Energy Transition and Climate Change in the
Caribbean Congress, May 22nd

Fachverband BIOGAS
German Biogas Association
Association Allemande du Biogaz
Asociación Alemana de Biogás
www.biogas.org

The Role of Biogas for Grid Stabilization and GHG Emission Reduction

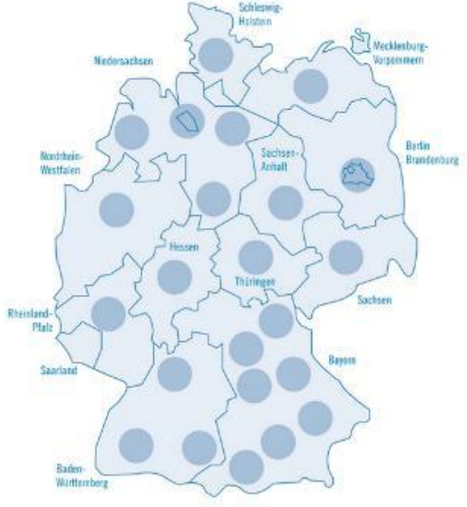
Frank Hofmann, International Affairs
Fachverband Biogas e.V., German Biogas Association

Content

- **The German Biogas Association - Fachverband Biogas e.V.**
- Biogas for el. grid stabilization
- Biogas and GHG Emission reduction
- Summary

The German Biogas Association

4900 members
throughout Germany



Above 40 employees
dedicated to the topic

- Operators of biogas plants
- Technology manufacturers
- Research institutions
- Public authorities
- Feedstock providers
- Interested individuals

Main objective: promotion of the biogas sector

- Definition of legal framework and technical standards
- Exchange of information
- Lobbying on federal, state and EU level

Objectives of the German Biogas Association

Fachverband BIOGAS

Main objective: promotion of the biogas technology

- Promotion of a sustainable energy supply
- Definition of legal frameworks for reliable and long-term investments
- Creation of adequate technical rules and standards for biogás
- Promotion of R&D
- Exchange of information
- Members services

Political advocacy for the biogas industry at national and international level in the fields of:

- Renewable Energy Act (EEG)
- Energy management
- Regulatory approval
- Environmental laws
- Laws on agricultural issues
- Tax law…

International Agenda of the German Biogas Association

- International Affairs Department: 7 staff members
- Supporting members with information about the international biogas markets
- Biogas Convention and Trade Fair
- Supporting Biogas Associations, Biogas Know-How and Trainings worldwide
- Cooperation with international organizations –
  promoting Biogas in Developing- and emerging countries

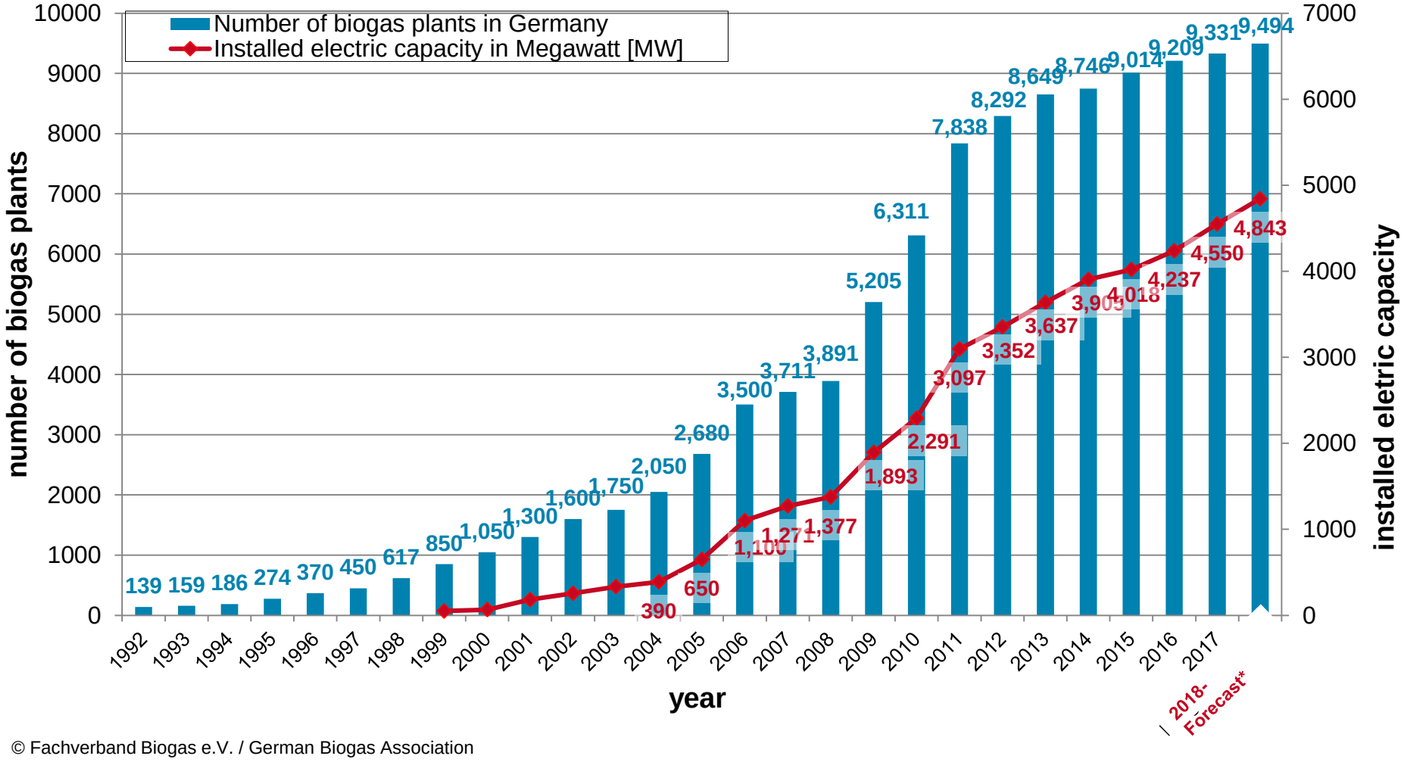
Services

International tailored-made biogas trainings

Presentations at international fairs

Delegation trips in Germany and Europe

Biogas in Germany - number of plants and installed capacity



Biogas sector at a glance

	2016*	Forecast 2017**
Number of biogas plants (biogas plants with biomethane injection)	9,209 (193)	9,346 (197)
Installed electric capcity in MW	4,237	4,497
Gross electricity production in TWh per year	32.8	33.0
Housholds supplied with biogas-based electricity in millions	9.4	9.4
CO_2 reduction by biogas in million tons	19.8	19.9
Turnover in Germany in Euro	9.4 Billion	9.4 Billion
Jobs in the biogas sector	46,000	46,000

* Own extrapolation based on country data / plant register BNetzA

** Based on a expert survey / plant register BNetzA

Content

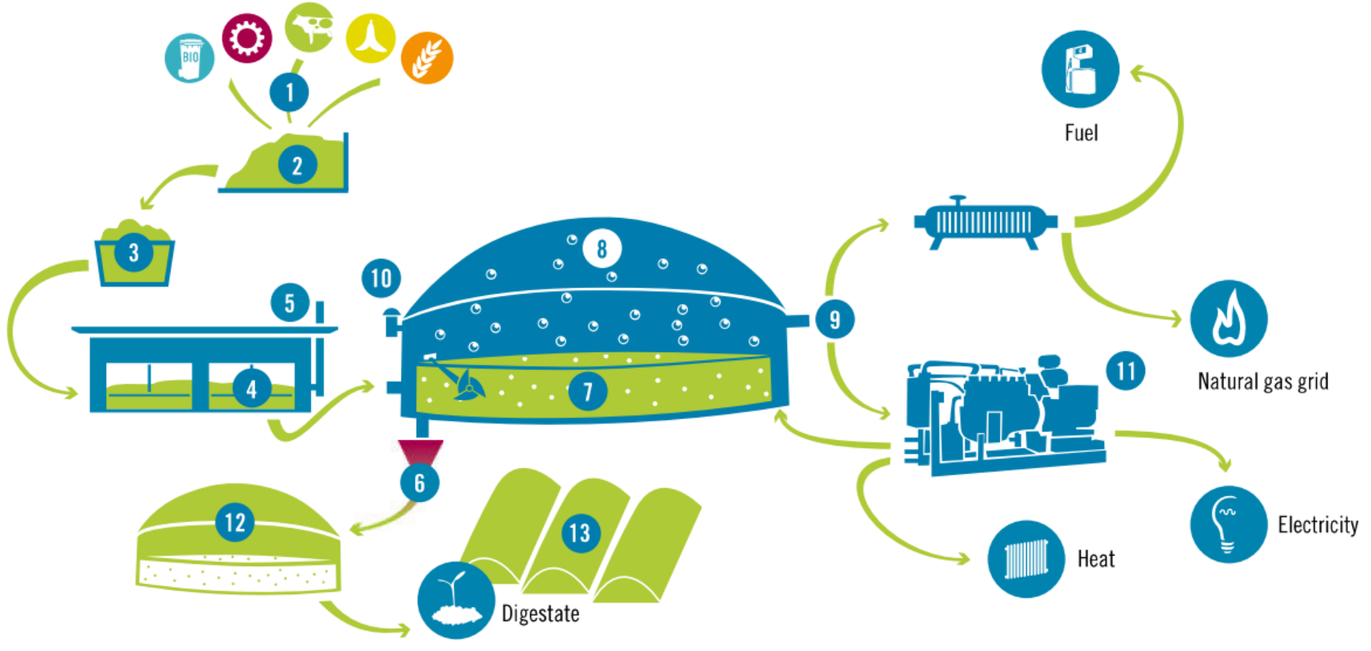
- The German Biogas Association - Fachverband Biogas e.V.
- **Biogas for el. grid stabilization**
- Biogas and GHG emission reduction
- Summary

Biogas and Biomethane

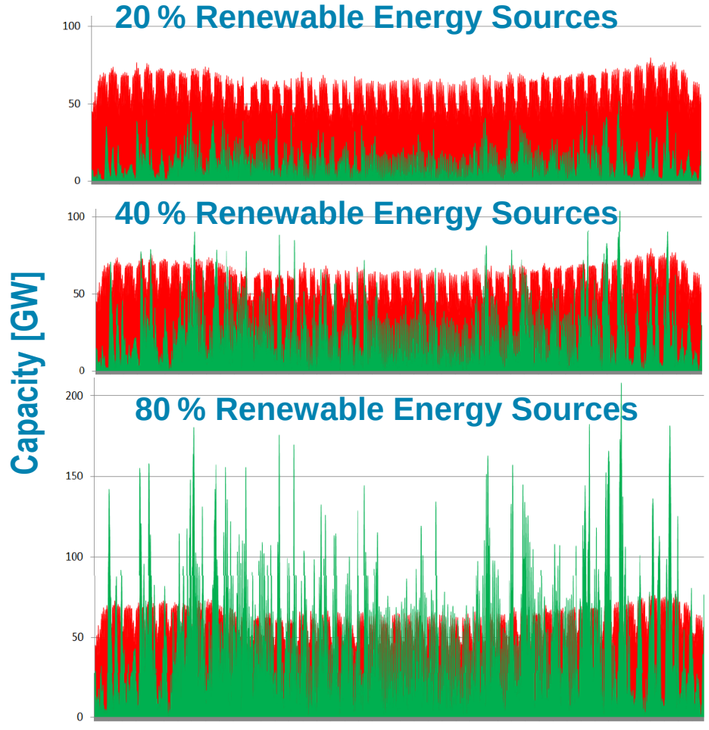
	Biogas	Biomethane (natural gas quality)
Methane (CH_4)	50-70 %	> 97 %
Carbon dioxide (CO_2)	30-45 %	< 3 %
Oxygen (O_2)	2-4 %	< 0.5 %
Hydrogen sulfide (H_2S)	< 0-6,000 ppm	< 5 ppm

- Biomethane has a lower heating value (9.97 kWh/m³) than natural gas

Biogas utilization



The challenge: High share of RE and el. Grid stabilization



With increasing share of RES, balancing power generation and consumption is importent

Flexible systems are needed

→CHP with bioenergy & natural gas

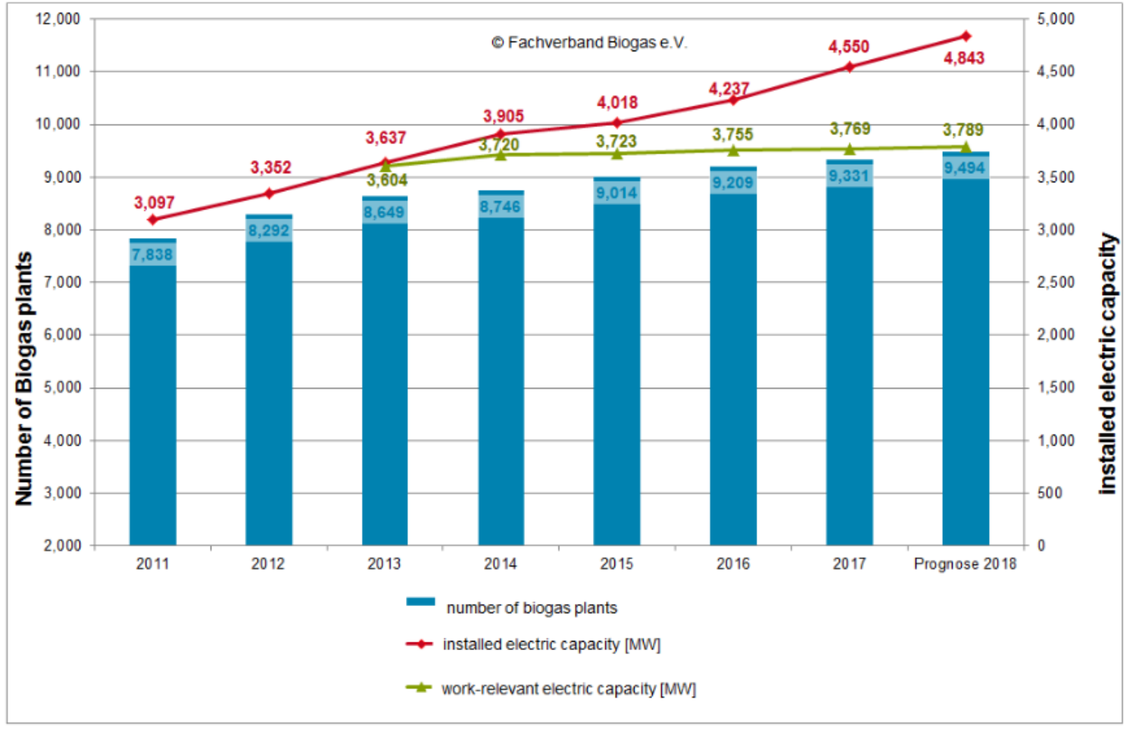
→New role of biogas

red	Demand
green	Production Wind & Solar

Challenge, el. grid stabilization, Germany as example

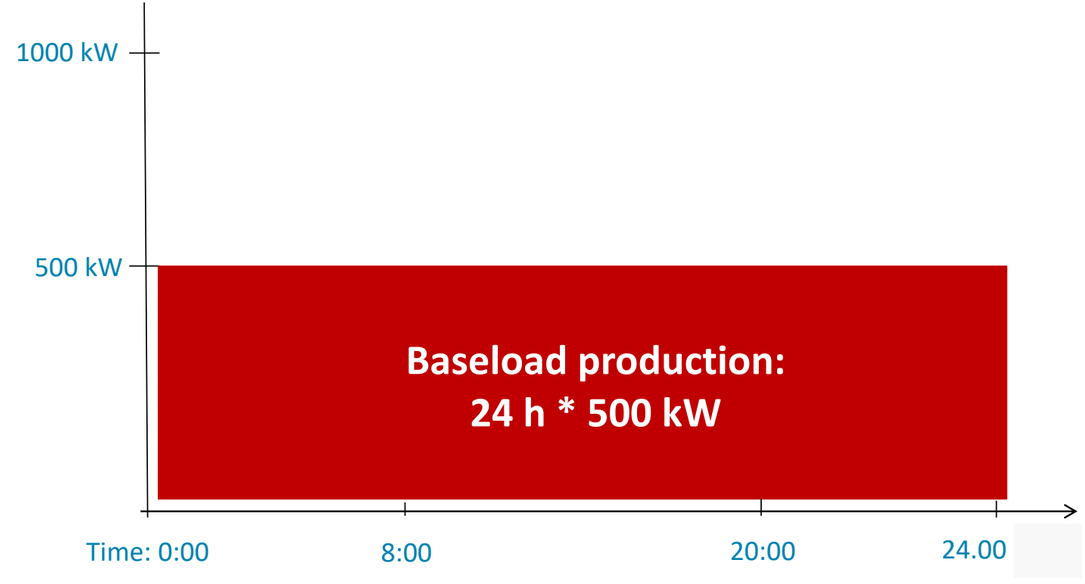
- Due to higher share of RE, there must be a balance of el. production and consumption
- The value of electricity is much depending on the time
- About 9500 biogas plants in operation, 4.5 GW installed power
- 5.5% of German electricity production by biogas
- Due to historical reasons most of biogas CHP are operating in baseload
- In 2019 Germany had a share of 40% RE in the el. grid
- Huge installations (nuclear power and coal power plants) will stop operation
- Storage and flexibility is a key element to achieve a high share of RE
- Switching biogas plants from baseload to flexible operation is one key element

Installed capacity, base load and flexibility

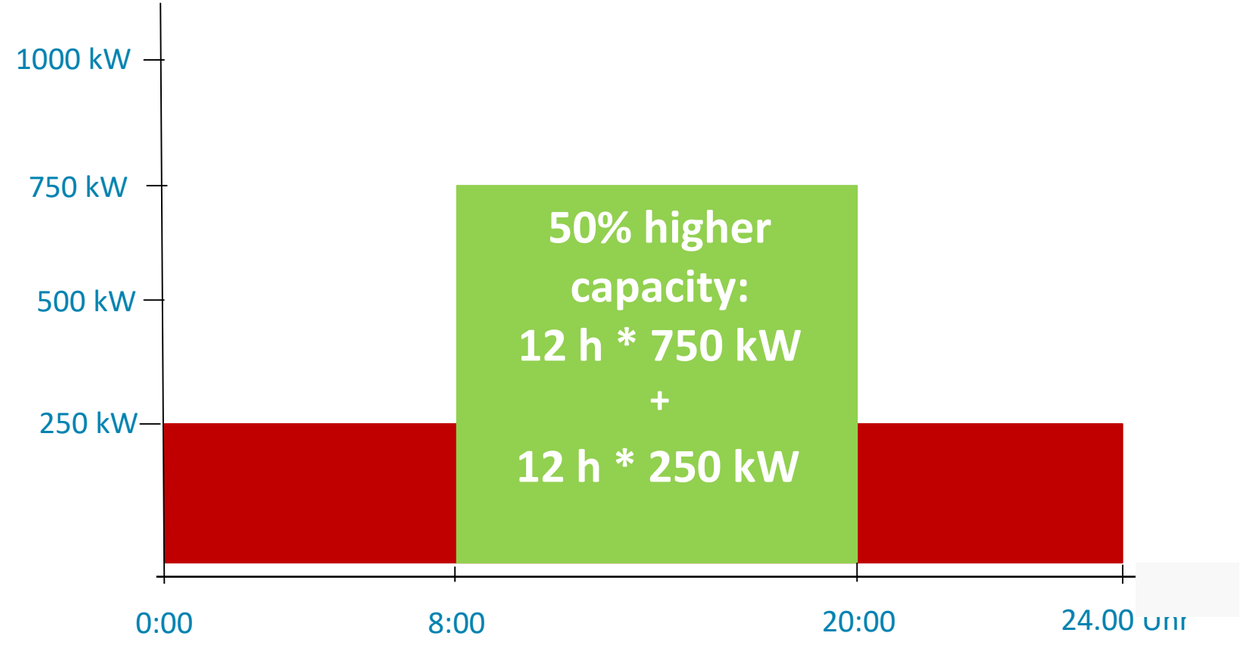


Challenge, el. grid stabilization, Technical adaptions of biogas plants

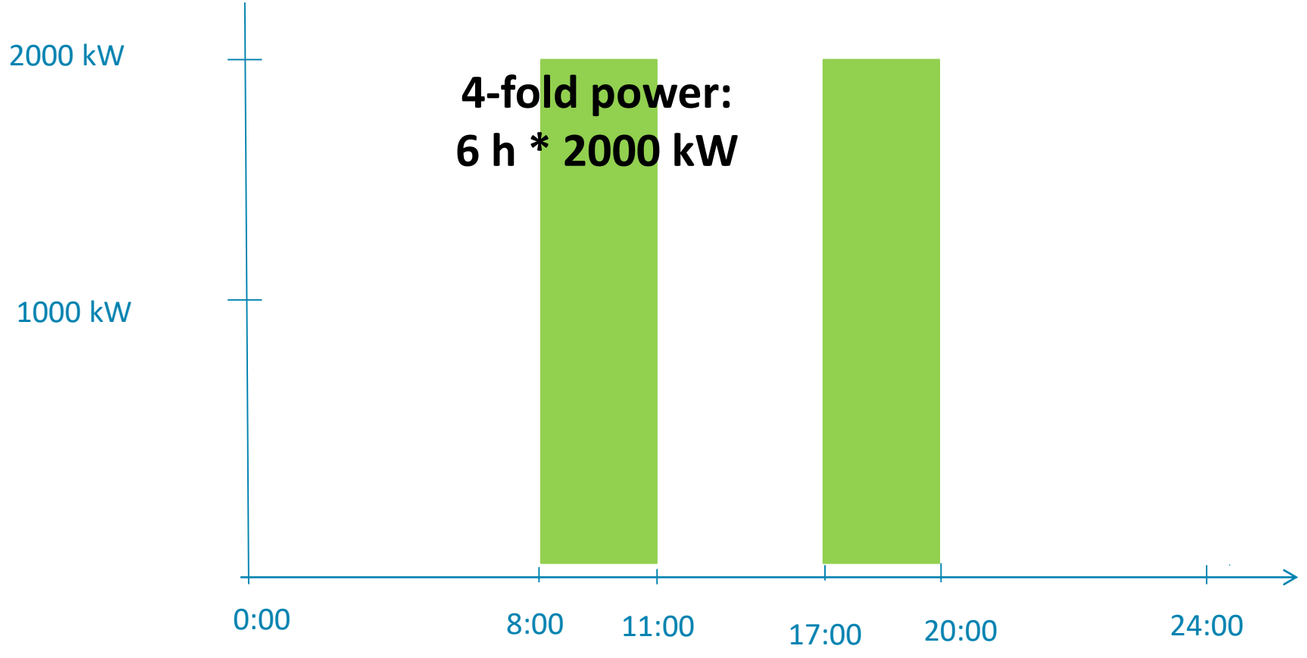
- Switch of a biogas plant from baseload to flexible operation
  - Investment in storage capacity
  - Bigger CHP
  - Software



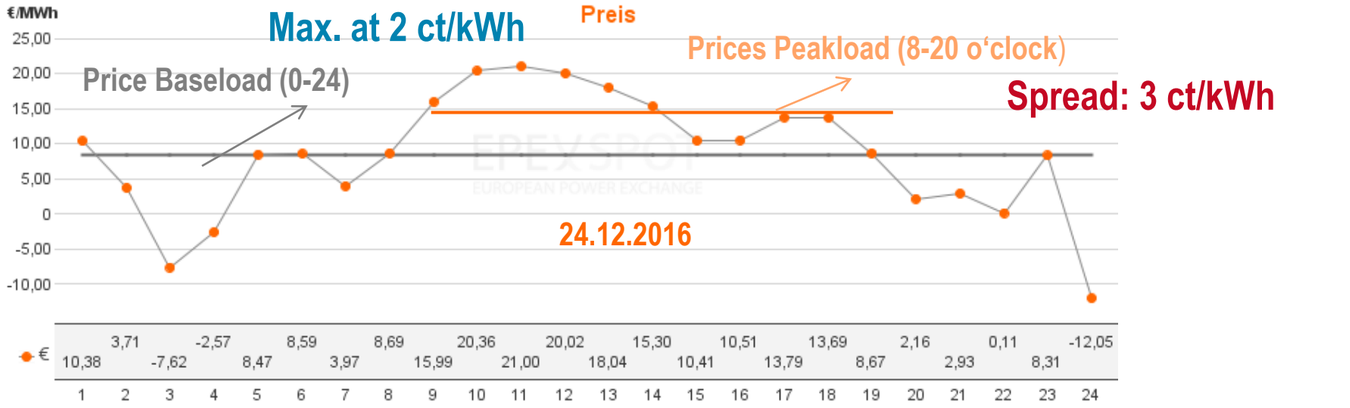
Challenge, el. grid stabilization, Technical adaptions of biogas plants

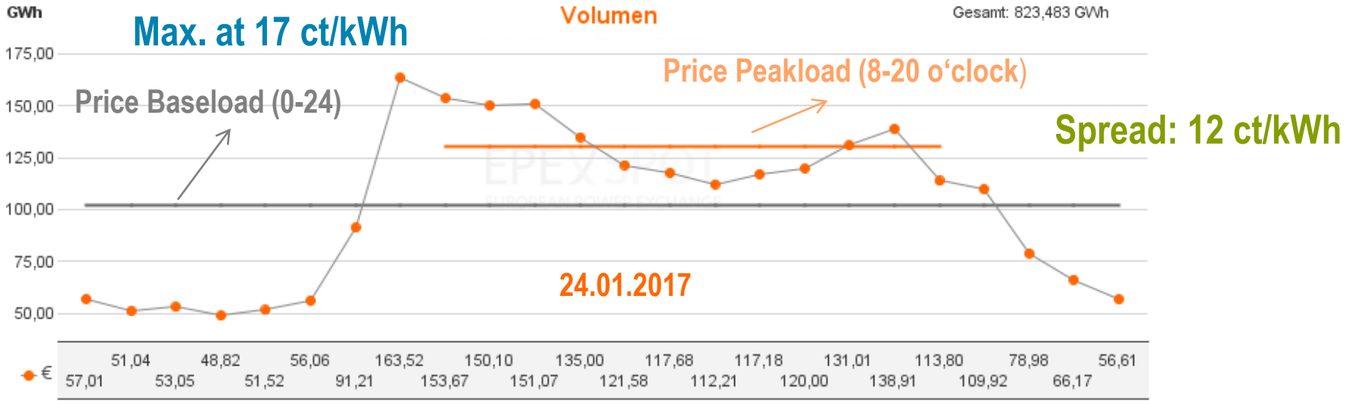


Challenge, el. grid stabilization, Technical adaptions of biogas plants



Electricity, Day ahead market





Quelle EPEX Spot SE)

18

Challenge, el. grid stabilization, Germany as example

- 4.5 GW installed base load power can be used to reach a flexible capacity of above 20 GW
- Several incentives (flexibility premiums on installed capacity and on flexible operation) create high flexibility in the el. System
- About half of all biogas plants in Germany are operating flexible with a flexible capacity of above 3 GW

Content

- The German Biogas Association - Fachverband Biogas e.V.
- Biogas for el. grid stabilization
- **Biogas and GHG Emission reduction**
- Summary

Biogas in the climate change discussion

- **Biogas is a renewable energy.**
- **Biogas production can help to reduce GHG emissions in several ways:**
  - Avoidance of methane emissions: during the storage of organic material (like manure or palm oil mill effluents) methane emissions occur. Due to the closed process taking place in the biogas plant and gas utilization those methane emissions are avoided and the methane converted into carbon dioxide.
  - Fossil fuel substitution: energy from biogas can substitute fossil energy carriers and by that CO_2 emissions avoided.
  - Production of fertilizer: digestate (the effluent of a biogas plant) is a good quality fertilizer. Its use helps to substitute synthetic fertilizers, which require fossil fuels for its production.
- **However, methane is a very effective GHG and methane emissions from biogas plants must be limited (e.g. by covering the storage of digestate or installing a flare which burns the produced methane in times the biogas utilization is not in operation).**

Biogas in the climate change discussion

Avoids uncontrolled methane emissions from open air storage of different waste material

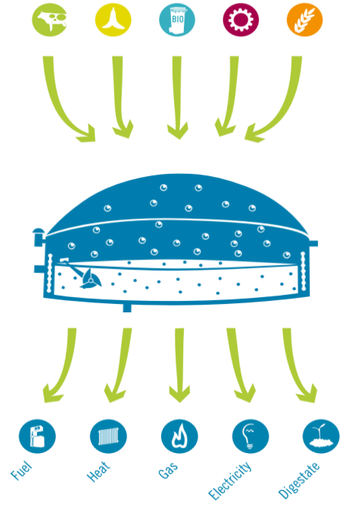
Generation of renewable energy- substitution of fossil fuels

Production of biofertilizer – substitution of mineral fertilizers

Biodiversity can be enhanced through crop rotation

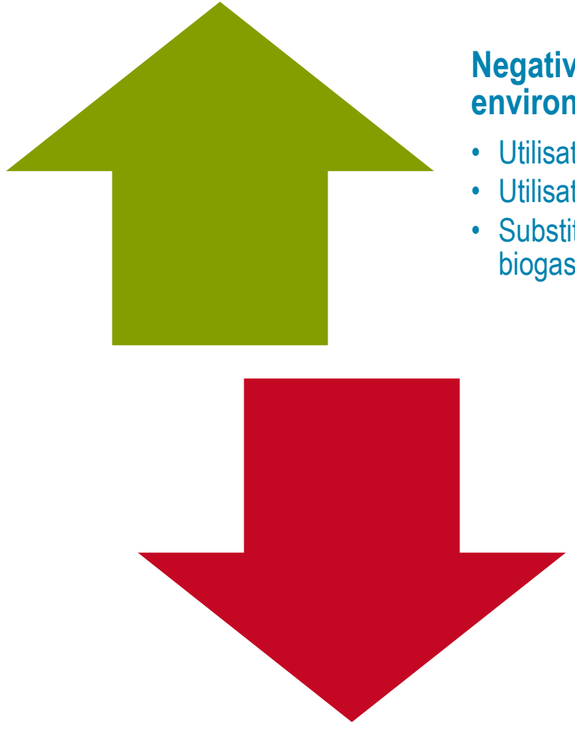
Reduction of odors in the immediate area of the biogas plant

Production of biofertilizer = closing nutrient cycles



22

Biogas in the climate change discussion



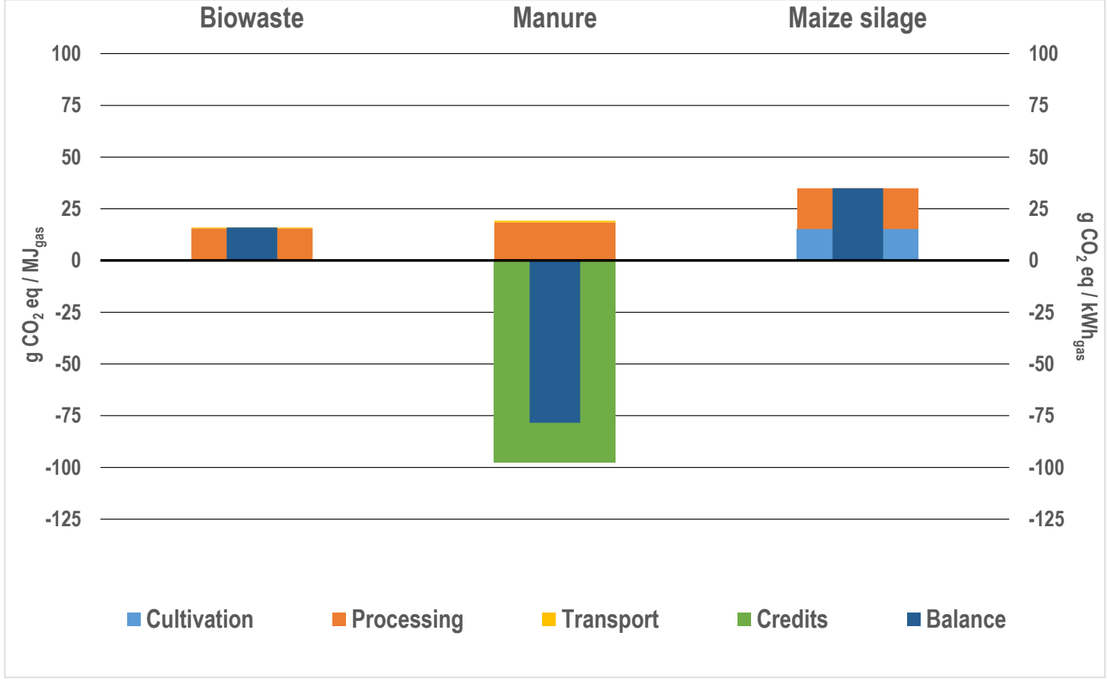
Negative GHG emissions ► Positive for the environment

- Utilisation of manure as feedstock.
- Utilisation of the heat produced in the CHP
- Substitution of mineral fertilizer with digestate from the biogas plant

Positive GHG emissions ► Negative for the environment

- Methane leakages
- Cultivation of energy crops
- Operation and construction necessary emissions. GHG emissions are very small compared to that of fossil comparator.
- Transport is of minor importance, except if the feedstock has high water content

Life Cycle Assessment of a biogas plant



Biogas in the climate change discussion

- The energy produced in any biogas plant performs better than the fossil comparator (except for 15% methane lost in biogas plants with low manure content).
- The more manure (or other open-air stored organic material) is processed the higher the GHG emission savings.
- Energy crop cultivation results in GHG emissions.
- The usage of residues and wastes offers the opportunity to convert biomass into energy with very low carbon emissions.
- The grown crops do have a high influence on humus balance (and therefore GHG balance). Some have positive effects (like clover grass) and other crops correlate with the risk of humus losses (like maize). But most important is sustainable farming practice.
- Optimal biogas utilization (electricity, heating or fuel) depends on the particular situation of each country.

Biogas in the climate change discussion

- **Methane leakage should be avoided whenever possible.**
  - Cover the post-fermentation storage. Most methane emissions in a biogas plant arise there.
  - Install an automatic starting flare in the time the CHP is not operating. A CHP operates typically below 8,200 h/a. During CHP standstill times the produced methane must be flared.
  - Regular leakage control of the biogas plant.
- **The produced heat should be used to substitute fossil fuel heat.**
- **Digestate should substitute synthetic fertilizer**
- **The digestate should be injected in the soil by drag hose (avoid baffle plate) to reduce NH_4 emissions**

Biogas example calculation GHG emissions

El. mix in Germany: 527 - 580 gCO_2/kWh

Emission reduction Biogas, default values accordingv to RED II,
(incl. operation, transport, agriculture and bonusses)
57,6 g CO_2/kWhel, Waste treatment plants
- 282,2 g CO_2/kWhel, Manure processing plants
125,6 g CO_2/kWhel, Biogas based on energy crops

Manure:

Open storage: 1 ton manure causes 3.75 m^3 Biogas

-> 0,036 ton CO_{2e} (= 1.4 kg CH_4)

Balance, Biogas:

- Avoidance of about 36 kg CO_{2e} per t manure
- minus 5.5 kg CO_{2e} / kWh for biogas plant operation
- plus CO_{2e} average emissions from energy production

Biogas in the climate change discussion

Waste:

Landfill: 1 ton organic material is generating about 100 m^3 Biogas

- > 1 ton CO_{2e} (= 42 kg CH_4)

Due to biogas:

- Avoidence 1 ton CO_{2e}

- minus 48 kg CO_{2e} / kWh biogas plant operation

- plus CO_{2e} electricity mix and substitution of (fossil) heat

Agenda

- The German Biogas Association - Fachverband Biogas e.V.
- Biogas for el. grid stabilization
- Biogas and GHG Emission reduction
- **Summary**

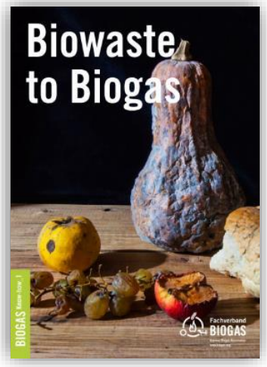
Summary

Biogas basics

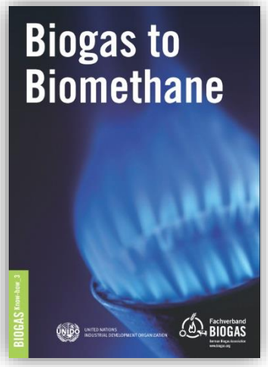
- Biogas can be used as energy carrier to generate:
  - Electricity
  - Heat
  - Vehicle fuel (biomethane)
- Biogas plants can be used to balance power production and consumption
- Environmental advantages of biogas
  - Avoidance of methane emissions from storage
  - Substitution of fossil fuels
  - Substitution of synthetic fertiliser
  - Recycling of nutrients
- In Germany about 9,500 are in operation with an installed capacity of 4.5 GW
- Biogas in an approved state of the art technology
- Experiences since decades

English publications

Available at
www.biogas.org

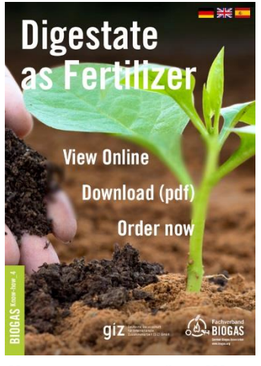


www.biogas-to-biowaste.com



www.biogas-to-biomethane.com

www.biogas-safety.com



www.digestate-as-fertilizer.com

Thank you for your attention!

Congreso Transición Energética y Cambio Climático en el Caribe