

Impact of the Clean Coal Industry on employment: Country Study Germany

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Gross electricity production Germany 2007 and 2030

Gross electricity production in Germany 2007 and 2030

Energy source	2007	2030*
Coal	46,2 %	48,1 %
Nuclear	21,9 %	-
Gas	11,9 %	13,1 %
Combustible renewable, waste and others	6,2 %**	19,8 %
Oil	-	0,7 %
Hydro, Geothermal, Solar, wind, ect.	11,9 %	18,2 %

Main Assumptions for 2030

- Coal will remain major energy source with 48,1 %
- End of nuclear energy (German governments' decision on the nuclear phase out)
- Nuclear energy will be replaced by renewable energies

Source: Own illustration based on Umweltbundesamt 2009 and IEA: Energy policies of IEA countries: Germany Review, 2007. * Total production ** In 2007: Inclusive of oil, exclusive of combustible renewable

CO₂ Emissions in Germany

CO₂ Emissions in Germany

Fossil fuel	2007	2008	Changes
	Million t	Million t	%
Total amount	841,2	831,8	-1,1 %
Hard Coal	147,8	135,9	-8,0 %
Lignite	181,0	174,5	-3,6 %

Source: Umweltbundesamt 2009, estimations for 2008

Energy generation is the main source for CO₂ emissions

- 45,8 % of the total CO₂ emissions in Germany are the result of energy generation
- 18,1 % from transport, 10,6 % from industry
- 15,2 % from households and 9,9 % from industry processes

German Energy Sector

Overview on four main energy providers of Germany

Energy provider in Germany	Employees in Germany	Energy Mix 2008	Capacity of power	
			Power Plants	Coal Power plants
E.ON	43.500	45 % nuclear 39 % Coal 7 % gas & oil 6 % renewable energy 3 % others	23.650 MW (installed capacity)	
			47	14
EnBW	19.500	47 % nuclear 32 % fossil energy & others 21 % renewable energy	9119 MW (installed capacity)	
			11	6
RWE	40.000	33 % lignite 29 % hard coal 19 % nuclear 12 % gas 7 % renewable energy & others	33.033 MW	
			24	13
Vattenfall*	19.670	60 % coal 22 % water power 12 % nuclear 7 % gas	13.378 MW	
			23	11

Source: wmp consult 2009; * Energy mix of the entire Vattenfall Group.

Political Framework

Milestones of the CCS Debate in Germany

- The general debate on using CCS technologies in Germany is a rather recent phenomenon and has only started few years ago in 2003.
- The Federal Ministry of Economics and Technology (BMWi) and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) as leading actors
- Further examples are initiatives like COORETEC - R & D Initiative of the BMWI, (Industry and Academia) or the IZ Klima communication platform of companies

Drafting of the legislative act on capture, transport and permanent storage of carbon dioxide (CCS) in April 2009

- Reading of the draft act was postponed in the German Bundestag.
- Problem: Lack of a broad acceptance of the German public. Particularly the government of Schleswig-Holstein, representing the areas with most of the planned CO₂ storage capacities, has rejected the current version of the draft act.
- The new government of Germany will discuss the CCS draft act again.

CCS Projects in Germany

German companies involved in CCS

- Vattenfall, RWE and E.ON are the main energy providers involved in CCS-projects.
- Their activities vary according to development stages, technologies, cooperation partners and investment volume.
- Equipment producing companies and chemical companies are bound in the construction phases of CSS-power plants.

Overview on companies involved in the CCS-technology

Carbon Capture and Storage Technologies		
Post Combustion	Oxy-fuel	Pre Combustion
Power Plant Operators - E.ON AG - RWE AG - Vattenfall Europe AG	Power Plant Operators - Vattenfall Europe AG	Power Plant Operators - RWE Power AG
Power Plant Engineers - Hitachi Power Europe GmbH - FISIA BABCOCK ENVIRONMENT GmbH - Babcock Noell GmbH - Siemens Energy - Alstom	Power Plant Engineers - Alstom Deutschland AG - Hitachi Power Europe GmbH - Linde AG	Power Plant Engineers /Chemical Industries - BASF AG - Linde AG - Siemens Energy

Estimated costs resulting from the introduction of CCS

Costs for CCS in conventional power plants in Germany (in EUR/ t CO₂ emissions)

Subprocess	Lignite	Hard Coal	Natural gas
	Newly constructed CCS-power plants in 2020 (pilot- and demo) In EUR/ t CO ₂		
Capture	20	41	84
Transport	5	5	5
Storage	6	6	6
TOTAL	31	52	95
Newly constructed power plants in 2030			
TOTAL	30	48	87
Retrofitted power plants, built between 2005-2020, in 2030			
TOTAL	33	52	>100

Source: Own calculation based on McKinsey 2007

Macroeconomic and sectoral effects – CCS-induced employment

Number of additional employees in the average of the period

Version 1

Employees	2016-2020	2021-2025	2026-2030
	Version I: Energy consumption 2030 / 2005: - 15 percent		
TOTAL	11,700	62,900	55.200

Version 2

Employees	2016-2020	2021-2025	2026-2030
	Version II: Energy consumption 2030 / 2005: Constant		
TOTAL	22.400	75.300	88.900

Source: Own calculation based on Prognos 2007

Effects from the implementation of CCS technology to Germany

- Relatively high employment effect in service sector, trade, restaurant/hotel industry and financial sector due to increasing income (income effect)
- Employment curve reaches its peak with 76.000 additional employees in 2025 (Version 1: power consumption minus 15 percent)
- Employment curve rises to 102.000 employees in 2025 and remains at a high level until end of the decade (Version 2: constant power consumption).
- Significant reduction of expenses for imported fuels (natural gas will be substituted by hard coal)

Not included additional effects

Not or only partially included in the prognos model are macroeconomic employment effects from

- The coal mining sector in Germany
- The coal mining industry had 30.400 employees in hard coal mining (2008) and 16.400 in lignite mining (2009)

- The construction of CO₂ pipelines and preparation of CO₂ storage sites
- Costs for infrastructure are estimated at 1 million € per km (Wuppertal Institut).
- Germany might need a pipeline length of 2.000 km.

- The export of CCS-technology
- Global market is estimated at 10 billion € for 2010 and 20 billion € in 2030 (McKinsey 2009).

Conclusions

- CCS power plants can contribute to a reduction of CO₂ emissions.
- CCS-technology may reduce emission rates of coal fired power plants by 90 %.
- Abatement costs for CCS vary from 31 EUR per tonne CO₂ to 52 EUR per tonne CO₂.
- If CO₂ certificate prices (ETS) correspond to abatement costs, CCS power plants can be competitive.
- CCS can generate positive employment effects in Germany.
- The political and public acceptance of CCS is still unclear.
- Uncertainty on public acceptance of CO₂ infrastructure and storage sites.
- Financial uncertainties on investments for CCS-demonstration power plants and infrastructure.
- CCS draft act will be subject of debate by the newly elected German government from October 2009 onwards.