Range of Biogas Plants designed by Krieg & Fischer Ingenieure GmbH

Torsten Fischer and Dr. Katharina Backes

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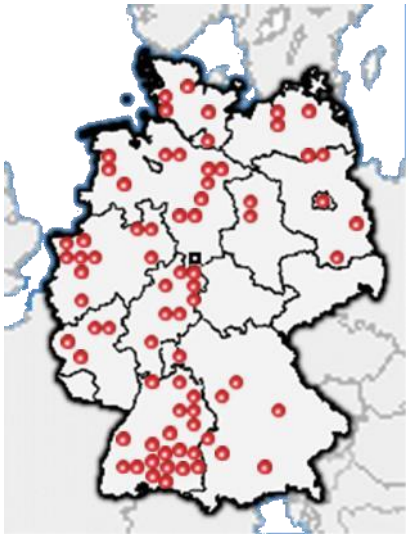
Sao Paolo, Brazil
June 29, 2010

Krieg & Fischer Ingenieure GmbH



Engineering Office, specialized in Design and Engineering of Biogas Plants

Foundation:	1999
Team:	18
Experience:	> 20 Years
References:	ca. 140 Biogas Plants
in:	Germany, Japan, Netherlands, Austria, Switzerland, Lithuania, Italy, Slovakia, Canada, USA, Spain, France, Ireland
Partner:	Japan, Korea, USA, Canada, Bulgaria, France, Hungary, Turkey, Poland, Italy Spain, Ireland, Serbia

Torsten Fischer

- President of Krieg & Fischer Ingenieure GmbH

→ Founded by Andreas Krieg  and Torsten Fischer in 1999

- Education: Engineer for Shipbuilding Construction
- Experience in the field of biogas since 1992

→ Special fields: - waste management and municipal engineering
- safety aspects of biogas plants

- **Lecturer** at the University of Höxter and Gießen
- Accreditation of the Chamber of Engineers of Germany as **Expert Witness in the field of biogas**

Service offerings of Krieg & Fischer in the field of Biogas

Krieg & Fischer Ingenieure GmbH

- Studies
- Concept Development
- Calculations
- Permits & Approvals
- Engineering
- Tendering and Commissioning
- Construction
- Start-up
- Optimization/Retrofits
- Supervision and Consulting

Key account


Krieg & Fischer Ingenieure GmbH


BIOENERGIE
RUHRTAL


Dalkia


Bioenergiezentrum
Göttingen GmbH


HSE
Energie für die Zukunft


EnBW


Inland Empire
UTILITIES AGENCY*
*A Municipal Water District


ALBA
SERVICE | MIT SYSTEM


국내 협력사
posco e&c


VATTENFALL


FCG
Finnish Consulting Group


EWE


MVV Energie


LES FERMES
CAVENDISH
FARMS


Bio-Nrj


Celtic
BioEnergy


StormFisher
BIOGAS


IBBK


ECOBIOGAS
especialistes en plantes de biogàs


RWE

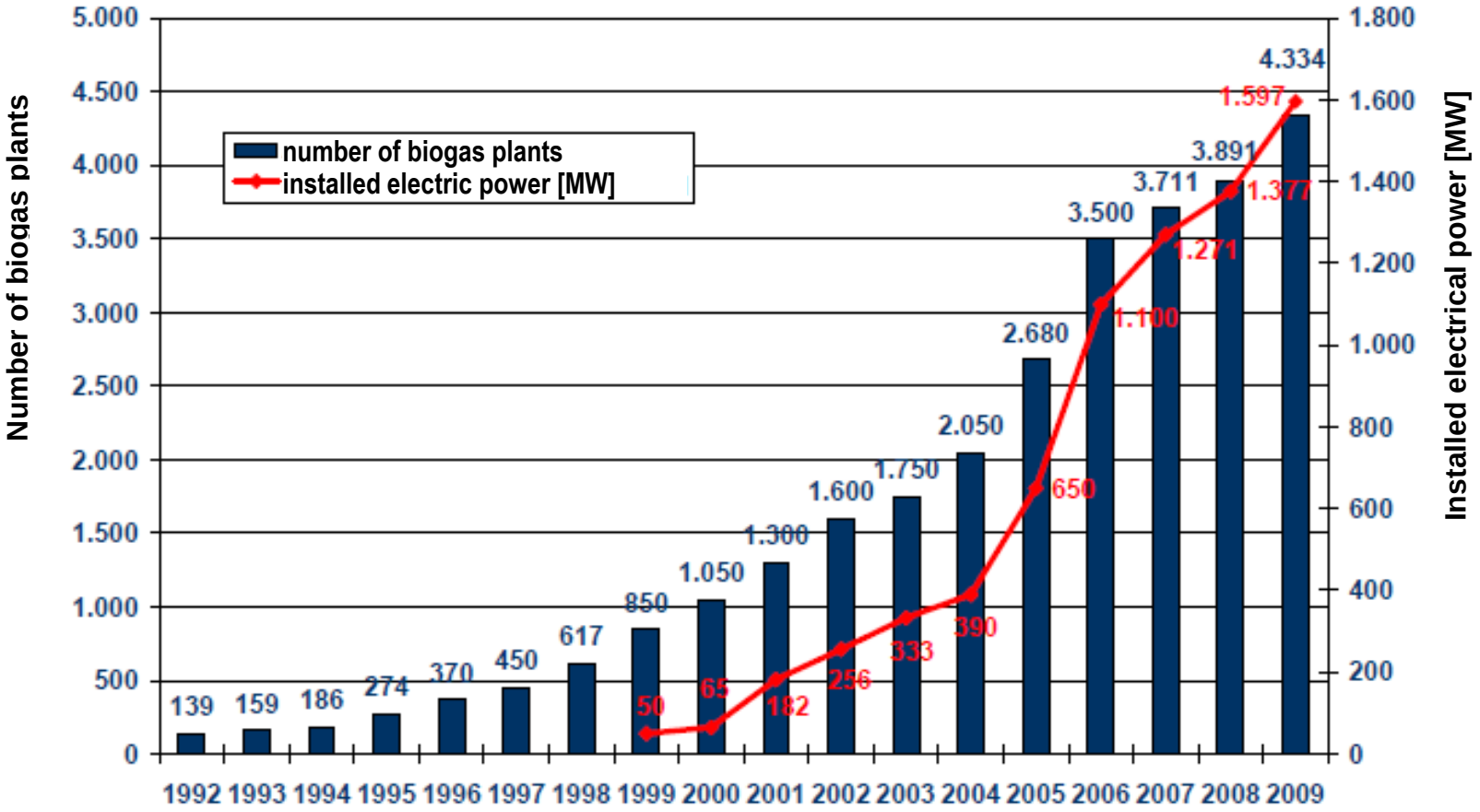

CES


Rabobank


EPURON
POWER FOR PORTFOLIOS

Development of Biogas in Germany

Krieg & Fischer Ingenieure GmbH

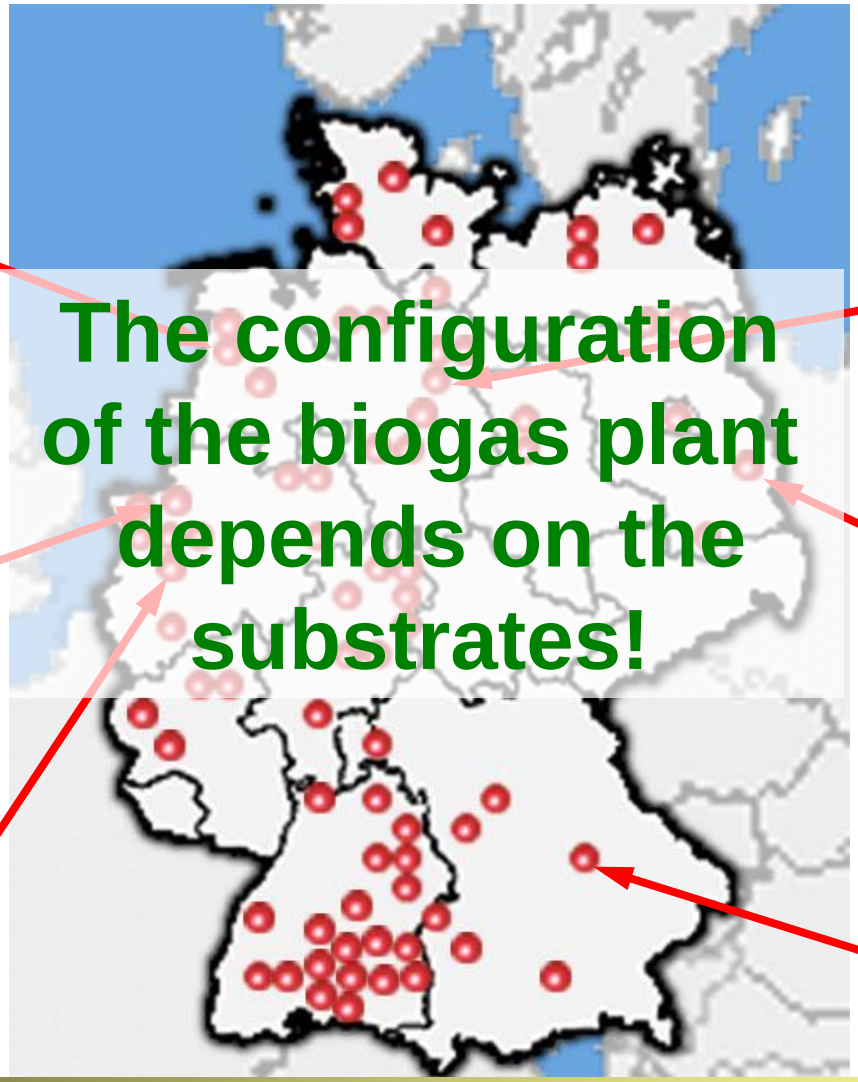


References - Examples

Central Biogas Plant

Energy Crop Biogas Plant

Kitchen Waste Digestion



The configuration of the biogas plant depends on the substrates!

Potato Residue Digestion

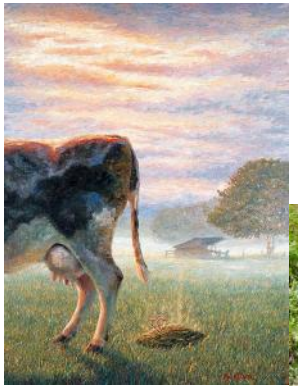
Energy Crops with Cattle Manure

Biowaste Digestion

Substrates used in Biogas plants

In Germany: energy crops

Worldwide: organic waste and manure



Werlte, Germany

Krieg & Fischer Ingenieure GmbH

- Built: 2002
- Substrate: manure 90,000 m³/a, fats 20,000 m³/a
- digester 2 x 3,200 m³ steel tank
- CHP: 2 x 1,3 MW_e gas engine
- Gasholder above secondary digester, heat usage; gas conditioning of 500 m³/h

Ameln, Germany

- Built: 2006
- Input: corn, wheat silage
- Digester: 2,560 m^3 steel tank
- CHP: 650 kW_e gas engine
- Gasholder above secondary digester, heat usage

Im Brahm, Germany

- Built: 2005
- Substrate: kitchen waste, pig manure, horse dung
- digester: 1,205 m^3 concrete tank
- CHP: 2 x 190 kW_e gas engine
- mesophilic process engineering with hydrolysis

Wietzendorf, Germany

- Built: 2000-2002
- Substrate: waste water of starch production (potato-starch) potato residues
- 4 digester, 2.500 m³ each, secondary digester with gas holder roof
- CHP: 4 x 2,1 MW_e gas engine
- Protein recovery, reverse osmosis, retention of biomass through decanter

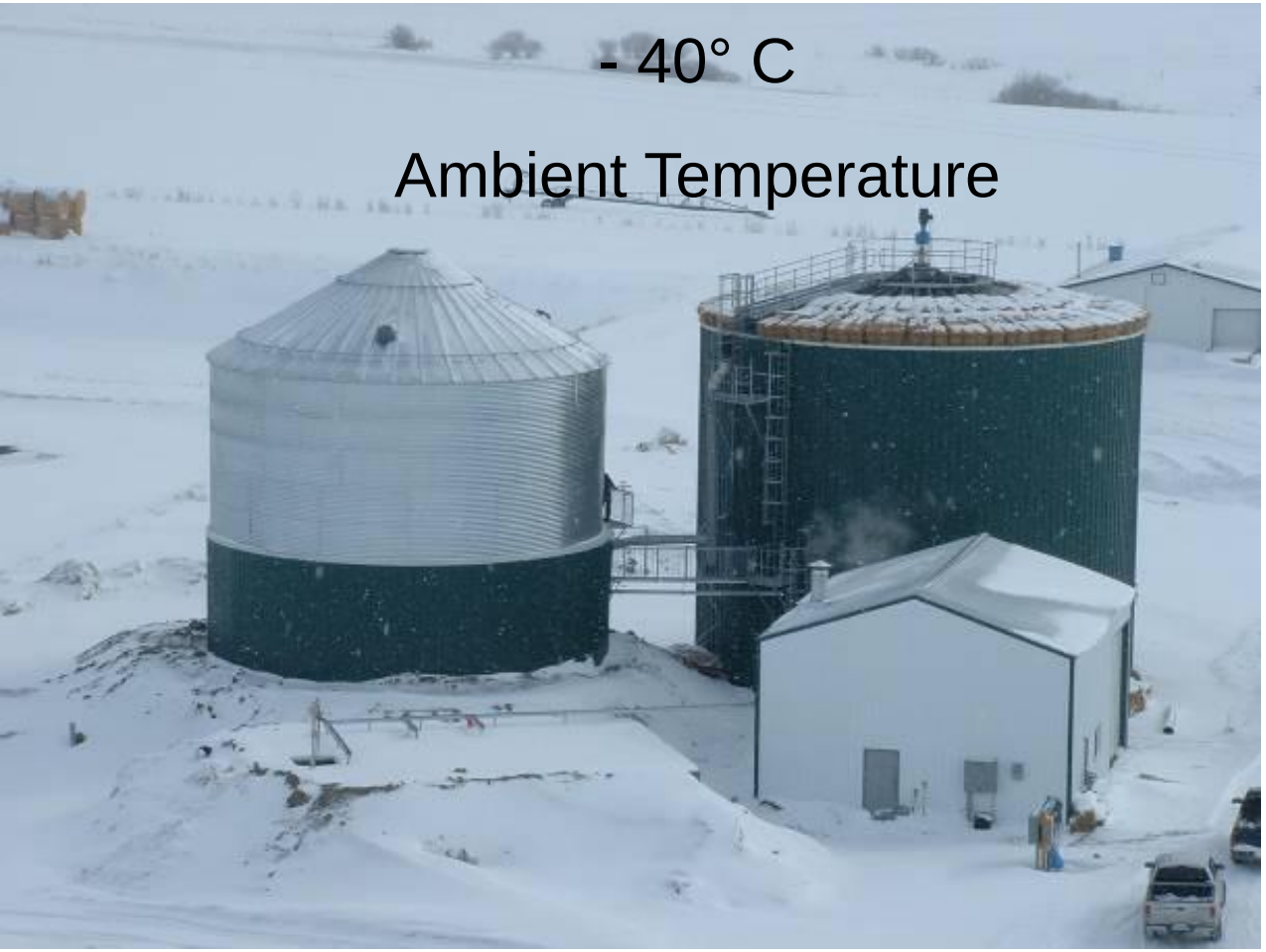
Wiesenau, Germany

- Built: 2007
- Input: cattle manure, cattle dung, corn-, grasssilage
- Digester: 4.300 m^3 concrete
- CHP: 2 x 526 kW_e gas engine
- Gasholder above secondary digester

Blümel, Germany

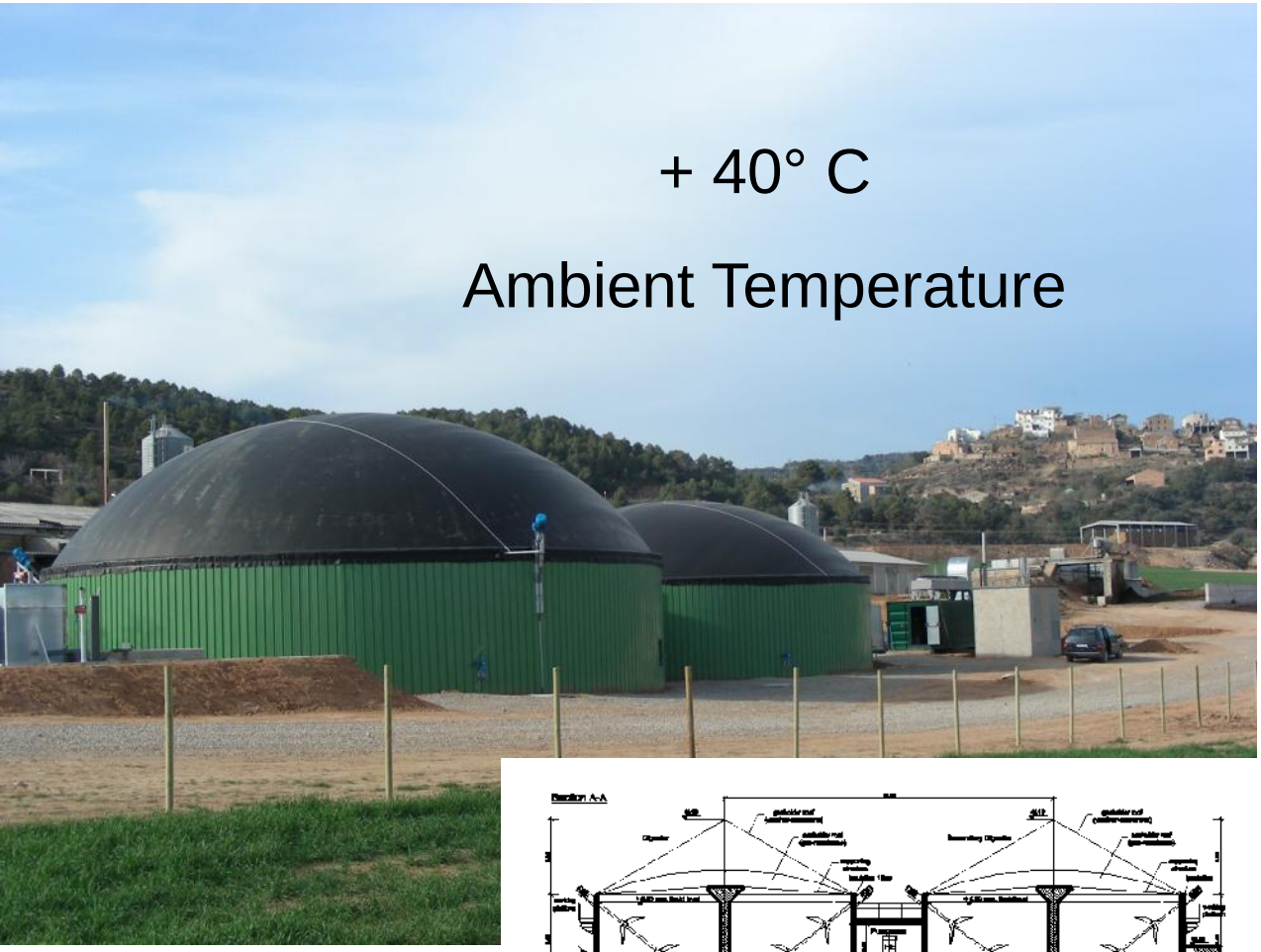
- Built: 1994/1995
- Input: separate collected household waste
- Digester: 2 x 800 m^3 concrete tank
- CHP: 2 x 160 kWe diesel gas engine
- Gasholder above digesters, pretreatment of waste, heat usage

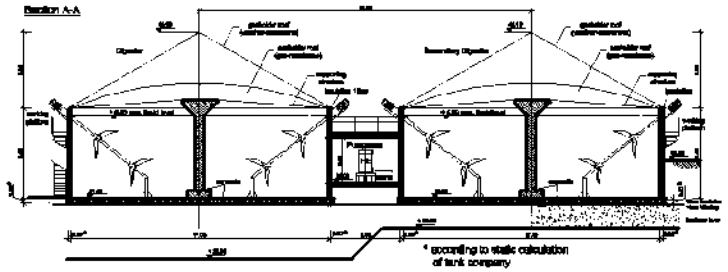
Saskatoon, Saskatchewan, Canada



- Built: 2003
- Substrate: pig manure, potatoes
- Digester: 2,000 m^3, steel tank
- CHP: 4 x 30 kW_e microgasturbines
- Designed for low outside temperature;
  special design: gas holder in a tank (left tank);
  special building material for gas holder roof and insulation

Montargull, Spain





- Built 2007
- Input: pig manure, FOG, slaughterhouse waste water sludge
- Digester (2.080 m³) and secondary digester with gas holder roof
- Special gas cooling system adopted to high ambient temperature
- CHP: 364 kWe gas engine
- Invest 820.000 €

Chino, California, USA

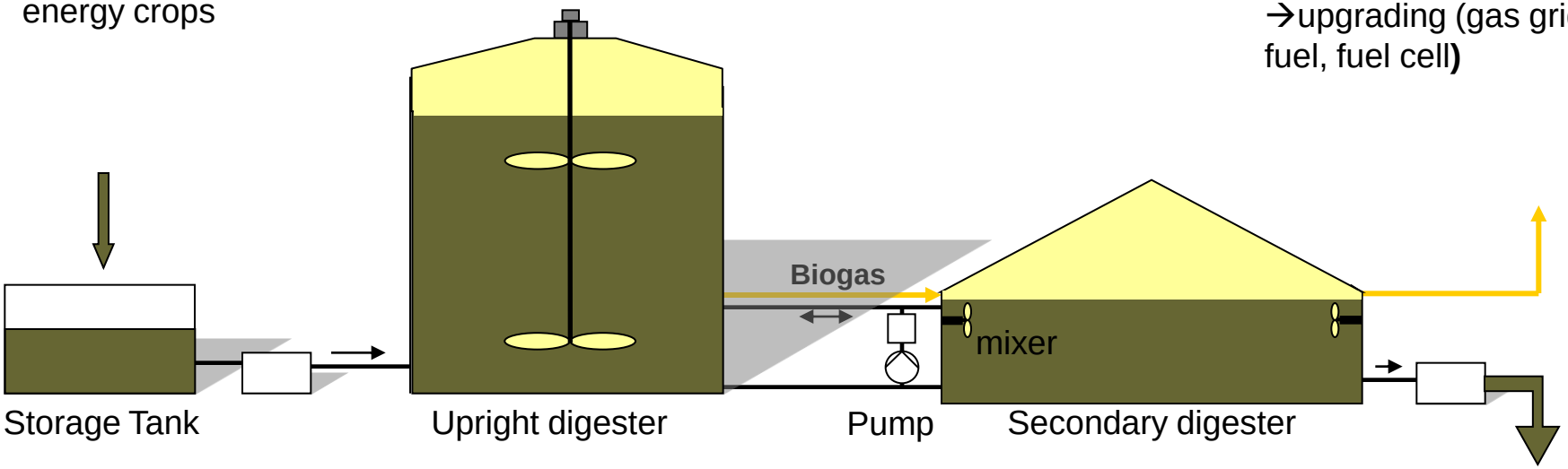
- Input: cattle manure (270 t/a, DM 12%), liquid waste from food industry (83 t/a) food waste
- Sediment removal from the digester
- Gas distribution in a biogas grid (~19.000 m^3/d)
- Power generation capacity: 1,500 kW_e
- Construction costs: $ 5 million

Biogas concept with upright digester

Substrate

manure
organic waste
energy crops

Gas utilization
→CHP (power, heat)
→direct use (heating, cooking, light)
→upgrading (gas grid fuel, fuel cell)



Input device
→piston pump, screw etc. (solids)
→pump (fluids)

Heat exchanger

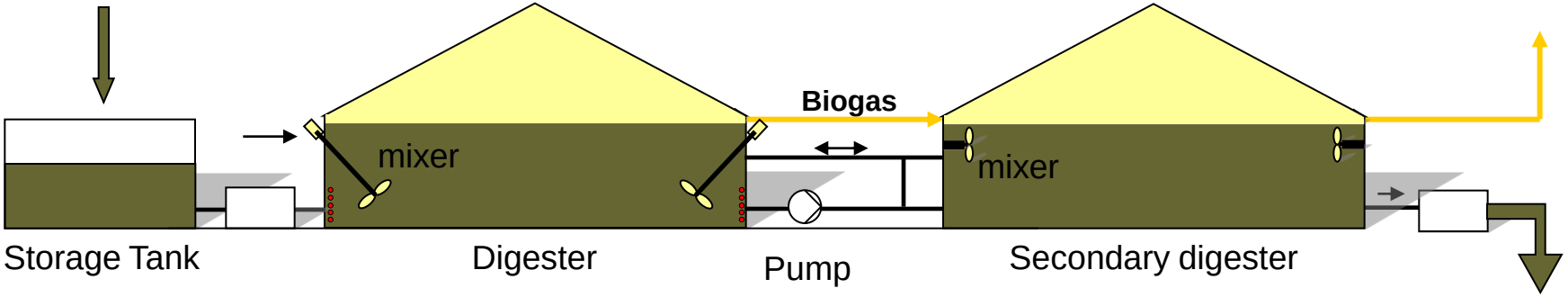
Digested substrate
→storage and use as fertilizer
→treatment

Biogas concept with flat digester

Substrate

manure
organic waste
energy crops

Gas utilization
→CHP (power, heat)
→direct use (heating, cooking, light)
→upgrading (gas grid fuel, fuel cell)

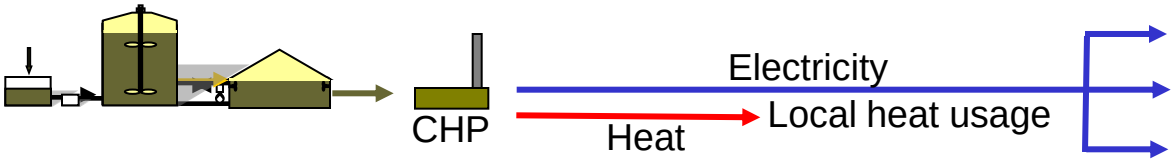


Input device
→piston pump, screw etc. (solids)
→pump (fluids)

Digested substrate
→storage and use as fertilizer
→treatment

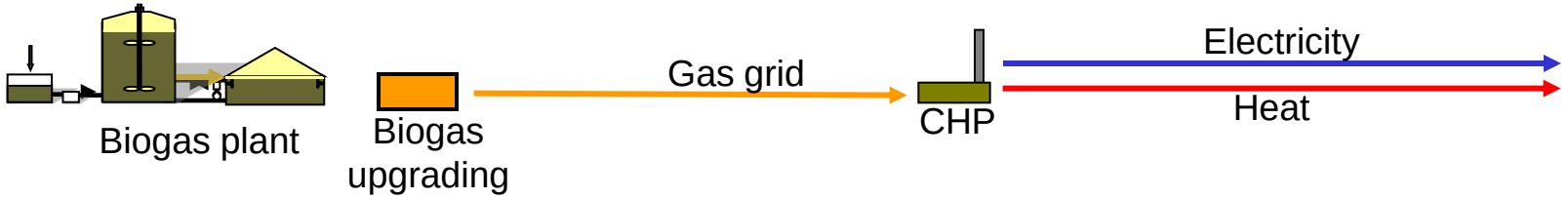
Biogas concepts

Local usage

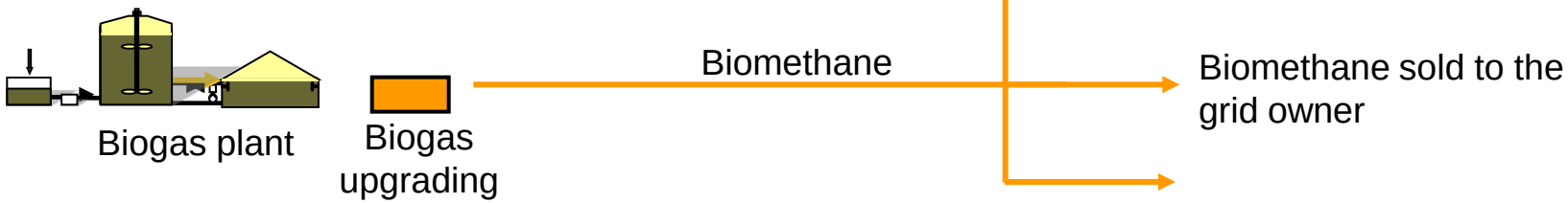


Transport of biogas

Transmission of biomethane

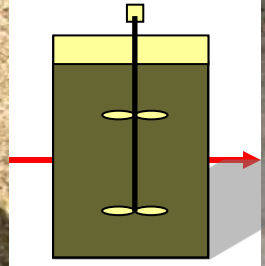


Biomethane feeding-in



Digestate

before



Digester

after

Digestate

- Use as fluid fertilizer and spread on land

- Treatment
  - solid digestate → composting (solid fertilizer)
    → drying (fuel…)
  - fluid digestate
    - use as process water
    - further treatment (reverse osmosis, ultra filtration)

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