Energy Efficiency & Renewable Energy – Opportunity or Threat?

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Agenda

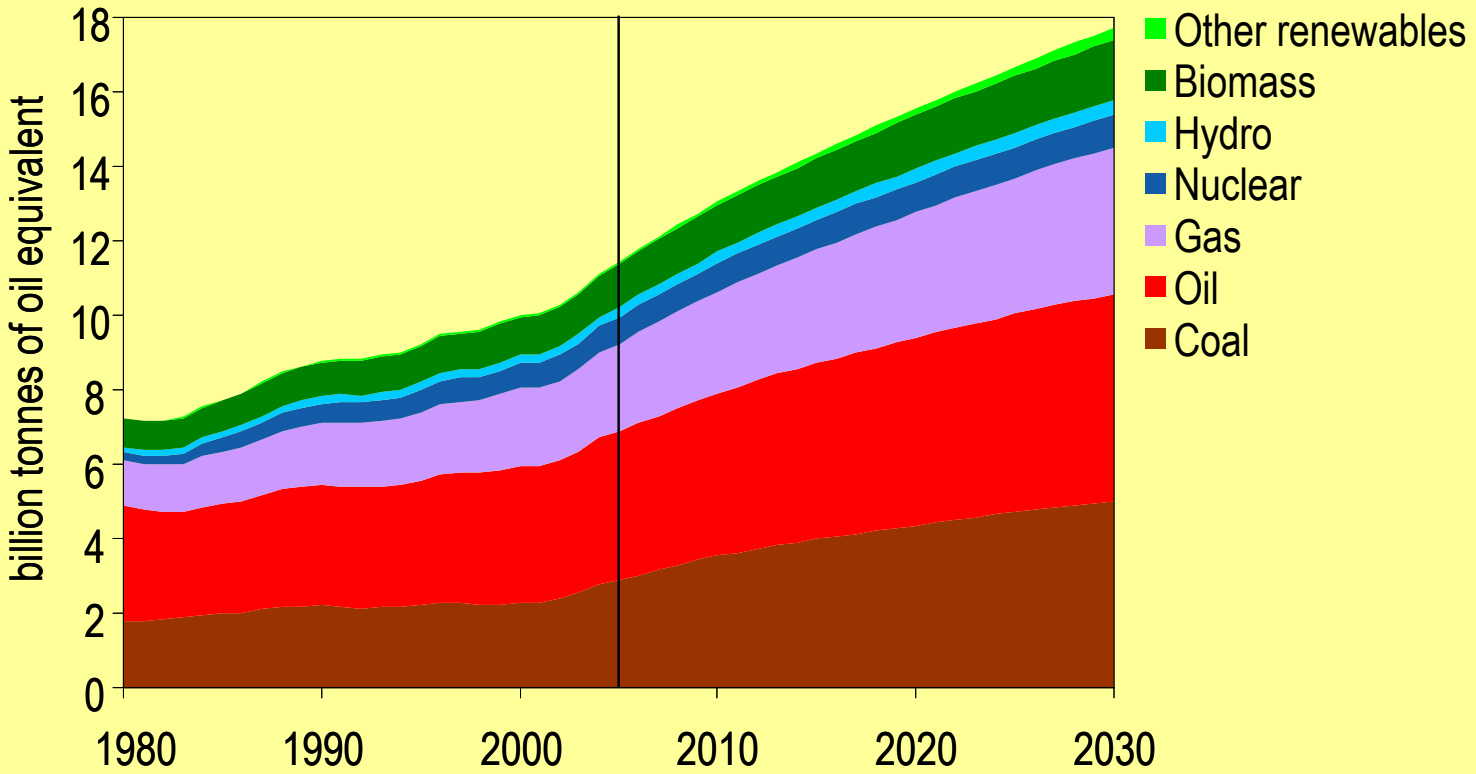
- **Growth in World Energy Demand**
- **Vattenfall's Global Climate Map**
- **The Power Sector's Contribution**
- **Energy Efficiency can mean Increased Electricity Consumption**

INTERNATIONAL ENERGY AGENCY

WORLD ENERGY OUTLOOK 2007

Reference Scenario:

World Primary Energy Demand



Global demand grows by more than half over the next quarter of a century, with coal use rising most in absolute terms

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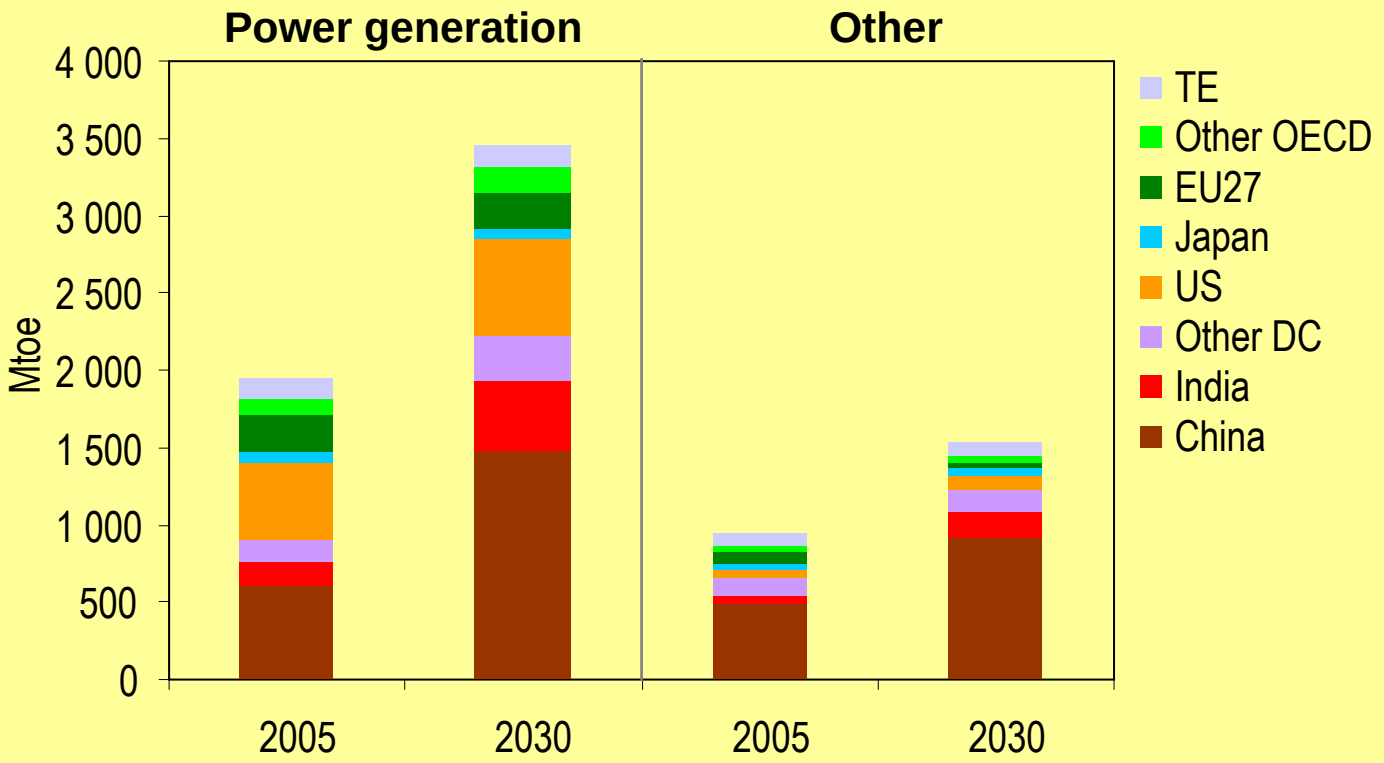
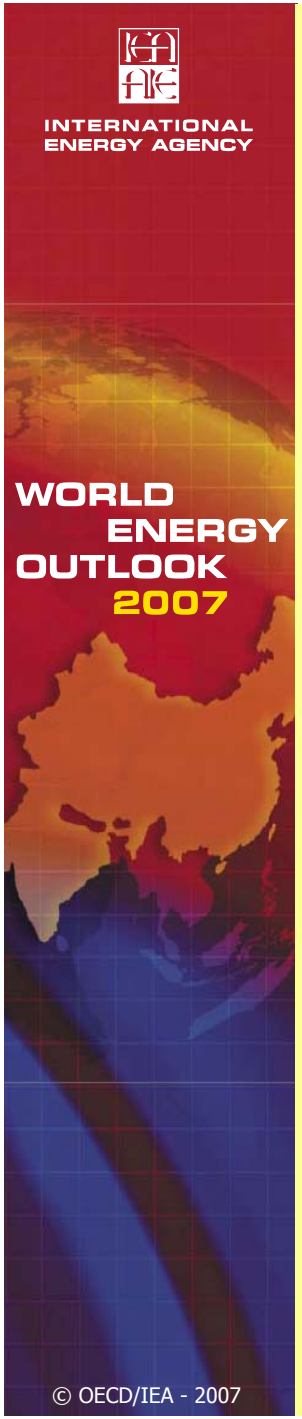
Reference Scenario:

Primary Coal Demand by Region



China & India account for 78% of the growth of coal use in power generation and 91% of the growth in other sectors

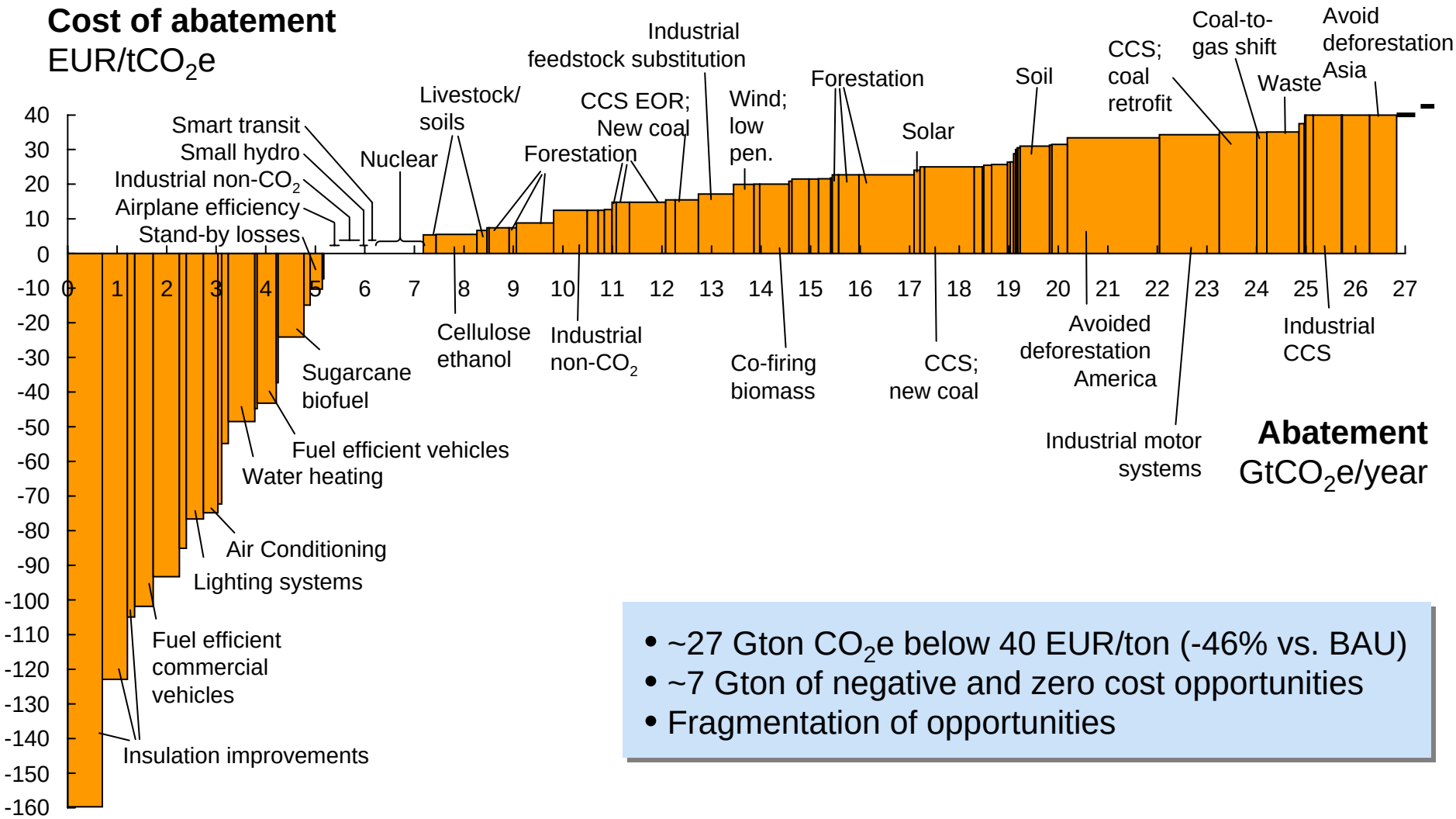


This is not sustainable!

- ✓ Investment not on track
- ✓ Reduced number of suppliers
- ✓ CO_2 emissions from 2005 to 2030:

+56%

Vattenfall's Global Climate Map for 2030



- ~27 Gton CO_2e below 40 EUR/ton (-46% vs. BAU)
- ~7 Gton of negative and zero cost opportunities
- Fragmentation of opportunities

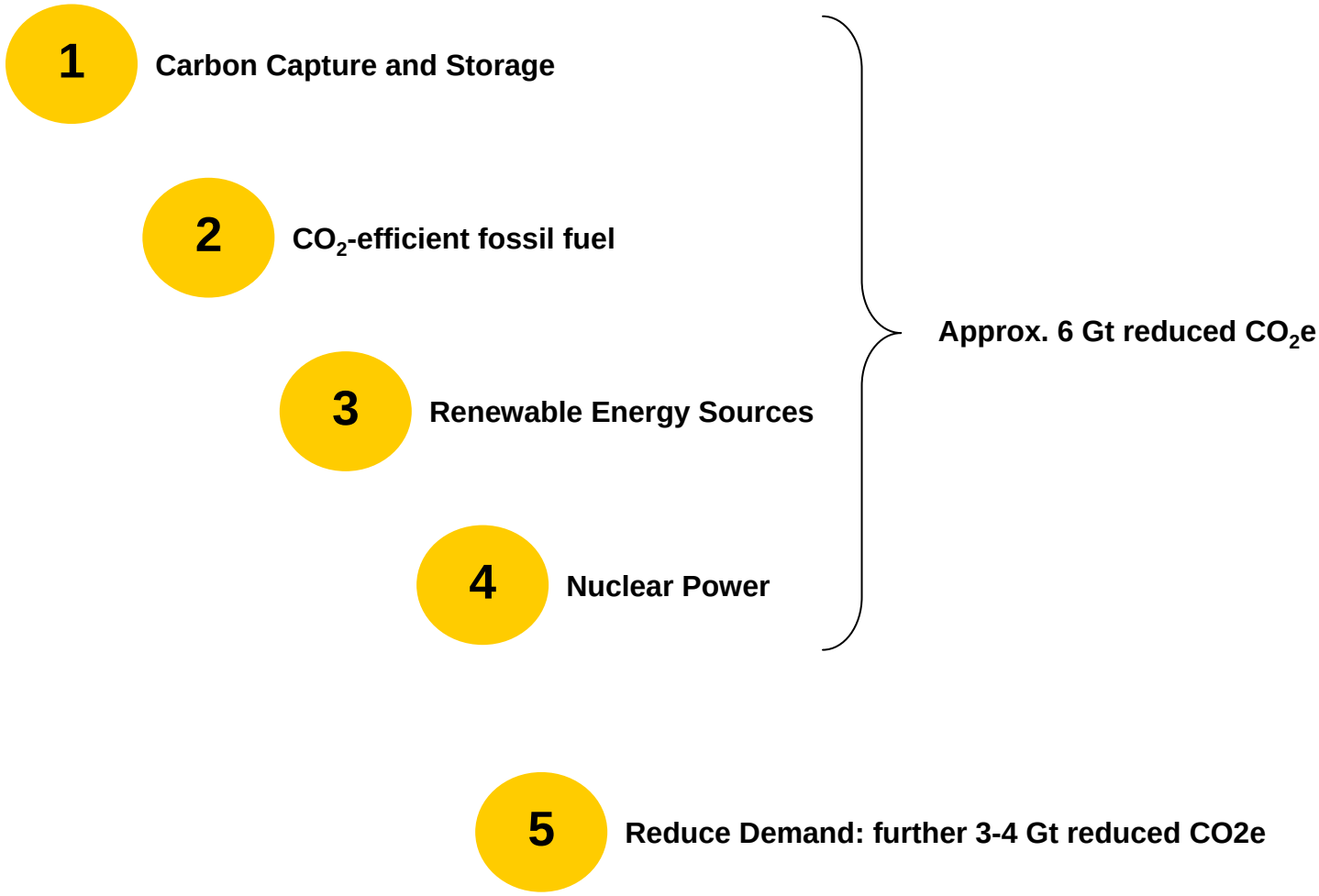
All sectors and regions will have to contribute

$GtCO_2e$, 2030

Sector	Regions: US + Canada	OECD Europe	Eastern Europe (incl. Russia)	Other Industrial*	China	Rest of world**	Total
Power	1.3	0.8	0.3	0.7	1.7	1.0	**5.9**
Industrial	0.8	0.6	0.7	0.8	1.5	1.5	**6.0**
Transportation	1.2	0.5	0.1	0.4	0.3	0.4	**2.8**
Buildings	0.8	0.5	0.4	0.5	0.7	0.8	**3.7**
Forestry	0.2	0	0	0	0	6.5	**6.7**
Agriculture	0.2	0.1	0.1	0.1	0.3	0.8	**1.5**
Total	**4.4**	**2.5**	**1.6**	**2.5**	**4.6**	**11.1**	**26.7**

* Australia, New Zealand, Japan, Singapore, South Korea, Taiwan, UAE, Saudi Arabia, Qatar, Oman, Kuwait, Israel, Bahrain, Mexico
** Africa, South and Central America excl. Mexico, Asia excl. China and countries included in “Other industrialized” (see previous note)

What can the Power Sector do until 2030?



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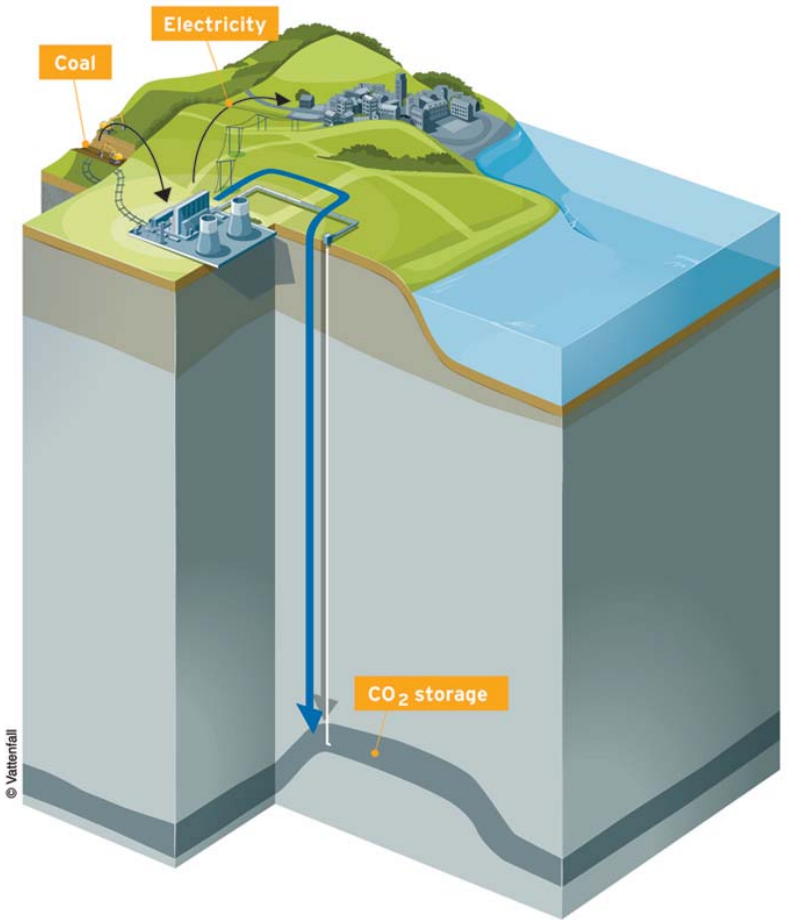
Carbon Capture & Storage, approx 3 Gt CO_2e

- Three capture technologies seem capable to be commercial by 2020: *Post-combustion, Pre-combustion and Oxy-fuel*

- All three largely contain known technology but require optimisation, scale up and process integration

- Policies needed: ETS, Demo plant financing, Legal framework for storage and transportation



Vattenfall's CCS projects

10 years of continuous R&D is now resulting in several large scale development projects.

Plant	**Schwarze Pumpe**, Germany	**Mongstad**, Norway	**Demonstration plants**, Germany, Denmark, Poland
Type	Large scale pilot plant	Large scale pilot plant	Demonstration plant
Capacity	30 MW	100 000 ton CO_2/a (~35 MW)	250 - 350 MW
Fuel	Lignite and hard coal	Gas from refinery	Hard coal, Lignite
CO_2 technology	Oxyfuel	Post-combustion	Post-combustion and oxyfuel
Operation	2008	2010	Ca 2015

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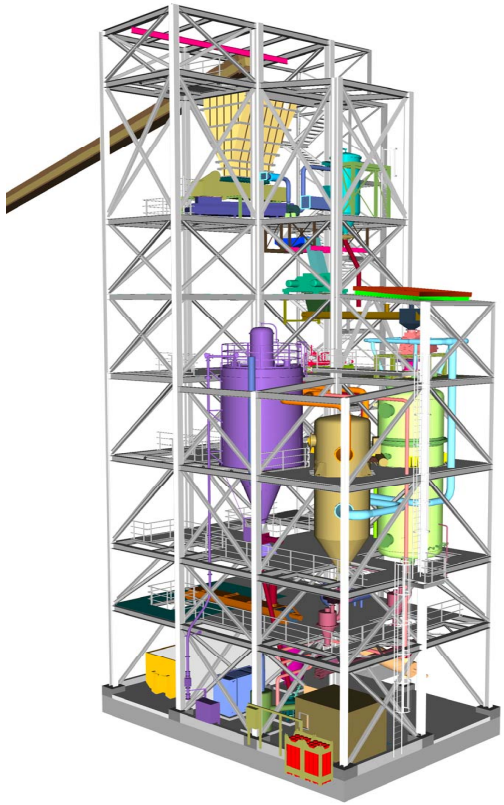
More efficient fossil fuel technology, approx 0,4 Gt CO_2e

- Global dependence on fossil fuels is a fact for the foreseeable future
- In addition to CCS, we must use the most efficient conventional technology available
- Competitive markets offer the best incentives for this
- R&D needed to further advance technology

Pressurised Fluidised Bed Dryer Pilot Plant

Reducing moisture of lignite from ~60% to ~15%



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Renewable energy sources, approx. 1,5 Gt CO_2e

- Wind, biomass, wave and solar power will experience cost reductions due to learning curve improvements and vendor competition

- At 40 €/tCO2, renewables could become competitive around 2020. Could potentially supply 20% of global power generation by 2030

- Policies needed: ETS, market-based support systems with possibility to trade between member states, stable regulation that gives incentives to invest in power grids

Construction of Lillgrund offshore wind farm, Sweden 2007

Nuclear power, approx. 1,1 Gt CO_2e

- Important contribution to the reduction of greenhouse gases and security of supply

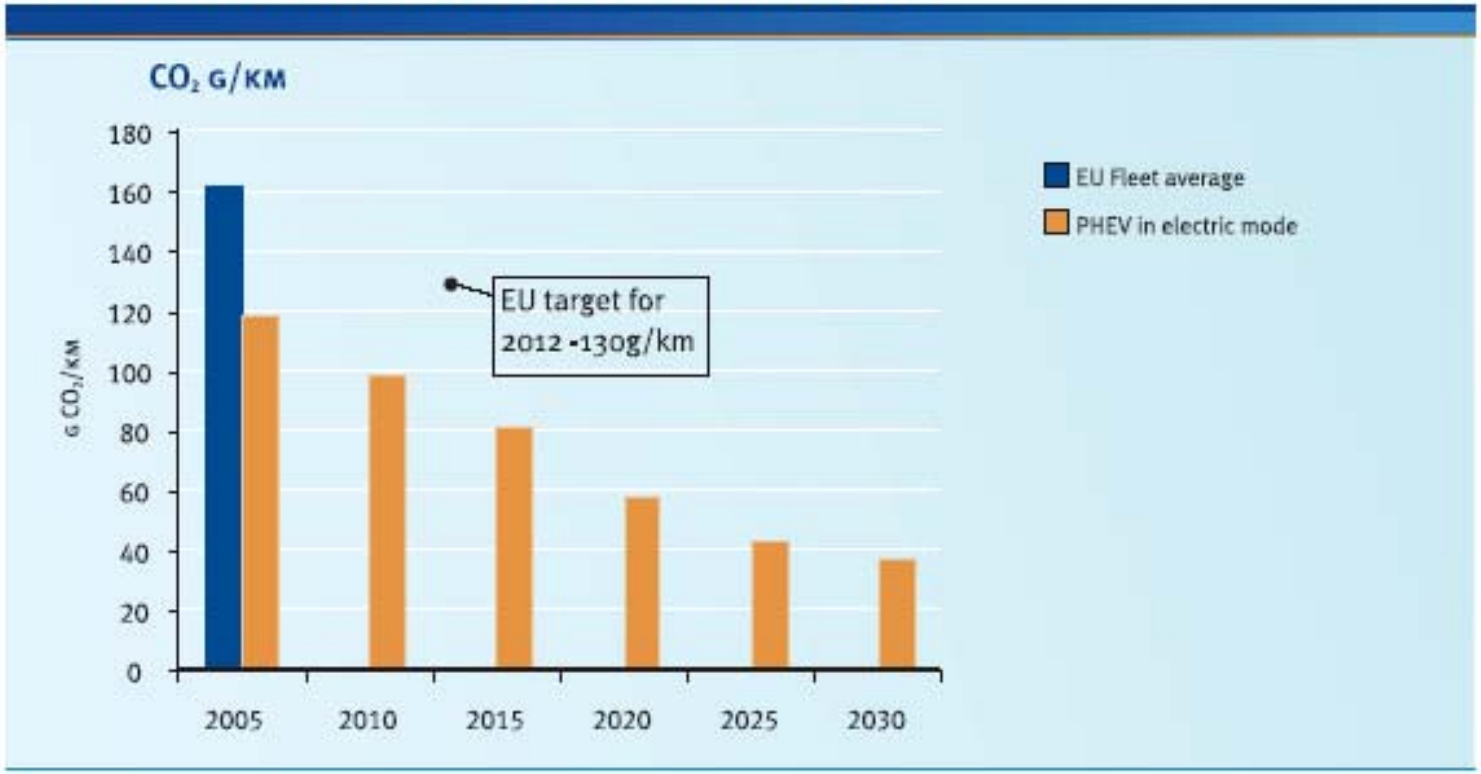
- Volume dependent on political decisions

Energy Efficiency can mean *more* electricity

Examples:
- Heat Pumps
- Rail Transport
- Electric Vehicles

Example: Plug-in Hybrid Electric Vehicles

FIGURE 11: COMPARISON OF THE CO_2 EMISSIONS OF AN ICE PETROL CAR, A HYBRID CAR AND A PHEV (PREDICTED TREND TO 2030)



Source: Eurelectric, 2007