



# **Sustainable Management of Waste by anaerobic Digestion**

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## Krieg & Fischer Ingenieure GmbH



**Engineering Office, Planning and Construction**

**Founded: 1999**

**Experience: 20 Years**

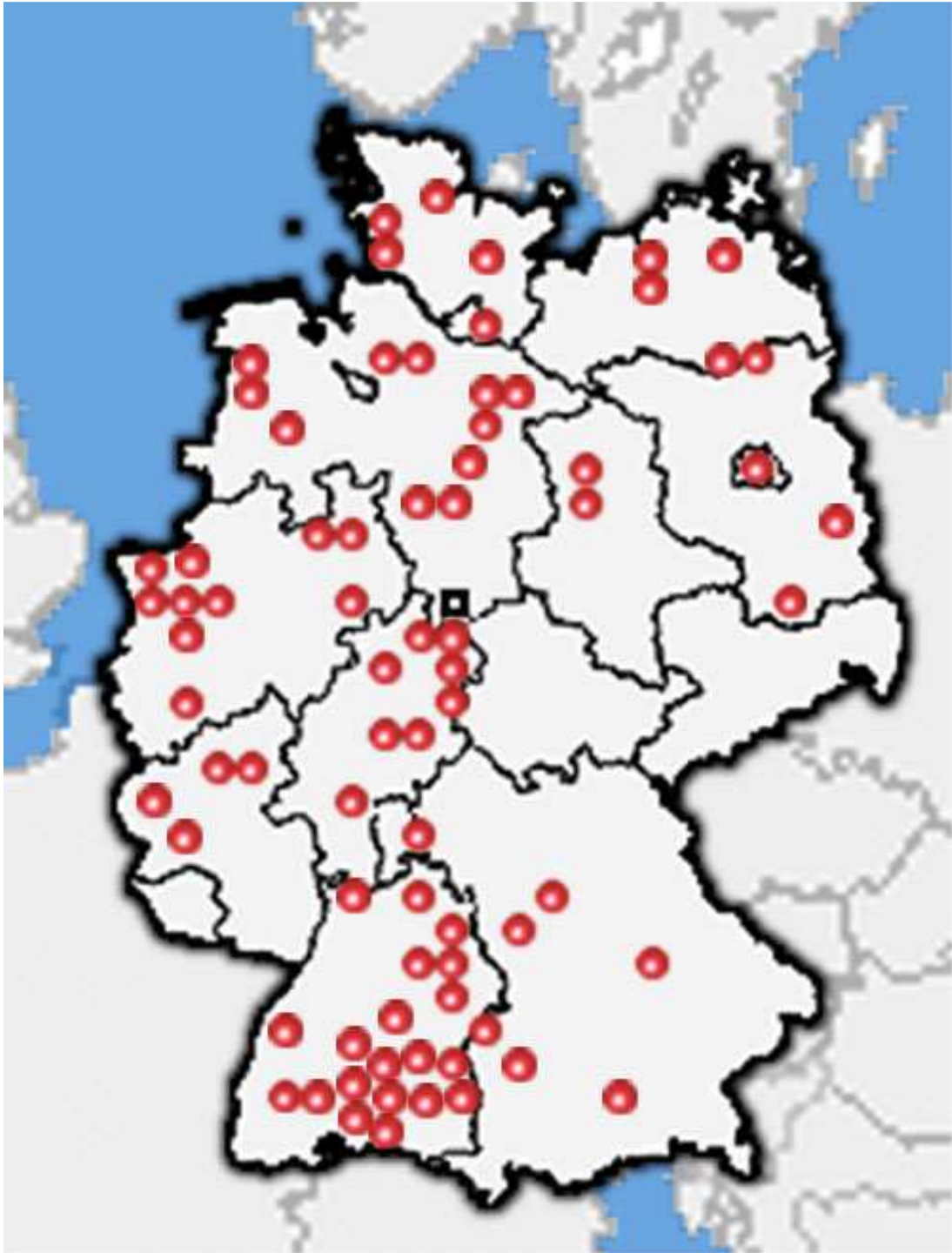
**References: about 120 total**

**about 90 farm-scale**

**Germany, Japan, Netherlands, Austria,  
Switzerland, Lithuania, Italy, Slovakia, Canada,  
USA, Spain, France**

**Team: 14**

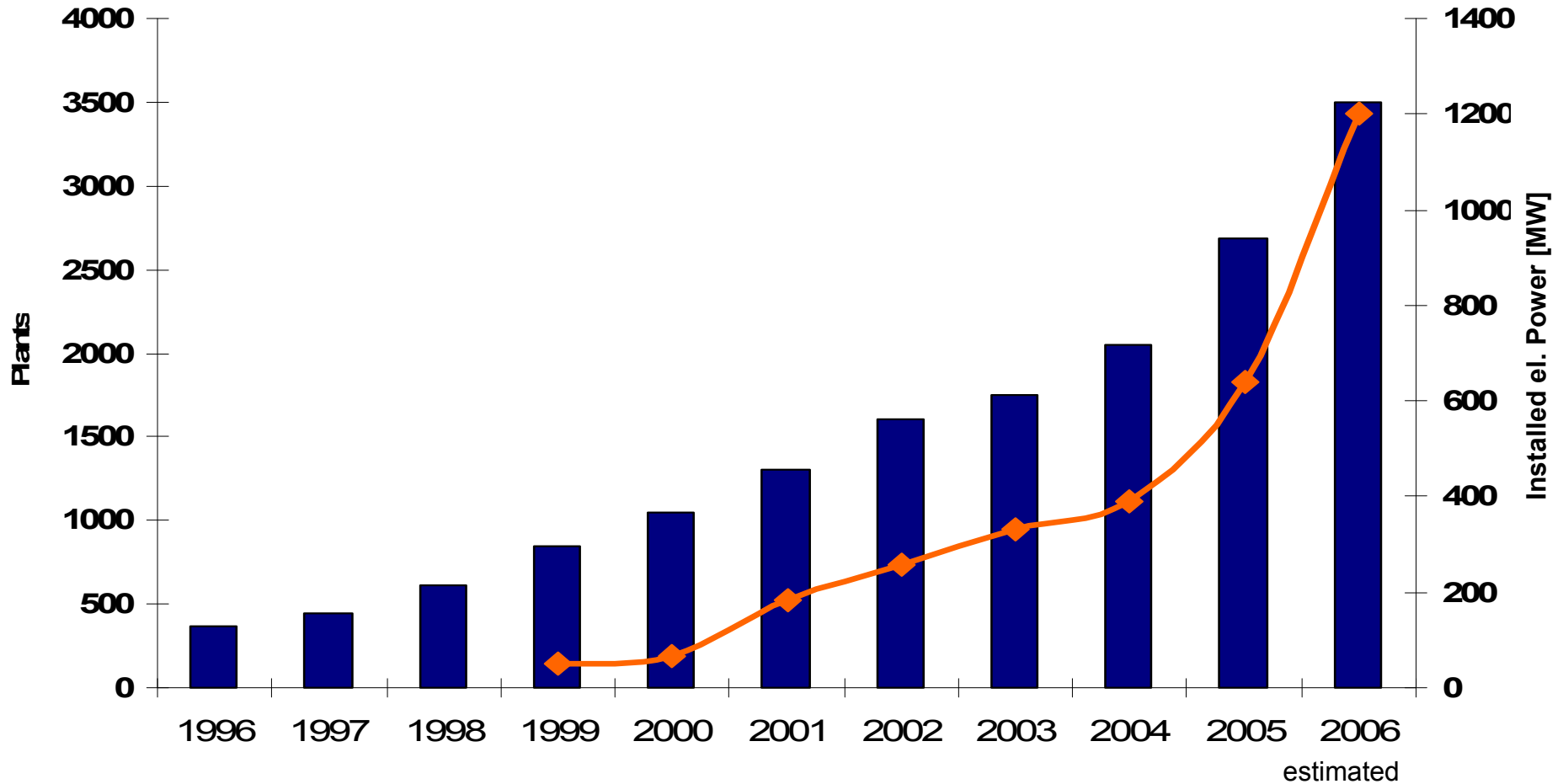
**Partners: Japan, USA, Austria, Bulgaria, France,  
Hungary, Turkey, Poland, Ireland**



KF



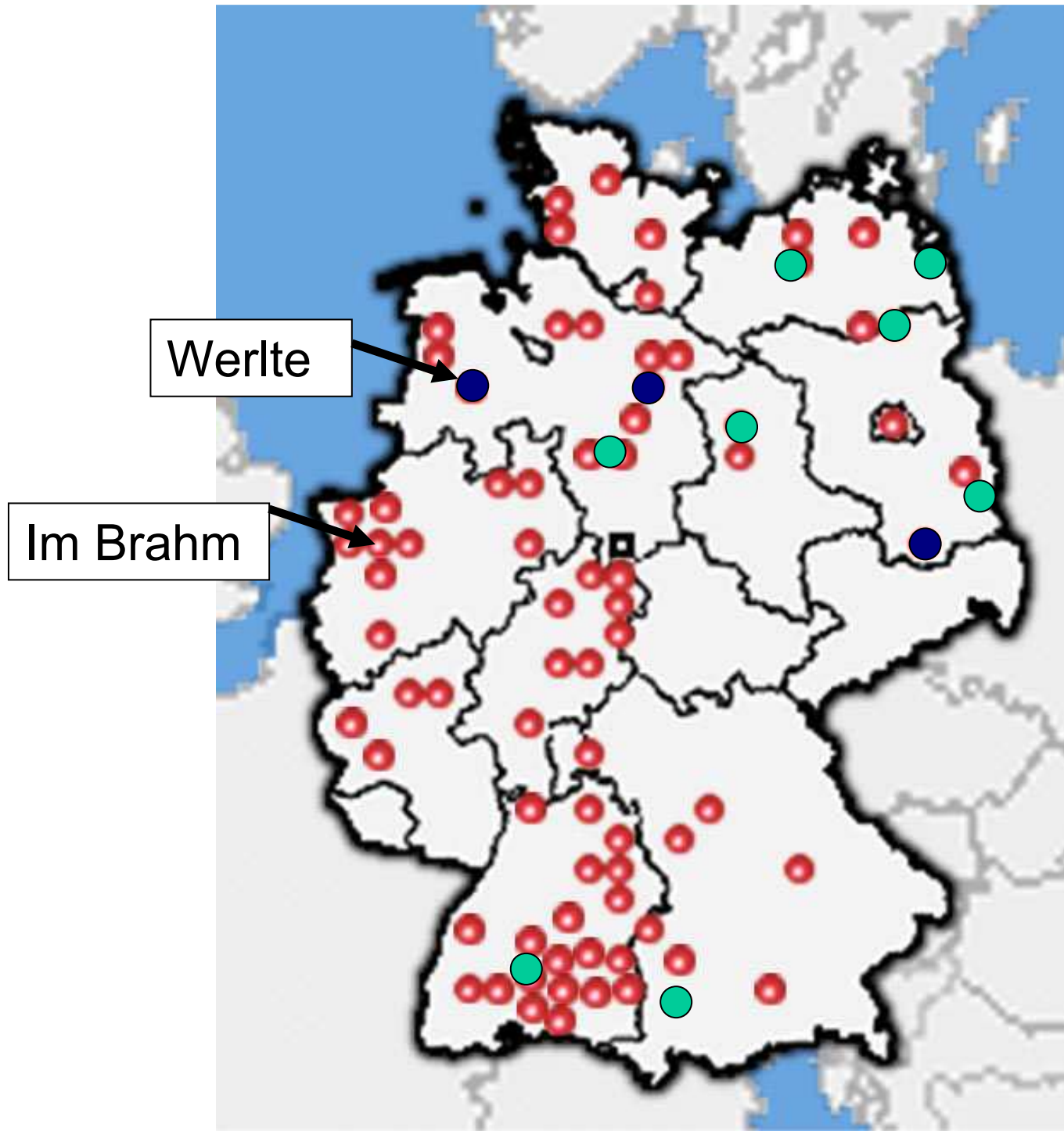
# Biogas Plants in Germany



Fachverband  
Biogas e.V.

German Biogas Association • Asociación Alemana de Biogas • Société Allemande du Biogaz

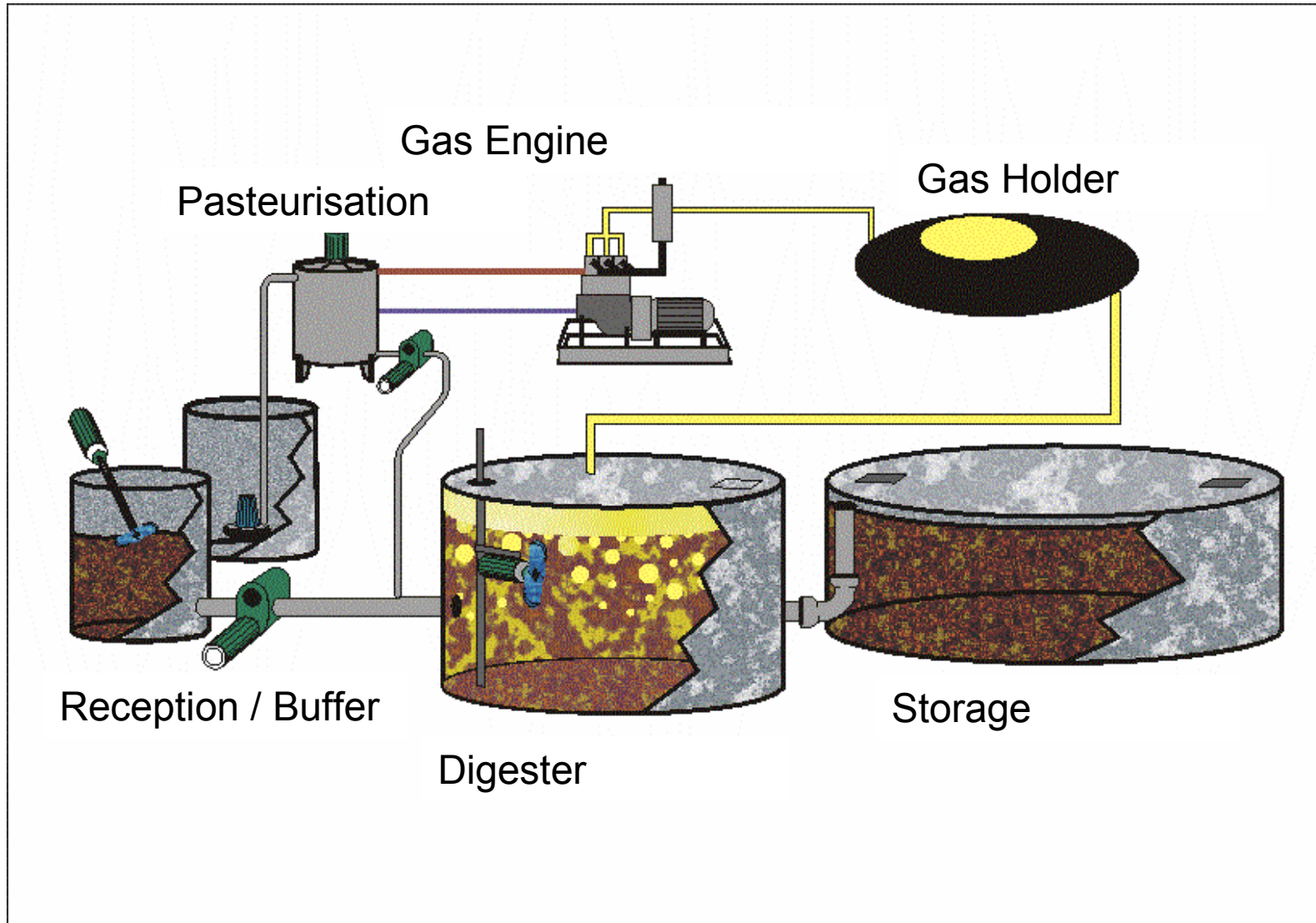




Werlte

Im Brahm

- Input Manure + Silage > 1 MW<sub>el</sub>
- Input Waste (+ Manure) > 1 MW<sub>el</sub>





## Planning of Biogas Plants

- ⇒ **Type of Input Substrate**
- ⇒ **Amount of Input Substrate per Year**
- ⇒ **Local Circumstances**
- ⇒ **Heat Usage**
- ⇒ **Pasteurisation**
- ⇒ **Automation Level**

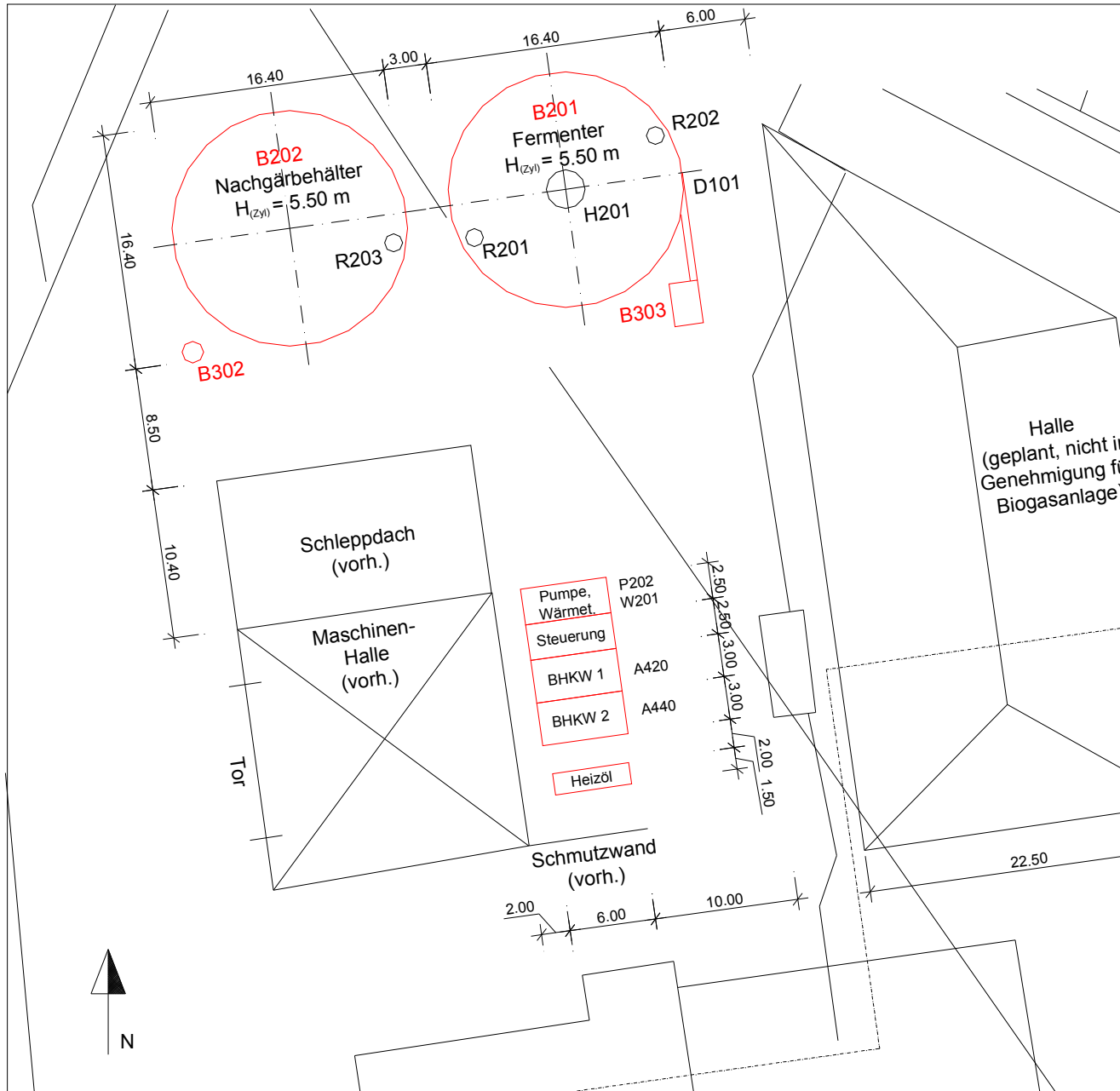




Im Brahm



Im Brahm







Im Brahm

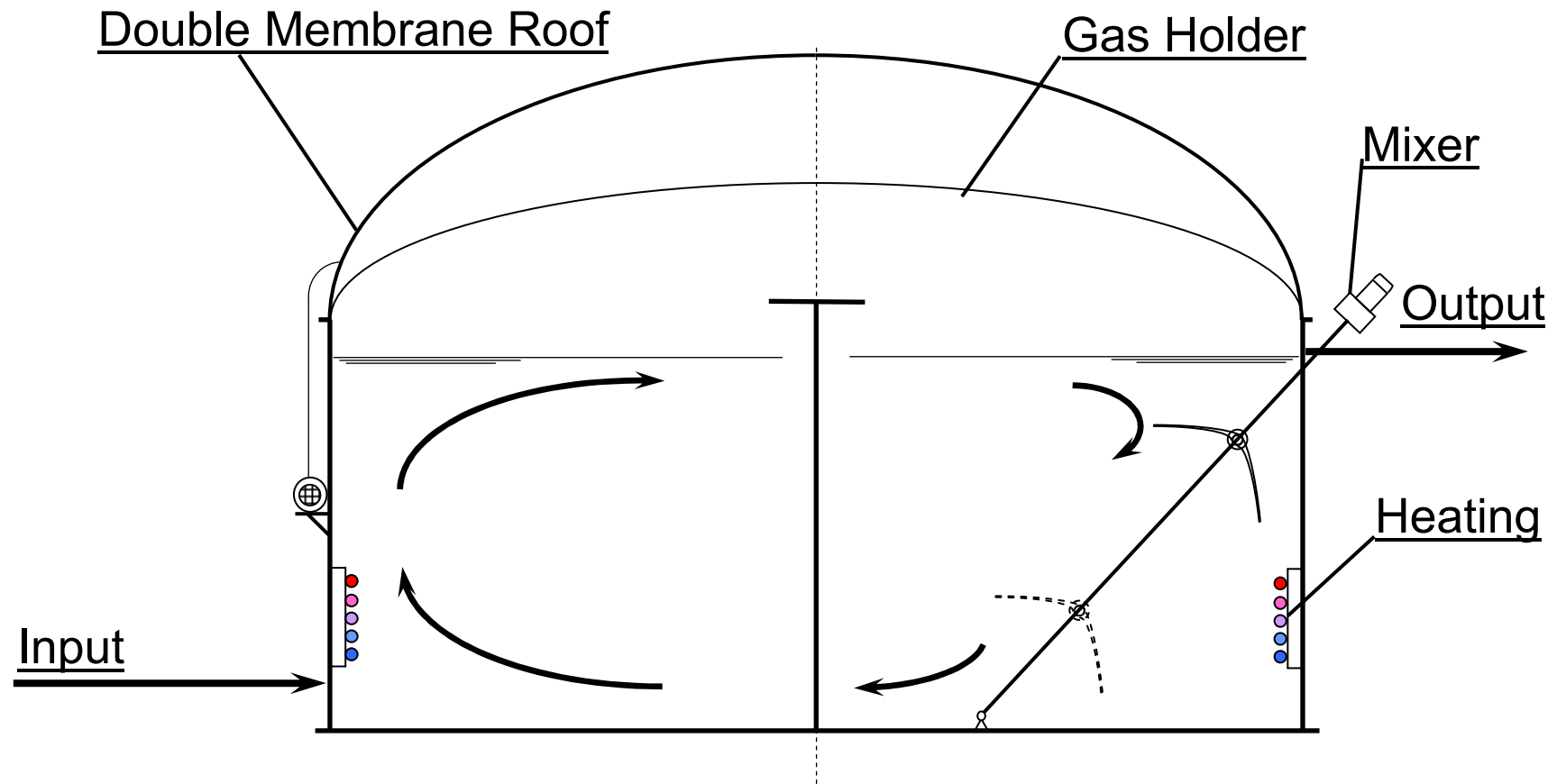
pig manure,  
kitchen waste





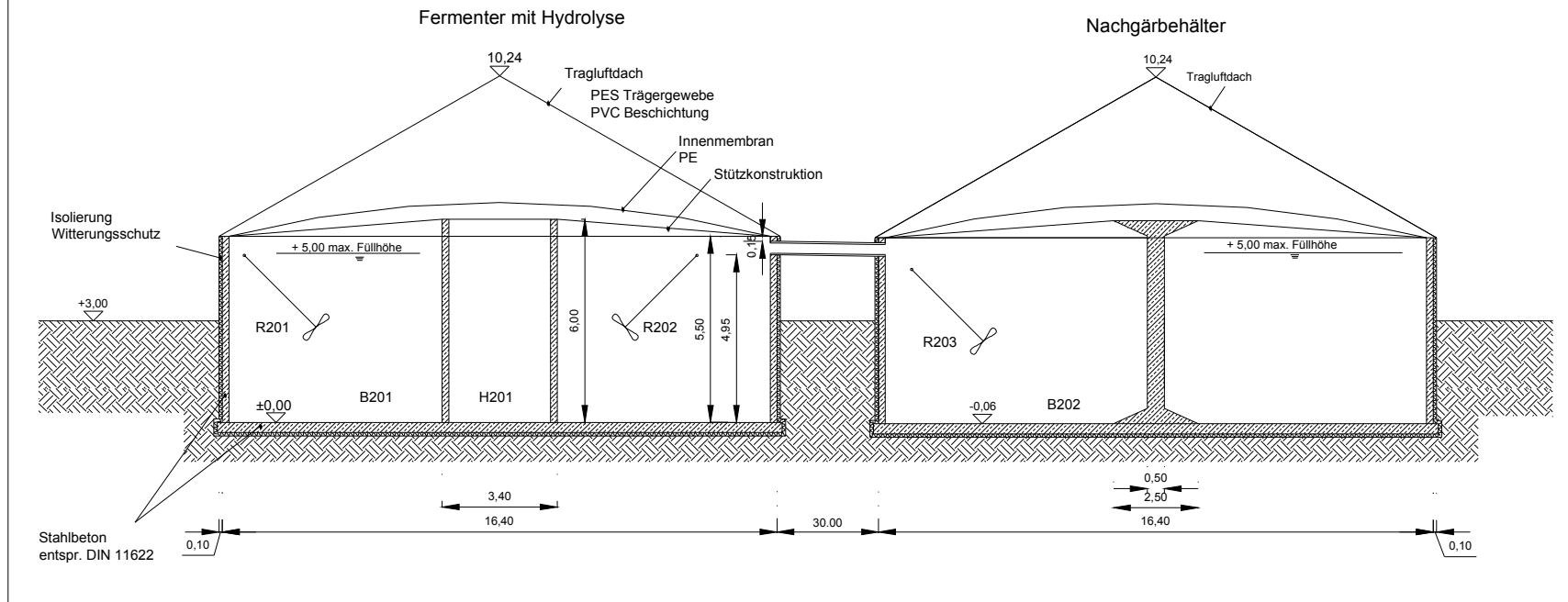
## Standard Digester in Agriculture

( up to 1.250 m<sup>3</sup> Volume)





### Schnitt A-A

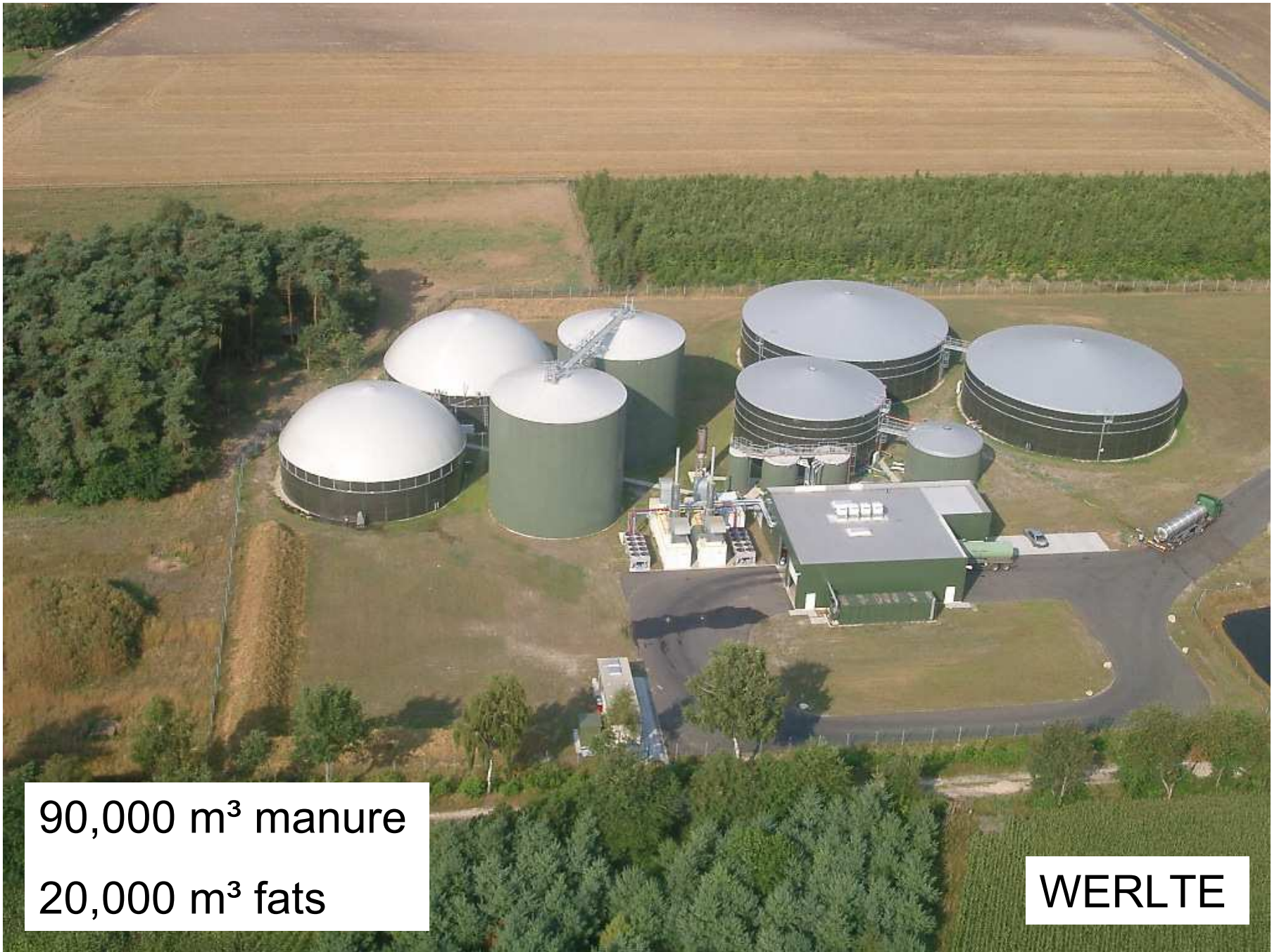






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90,000 m<sup>3</sup> manure

20,000 m<sup>3</sup> fats

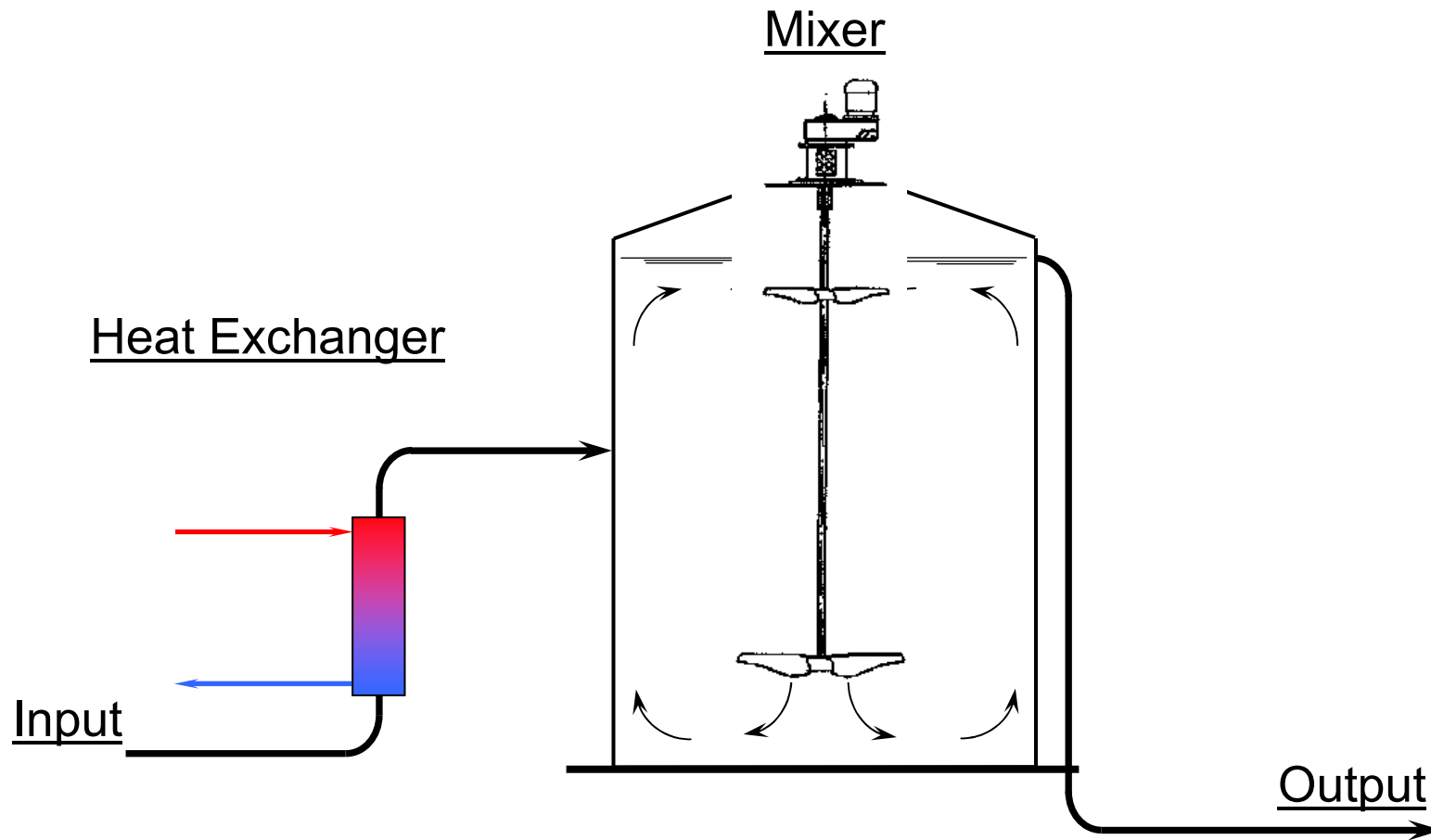
WERLTE

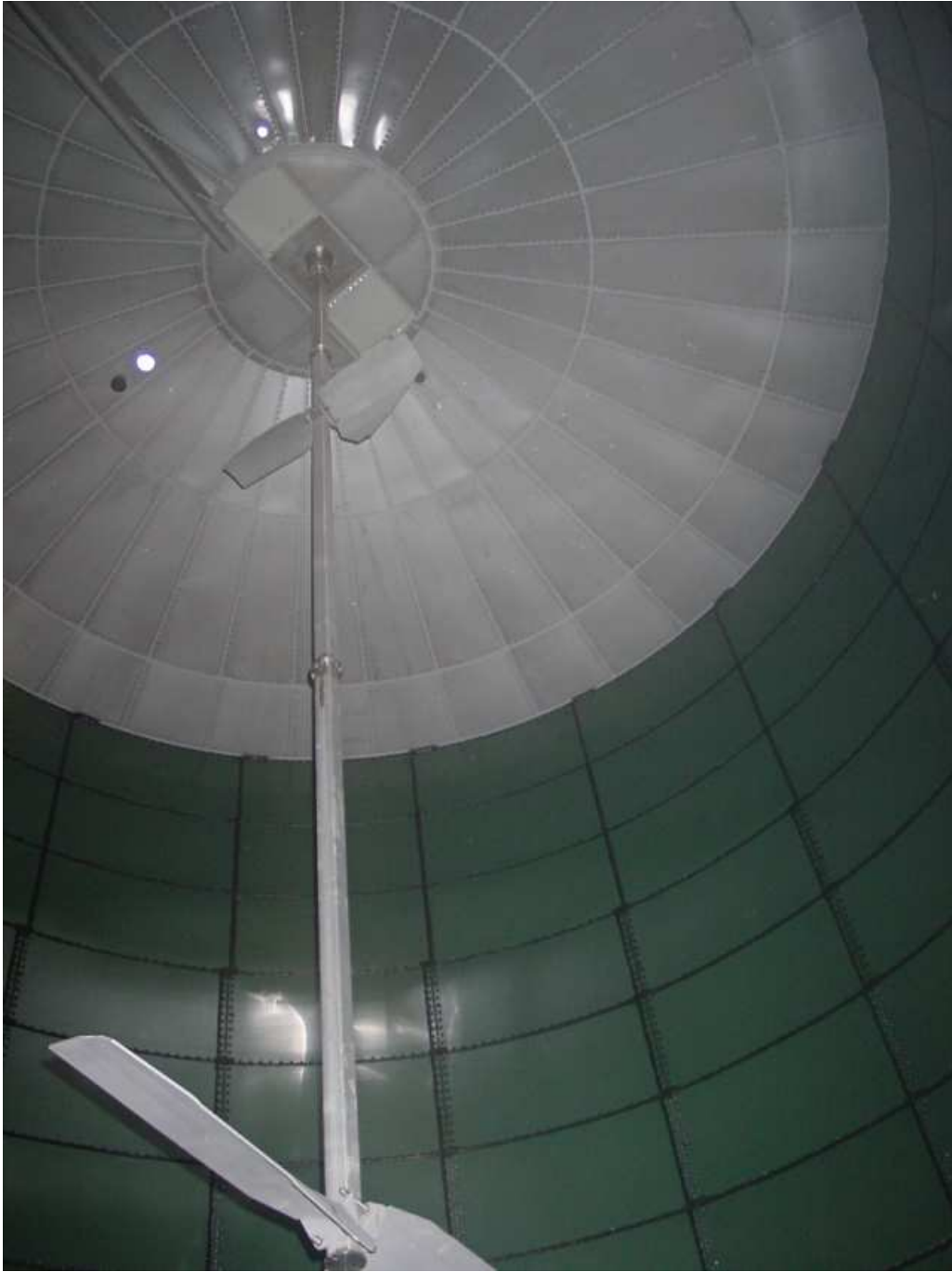




# Upright Large Digester

( up to 5.000 m<sup>3</sup> Volume)









	<b>Biogas plant IM BRAHM</b>	<b>Biogas plant WERLTE</b>
Location	Essen, Germany 150 m distance to a residential area and adjacent to a water protection area (WSG II)	Werlte, Germany in a water protection area (WSG III)
Construction period	2005	2002/2003
Planned input	6,250 t/a	110,000 t/a
Input material	manure (2,555 t/a) horse dung (2,750 t/a) kitchen waste, fats (8,395 t/a)  total: 13,700 t/a	manure (41,000 t/a) cosubstrates (33,000 t/a) as: fats, kitchen waste, gastrointestinal-tracts and content and blood total: 74,000 t/a
Co-Generator	gas engine (2 x 190 kW) containerized	gas engine (2 x 1,262 kW) containerized
Heat usage	Pasteurisation, farm buildings	Pasteurisation



	<b>Biogas plant IM BRAHM</b>	<b>Biogas plant WERLTE</b>
Temperature	mesophilic	mesophilic
Digester heating mixing  operation	1 concrete tank (1,205 m <sup>3</sup> ) internal pipe heating system side mounted agitator unit (2 x 11 kW) 2-stage digestion	2 steel tanks (2 x 3,200 m <sup>3</sup> ) external heat exchanger top-mounted mixer (2 x 11 kW) 1-stage digestion
Investment	Euro 1 Million	Euro 6 Million
delivery	reception hall with biofilter	reception hall with biofilter
pretreatment	grinding and full stream pasteurisation (70° C, 1 h)	grinding and full stream pasteurisation (70° C, 1 h)
Solid input device	for horse dung	-
receipts	50 Euro/t (average)	5 Euro/t
Necessary expert's reports	odor emissions noise	odor emissions noise





## Economical Background in Germany

- Income until 2000: about 50% by tipping fee for waste, about 50% by selling electricity to public grid
  - Income until 2004: about 25% by tipping fee for waste, about 75% by selling electricity to public grid
  - Income now: 100% by selling electricity to public grid (energy crops and manure); about 25% by tipping fee for waste, about 75% by selling electricity to public grid (waste digestion)
- all the time: low interest rates for investment in renewable energies



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