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**Experience and future perspectives of  
biomethane in the natural gas grid in  
Germany**

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**Ecologic Institute**

On secondment to the Federal Ministry for the  
 Environment, Nature Conservation and Nuclear Safety  
 Division KI III 2 – Solar Energy, Biomass, Geothermal Energy,  
 Market Introduction Programmes for Renewable Energies



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**Ecologic Institute**


- think tank for applied environmental research, policy analysis and consultancy
- offices in Berlin, Brussels, Vienna and Washington DC
- private, independent and non-profit Institute
- founded in 1995
- partner in the network of Institutes for European Environmental Policy
- our project: legal and scientific assistance for Federal Ministry for the Environment (BMU)
  - evaluation and advancement of Renewable Energies Sources Act (EEG) and associated ordinances
  - advancement of legal framework conditions and guidelines for biogas production, -upgrading and -grid injection,
  - knowledge development and implementation of sustainability standards for energetic utilization of biomass
  - evaluation and advancement of Renewable Energies Heat Act (EEWärmeG)

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## Outline


- biomethane – political targets, utilization priorities
- legal framework and incentive scheme
- biogas feed-in in Germany
  - recent developments
  - economic issues
- biomethane – challenges, future perspectives and conclusions from amendment of legal framework
- impressions of selected biogas feed-in projects at a glance

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## Political targets – Energy strategy 2050 Government

- **Goal:** Germany, most energy efficient and climate friendly economy with competitive energy prices and high prosperity level at the same time
- longterm strategy until 2050 for transformation of energy supply towards a sustainable energy economy
  - renewable energy as a key towards sustainability
  - energy efficiency, halving primary energy consumption
  - reorganization of grid infrastructure (power, gas)
  - energetic building refurbishment
  - sustainable mobility
  - binding policy targets, agreement on financing concept ...

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**National targets for 2020 (a selection):**

- CO<sub>2</sub>-emission reduction of 40% (compared to 1990)
- share of renewable energies in different energy sectors:
  - 35% in electricity sector („at least“)
  - 14% in heat sector
  - 10% biofuels
- CHP share within electricity sector at least 25%


**National targets for 2050:**

- CO<sub>2</sub>-emission reduction up to 80 – 95%
- consequences: power generation almost entirely by RES necessary

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**Gov's Energy strategy 2010: establishment of obligatory targets**


	Climate	RES		Efficiency		
	GHG reduction (base 1990)	share power sector	share total	primary energy	energy productivity	building refurbishment
2020	- 40 %	35%	18%	- 20%	yearly improvement 2%	rate double 1% → 2%
2030	- 55 %	50%	30%	<div> ↓ </div>		
2040	- 70 %	65%	45%			
2050	- 80-95 %	80%	60%			


source: BMU 2010

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## How can biomethane contribute to achieve the targets?


- biogas potential based on energy crops, residues and waste materials
- contribution of biogas to climate protection (GHG reduction)
  - environmental impacts – sustainable biomass supply
  - minimization of GHG-emissions along the value chain of biogas production
  - biogas utilization pathways
  - energy efficiency
  - assessment of biogas utilization pathways within in the whole bioenergy sector
- conclusions for amendment of incentives, laws and ordinances
  - fields of action within the different energy sectors?

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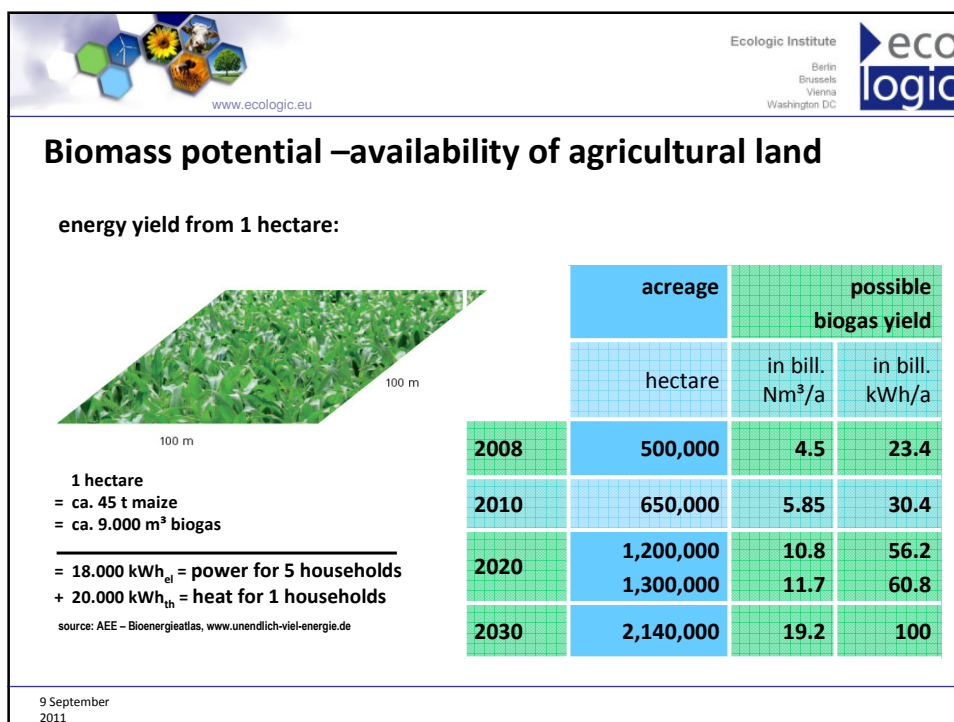
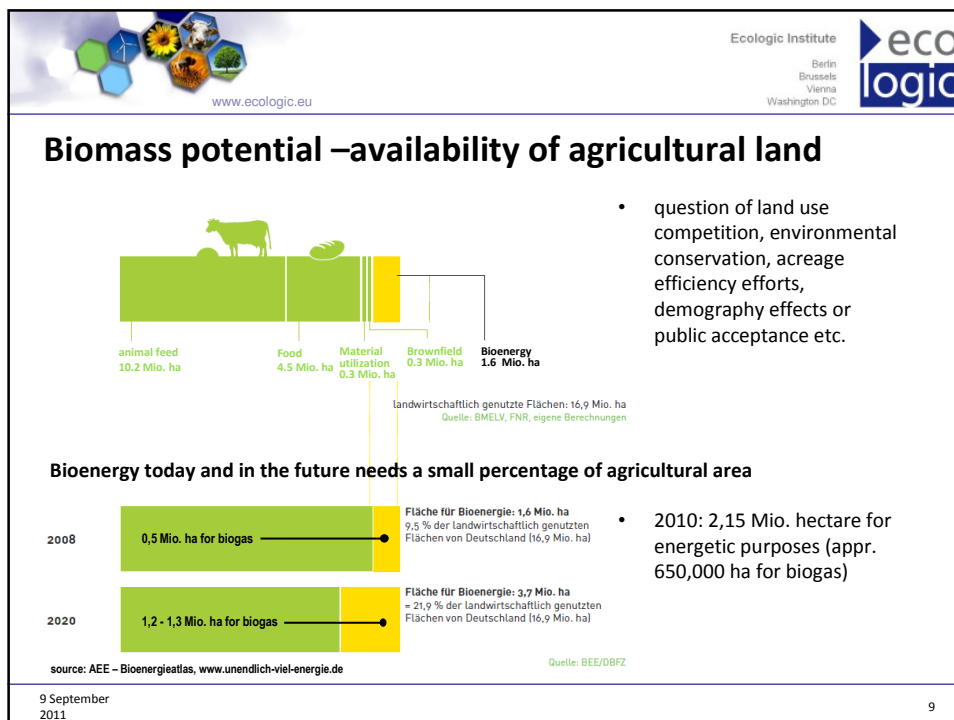
## Biogas potential from residue and waste materials


residue and waste material categories technical potential for 2020 (Germany)	billion kWh/a
grass clipping	6.4
landscape conservation materials	4.4
solid dung, liquid manure, slurry of animal orig.	26.7
waste materials from commercial and industry	3.3
other harvest residues	3.6
organic fraction of municipal waste	5.6
total	50

- max. economic accessible potential ca. 23 bill. kWh/a
- complies with acreage substitution for energy crops of 490.000 ha


source: BMU-Leitstudie 2009; NREAP 2010; BGW-DVGW 2005; BMU 2004 – DLR, IFEU, WI; own calculations 2011

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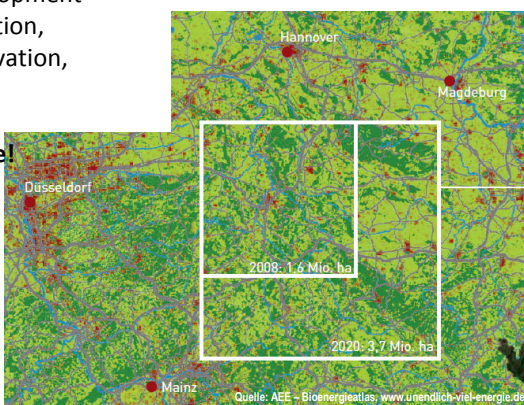
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## Energy crops supply

- availability of acreage for energy crops in Germany limited
- therefore increase of acreage for energy crops needs critical review to avoid conflicts in spatial development (food and animal feed production, nature- and landscape conservation, recreation)

**Question of public acceptance!**


- Hectare yields cannot be increased arbitrarily high!
- limiting factor: water
- 2010: 2,15 Mio. hectare




Quelle: AEE – Bioenergieatlas; [www.unendlich-viel-energie.de](http://www.unendlich-viel-energie.de)

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## Biomethane – contribution to climate protection

**Biomethane, the allround talent**

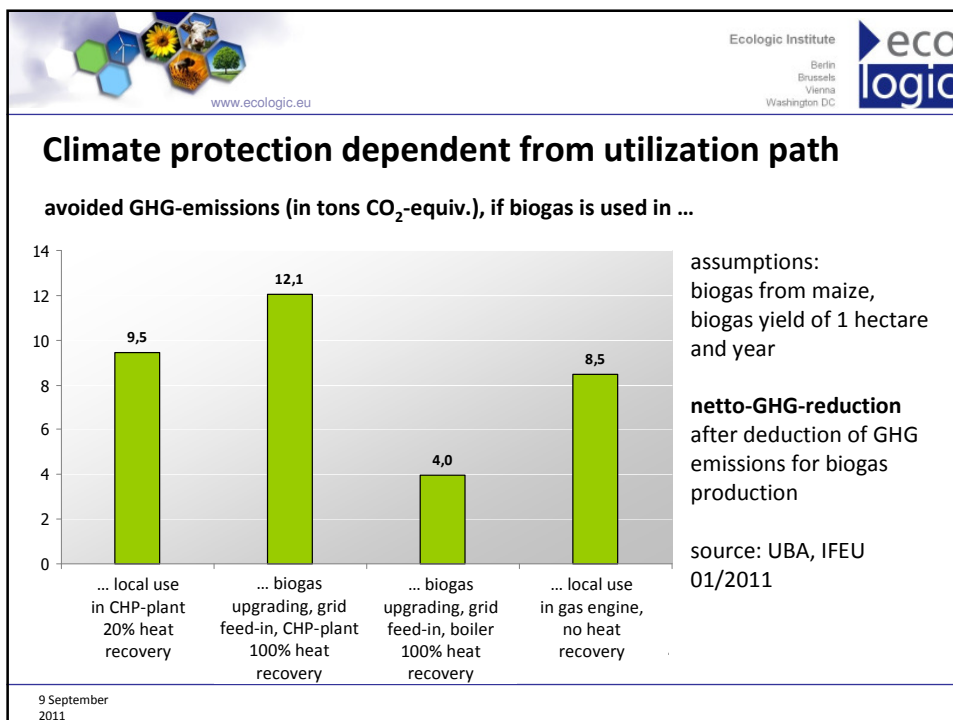
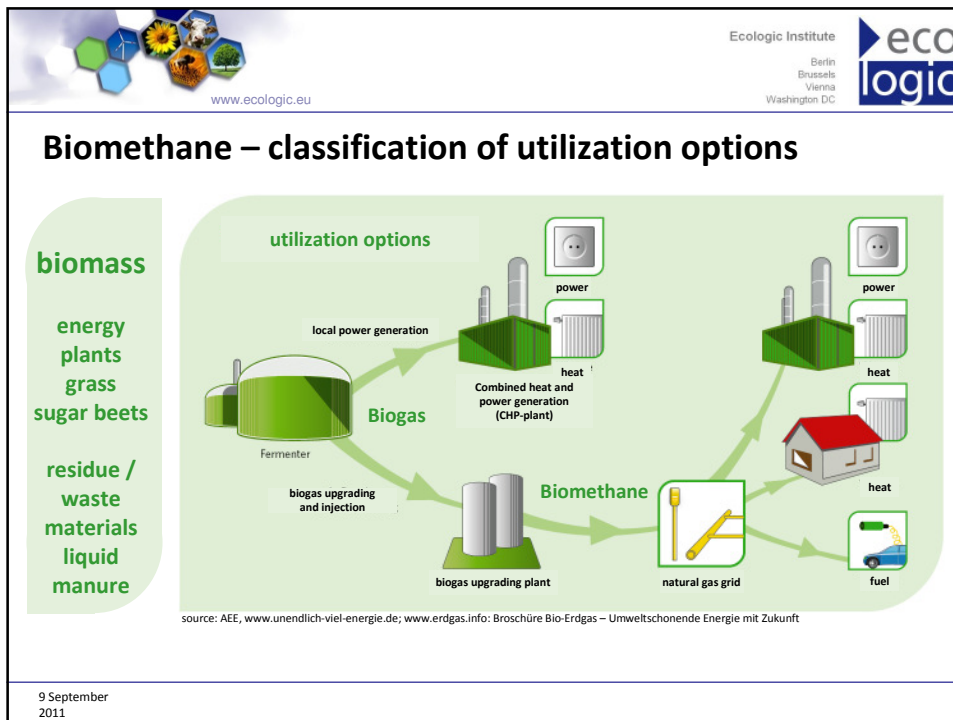



- most flexible RES
- easy to store and to transport

**What is the best option from**


- economic
- ecologic
- social

**point of view?**





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## contribution of biogas to meet the targets

- as a prerequisite to understand the german biogas strategy:
  - limitation of biomass resources, restrictions of biomass imports
  - high CFP of german power plant mix ruled by coal and nuclear power
  - heat supply in Germany governed by gas, oil, wood, distr. heating & CHP systems
  - optimal utilization of different biomass resources (e.g. wood chips for heat sector)
- top priority for biogas utilization: power generation! Preferably CHP!  
followed by biomethane utilization within transport sector
- local power generation with heat utilization prior to  
biogas upgrading and feed-in into the gas grid from economic and ecologic  
considerations



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## Biogas feed-in in Germany – legal framework and incentives





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## Incentive scheme for biomethane I


- Renewable Energy Sources Act (EEG): feed-in tariff system for power generation from RES

- Gas network access ordinance (GasNZV) and Gas network fee ordinance (GasNEV)





**EEG: main driver for biomethane production in Germany**

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## Incentive scheme for biomethane II

- biomethane in transport sector**
  - biofuel quota act: biomethane can be charged to quota
  - reduced energy tax for natural gas and biomethane use in vehicles
  - self-commitment of NG companies: 1,400 CNG filling stations and 1.5 Mill. CNG-vehicles until 2020
- biomethane in heat sector**
  - Renewable Energy Sources Heat Act: obligation use of RES or high energy efficiency measurements in new buildings, e.g. biogas fired (micro-) CHP devices, wood firing, solar heating, thermal insulation of buildings, waste heat recovery etc.
  - role model of public sector at building renovation: obligation use of RES and high energy efficiency measurements
  - Biogas use: CHP-obligation
  - subsidy program for energy-efficient building renovation (MAP): 500 Mio. €/year

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## Renewable Energy Sources Act (EEG) I

- prior grid access for RES-power, technology specific feed-in tariff for each RES-technology guaranteed by law for 20 years, degression 2% p.y.
- indirect subsidy for biomethane feed-in via EEG
- EEG: feed-in tariff system for power generation of biogas / biomethane
- height of feed-in tariff in ct/kWh el dependant of \*
  - CHP-plant size or biogas plant size resp. between 6 - 14.3 ct/kWh
  - used biomasse resource (waste, energy crops, ecologic important materials)
  - bonus for biogas feed-in (3-2-1-0 ct/kWh in regard to upgrading plant capacity)

\* base: as it will be in 2012 or later    selected aspects of EEG regulations



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## Renewable Energy Sources Act (EEG 2012\*) II


installed power plant capacity	EEG feed-in tariff in €ct/kWh el							
	biogas plants and solid biomasses (e.g. wood)				biowaste AD plants recycling of solid fermentation residues <sup>5)</sup>	mini AD plants for liquid manure		
	base tariff	feedstock remuneration		biogas upgrading bonus				
		energy crops tariff <sup>1)</sup>	eco tariff <sup>2)</sup>					
[kW <sub>el</sub> ]								
≤ 75 <sup>4)</sup>						25 <sup>4)</sup>		
≤ 150	14,3			≤ 700 Nm³/h: 3				
≤ 500	12,3	6	8	≤ 1.000 Nm³/h: 2	16			
≤ 750	11	5		≤ 1.400 Nm³/h: 1				
≤ 5.000	11	4	8 / 6 <sup>3)</sup>					
≤ 20.000	6	-	-	-	14	-		

max. feed-in tariff for power from biomethane from energy crops 23-25 ct/kWh el  
or in gas equivalent appr. 9 ct/kWh for biomethane

\* base: as it will be in 2012 or later    selected aspects of EEG regulations




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## Renewable Energy Sources Act (EEG) III

- biomethane utilization in heat-controlled CHP-plants mandatorily
- legal fiction of trade off: gas shall be deemed to be biomass, if the same amount has been fed-in into the gas grid before
- guaranty of origin (assured EEG properties) to prove by mass-balancing system
- **EEG 2012: establishment of new incentives for integration of biomass power plants into power market and supply infrastructure**
  - demand based power generation from biogas / biomethane via flexible biogas-CHP-engine capacities
  - market integration: direct trading and marketing of RES-power at energy exchange (EEX) in Leipzig, incentives cover spread between feed-in tariff and EEX-prices, 2014: obligatory for Biogas driven plants > 750 kW
  - participation at balancing and system energy market (ancillary system services)



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## Gas network access ordinance (GasNZV) I


- Gas network access ordinance (GasNZV), renewed in 2008 and 2010
- prior grid access for biogas feed-in, point of access chosen by client refusal only in cases of technical impossibility or economic unreasonableness
- distribution of CAPEX between grid operator and grid access client 75% : 25%, cut at maximum 250,000 €, grid operator fully responsible for OPEX
- Grid operators are allowed to allocate all biogas related costs to all gas customers (grid fees)

CAPEX – capital expenditures, OPEX – operational expenditures

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## Gas network access ordinance (GasNZV) II

- permanent availability of the grid connection of at least 96 %
- reduced fees for energy balancing (1€/MWh) and credit for avoided mains operation (7€/MWh) which covers often all grid fees and transport costs
- grid access contract with time schedule for realization of grid access between grid operator and client
- technical biogas quality standards ruled by DVGW (german association of gas and water, private organization of technical standards)
- methane emission limits: reliefs only offered for biogas upgrading facilities with methane emissions below 0.5 % (from May 2012: 0.2 %)

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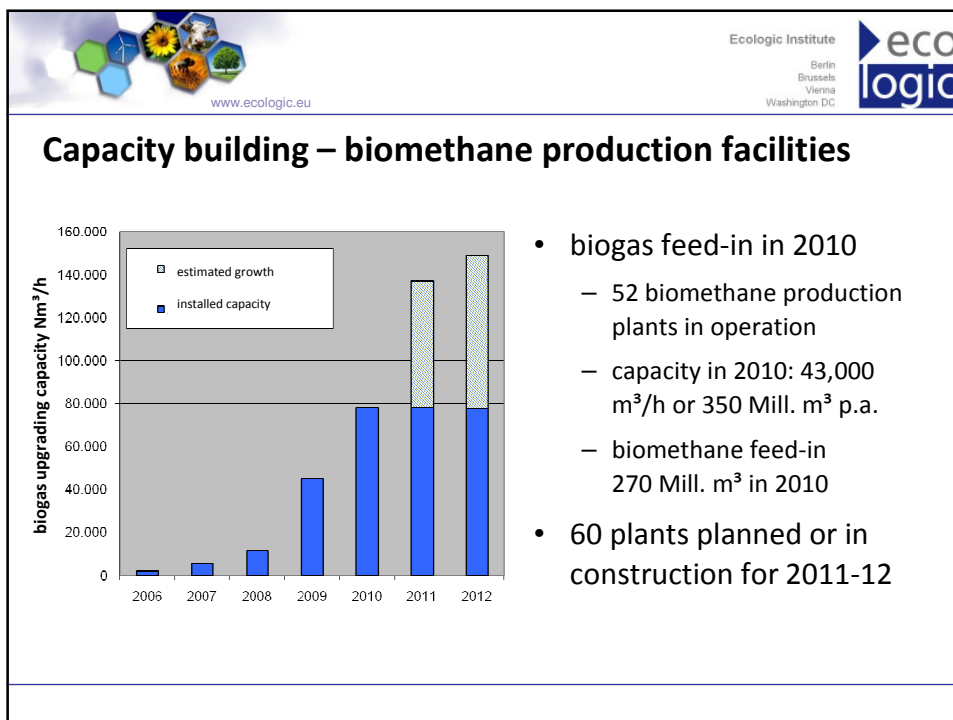
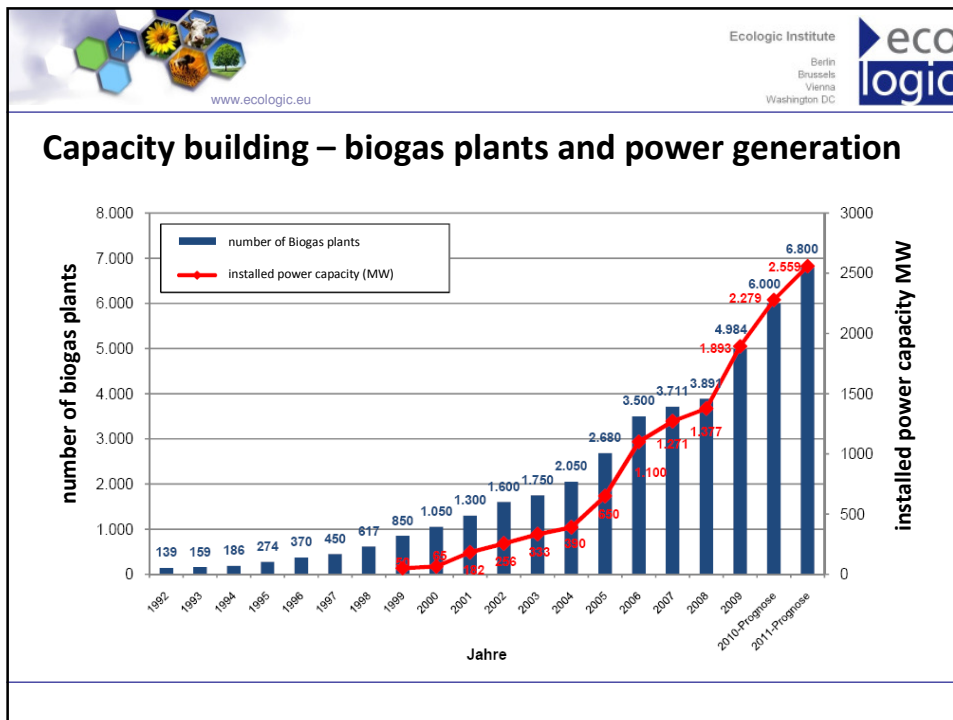
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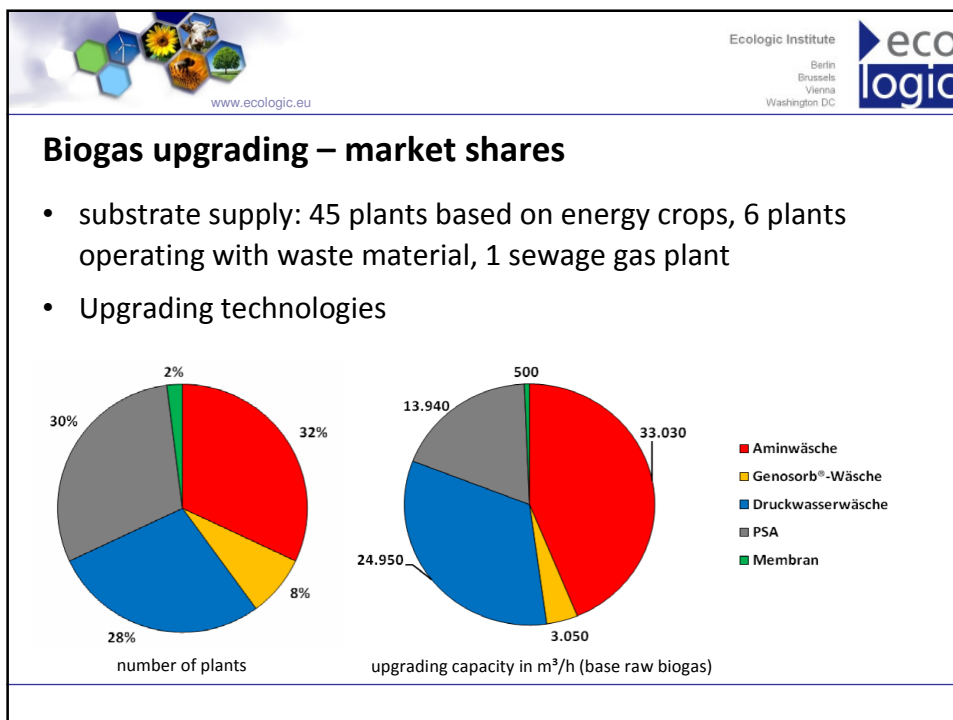
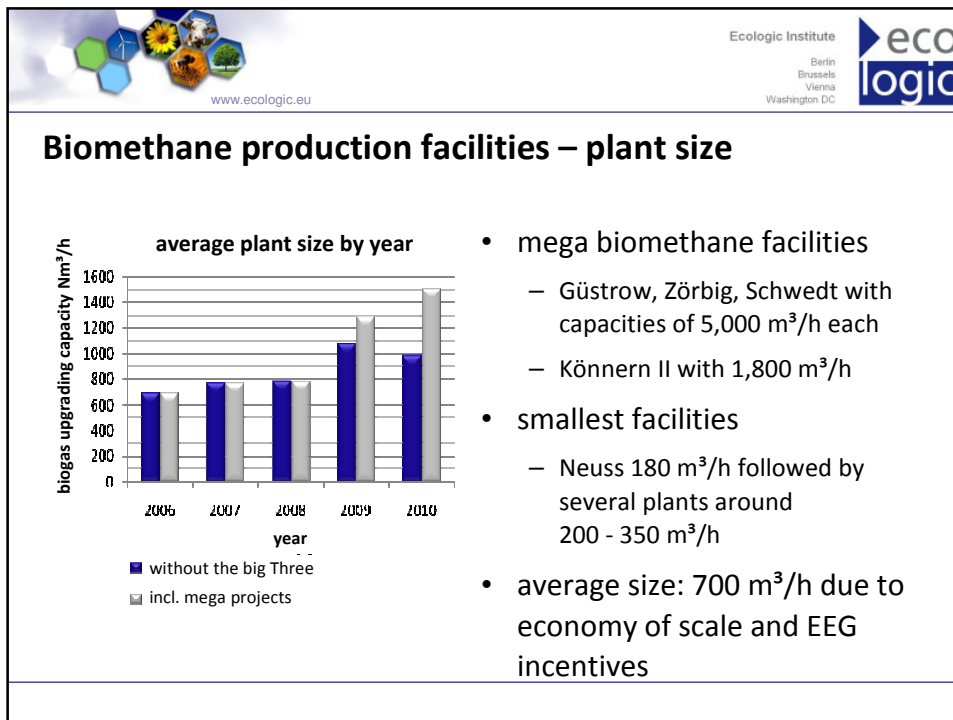


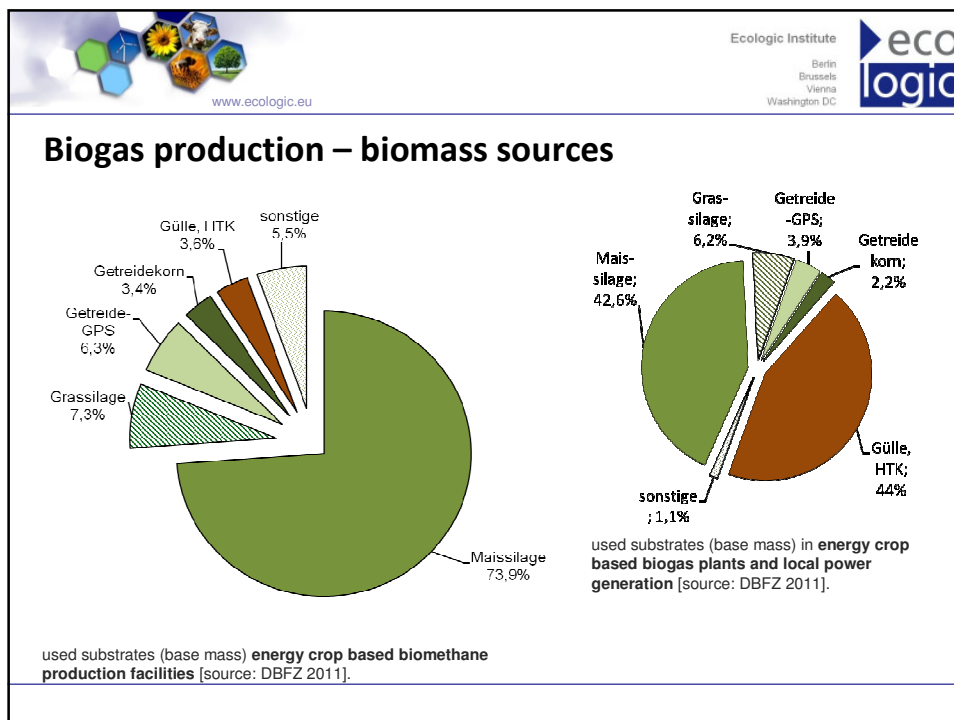
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## Biogas feed-in in Germany – recent market developments







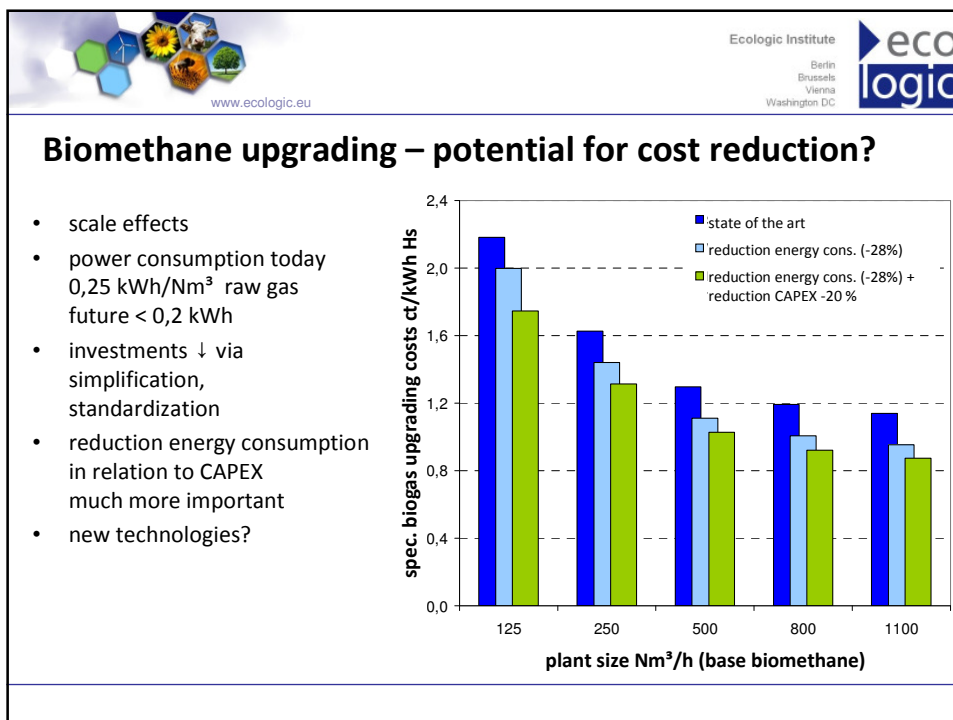
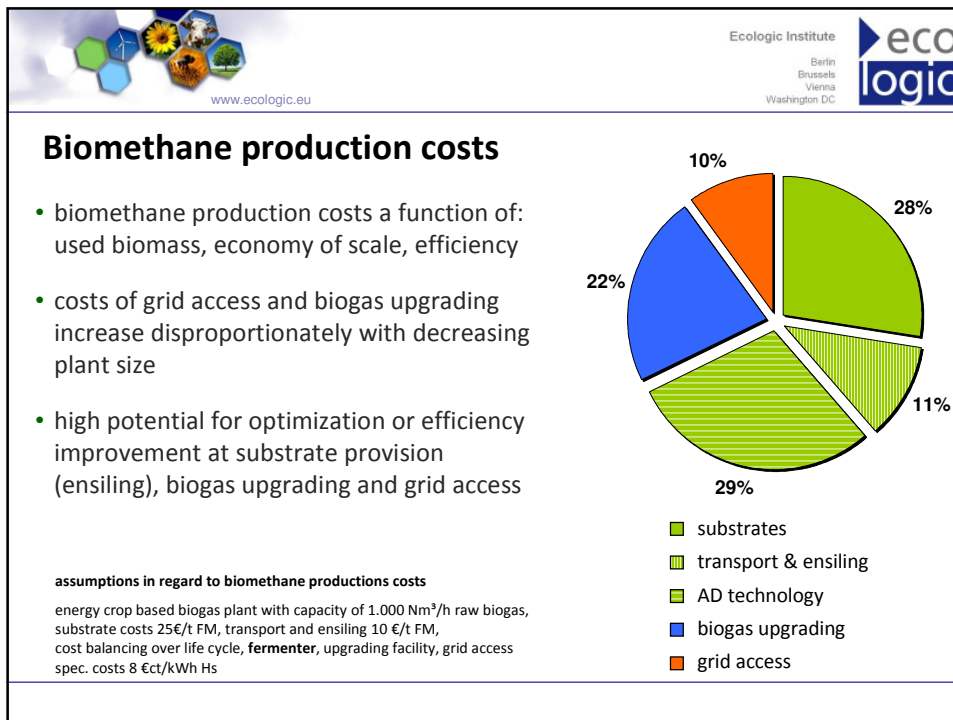


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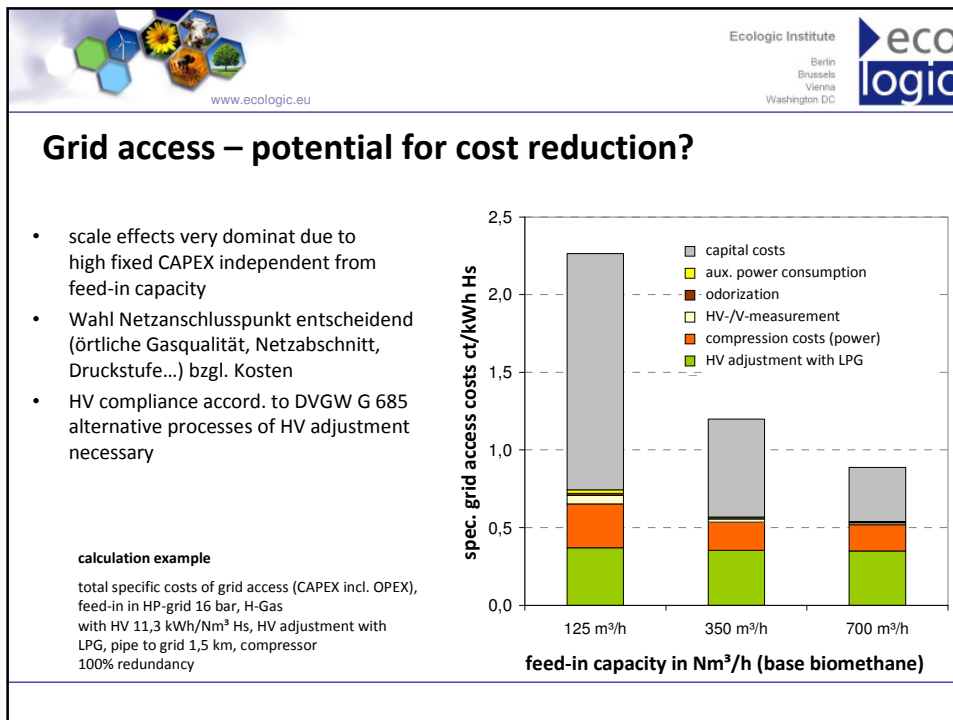
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## Biogas feed-in in Germany – economic issues







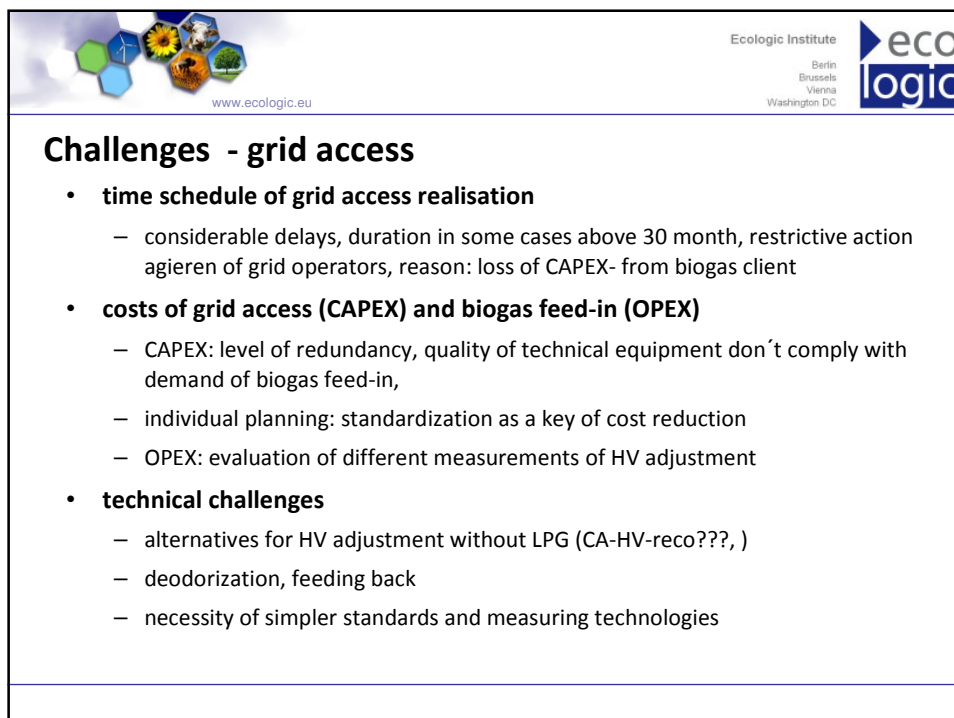
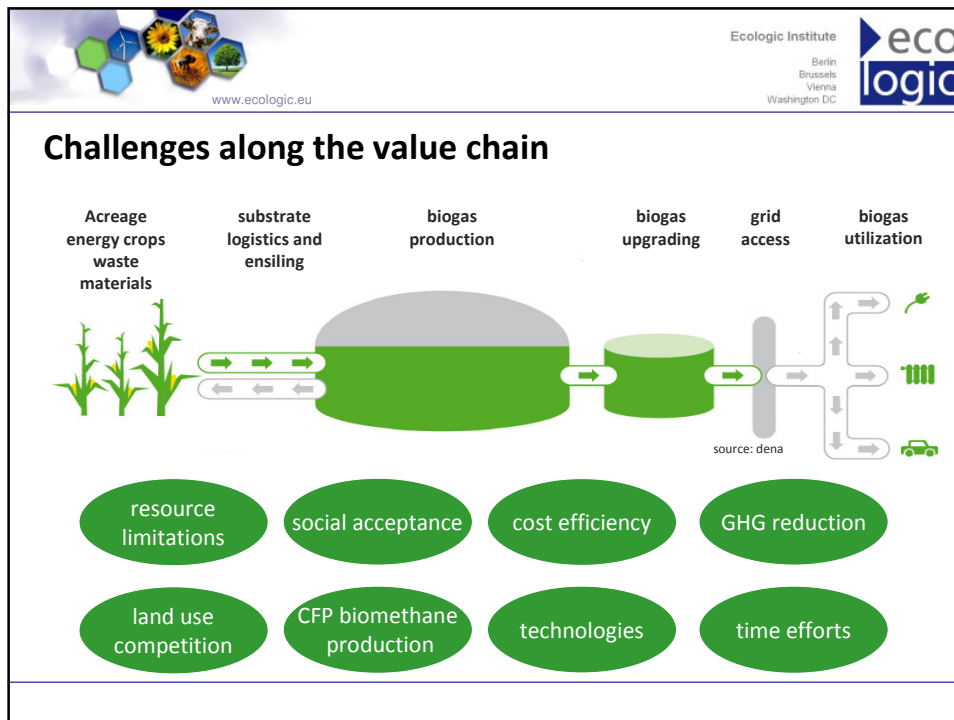



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## Biogas feed-in in Germany – challenges, future perspectives and conclusions for advancement of government





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## Challenges in regard to sustainability

- **carbon footprint of biomethane**
  - GHG reduction as a function of biomass input, technology aspects, biomethane utilization pathway, sustainability (today 120-140 g CO<sub>2</sub>-equiv. per kWh Hs)
  - technology: methane losses, energy consumption and efficiency, plant size, integrated plant concepts, plant availability, redundancy, ensiling,
- **reduction of costs**
  - biomass input: energy crops (expensive, less limited) vs. waste materials (cheap, very limited)
  - economy of scale vs. public acceptance („maizening of landscape“, biodiversity problems, land use competition)

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## Conclusions I


- Biogas is a limited resource
  - Land use competition: energy crops vs. food vs. animal feed vs. other energetic or material utilization of biomass, sustainability!
  - residues and waste materials: potential vs. activation costs
  - biomass import: sustainability! avoidance of new dependencies, costs
- **obligation to climate- and energy efficient utilization!**
- GHG reduction impact dependent on utilization path
  - expansion of CHP sector necessary
  - utilization of biomethane must mandatorily be more energy efficient and climate friendly than state of the art (wood firing, local power generation)
  - lowest GHG reduction in boilers
- **biogas upgrading and feed-in is not an end in itself!**

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## conclusions II

- **cost- and energy efficiency**
  - high costs for upgrading and injection is justified or can be incentivised if used in pathways with high energy efficiency and high GHG savings
- **sustainable supply of biomass**
  - minimize GHG-Emissions throughout biogas production chain (fertilization, biomass conservation, reduction CH<sub>4</sub>-emissions)
  - minimize harmful environmental impacts (soil erosion, water protection, landscape protection, Emission reduction...)
  - strengthen utilization of residues and waste material potential and limitat energy crops cultivation, minimize land use competition and biomass imports
- **joker for system integration of RES:** storage capacity of biogas, flexibility of CHP-plants

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## Biogas feed-in in Germany – some impressions



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## Güstrow near by Rostock (Nawaro AG)



source: own

- World largest biomethane production facility with capacity of 5,000 Nm<sup>3</sup>/h or 40 Mill. Nm<sup>3</sup> p.a.
- biogas origin: energy crops (maize) from 10,000 hectares
- 460,000 t p.a. fermenter residues upgraded to high grade fertilizer

source: Nawaro AG

- investment 80 Mill. €
- 5 water scrubber from Flotech (S, NZ)



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## Zörbig (VERBIO Vereinigte BioEnergie AG)

- biogas origin: waste material from ethanol production
- 2 upgrading facilities á 2,500 Nm<sup>3</sup>/h (amine scrubber)
- biomethane feed-in 5,000 Nm<sup>3</sup>/h or 40 Mill. Nm<sup>3</sup> p.a.
- CAPEX 40 Mill. €
- VERBIO 300,000 t ethanol and 450,000 t biodiesel p.a.



source: VERBIO AG

## Neuss, NRW

source: own



- Cirmac amine scrubber
- intelligent repowering concept for existing biogas plants
- smart grid access station with a capacity of 190 m<sup>3</sup>/h and low CAPEX and OPEX
- biogas origin: energy crops and agricultural waste materials

## Könnern II, Lower Saxony



source: WELtec AG

## Könnern II (AGRIDEA / WELtec / E.on)



- CAPEX 31.5 Mill. € in 2009
- biomethane production capacity 1,800 Nm<sup>3</sup>/h or 15 Mill. Nm<sup>3</sup> p.a.
- 135,000 t energy crops (maize) and 40.000 t liquid manure p.a.
- amine scrubber by Cirmac
- grid access MITGAS HP-grid
- biomethane sales and marketing by E.on

## Rathenow near Berlin



- CAPEX 10 Mill. € in 2009
- biomethane production capacity 500 Nm<sup>3</sup>/h
- 135,000 t energy crops (maize) and 40.000 t liquid manure p.a.
- Genosorb<sup>®</sup> scrubber by Haase Energietechnik
- intelligent feed-in concept without HV adjustment without LPG





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## **Thank you for your attention!**

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