

Round Table Expert-Meeting - Experiences with Biogas Upgrading and Injection to the Natural Gas Grid -

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Hannover, NBank, April, 27th, 2010

Krieg & Fischer Ingenieure GmbH



Krieg & Fischer Ingenieure GmbH

Engineering Office, specialized in Design and Engineering of Biogas Plants

Foundation: 1999

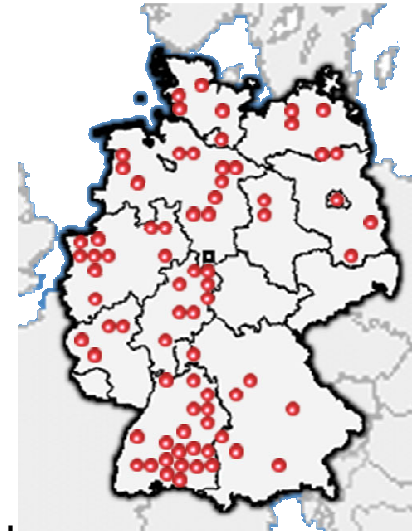
Team: 20

Experience: > 20 Years

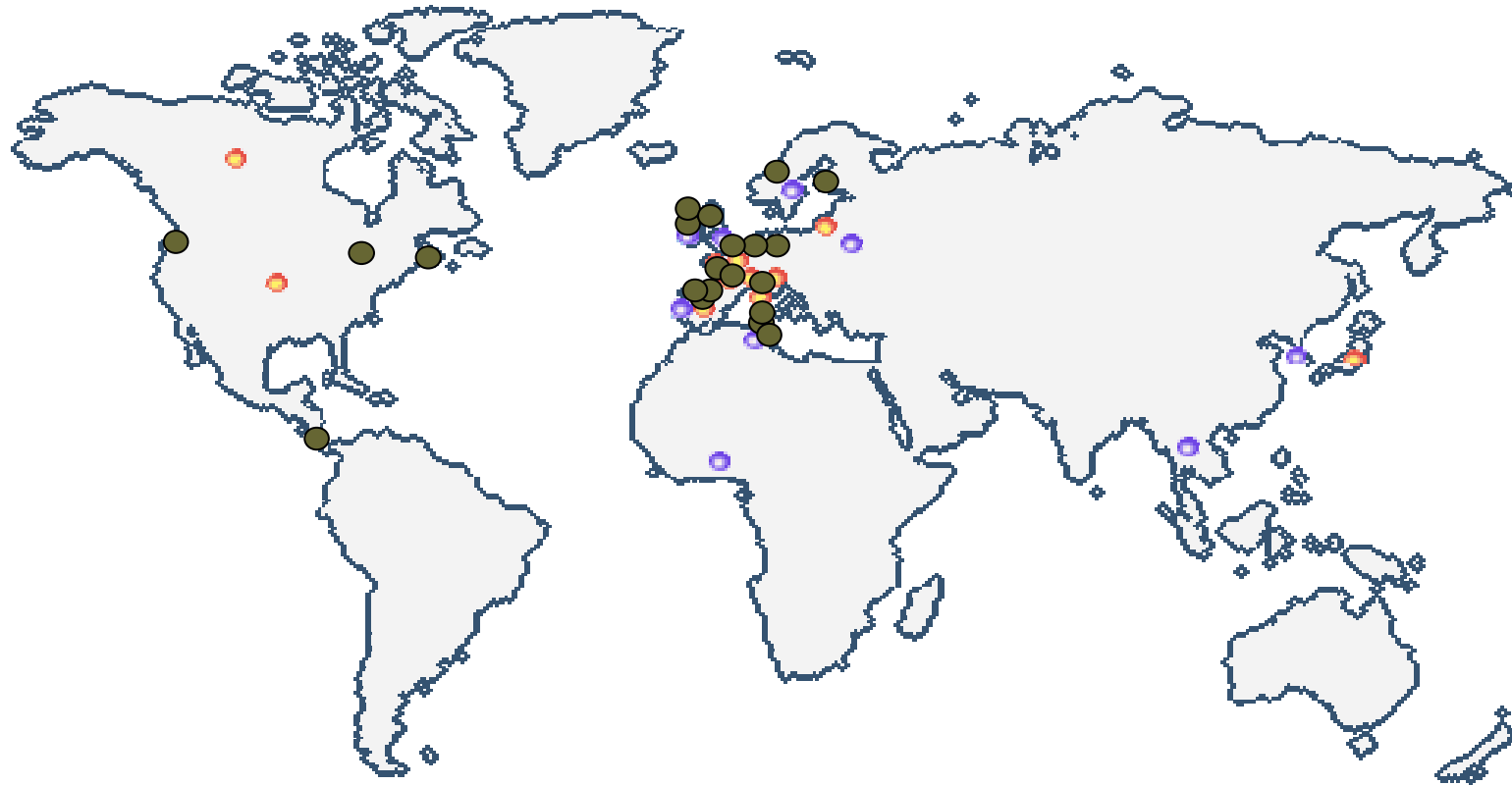
References: ca. 140 Biogas Plants

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



Krieg & Fischer Orders at this Moment (April, 2010)



in France, Spain, Italy, Ireland, USA, Germany, Norway,
Serbia, Poland und Canada, The Netherlands,
United Kingdom and Finland.

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



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

Key account



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References - Examples



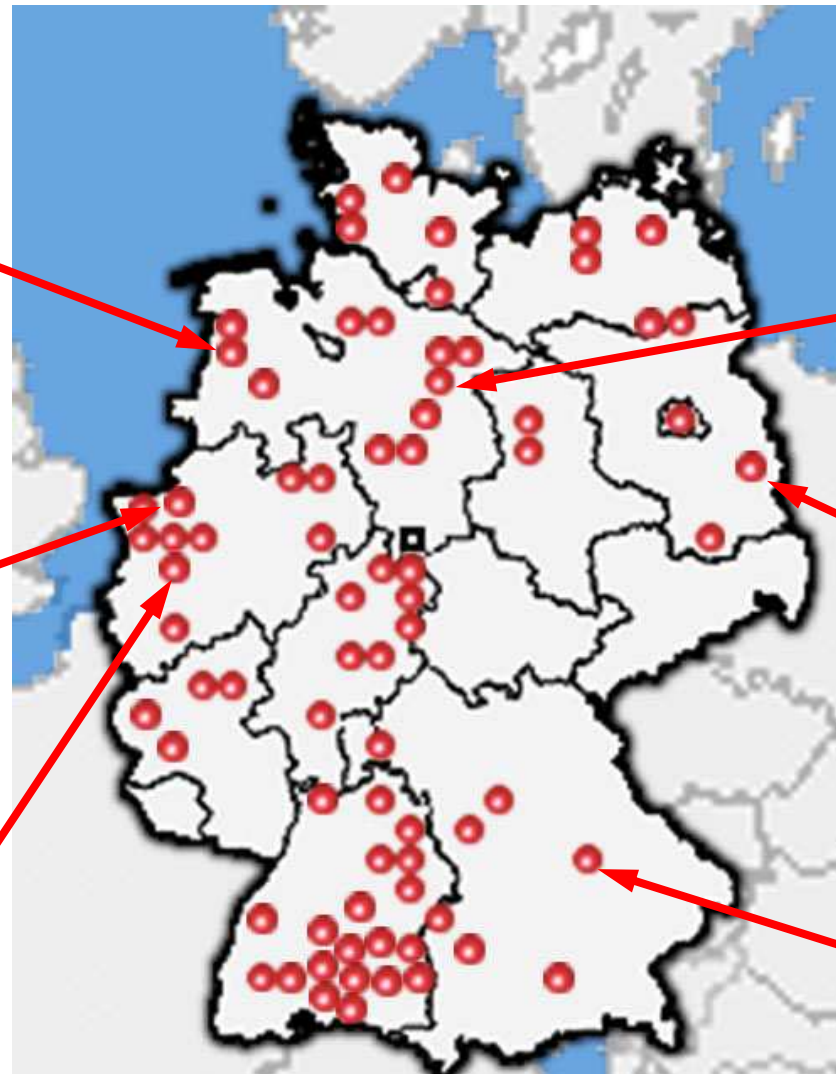
Central Biogas Plant



Energy Crop Biogas Plant



Kitchen Waste Digestion



Potato Residue Digestion



Energy Crops with Cattle Manure



Biowaste Digestion



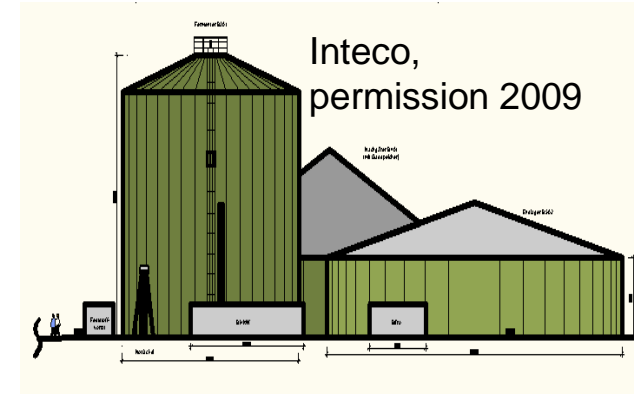
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References in Italy



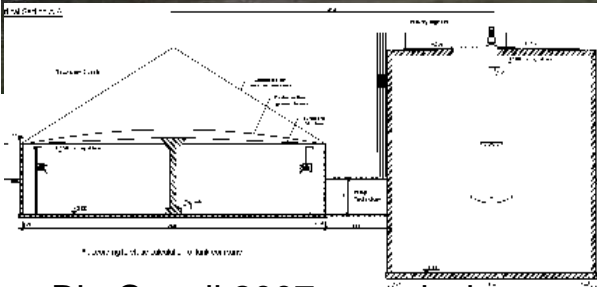
Prato allo Stelvio 2001

- Termoli, permission 2007
- Boldini, study 2002
- Brentonico, study 2002
- Schluderns, preplanning 2001



Bosco della Cascina, 2009

- Terenten, study 2001
- Forni di Sopra, study 1999



Bio Canali 2007, permission planning



Forcate 2009

Our partner in Italy:
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 33170 Pordenone, Italy
 Phone: +39 (0434) 365126
 Mail: pia@intecoeng.it
<http://www.intecoeng.it>

Biogas Upgrading with Participation of K&F



- Stadtwerke Magdeburg (study in 1997)
- Werlte (in operation since 2008)
- Semd (startup in May 2010)
- Oranienbaum (in planning)
- Im Brahm (in approval procedure)
- Baden-Württemberg (in planning)
- Rheinland-Pfalz (in approval procedure)

Werlte, Germany



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- Built: 2002
- Input:
manure 90,000 m³/a,
fats 20,000 m³/a
- Digester 2 x 3,200 m³
steel tank
- CHP: 2 x 1,3 kW_e gas
engine
- Upgrading of biogas
since 2008;
PSA (Carbotech)
500 m³/h biogas →
350 m³/h biomethane
- Injection to the local
distribution net
(0,8 bar)



Werlte, Germany



| | 2008 | 2009 |
|-----------------|--------------------------|--------------------------|
| Biomethane | 1,641,767 m ³ | 2,518,000 m ³ |
| Operation hours | 6,800 h | 7,194 h |

- Gas grid: during warmer days in June 2008 and July 2009 the injection had to be reduced, the local gas grid was overfilled.
- PSA: 2008: 46 days with problems
In July and November 2008 problems with the electric occurred that could not be managed ad hoc.
- Biogas plant 2009: because of high H₂S concentration in the biogas, the upgrading plant was switched off for a week.

Semd, Germany Water scrubbing



Krieg & Fischer Ingenieure GmbH



- Built: 2009
- Input:
corn silage 13,800 t/a
- Digester 2,300 m³
concrete tank
- Full stream separation
- Upgrading of
340-360 m³/h biogas
by water scrubbing

Semd, Germany Water scrubbing, Malmberg



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Installation of the preinstalled
plant delivered in a container from Sweden

Im Brahm, Germany



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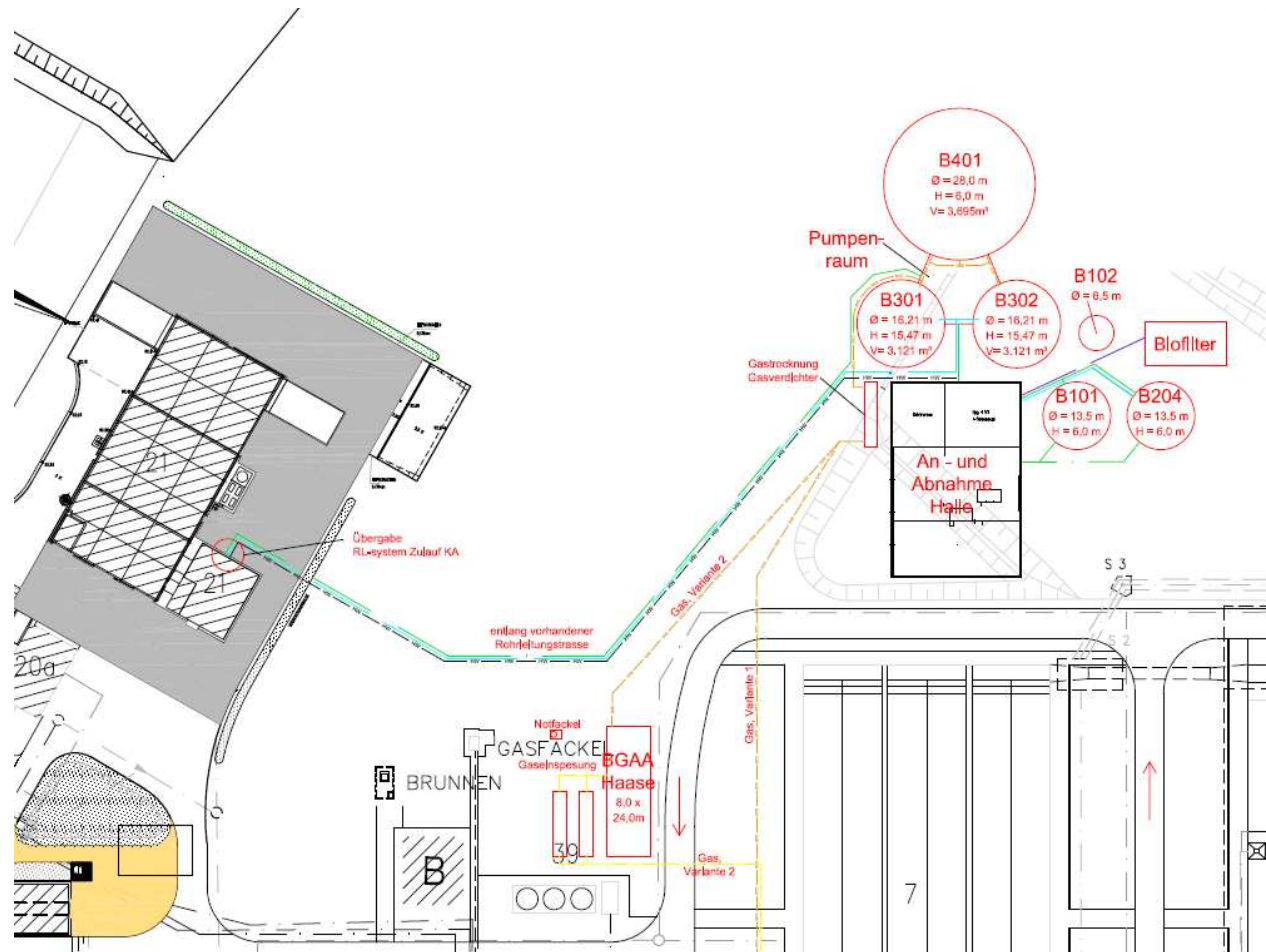


- Built: 2005
- Input: kitchen waste, pig manure, horse dung
- Digester: 1,205 m³ concrete tank
- CHP: 2 x 190 kW_e gas engine
- Mesophilic process engineering with hydrolysis
- Enlargement 2010: 3. digester and biogas upgrading and injection

Baden-Württemberg, Germany



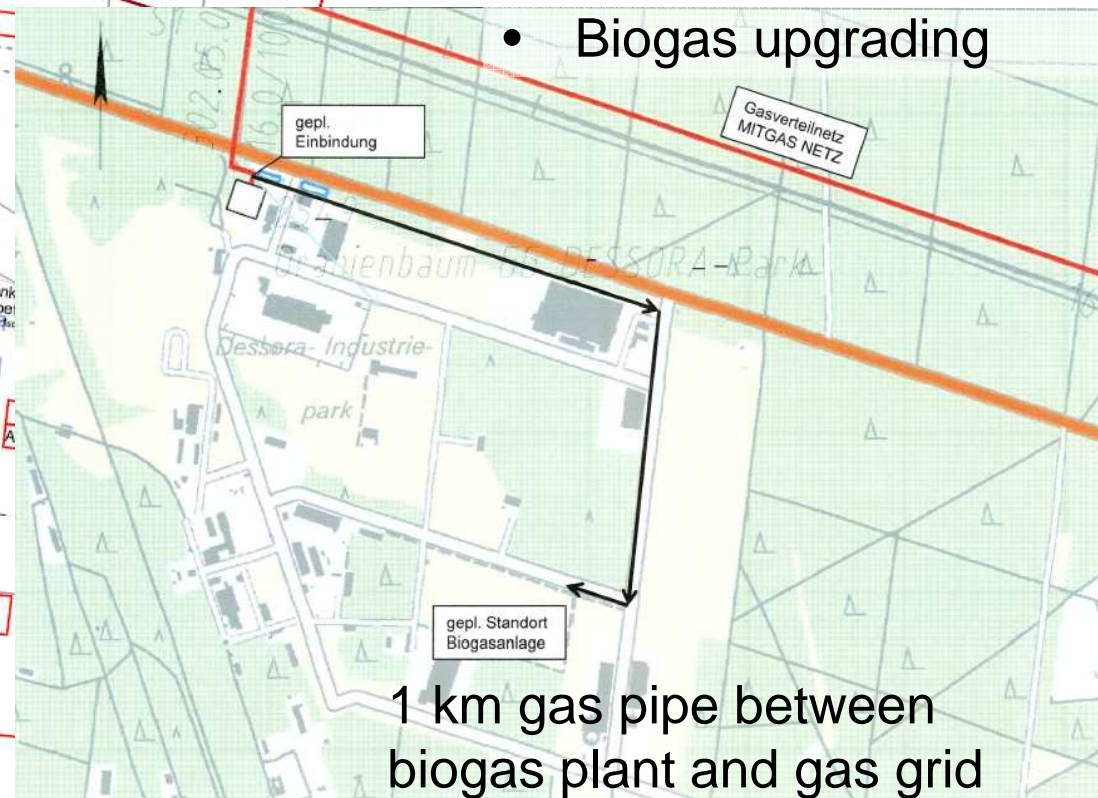
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- Study in 2009
- Input: kitchen waste, bio waste, manure,
- Digester: 2 x 3,121 m³
- Mesophilic process engineering with sanitation
- Gas purification of about 500 m³/h

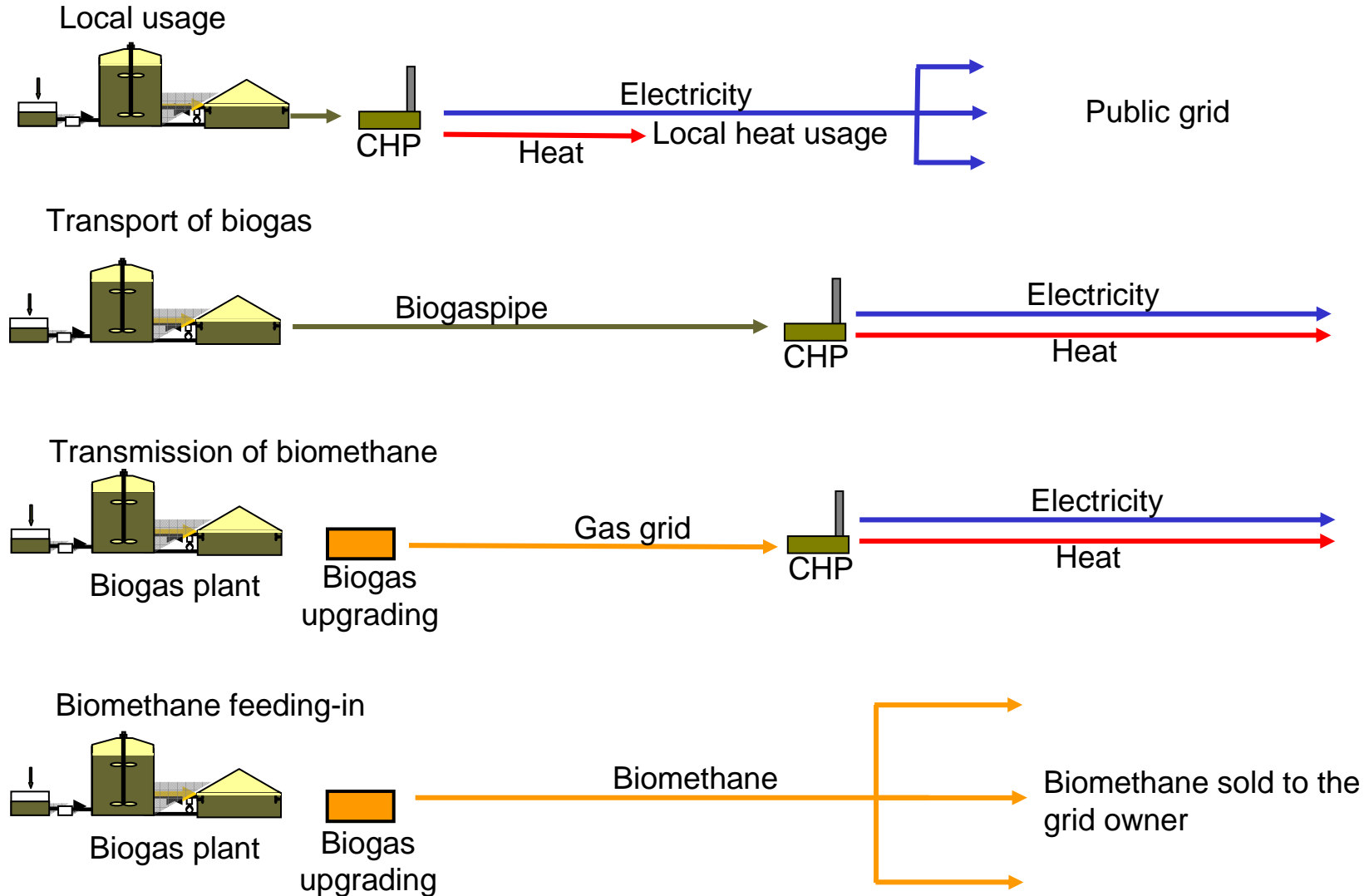
Oranienbaum, Germany

- Planning: 2010
- Input: energy crops
- 2 Digester: 4,954 m³ steel tank each
- Biogas upgrading



1 km gas pipe between biogas plant and gas grid

Biogas concepts



Choosing the upgrading system

The upgrading system has to be suitable to the biogas plant and the local conditions.

- Availability of heat on site
- Heat demand on site
- Costs of electric energy
- Amount of biogas
- Biogas quality (H_2S , Air O_2 , N_2)
- Natural gas grid (pressure, distance)
- Demanded biogas quality

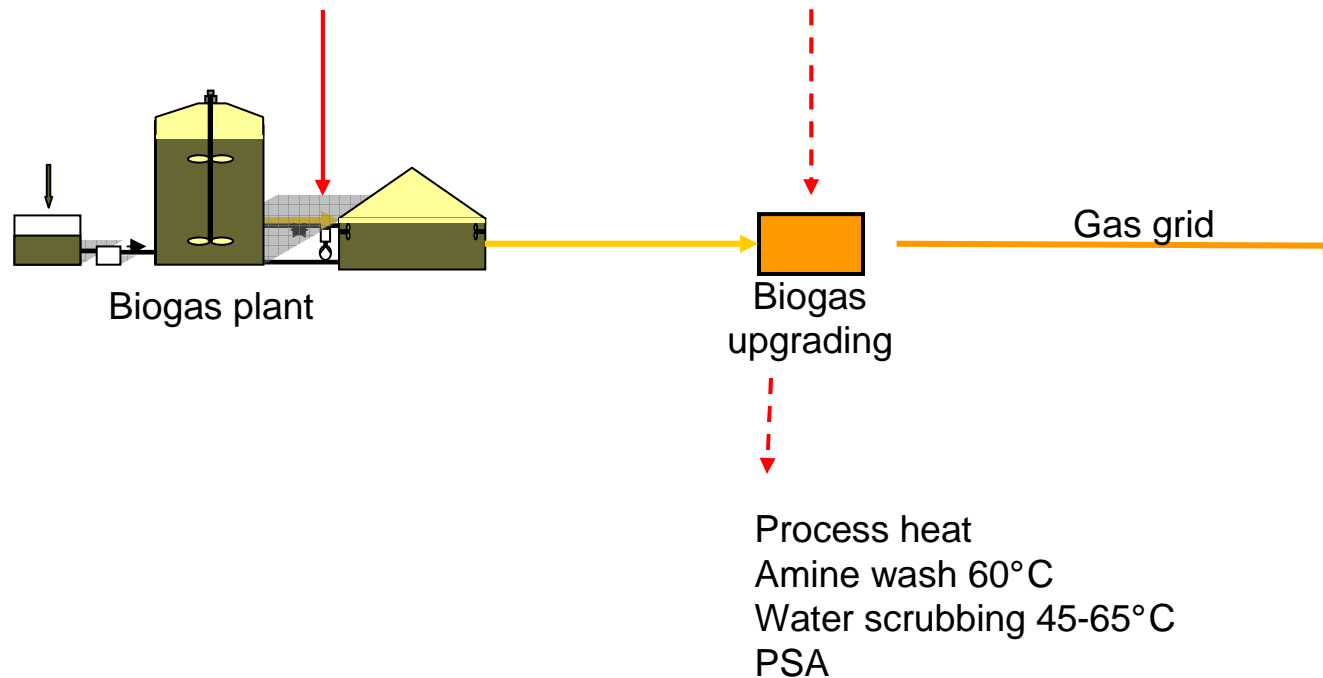
Heat demand on site

Supply of parasitic heat

- CHP
- Boiler
- Process heat biogas upgrading
- External heat supply

Heat demand

- Amine wash 160°C
- Genosorb wash 80°C



Conditions in Germany

- 24 biogas plants with upgrading system
- Feeding rate is not defined but has to be negotiated with the grid operator
- It is possible to use biomethane injected to the natural gas grid in a distant CHP
- The selection of the best fitted upgrading system depends on the local conditions (parasitic heat, costs of heat and energy supply)

Interfaces biogas upgrading

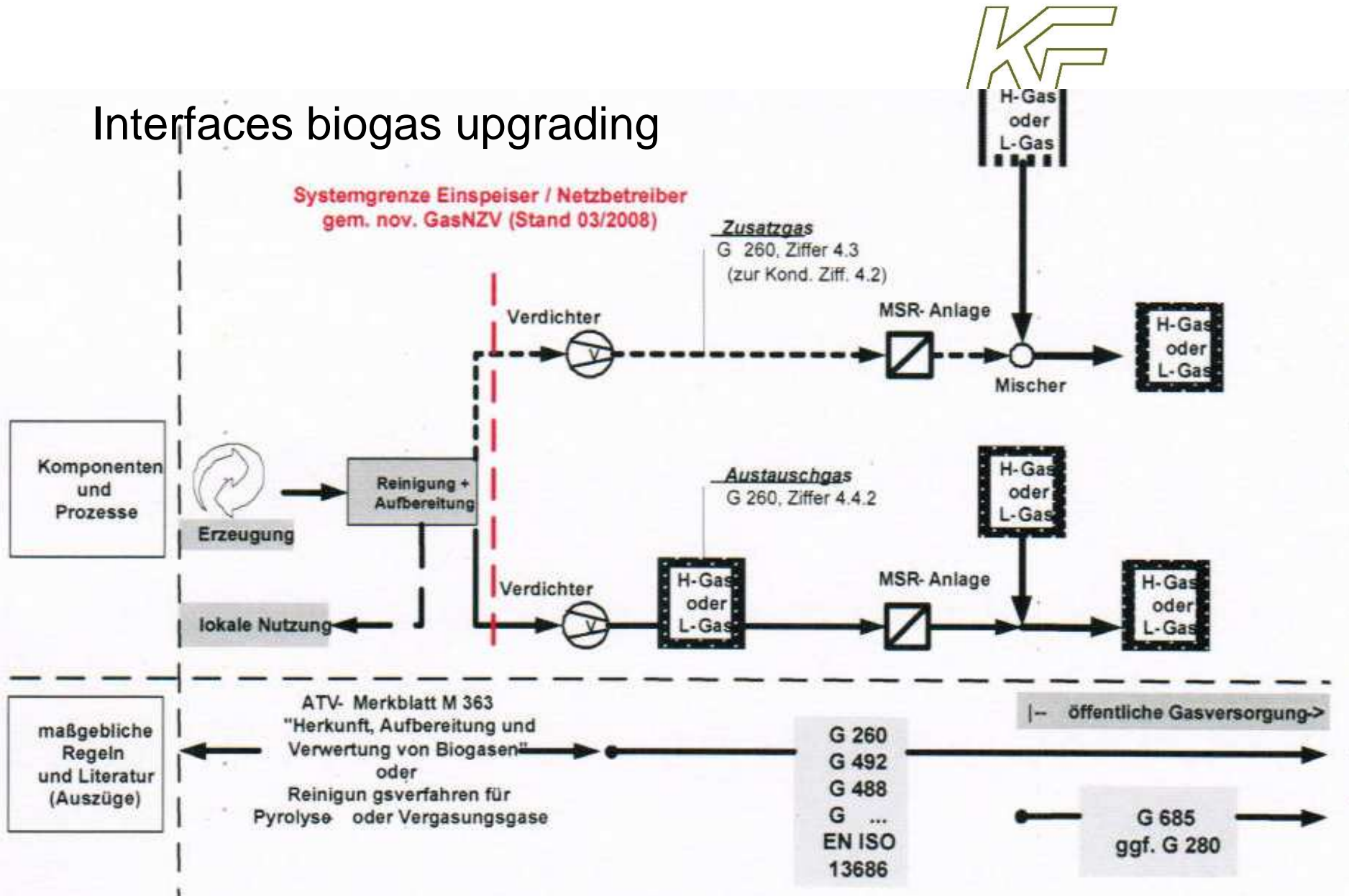


Abbildung 1-4: Einspeiseschnittstellen und relevantes Regelwerk [6]



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Injection to the national gas grid



Conditioning of the biomethane to adapt it to the local quality of the natural gas

Regulations

Biogas plants with upgrading system have to fulfill the requirements defined in the regulations of DVGW

- Special building materials have to be used.
→ PVC is not allowed for gas pipes.
But about 80 to 90% of all biogas plant suppliers use PVC!
Krieg & Fischer use PE and stainless steel since 2001.
- Special inspections have to be accomplished:
periodic pressure tests, tightness tests etc.
- The safety regulations of the German biogas association are valid only in some extent.

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