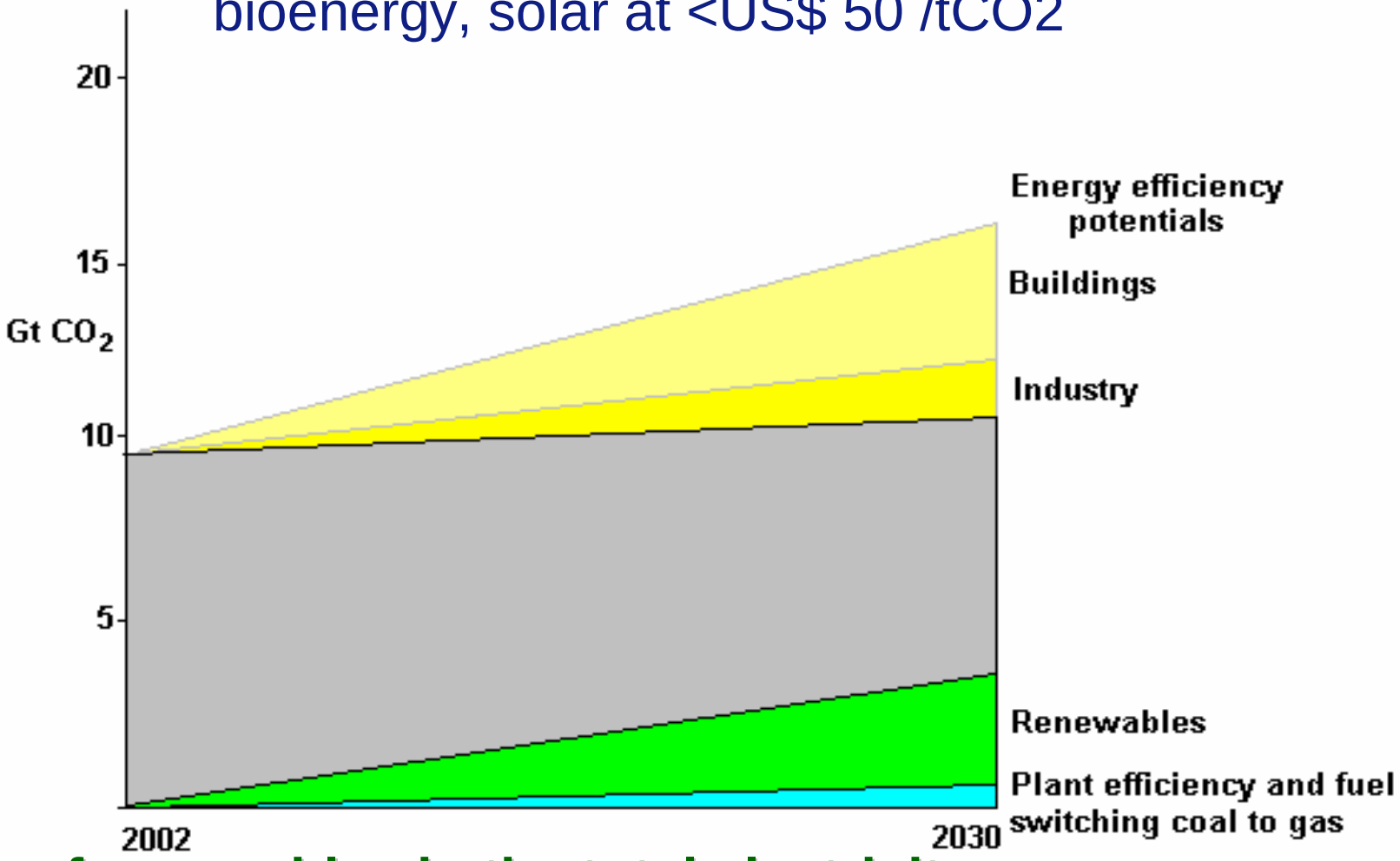
Electricity sector emissions, from 2002 to 2030 WEO, 2004 Reference scenario baseline



Potential from improved generation plant efficiency and fuel switching at <US$50 /tCO2

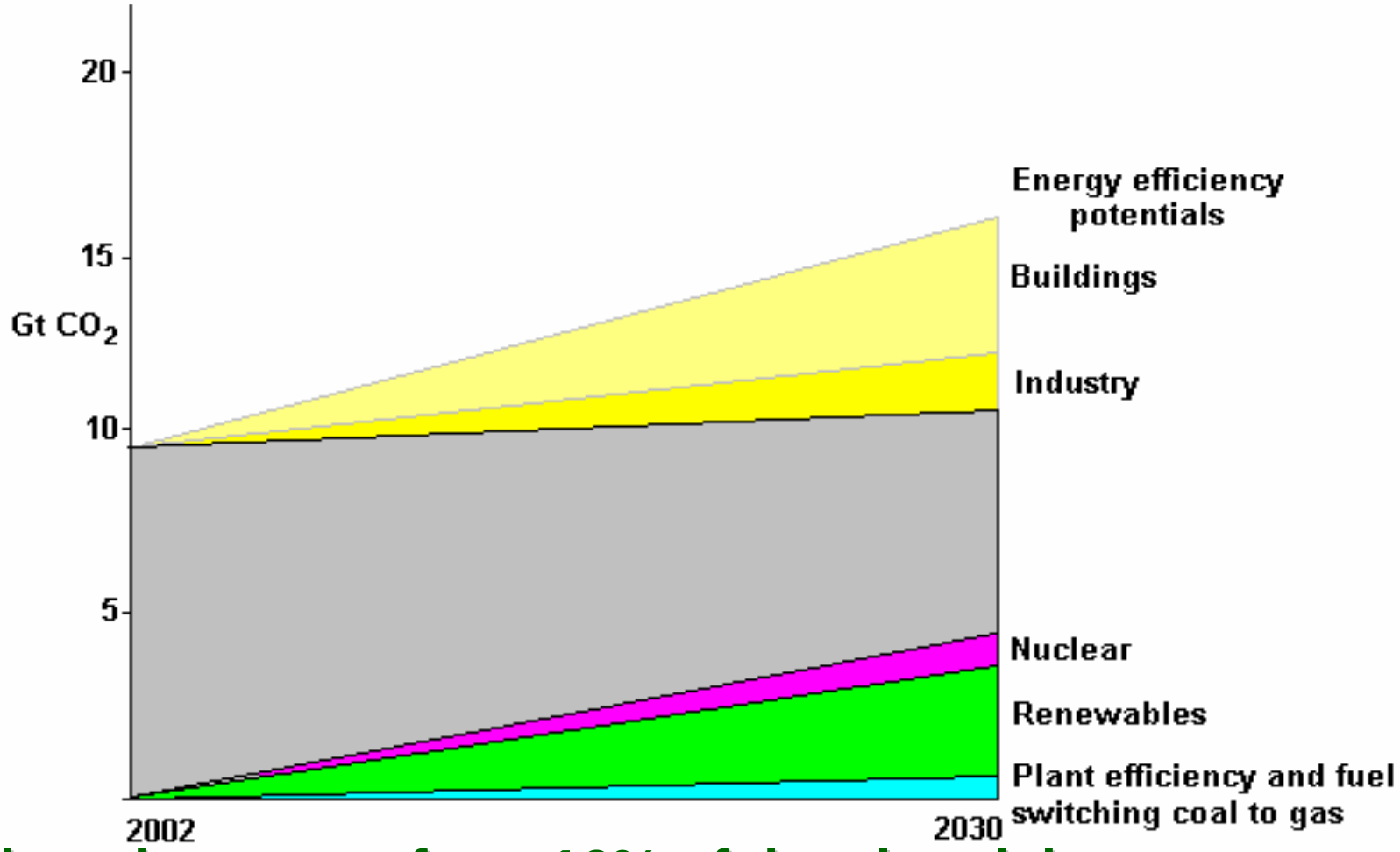


Potential below baseline from hydro, wind, geothermal, bioenergy, solar at <US$ 50 /tCO2



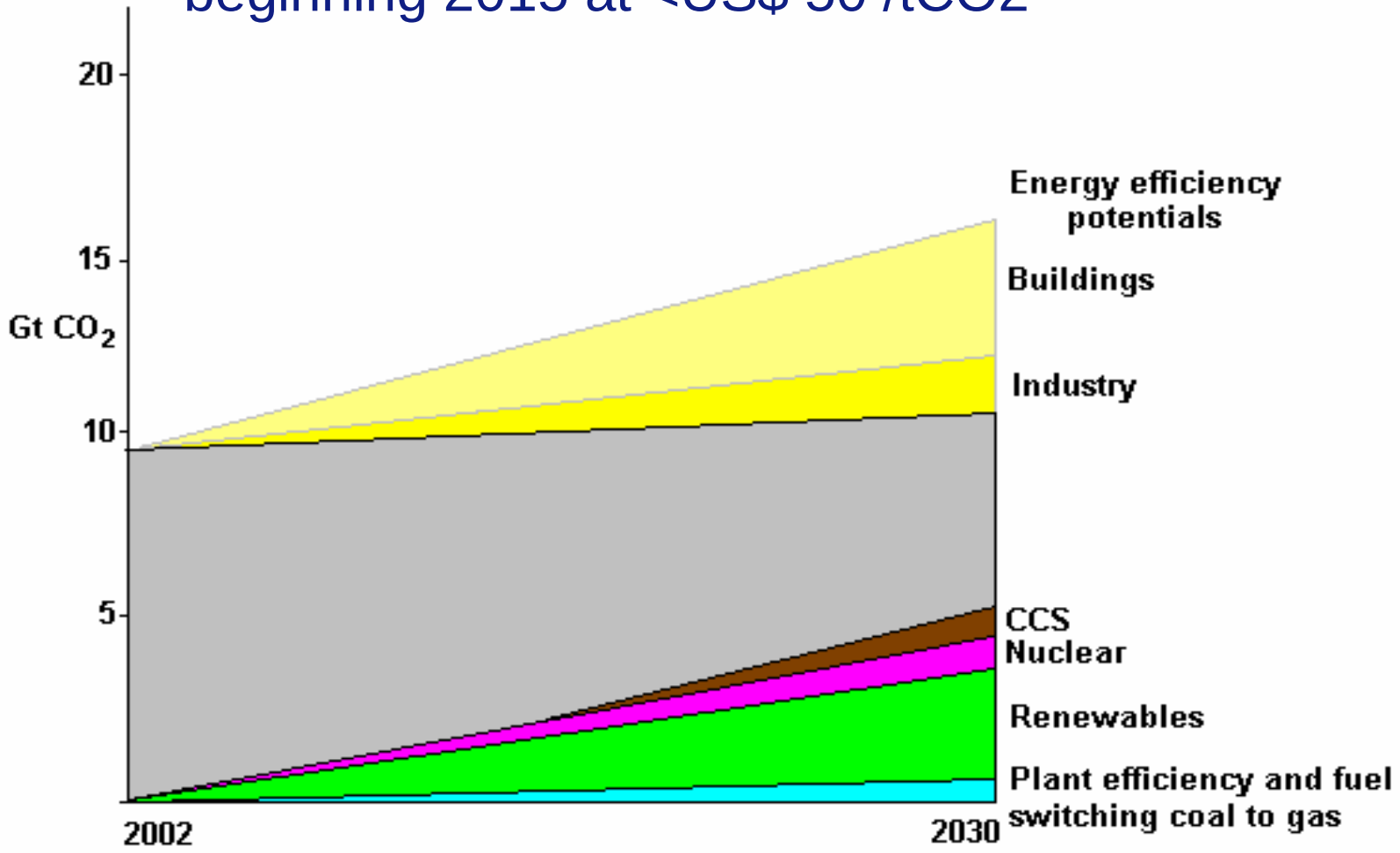
The share of renewables in the total electricity supply rises from 18% in 2005 to 30 – 35% by 2030.

Potential below baseline from nuclear power at <US$ 50 /tCO2



Nuclear share increases from 16% of the electricity supply in 2005 up to 18% in 2030.

Potential from CCS in new coal and gas plants beginning 2015 at <US$ 50 /tCO2



Fossil fuel share of electricity generation without CCS drops to < 50% of total supply by 2030