Electricity: Renewable Energies Act (EEG)

Guaranteed electricity feed in tariffs

- Planning guarantee: feed in conditions for 20 years
- Degression of tariffs and bonuses: 1 % p.a.
- Internal rate of return about 10 %

ct / kWh_{el}	**Tariff composition**						
	Basis tariff	Bonus, additive					
		Natural biomass		Manure > 30 %	Rural Conser-vation	CHP	Immis-sion
		Biogas	Others				
≤ 150 kW_{el}	**11,67**	+ 7,0	+ 6,0	+4,0	+2,0	+ 3,0	+ 1,0
≤ 500 kW_{el}	**9,18**	+ 7,0	+ 6,0	+1,0	+2,0	+ 3,0	+ 1,0
≤ 5 MW_{el}	**8,25**	+ 4,0	+ 4(2,5)			+ 3,0	
≤ 20 MW_{el}	**7,79**					+ 3,0	

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Electricity: Renewable Energies Act (EEG)

Regulations for bonus system:

- All bonus schemes are additive
- CHP bonus: when on positive list **or** substitution of fossile fuels is realised **or** additional costs for heat use > 100 € / kW for investment
- Immission bonus: keep within limits of formaldehyde emissions
- Natural biomass (energy crops): only for electricity **share** from natural biomass and covered residues storage
- Innovation (additive): Fuel Cells, gas turbines, steam engines, ORC-processes, Kalina Cycle processes, Stirling engines, biowaste use with aftercomposting **and** electrical efficiency > 45 %: 2 ct/kWh up to 5 MWel **or** gas upgradation < 350 Nm^3/h 2 ct/kWh; < 700 Nm^3/h 1 ct/kWh at < 0,5 % methane emissions and < 0,5 kWh / Nm^3 electricity demand and renewable heat supply

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Teamwork

Exemplary calculation of tariffs for biogas plants.

1200 kW_{el} from 10 % manureand
90 % energy crops

Calculation Example: Biogas Plant based on maize silage and manure

1,2 Mwel CHP plant 7300 hours full load per year
Average: 1200x(7300/8760) = 1000 kWel electricity generation
Heat use: 40 % of excess heat (without own demand) ca. 300 kW
Calculation of tariff and income:

150 kW share		basis tariff	11,67 ct/kWh		
150x8760	1314000 kWh	natural biomass	7,00 ct/kWh		
		CHP use	1,20 ct/kWh		
		emission	1,00 ct/kWh		
		Total tariff	**20,87 ct/kWh**	**274.231,80 €**	
150-500 kW share		basis tariff	9,18 ct/kWh		
350x8760	3066000 kWh	natural biomass	7,00 ct/kWh		average
		CHP use	1,20 ct/kWh		Tariff
		emission	1,00 ct/kWh		16,29 ct/kWh
		Total tariff	**18,38 ct/kWh**	**563.530,80 €**	
500-1000 kW share		basis tariff	8,25 ct/kWh		
500x8760	4380000 kWh	natural biomass	4,00 ct/kWh		
		CHP use	1,20 ct/kWh		
		emission	0,00 ct/kWh		
		Total tariff	**13,45 ct/kWh**	**589.110,00 €**	
				1.426.872,60 €	

Additional income: Heat sales 3 ct/kWh:	78.840,00 €	**1.505.712,60 €**
(Fertilizere sales:)	45.000,00 €	1.550.712,60 €
Main costs: Investment 4 Mio €:	300.000,00 €	
Maintenance and others:	170.000,00 €	
Energy demand:	105.000,00 €	
Substrates:	500.000,00 €	
Personnel:	120.000,00 €	**1.195.000,00 €**

Calculation Example: Biogas Plant based on food residues and manure

1,2 Mwel CHP plant 7300 hours full load per year
Average: 1200x(7300/8760) = 1000 kWel electricity generation
Heat use: 40 % of excess heat (without own demand) ca. 300 kW
Calculation of tariff and income:

150 kW share		basis tariff	11,67	ct/kWh		
150x8760	1314000 kWh	natural biomass	0,00	ct/kWh		
		CHP use	1,20	ct/kWh		
		emission	1,00	ct/kWh		
		Total tariff	**13,87**	**ct/kWh**	**182.251,80 €**	
150-500 kW share		basis tariff	9,18	ct/kWh		
350x8760	3066000 kWh	natural biomass	0,00	ct/kWh		average
		CHP use	1,20	ct/kWh		Tariff
		emission	1,00	ct/kWh		10,79 ct/kWh
		Total tariff	**11,38**	**ct/kWh**	**348.910,80 €**	
500-1000 kW share		basis tariff	8,25	ct/kWh		
500x8760	4380000 kWh	natural biomass	0,00	ct/kWh		
		CHP use	1,20	ct/kWh		
		emission	0,00	ct/kWh		
		Total tariff	**9,45**	**ct/kWh**	**413.910,00 €**	
					945.072,60 €	

Additional income: Heat sales 3 ct/kWh:	78.840,00 €	**1.023.912,60 €**
(Fertilizere sales:)	45.000,00 €	1.068.912,60 €
Main costs: Investment 4 Mio €:	300.000,00 €	
Maintenance and others:	170.000,00 €	
Energy demand:	105.000,00 €	
Substrates:	- €	
Personnel:	120.000,00 €	**695.000,00 €**

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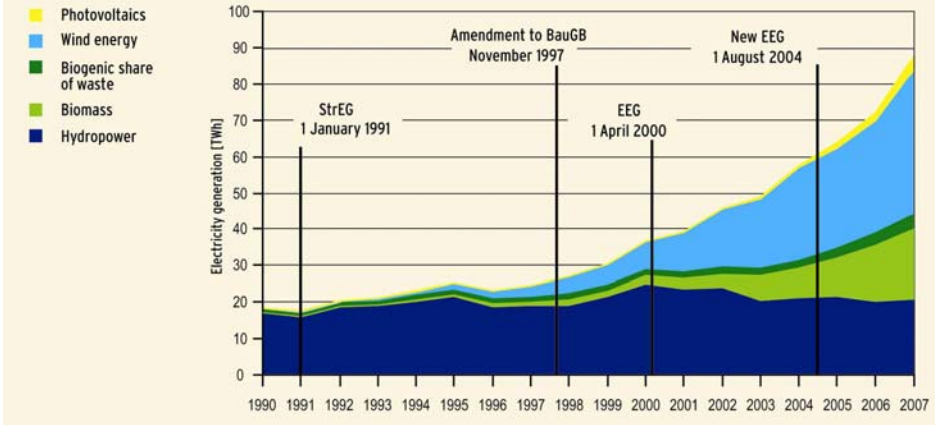
Development of RES sector in Germany



StrEG: Act on the Sale of Electricity to the Grid
BauGB: Construction Code
Geothermal electricity generation not shown, due to the negligible quantities of electricity produced

Source: BMU publication „Renewable energy sources in figures - national and international development", Status: June 2008

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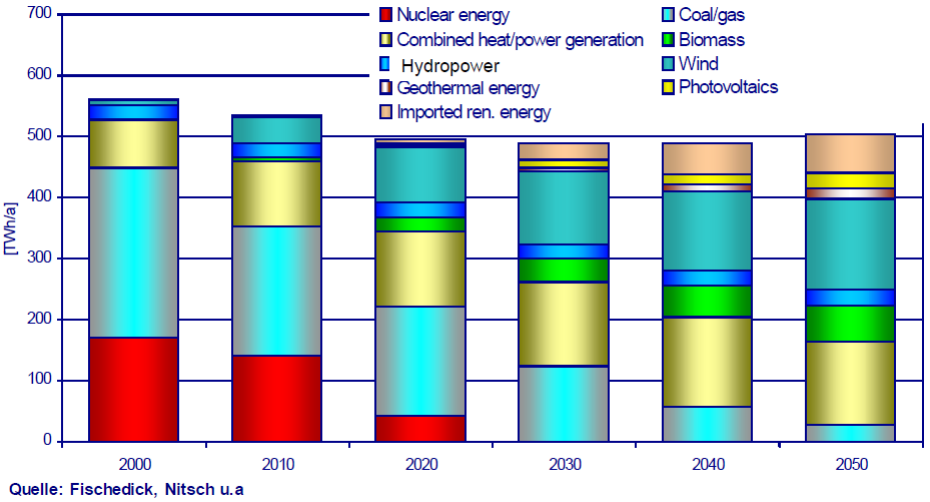
Electricity scenario up to 2050 – achievable with EEG support



Quelle: Fischedick, Nitsch u.a

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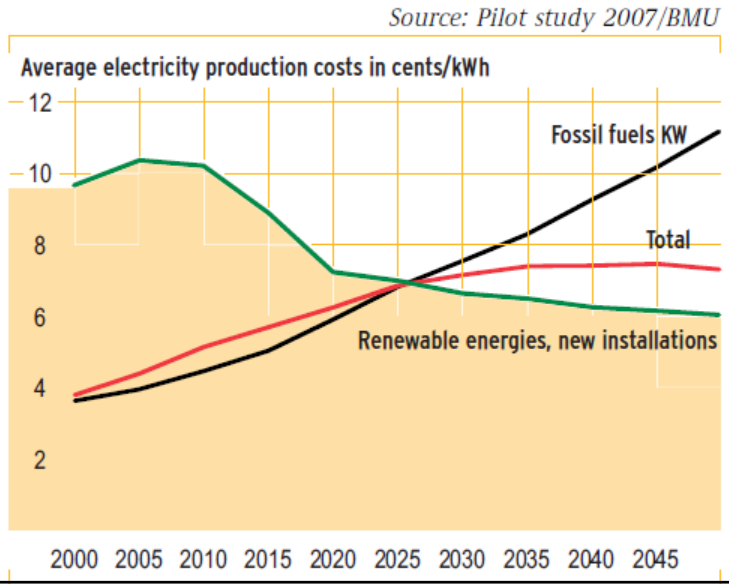
Average electricity production costs



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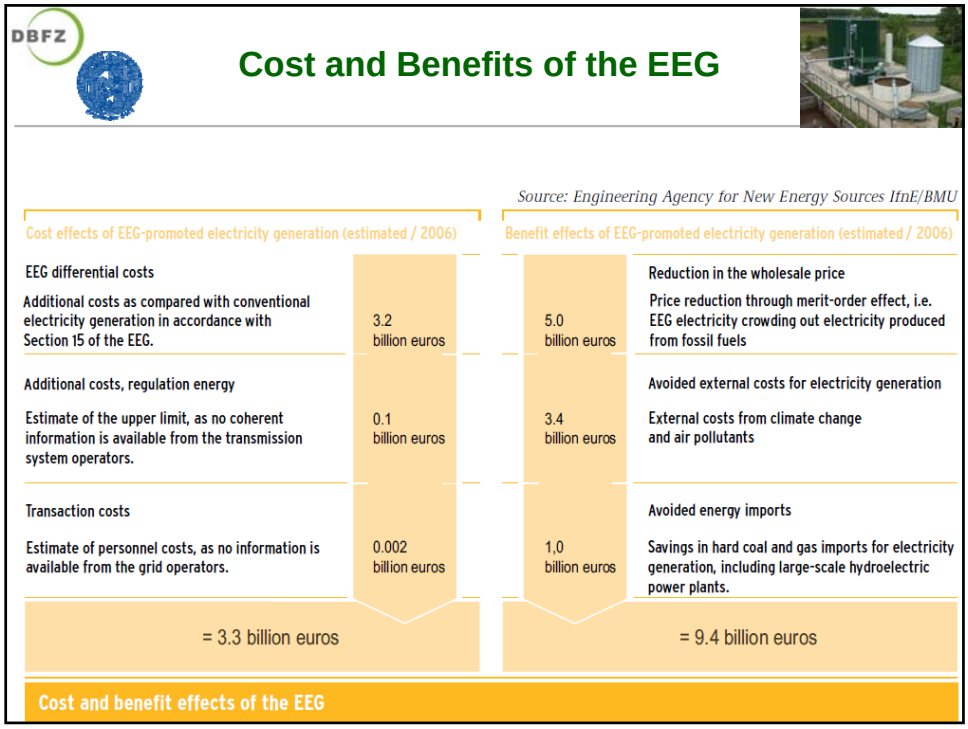
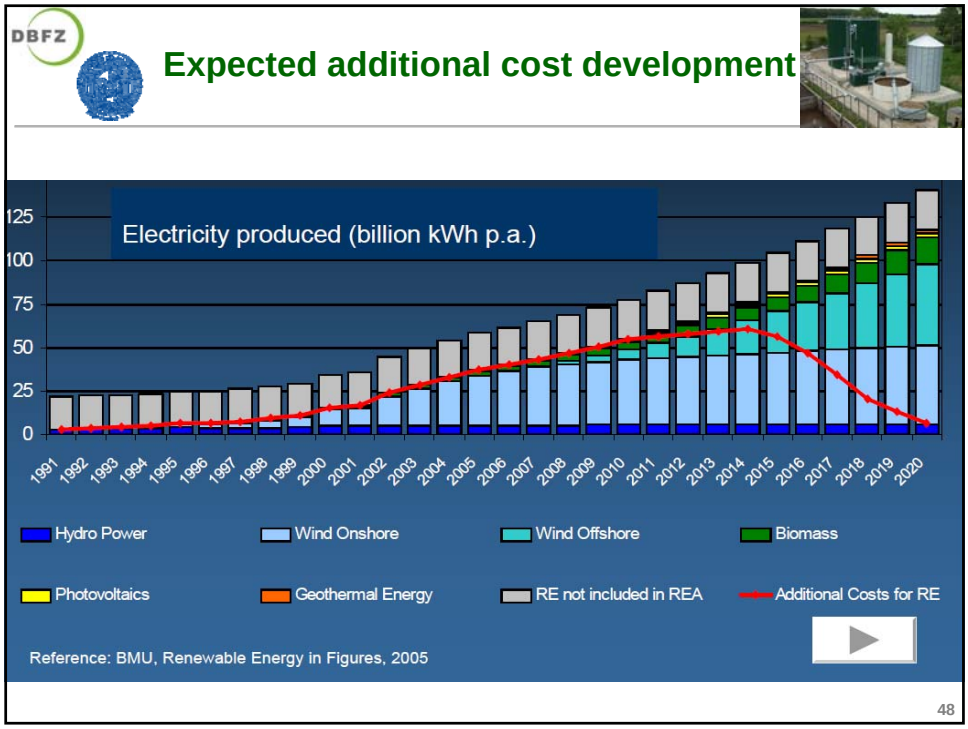

DBFZ
Cost and Benefits of the EEG
Source: Engineering Agency for New Energy Sources IfnE/BMU
Cost effects of EEG-promoted electricity generation (estimated / 2006)
Benefit effects of EEG-promoted electricity generation (estimated / 2006)
EEG differential costs
Additional costs as compared with conventional electricity generation in accordance with Section 15 of the EEG.
3.2 billion euros
Additional costs, regulation energy
Estimate of the upper limit, as no coherent information is available from the transmission system operators.
0.1 billion euros
Transaction costs
Estimate of personnel costs, as no information is available from the grid operators.
0.002 billion euros
= 3.3 billion euros
Reduction in the wholesale price
Price reduction through merit-order effect, i.e. EEG electricity crowding out electricity produced from fossil fuels
5.0 billion euros
Avoided external costs for electricity generation
External costs from climate change and air pollutants
3.4 billion euros
Avoided energy imports
Savings in hard coal and gas imports for electricity generation, including large-scale hydroelectric power plants.
1,0 billion euros
= 9.4 billion euros
Cost and benefit effects of the EEG


DBFZ
Expected additional cost development
Electricity produced (billion kWh p.a.)
125
100
75
50
25
0
1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
Hydro Power
Wind Onshore
Wind Offshore
Biomass
Photovoltaics
Geothermal Energy
RE not included in REA
Additional Costs for RE
Reference: BMU, Renewable Energy in Figures, 2005
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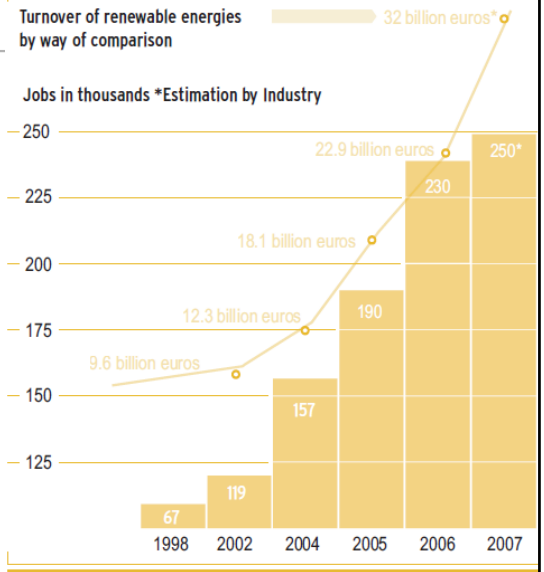
Job Effects and Turnover – all renewables in Germany due to EEG

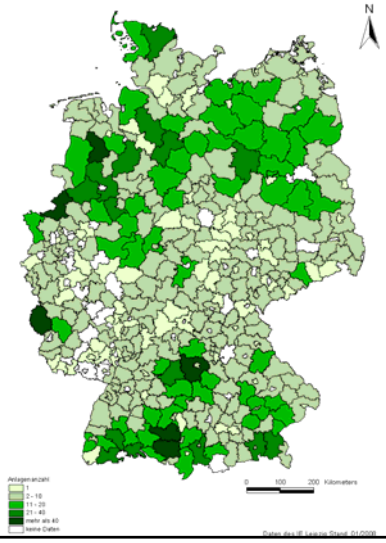
Source: DIW/DLR/GWS/ZWS/ Job impact Turnover – BMU/ Renewable Energies Statistics



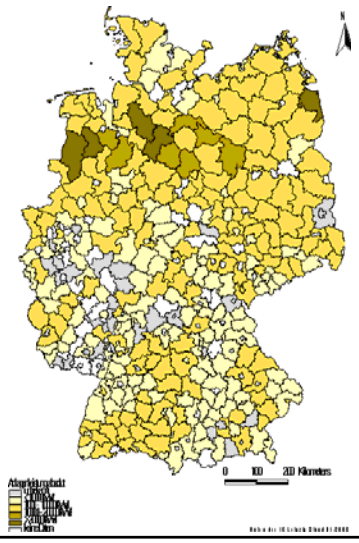
Jobs and turnover for the German renewable energies sector

Number and installed capacity of electricity producing biogas plants

Plant number



installed elektrical capacity



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Conclusions from support schemes

- EU-Commission (2005):
  - „feed-in tariffs are currently in general cheaper and more effective than so called quota systems“, because
    - They give high planning and investment security
    - Involve lower rists for investors
    - Cause low transaction costs
- Success depends highly on details of regulation
  - Design carefully and properly!
    - Different tariffs
    - Sufficient payback periods
    - Administrative framework conditions, e.g. admission regulations, electricity grid capacity, priority feed in…

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Heat: Renewable Heat Act and Market Incentive Program

- **Renewable Heat Act**
  - Obligation to use renewable energy in new buildings
  - As of 1 January 2009 owners of new buildings > 50 m² will be obliged to provide a minimum share of their heat demand with RES:
    - min. 15% with solar energy **or**
    - min. 30% with biogas district heating if provided by a CHP plant **or**
    - min. 50% with liquid biofuelswhen sustainability is certified **or**
    - min. 50% with biomass in high efficient systems **or**
    - min. 50%with heat pumps.

- **Market Incentive Program**
  - Subsidies for modern ovens for pellets / split logs
  - Subsidies for raw biogas grids and district heating grids
  - Investment grants for innovative bioenergy production plants / demonstration plants

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Biofuels: BiofuelsDirective, Biofuels Quota Act, Energy taxes Act

- **BioFuelsDirective / Biofuels Quota Act**
  - Clear target quotas; biogas is one of the biofuels options
  - Intention: Increasing share of biofuels to > 6,25% by 2015 (relating to energy content)
  - Fuel selling enterprises are obligated to sell a minimum quota of biofuels; purchase at market conditions
  - Biofuels are fully taxed within the quota
  - Pure biofuels enjoy tax privileges until 2012
  - E85 and the 2nd generation of biofuels enjoy tax exemption until 2015
  - (pure as well as in blendings)
  - Pure biofuels used in agriculture remain tax-exempt

Biofuel quota act

- Biofuel Quota Act (Jan 2007)
  - Introduction of biofuel quotas for:
    - Producers and traders of Diesel fuel and gasoline
    - Producers of biofuels (biodiesel, vegetable oils)
  - Quotas related to energy content

Year	Total quota	Diesel quota	Petrol quota
2007	-	4,40	1,20
2008	-		2,00
2009	5,25		2,80
2010	6,25		3,60
2011	6,25		
2012	6,25		
2013	6,25		
2014	6,25		
2015	6,25		

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Energy taxes Act

- **Until July 2006:**
  - **Compensation of cost disadvantages of biofuel production plus small incentive**
- **Since August 2006:**
  - **Avoiding overcompensation of fiscal support**
  - **Gradual increase of taxes for biodiesel and vegetable oil fuel**
  - **Adjustment of fiscal support of biofuels due to changes in**
  - **cost structures**

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Energy taxes Act

- Energy Tax Act (Aug 2006)
  - Since Aug 2006 taxation of pure biofuels
  - Tax exempted:
    - 2nd generation until 2015
    - Biofuels used in agriculture and forestry

Year	Tax rate biodiesel (Cents/l)	Tax rate vegetable oil (Cents/l)
2006	9	0
2007	9	2,15
2008	15	10
2009	18	18
2010	24	26
2011	30	33
From 2012	45	45

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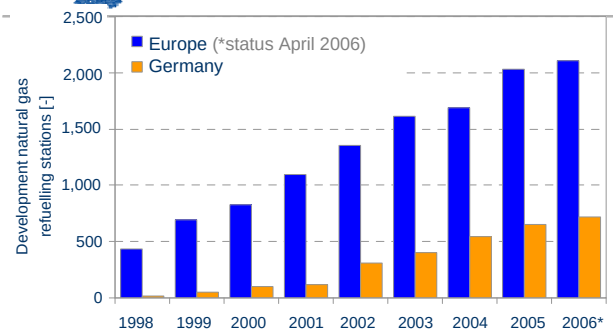
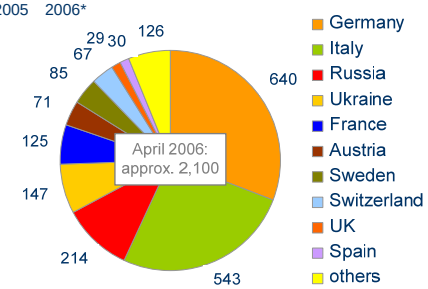
Biofuels: Industrial commitment

- **Commitment of Gas Suppliers**
  - 10/20% biomethane for transportation using natural gas in 2010/2020
  - No governmental regulation
  - Voluntary
  - Market share of gaseous fuels will raise significantly

Present status of gaseous fuels in Europe and Germany

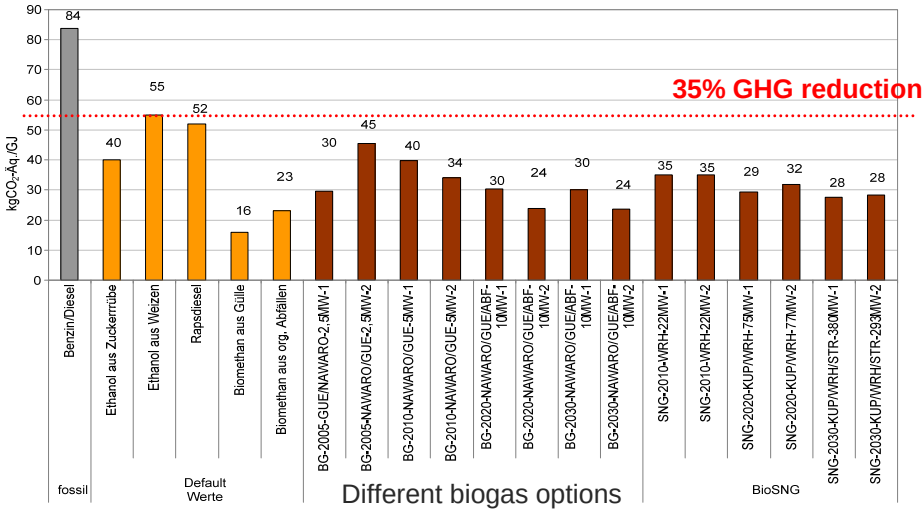


Germany
- 07/2007: more than 62,000 CNG vehicles (overall approx. 46.5 mn vehicles)
- 10/2007: approx. 755 refuelling stations, one biogas refuelling station (overall approx. 14,660 stations)



Source: ENGVA, 2007 / IE Leipzig, 2007

Sustainability of biofuels is required



Quelle: FNR-Studie Biomethan als Kraftstoff 2009

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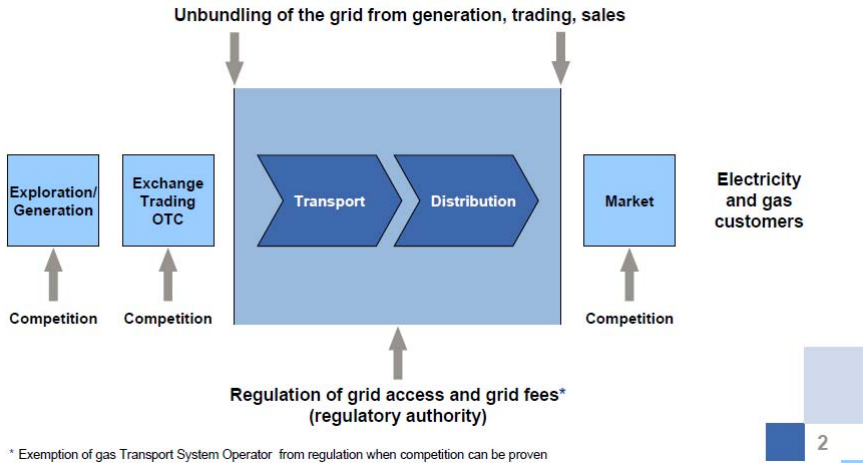
Biomethane: Gas Entry Act; Basis: Trading models



* Exemption of gas Transport System Operator from regulation when competition can be proven

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Biomethane: Gas Entry Act

- Priority for renewable gas injection into the national gas grid
  - If free capacities!!
- Clear process for application of gas injection point
  - Time schedules
  - responsibilities
- Defined shares of investment for biogas and grid operator
  - Upgradation: biogas producer
  - Quality and pressure adaption and measurement: 50/50
- Defined tariff for avoided gas grid costs (0,7 ct/kWh)
- Costs for gas grid use (>= 0,1 ct/kWh)
- Defined gas quality requirements (DVGW)
- Technology requirements
- Trading: responsibility is at biogas producer or third party
  - To be balanced within one year

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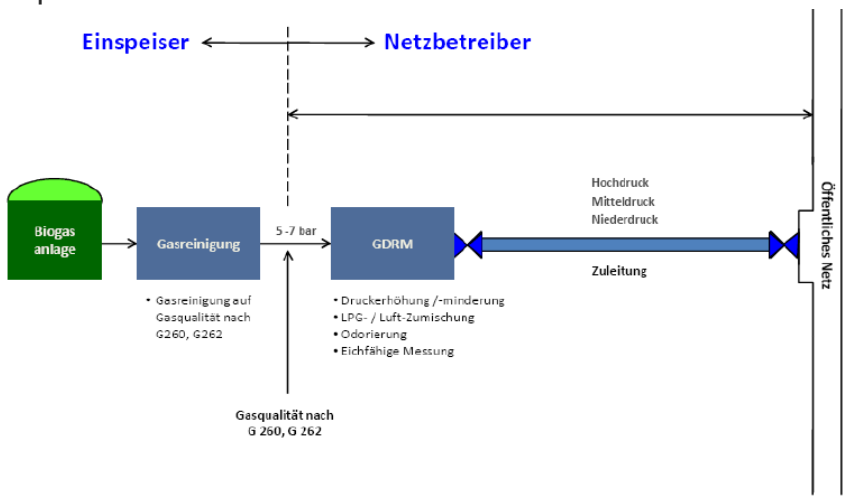
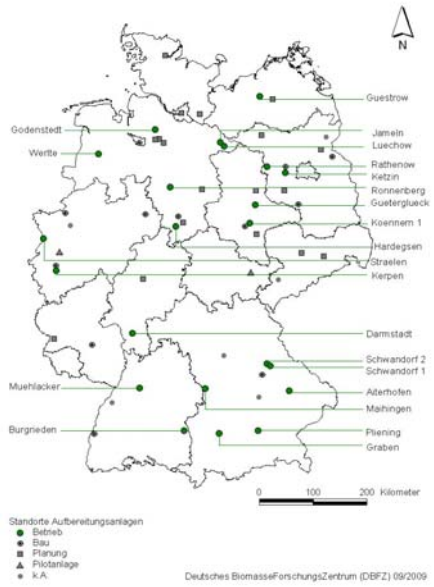
Biomethane: Gas Entry Act

- Responsibilities



Darstellung: BMP Green Gas GmbH, München

Biogasupgradation and injection plants in Germany in Operation / Planning



actually 23 Biogas upgradation plants in operation

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General enforcement for biogas production and utilization

- **Reduced interest rates for loans for biomass plants, CHP, heat storage vessels, equipment for biogas conditioning**
- **Kyoto mechanisms**
  - **Not always to be seen as additive**
- **Waste management rules (Landfill directives) for (biological-mechanical) pretreatment of waste**
- **Massive support of applied and basic research**
- **Market interest in energy from biogas**

Summary

- **Strong, effective and complex political support of bioenergy supply, i.e. biogas production and utilization lead to**
  - **about 4.000 biogas plants in Germany**
  - **the situation that Germany is one of the most important technology provider in this sector**
  - **German research institutions are working very hard for improvements of the biogas process**
- **Most important facts for this development:**
  - **Reliability of long lasting support measures**
  - **Clear rules for guaranteed priority feed in of energy from biogas**
  - **Clear financial rules/tariffs for biogas energy sales**

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References / Sources of information

- WBGU-Report on climate change
  - http://www.wbgu.de/wbgu_jg2007_engl.html
- German Minstry of Environment (Renewable Energy Sources Act, Statistics and other english general information)
  - http://www.erneuerbare-energien.de/inhalt/3860/
  - http://www.erneuerbare-energien.de/inhalt/42934/
- Federal Agency on renewable biomass supply
  - http://www.fnr-server.de/cms35/index.php?id=139
- Export initiative Renewable Energies
  - http://www.renewables-made-in-germany.com/

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