

MASTER

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The Quality of Energy Supply

COGENERATION'S ROLE IN SUSTAINABLE DEVELOPMENT



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The future of industrial CHP in Germany, including the Tertiary Sector

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CHP application has a long tradition in the German Industry. The economic and environmental advantage of CHP plants pays off in situations, where a continuous heat and power demand exists. As industrial heat demand is mainly dominated by process heat and not by space heating, a heat demand at industrial sites exists throughout the year. About 48 % of the industrial heat demand is technically suited for the application of CHP. The remaining part is used at temperatures above 400 °C, e.g. in the iron and steel industry, and can therefore not be produced in CHP installations. Actually more than 1000 CHP installations are operated by the German Industry. They are mainly installed in the energy intensive sectors, such as the chemical or petrochemical industry, the paper industry and the food and tobacco industry.

In 1998 the electricity production in industrial installations in Germany was about 40 TWh. This accounts for 66 % of the total electricity production with CHP plants in Germany. The presentation will analyse the developments for industrial CHP throughout the last 10 years and will try to explain the developments.

The difficult situation for the industrial CHP shows up from the sharp decrease of the total installed capacity by about 2000 MW during 1996 and 1998, already in approach of the full liberalisation of the electricity market in Germany, which has resulted in further and even more plant shut downs. Based on a survey of the German Association of Industrial Autoproducers and Energy Consumers (VIK) plants with a total capacity of 500 MW were closed down in 1999, and about 60 % of the industrial CHP installation are facing serious economic problems. The presentation will show some sample economic calculations for different types of plants (Coal fired steam turbines, gas turbines, IC-engines). These results will be compared to the actual energy cost structures for industrial customers. Based on large over capacity in power generation, the offered electricity prices for industrial customers tend to be in the range off the operating cost of the industrial CHP plants. One way out of this dilemma is sometimes the outsourcing and contracting of CHP installations, which has been and still is a growing business in Germany, and utilities regard these options as a possibility to keep their industrial customers.

A technical important issue when dealing with industrial CHP is the changes in the ratio of electricity to-heat demand in industry. During the last 20 years significant improvement where made to reduce the heat consumption of industrial processes. However the electricity consumption has increased due to higher automatisisation. The extension of process heat recovery has also increased energy consumption for pumping and transportation. As CHP plants have generally a fixed heat to electricity ratios, this has also caused plant modifications or shut downs, as back up power is still very expensive.

However, in contrast to the long term economic and ecological advantages of industrial CHP only minor parts of the total heat and electricity demand are satisfied by CHP. In 1995 only 13 % of the total heat demand in industry and 1 % of the total heat demand in the tertiary sector has been supplied from CHP plants. Demand forecasts for industry, disaggregated by industrial sectors result in a reduction of the industrial heat demand by about 4 % in 2005. However still large CHP potentials can be tapped, if the market situation gets stabilised and policy measures will be implemented to promote CHP.

In Germany already owners of CHP plants do not have to pay the "Ecological Tax" (Ökosteuer) under certain conditions (Power smaller than 2 MW_e; Total efficiency higher than 70 %). Other policy measures, however, e.g. the shortly introduced bonus system for public CHP plants do not take into account the industrial CHP installations.



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Industrial Cogeneration in Germany

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Papers presented at the COGEN EUROPE'S 7th Annual Conference,
18 - 20th October 2000, Brussels

- Setting the Scene for CHP
- Actual Status of Industrial CHP
- Economics of Industrial CHP
- Future Trends and Targets
- Summary

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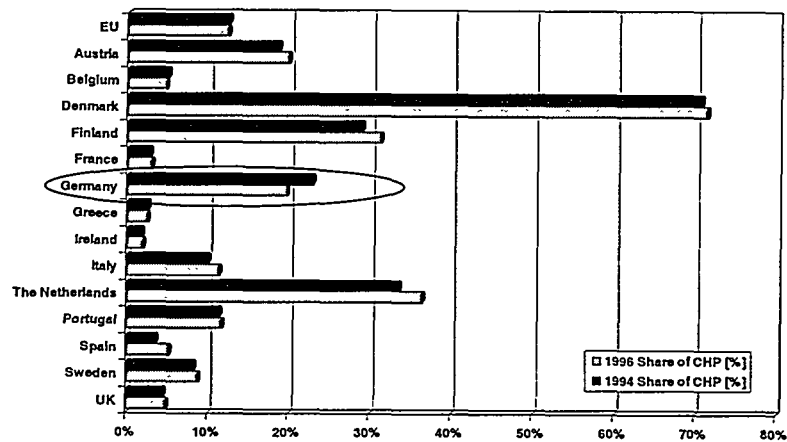


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Folie 1

Dr. Peter Radgen, Institut für Systemtechnik und Innovationsforschung

Share of CHP in the EU (capacity)



Share of CHP of total gross installed electrical capacity

Source: European Cogeneration Review 1999

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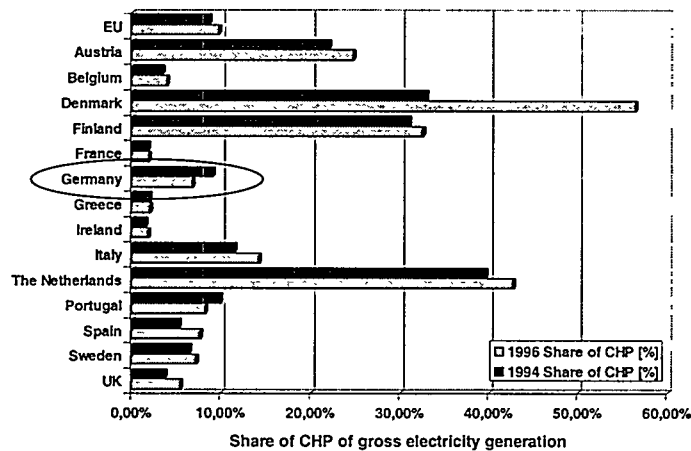


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Folie 2

Dr. Peter Radgen, Institut für Systemtechnik und Innovationsforschung

Share of CHP in the EU (generation)



Source: European Cogeneration Review 1999

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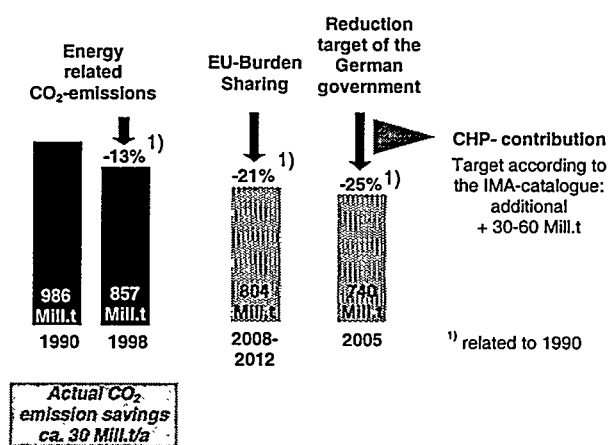


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CHP in Germany and its impact on the Kyoto target



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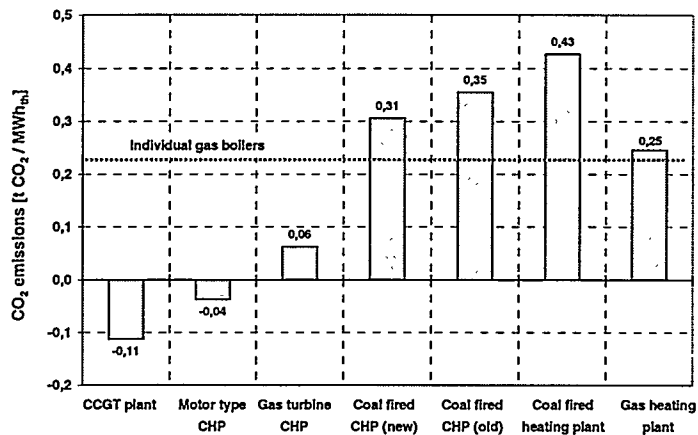


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Specific emission reduction by CHP



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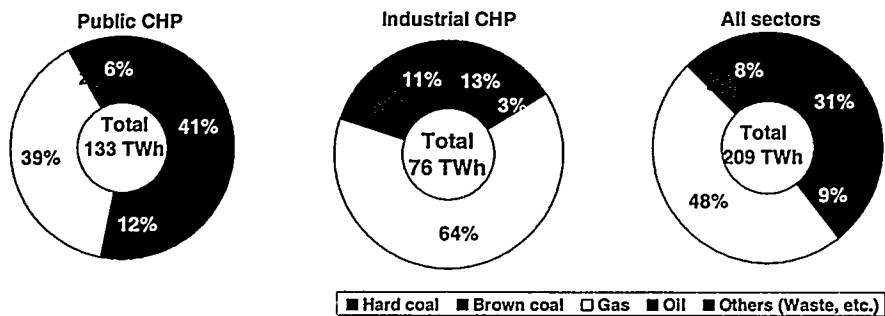


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Folie 5

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Fuels used for CHP in Germany



Source: AGFW Vorstudie 2000; values of 1998 (public sector) and 1997 (industrial sector)

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Folie 6

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Electricity from CHP in Germany

Sector of production	Year	Electricity demand	Electricity generation	Electricity generation from CHP		Heat demand (< 100°C)	Heat generation	Heat generation from CHP	
		TWh	TWh	TWh	%	TWh	TWh	TWh	%
Public supplier	1991	-	459,1	18,7	4,1%	-	98,9	56,3	57,0%
	1998	-	493,3	28,1	5,4%	-	98,7	65,4	66,0%
Industry	1991	223,8	73,7	39,2	18,0%	-	-	-	-
	1998	215,5 ¹	51,5	40,5 ^{1 2}	19,0%	1191	-	70,2 ¹	59,0%
Tertiary sector	1997	124	-	-3	2,0%	313	-	-4	1,0%

¹ 1997 ² incl. condensing- and -tapping operation

Sector	Year	Steam turbine		Gas turbine		CCGT		Motors		Total	
		MW	number	MW	number	MW	number	MW	number	MW	number
Public CHP	1998	8370	168	1067	47	1602	20	420	386	11459	621
Industrial CHP	1997	5880	-	1378	-	0 ¹	-	208	-	7466	-

¹ not separately classified; included in steam turbines

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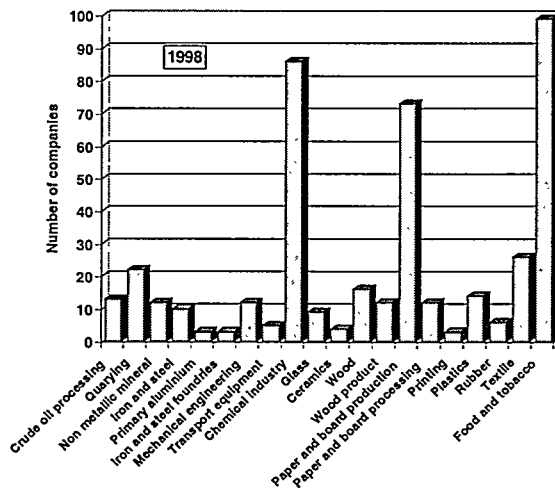


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Number of auto producers of electricity in Germany by sector



Source: Bode, Systemtechnik GmbH

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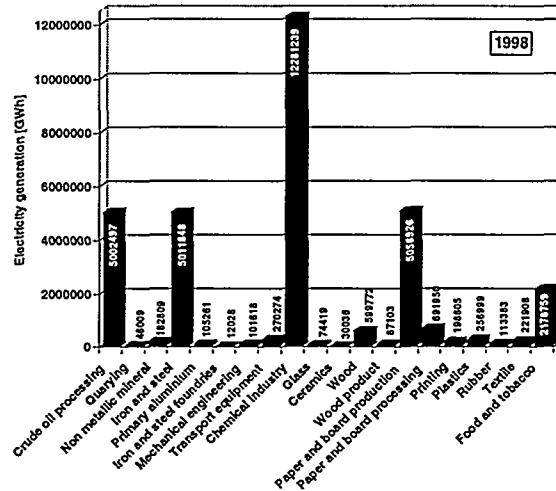


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Electricity generation in the German industry by sector



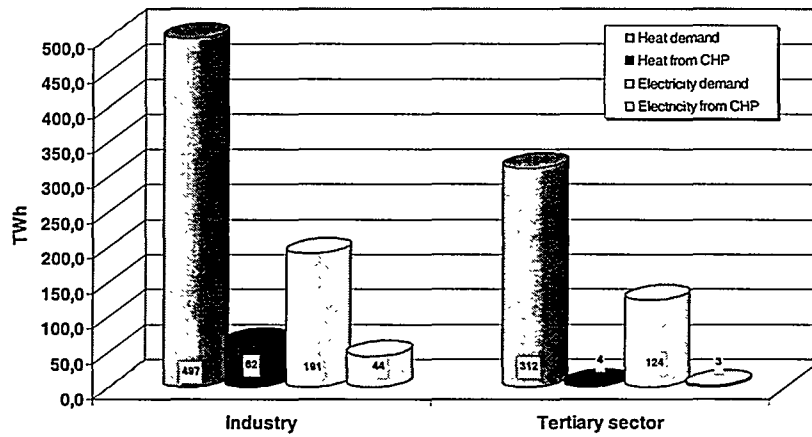
Source: Bundesagentur für Wirtschaftsinformationssysteme

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Combined heat and electricity generation in Germany (1995)



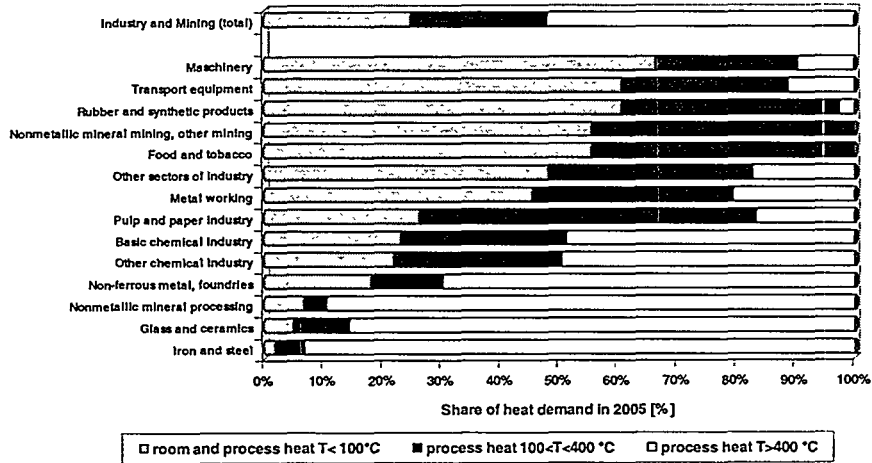
Source: Fhg-ISL, 1999

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Outlook on industrial heat demand in Germany in 2005

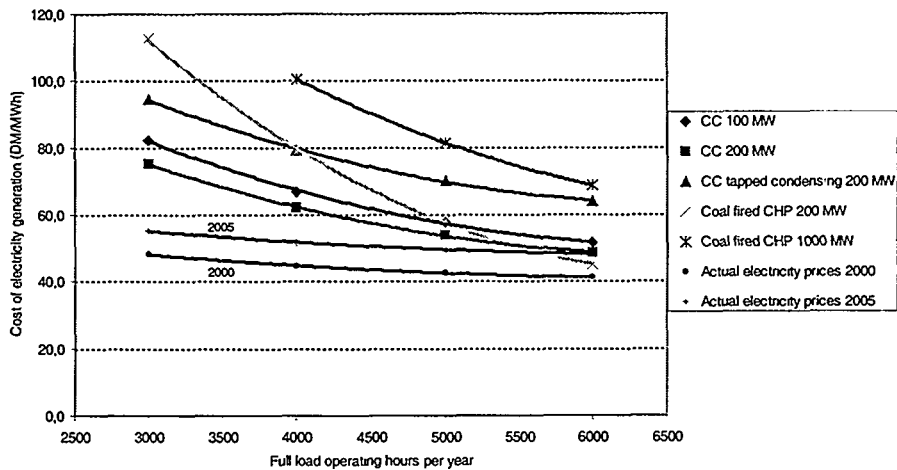


Source: Fraunhofer ISI, 1999

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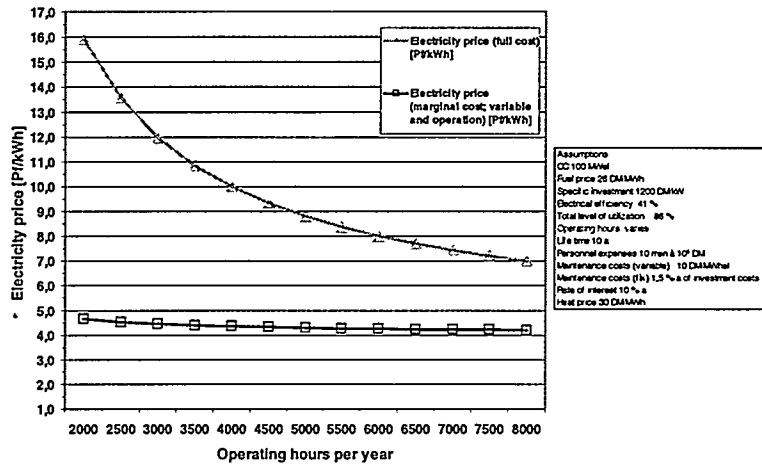
Achievable cost for electricity with new CHP installation assuming a heat revenue of 40 DM/MWh



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Economics of CHP (operating hours)



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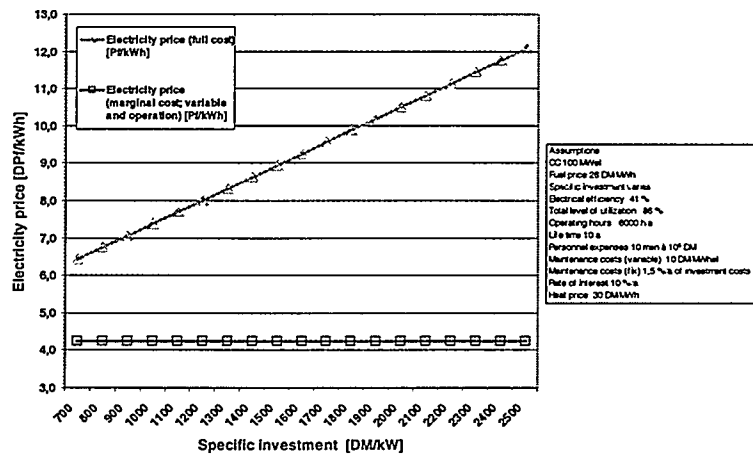


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Economics of CHP (specific investment)



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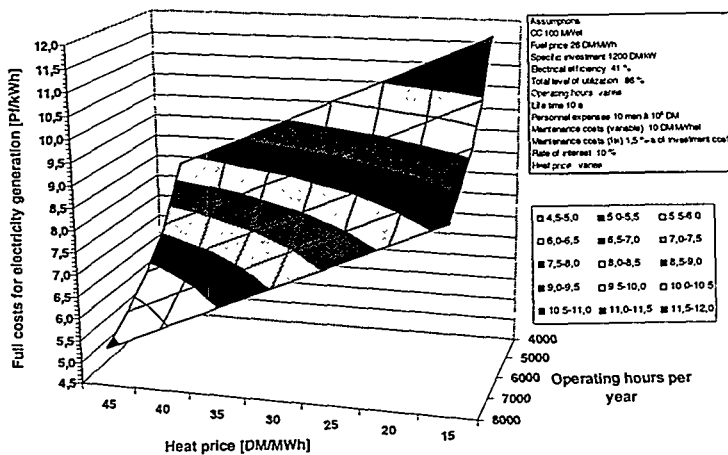


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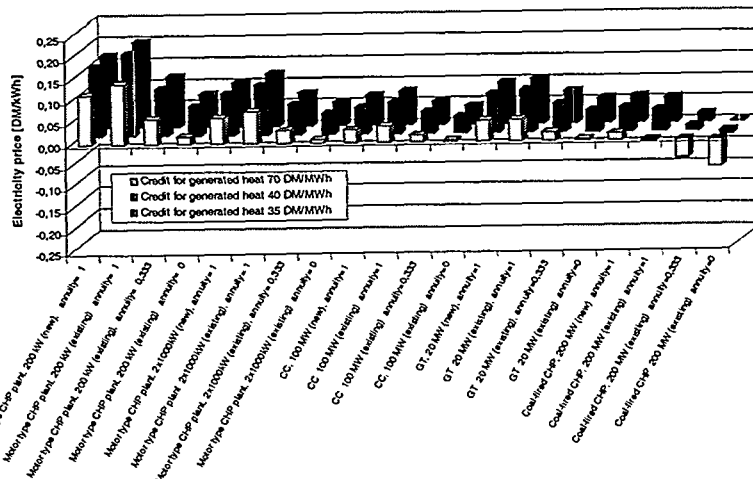
Economics of CHP (heat price and operating hours)



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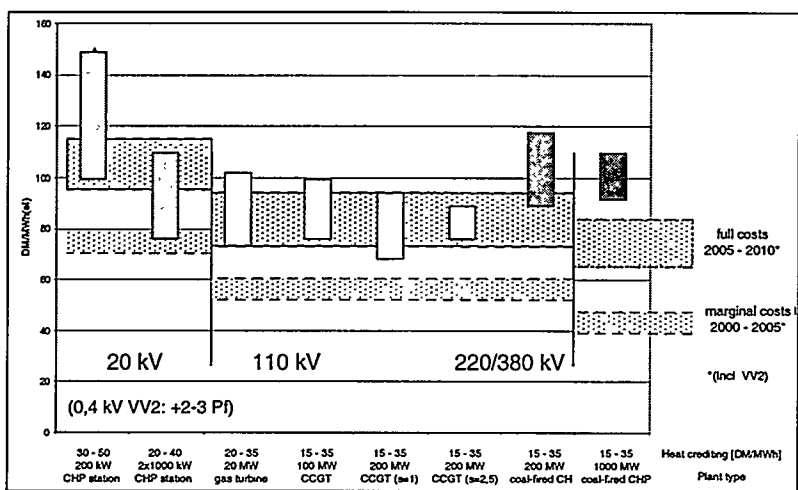
Necessary electricity prices for profitable CHP operation



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Cost of electricity from CHP in Germany



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Capacity expansion for electricity generation

Capacity Expansion for power in GW _{el}						
	1995 - 2000	2000 - 2010	2010 - 2020	1995 - 2020	2020 - 2030	
Utilities	54,7	134,3	225,4	414,4	281,3	
Industrial Generators	11	49,1	39,7	99,8	70,9	
Other Generators	6,1	27,3	46,1	79,5	41,6	
Total Power	71,8	210,7	311,2	593,7	393,8	
of which with CHP possibility (in GW _{el})						
Utilities	11,5	6,8	25,7	44	19,8	
Industrial Generators	8,2	45,3	38	91,5	69,4	
Other Generators	2,3	17,3	25,2	44,8	19,2	
Total CHP	22	69,4	88,9	180,3	108,4	

Source: Energy in Europe 1999

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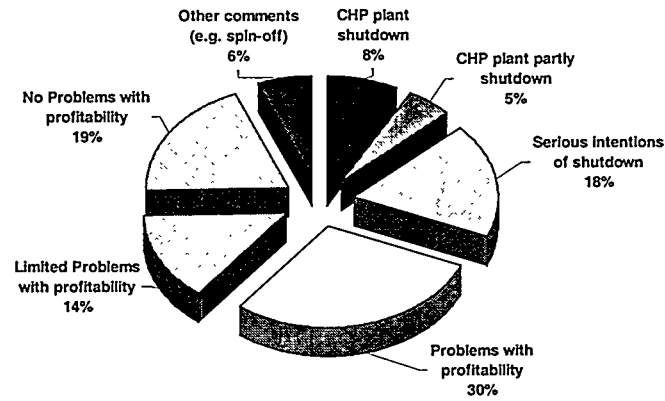


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The future of CHP - an industrial perspective



More than 30 % of industrial CHP may be shutdown in the near future.

source: VIK, Februar 2000

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Dr. Peter Hagen, Fraunhofer IPT, Bielefeld, 0511/346410, Fax: 0511/346412, e-mail: Peter.Hagen@ipt.fraunhofer.de

CHP under pressure

Shut down of industrial CHP installations

(about 500 MW realised; much more under risk)

Straßfurt (Chemical industry, 8000 h) CCGT 150 MW
Bernburg (Chemical industry, 8000 h) CCGT 150 MW
Rhodia/Freiburg (Chemical industry, 7000 h) GuD 70 MW
Grünperga (Paper, 7000 h) Steam turbine
Neustadt (Paper, 7000 h) Steam turbine
Albbruck (Paper, 7000 h) Steam turbine
Dow Chemical (Chemical industry, 7000 h) Gas turbine
Penig (Paper, 7000 h) Steam turbine
KBC/Lörrach (Textile, 4500 h) Steam turbine
Micheln/Homberg (Reifen, 7000 h) Gasturbine

Shut down of CHP in the public sector (realised or planned)

- . Bremen
- . Munich
- . Berlin
- . Duisburg
- .
- .

shut down: about 1000 MW
under risk: about 1/3 of total capacity

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Why CHP should be supported

- To motivate industry to make long term investments in CHP which make good economic and ecological sense.
- To avoid shut down of CHP (industrial and public) which are competitive on the basis of full costs, compared to the separated generation of heat and power.
- To use the ecological potential of CHP to reduce the greenhouse gas emissions at low costs.
- To reduce the cost of CHP installations and heat distribution systems to compete with other technologies at lowest level.
- To prevent that short term overreaction on market liberalisation will hinder an efficient generation of heat and power in the future.