Rohstoffmanagement und Biomethan-Erzeugung
Feedstock Management and Biomethane Production

Kiev, 22nd November 2012

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Content:

- Biomethane production at E.ON and in Germany
- Feedstock for Biomethane production
- Case Study: Green House Gas balance of the Biomethane plant in Einbeck

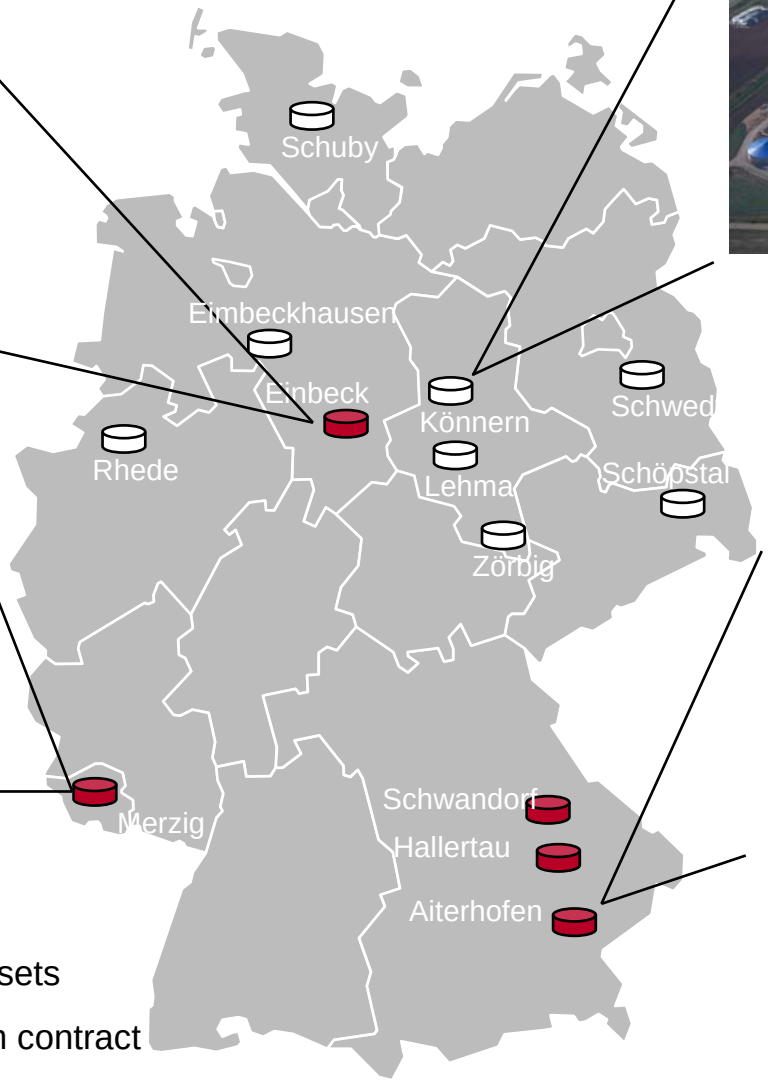
E.ON biomethane projects in Germany

Einbeck:
50 GWh/a
in operation since 09/2009

Könnern:
150 GWh/a
in operation since 09/2009

Merzig:
50 GWh/a
in operation since 05/2011

Aiterhofen:
90 GWh/a
in operation
since 09/2009

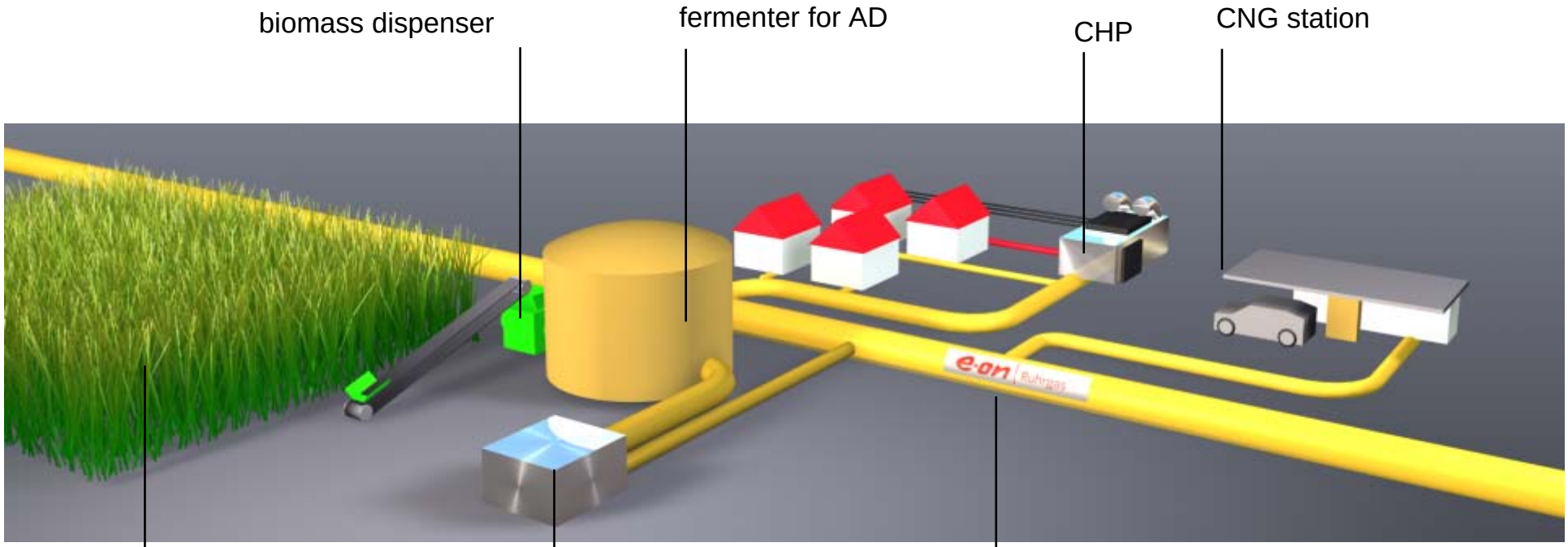


E.ON assets

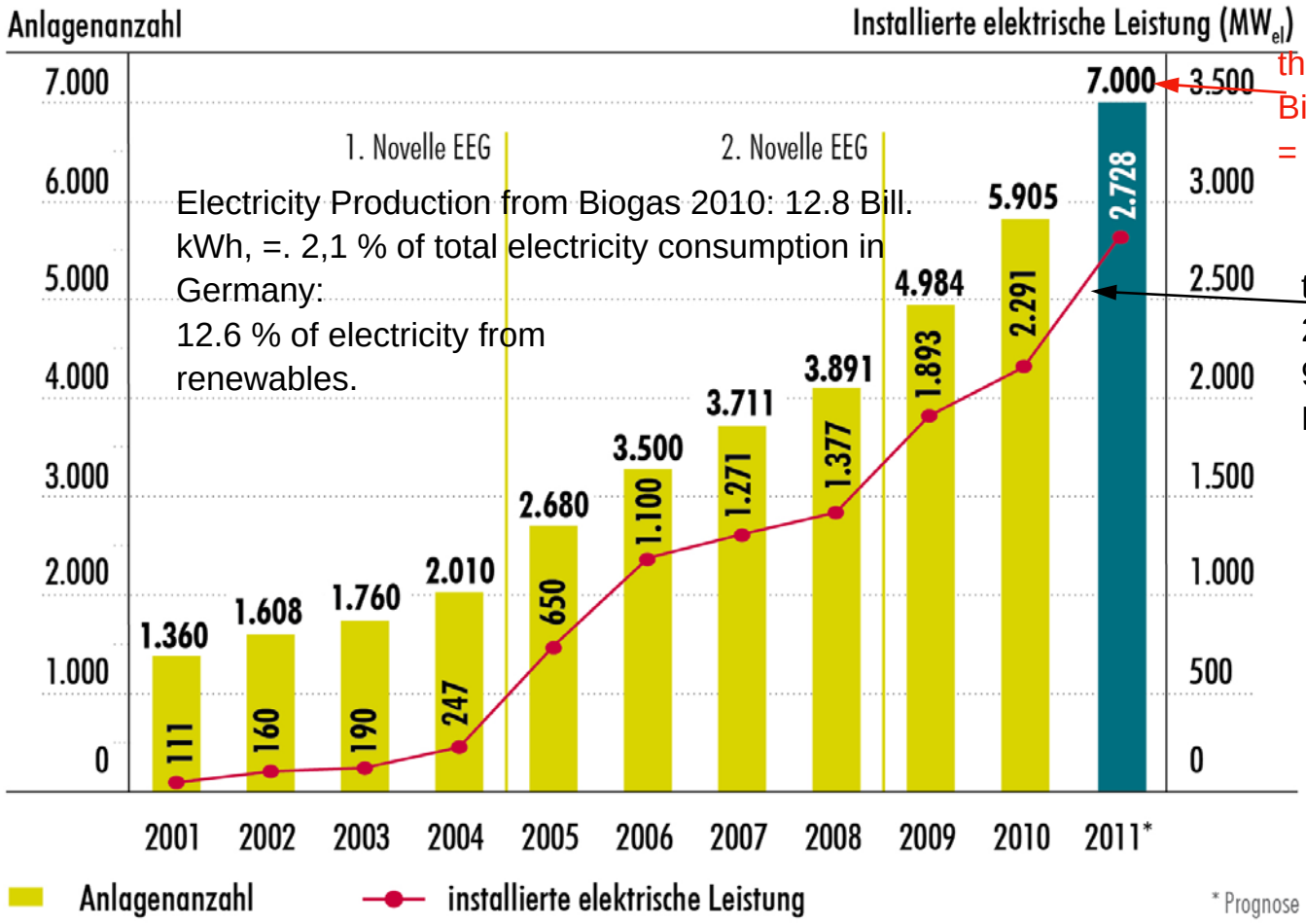
long term contract

Production of biomethane

- Biomethane injection uncouples the production and usage of bioenergy
- Biomethane injection enables usage of bioenergy even in metropolitan areas



Development of Biogas Production in Germany



Electricity Production from Biogas 2010: 12.8 Bill. kWh, =. 2,1 % of total electricity consumption in Germany:
12.6 % of electricity from renewables.

thereof about 80 Biomethane Plants = 1.1%

thereof about 250 MWel = 9% Biomethane

Source: Fachverband Biogas, FNR

Biomethane: best energy yield per area among bio-fuels

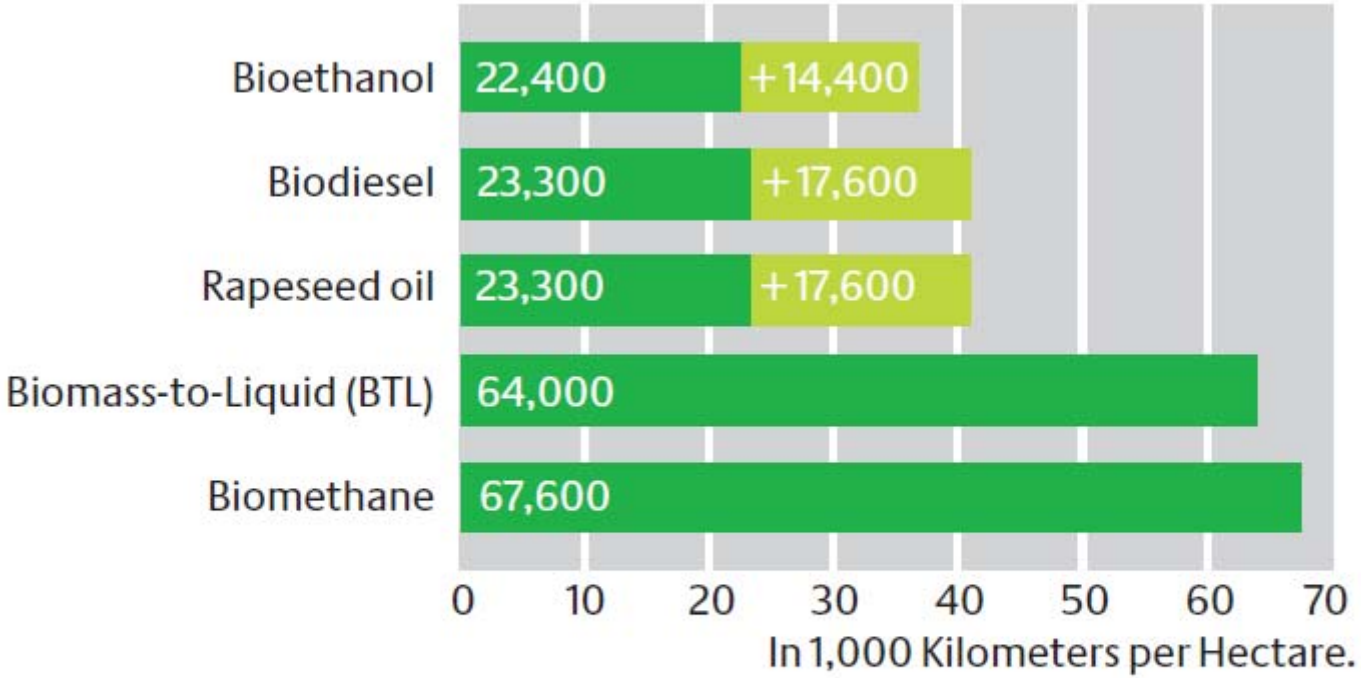


Figure: Yield of biofuels in km per hectare

Biomethane from byproducts (mash,

Source: DENA and Fachagentur Nachwachsende Rohstoffe

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Biomethane has highest diversity of input materials

- biogas / biomethane

- bioethanol

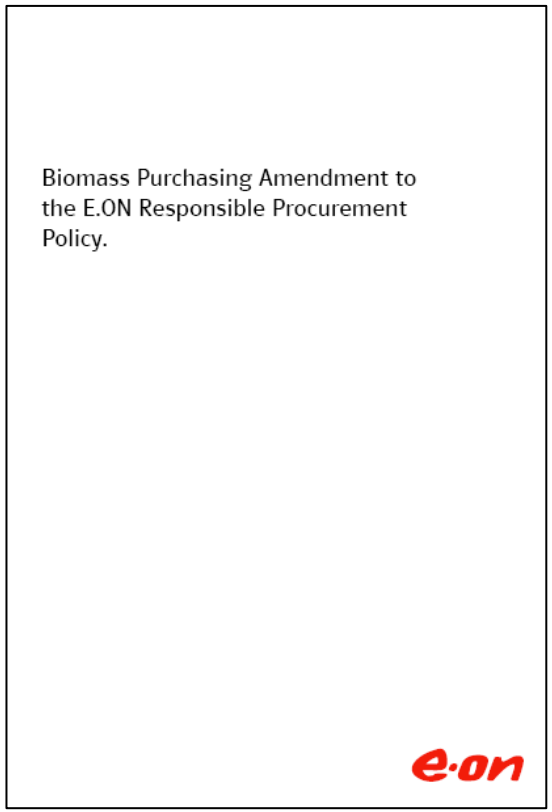
- biodiesel

source: KWS, www

E.ON Activities in Energy Crops

E.ON principles for utilisation of energy crops :

1. We will not use human food as a biomass fuel.
2. Animal feed, crops grown for energy use and agricultural residual products, can only be used as a biomass fuel if:
   - 1. the use of such biomass is in line with respective Government (and / or EU) regulations or programs, and
   - 2. local and global food prices and security will not be distorted from utilising such biomass.



Broad Range of Energy Crops as Biogas Feedstock

- Nearly every agricultural crop is usable for biogas production,
- Green Rye, Gras, Clover, Maize Silage are traditional energy crops for biogas production,
- A mix of different energy crops provides for stable gas production,
- Double-Cropping systems allow for combined food and energy crop production,
- ”New” energy crops like Silphium Perfoliatum, Sorghum, Trifolium and Lucern are promising but require additional R & D,

Investigating in „new“ energy crops and cropping systems

Perennial crop mixtures

Alternative arable crops

Permanent crops

Residues from agriculture and food processing

Investigation of potential sources for residues from

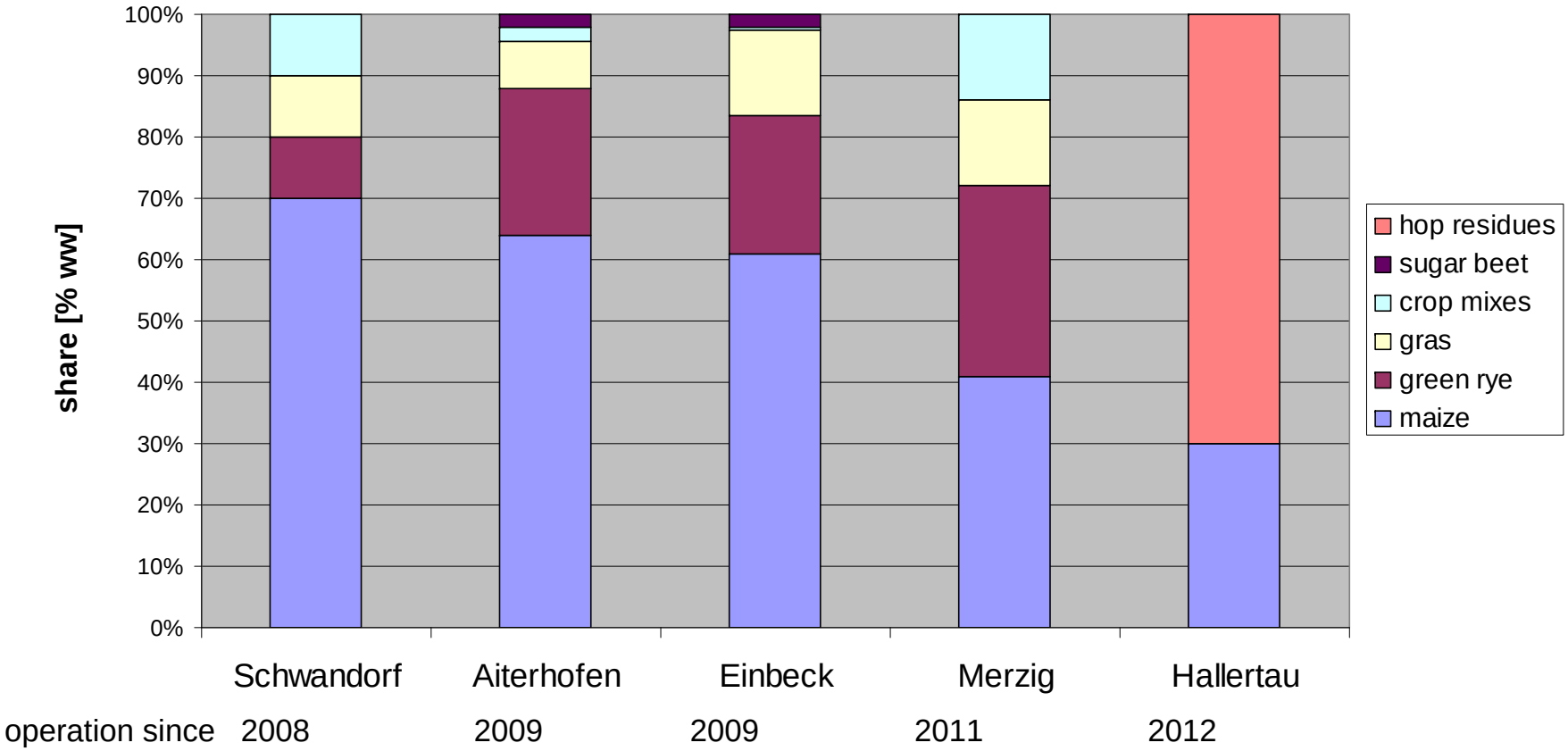
- Straw, hop and other agricultural residues,
- Grain processing,
- Sugar production,
- Dairies,
- Kitchen,
- Breweries,
- Others.

Sugar beet pulp

Cereal residues

Kitchen waste

Increasing diversity of substrates



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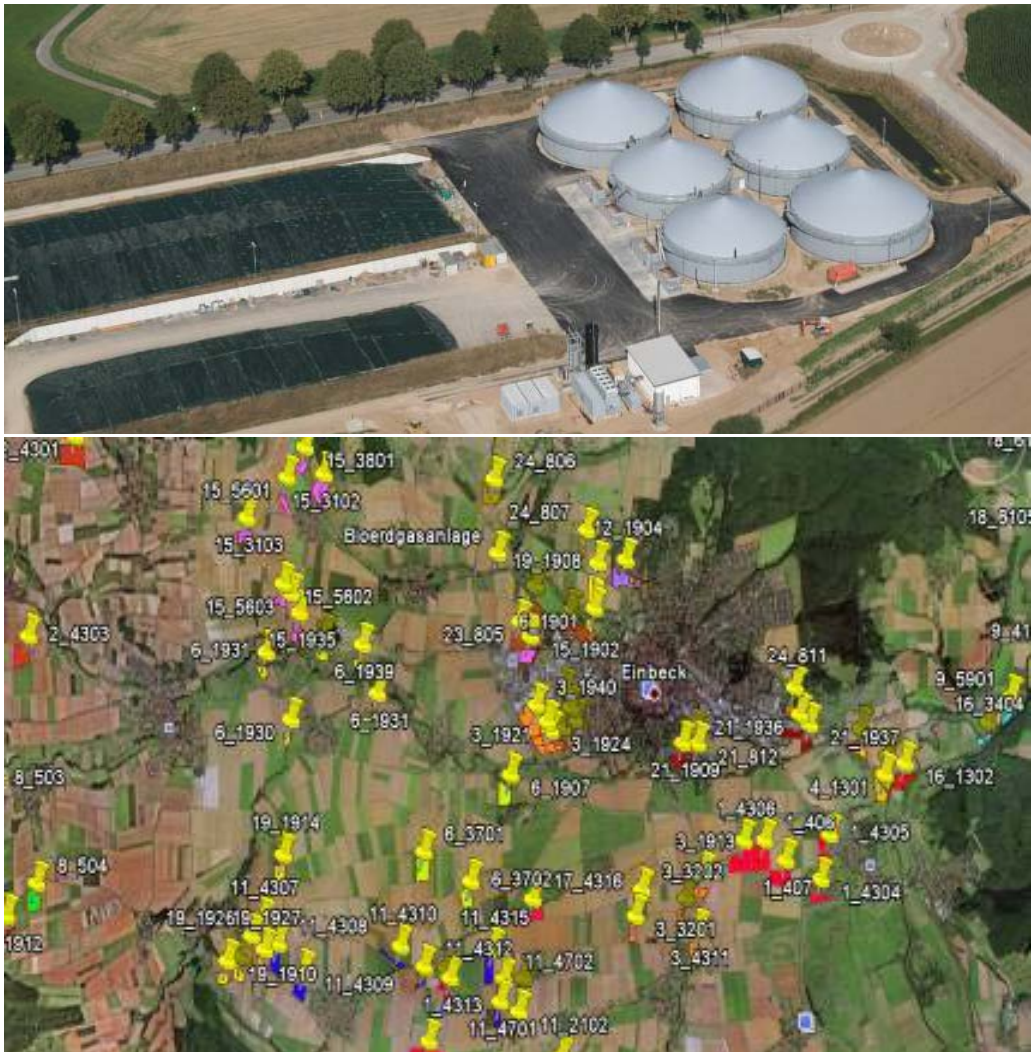
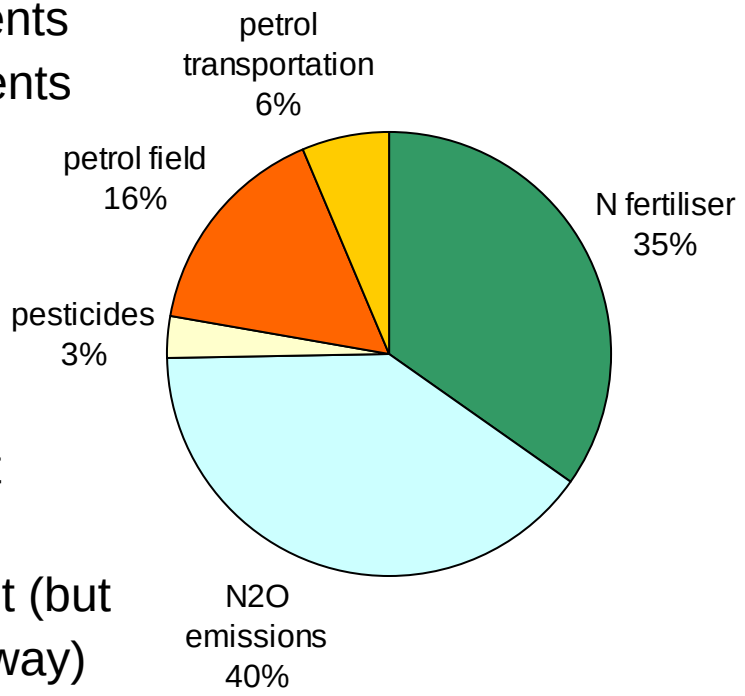
CO2 – emissions of biomethane production: Einbeck



- capacity 5 MW (maize, gras, rye)
- Deedstock sourcing within 15 km radius.
- average transportation distance: 8 km
- high CH4 yield (appr. 110 Nm³/t maize)
- GHG emissions of biomass production, fermentation and biogas upgrading: 43 g CO2 eq/kWh,hcv

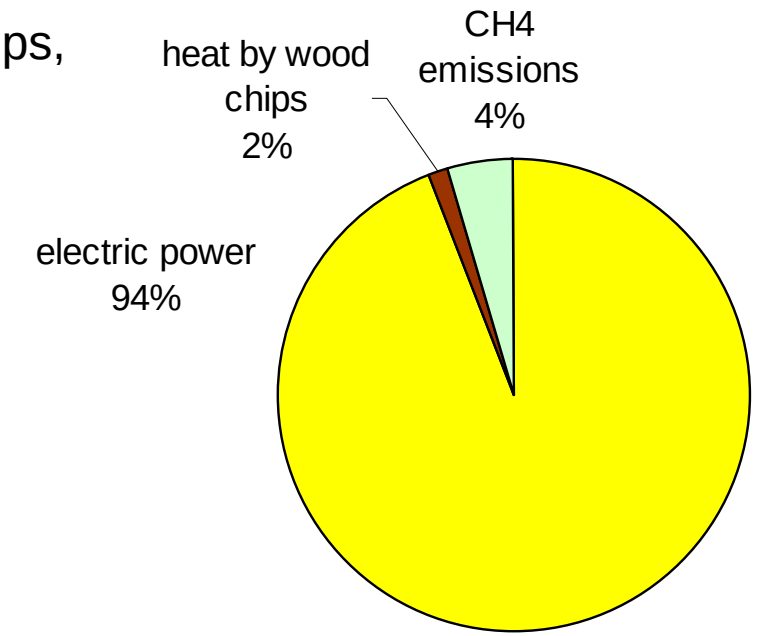
Feedstock production accounts for 54% of GHG emissions

- GHG factors CO2 = 1
  CH4 = 25 CO2 equivalents
  N2O = 298 CO2 equivalents
- N2O emissions largest GHG source yet based on assumptions
- N- fertiliser production 2nd largest source
- petrol consumption and transport distances are ecologically not crucial but important for economics
- pesticides are climate-wise less important (but energy crops require less pesticides anyway)
- summary GHG emissions of biomass production: 23 g CO2-eq/kWhhcv

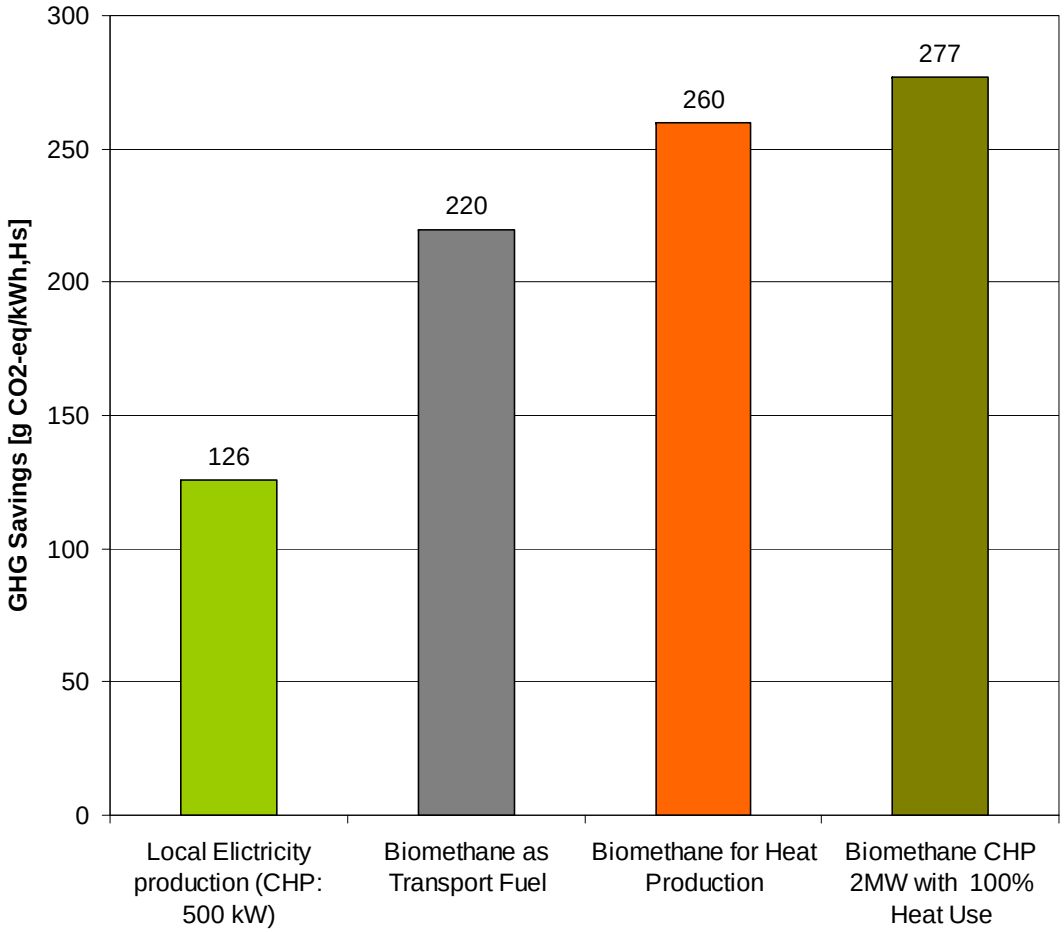


Biogas production / upgrading emit 46% of GHG

- largest GHG source of biogas production and upgrading: electric power for pumps, agitators etc.
- CH4 emissions mainly in waste gas from upgrading; leakages were neglible
- heat production with wood chips is good for GHG balance, but expensive
- summary GHG emissions of biogas production and upgrading:
  20 g CO2-eq/kWhhcv



GHG-Savings of Biomethane



- biomethane has near equally high GHG savings in all applications
- in CHP maximum heat utilisation is crucial

Summary of advantages of biomethane

- Biomethane is a dispatchable and storable energy source (unlike wind and solar power) with the highest end usage versatility of all renewable carriers: fuel for transport, heat and electricity
- Biomethane is available year-round (24/7); plants run in base load
- Anaerobic digestion has the highest energy yields per area and the highest versatility of input materials:
  - dilute organic waste, solid organic waste, wet crops, dry corn
  - root, stem, leaves and fruit
- Anaerobic digestion has a closed cycle of matter: nutrients from biomass return as organic fertiliser to the fields
- Biomethane has high CO2 savings in all applications

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