Biogas Upgrading Technology

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Gasaufbereitungs-Technologie

Agenda

1. Company Facts
2. Biogas Pre-treatment
3. Amine Scrubbing Basics
4. Membrane Separation Basics
5. References
6. Membrane vs. Amine
7. Upgrading Costs

1. Company Facts

2008 MT-Biomethan Founded

2009 First Upgrading Plant (Amine) Built

2010 8 Upgrading Plants (Amine) in Operation

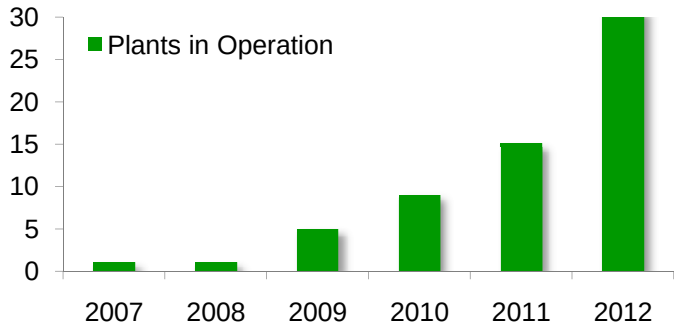
2011 90 Employees, 15 Mio. € Turn-Over

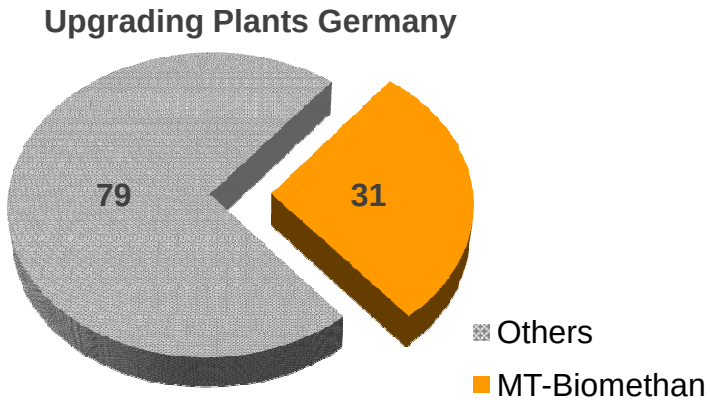
2012 Launch of Membrane Separation

2013 International Expansion

1. Company Facts

- Company Founded : **2008**
- Employees: **100** (2012)
- Turn-Over: **24 Mio. €** (2012)
- Plants in Operation: **31** (end of 2012)
- Certifications: EN ISO 9001, EN ISO 3834-3





2. Biogas Pre-Treatment

- Biogas leaves biogas plant water saturated and with H2S

  → Water and H2S needs be remvoved prior to upgrading

- **Cold water heat exchanger** (5°C) to condensate and remove water
- **Activated carbon filter** to remove H2S levels (< 5ppm)

Biogas Cooling Skid

Biogas Cooling Container

FAKA 2000

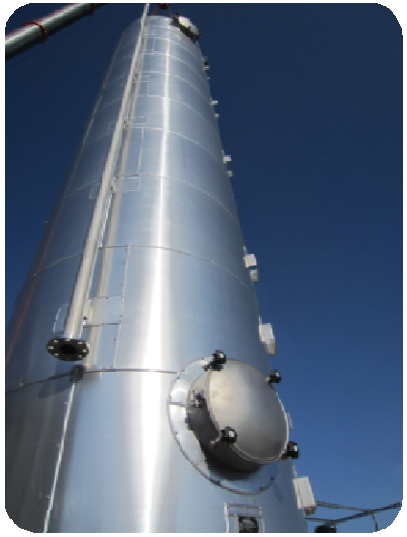
FAKA 6000 Twin

3. Basics Amine Scrubbing

- CO_2 separation using a chemical absorption process
- Absorption medium (scrubbing solution) = MDEA + Water (50/50)

  → No process water needed

  → Scrubbing solution can be regenerated to be re-used in the process



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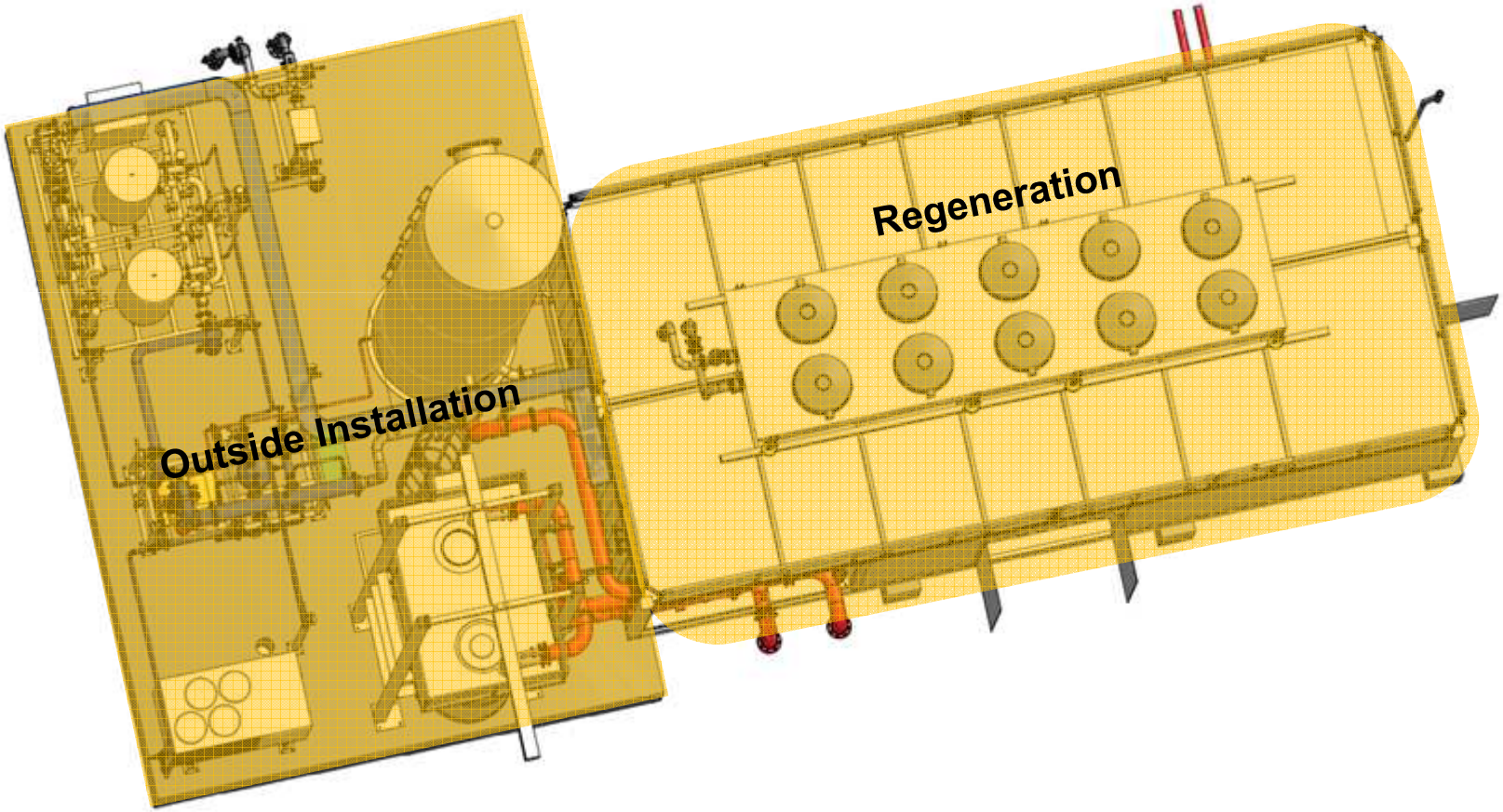

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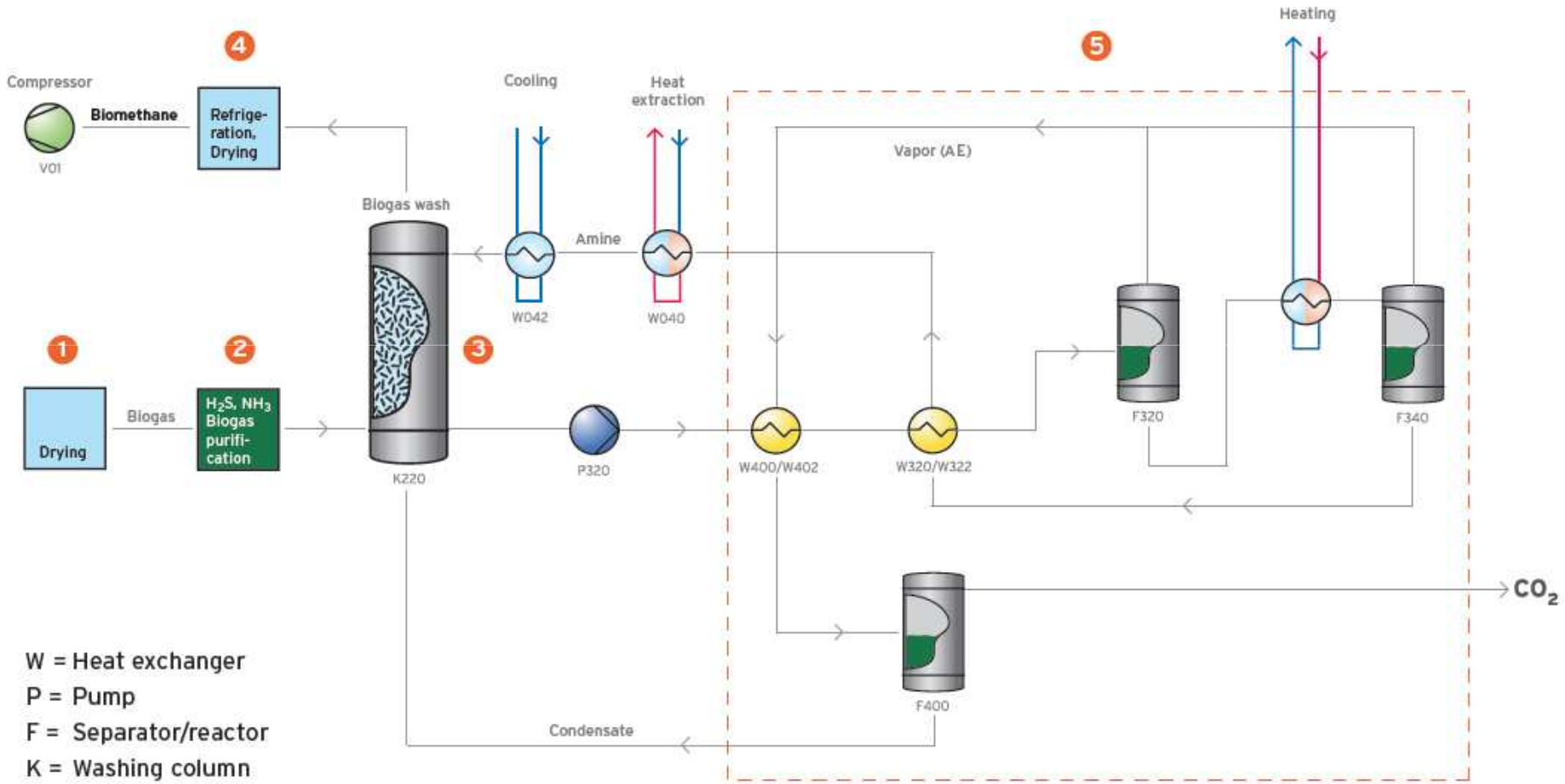
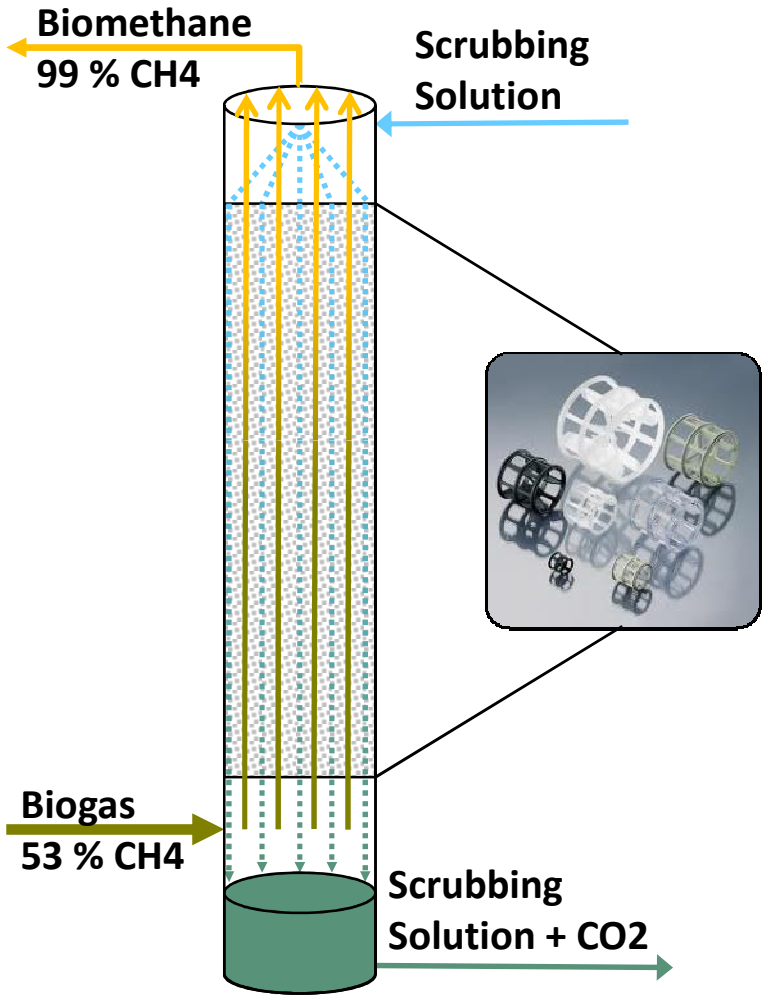


3. Basics Amine Scrubbing

3. CO2-Separation

- Reaction surface in the tower is maximized by fill package
- Biogas flows bottom-up
- Scrubbing solution is sprayed into the tower at the top Biogas leaves scrubbing tower as Biomethane
- „loaded“ scrubbing solution collected in the bottom of the tower



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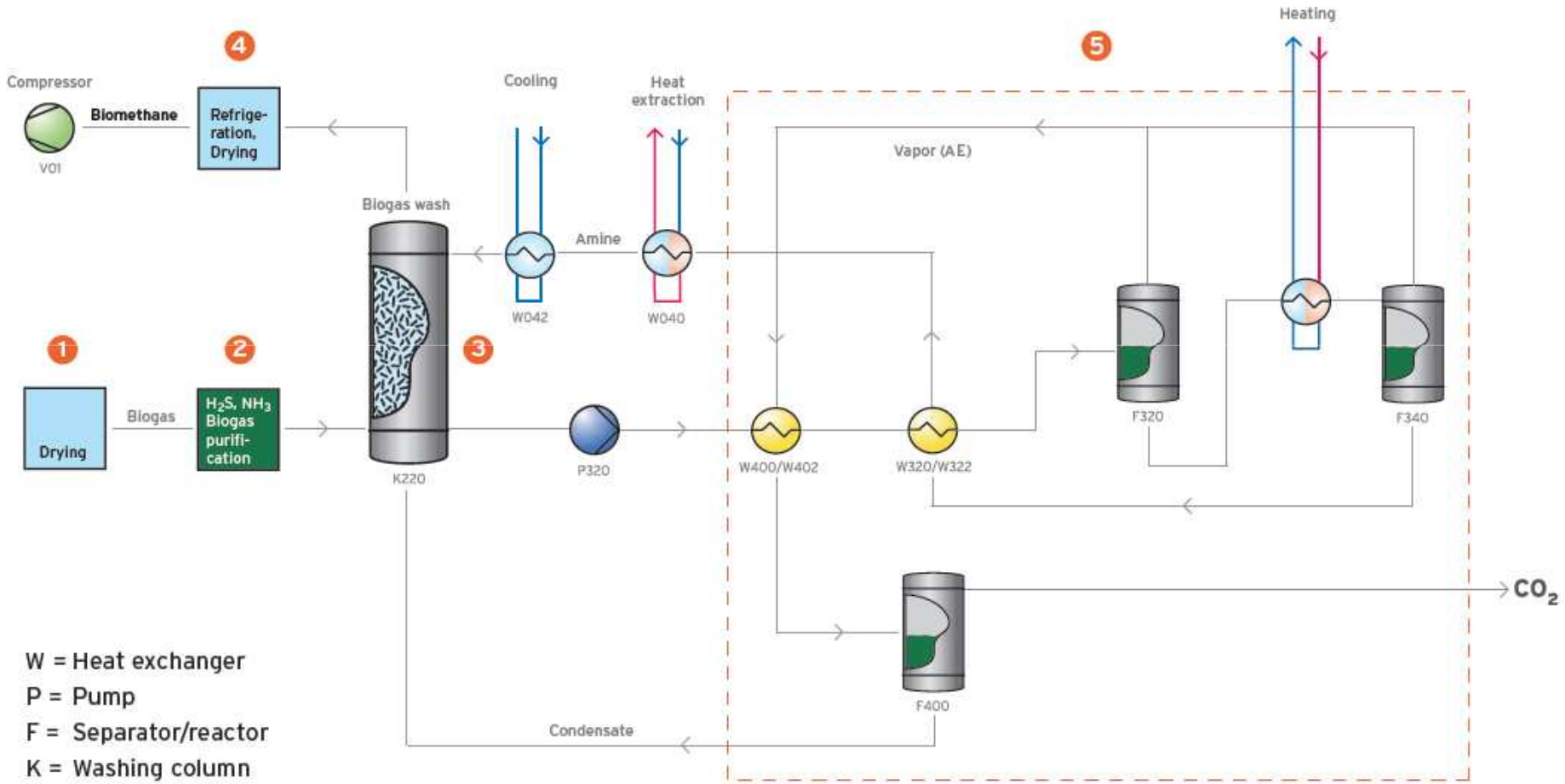
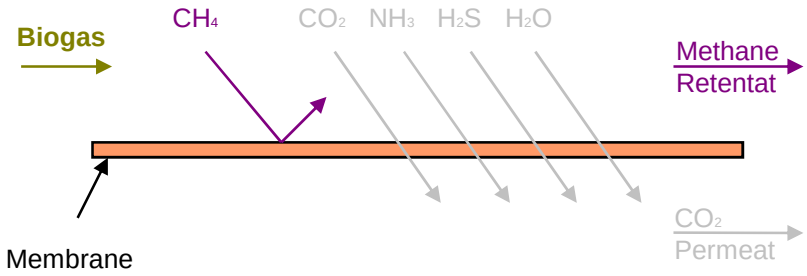


4. Basics Membrane Separation

- CO2 separation by selective permeation
- Permeation:
  - → penetration of gas (biogas) through a solid (membrane)
  - → pressure difference as main driving force
  - → process pressure of 10 – 16 bar required



4. Basics Membrane Separation

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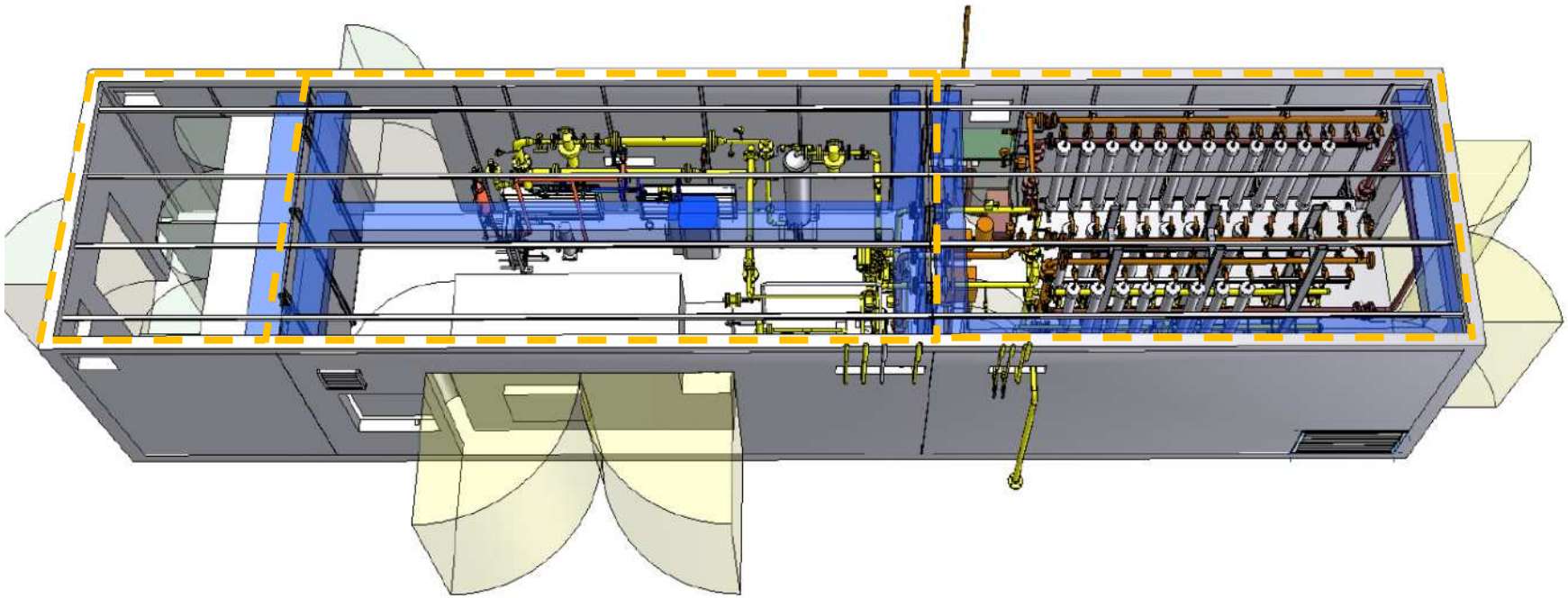
Controls **Compressor** **Membranes**



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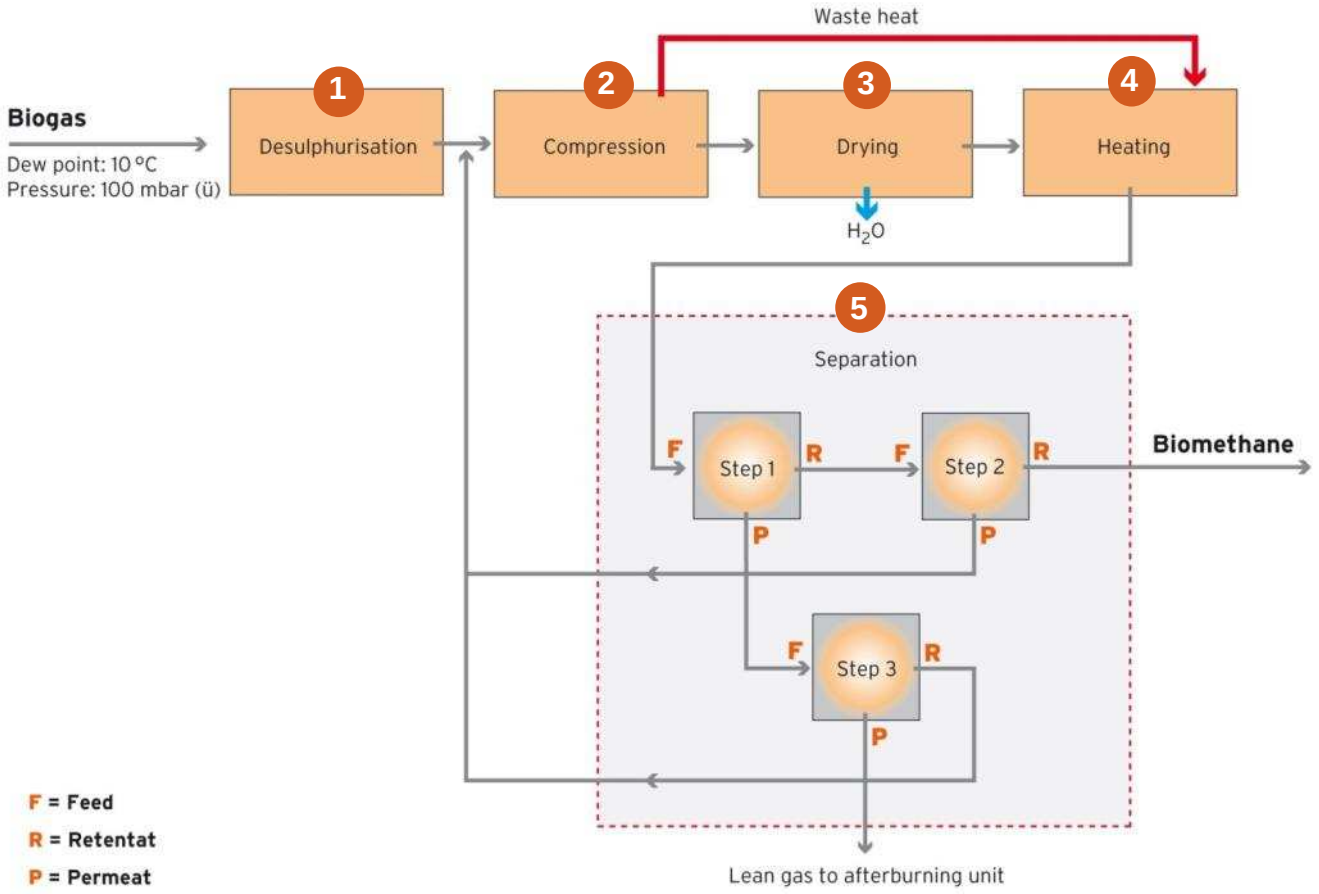

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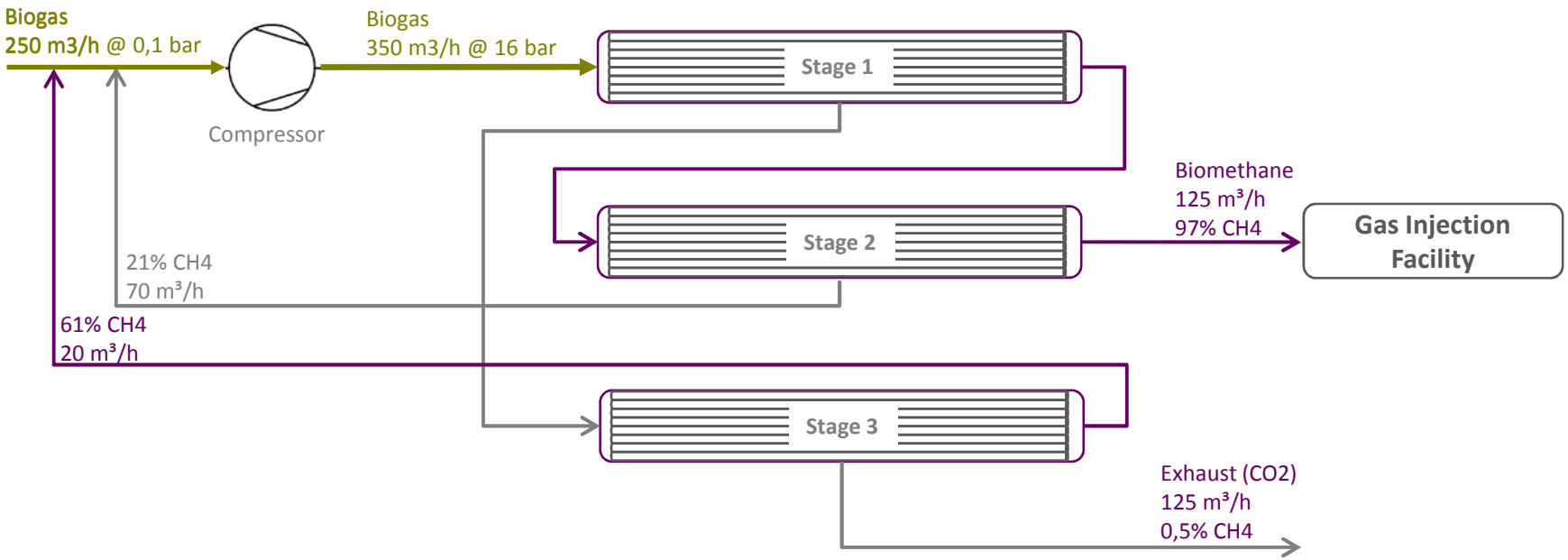


5. References (Germany)

- 31 plants in operation in Germany:
  - 30 using Amine scrubbing
  - 1 using Membrane separation

5. References (Germany)

Werlte – First Commercial Power-to-Gas Project

Operator: Audi / EWE

Upgrading capacity : 1.000 Nm³/h Biogas

Injection capacity: 650 Nm³/h Biomethane

5. References (Germany)

Zeven II

Operator: MT-Biogas GmbH

Upgrading capacity : 250 Nm³/h Biogas

Injection capacity: 125 Nm³/h Biomethane

1st MT-Upgrading Plant using Membrane Technology

6. Membrane vs. Amine

	Amine	Membrane
Functional Principal	Chemical Absorption	Physical Permeation
Electricity Demand	0,10 kWhel/m³	0,25 kWhel/m³
Heat Demand	0,60 kWhth/m³	-
Purity Biomethane	> 99%	> 97%
Methane Loss	< 0,1%	< 0,5%
Outlet Pressure	0,10 - 0,15 bar	6 - 16 bar

Standard Sizes: **125, 250, 500, 700, 1.000, 1.400, 2.000 m³/h**

6. Membrane vs. Amine

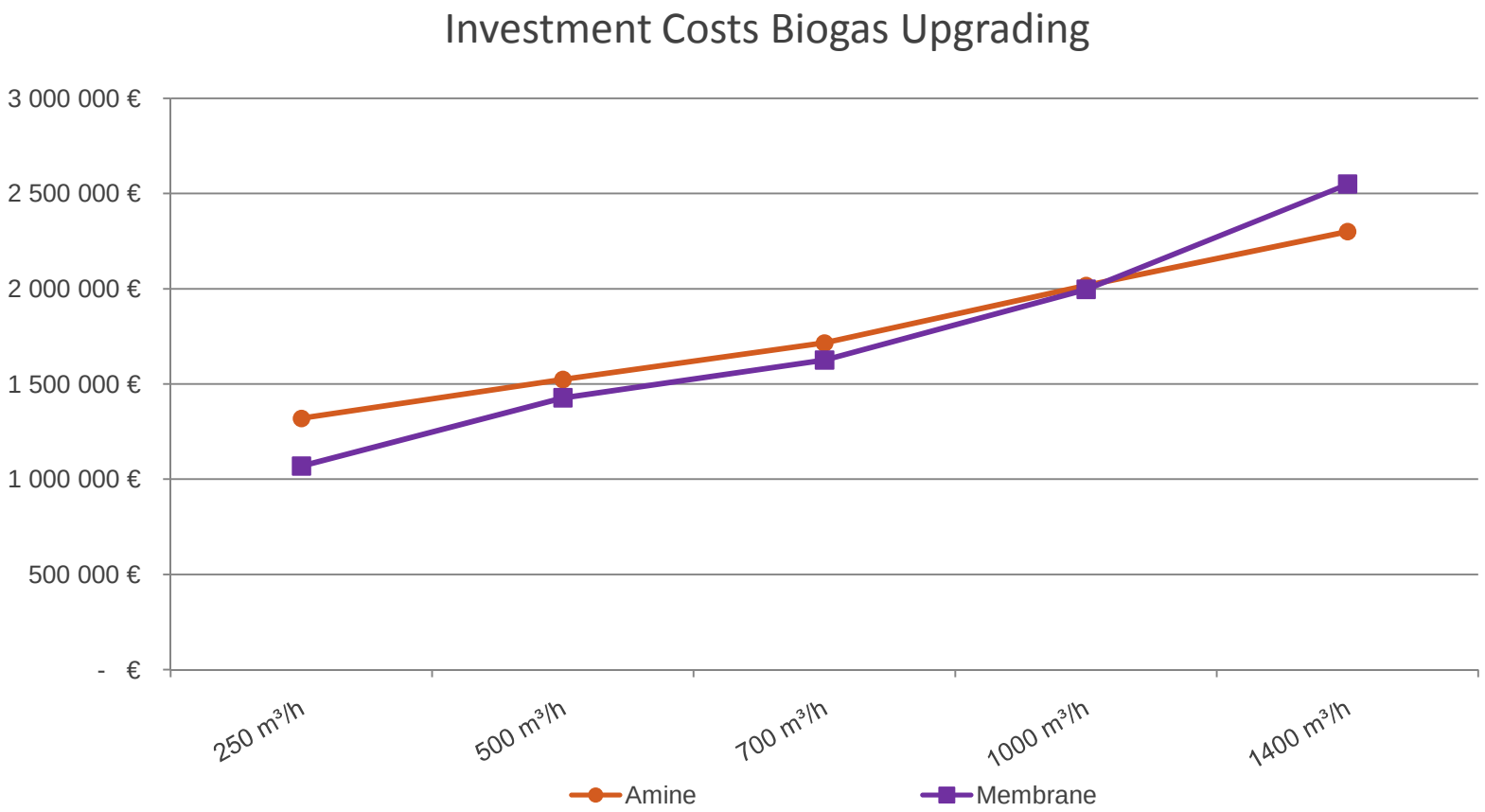
Factors pro Amine Scrubbing:

- inexpensive heat source available
- high biomethane purity required
- high CO2 purity required
- fits to **LNG** requirements

Factors pro Membrane Separation:

- inexpensive and predicable electricity costs
- small and fluctuating biogas flow rates
- high outlet pressure required
- fits to **CNG** requirements

7. Upgrading Costs



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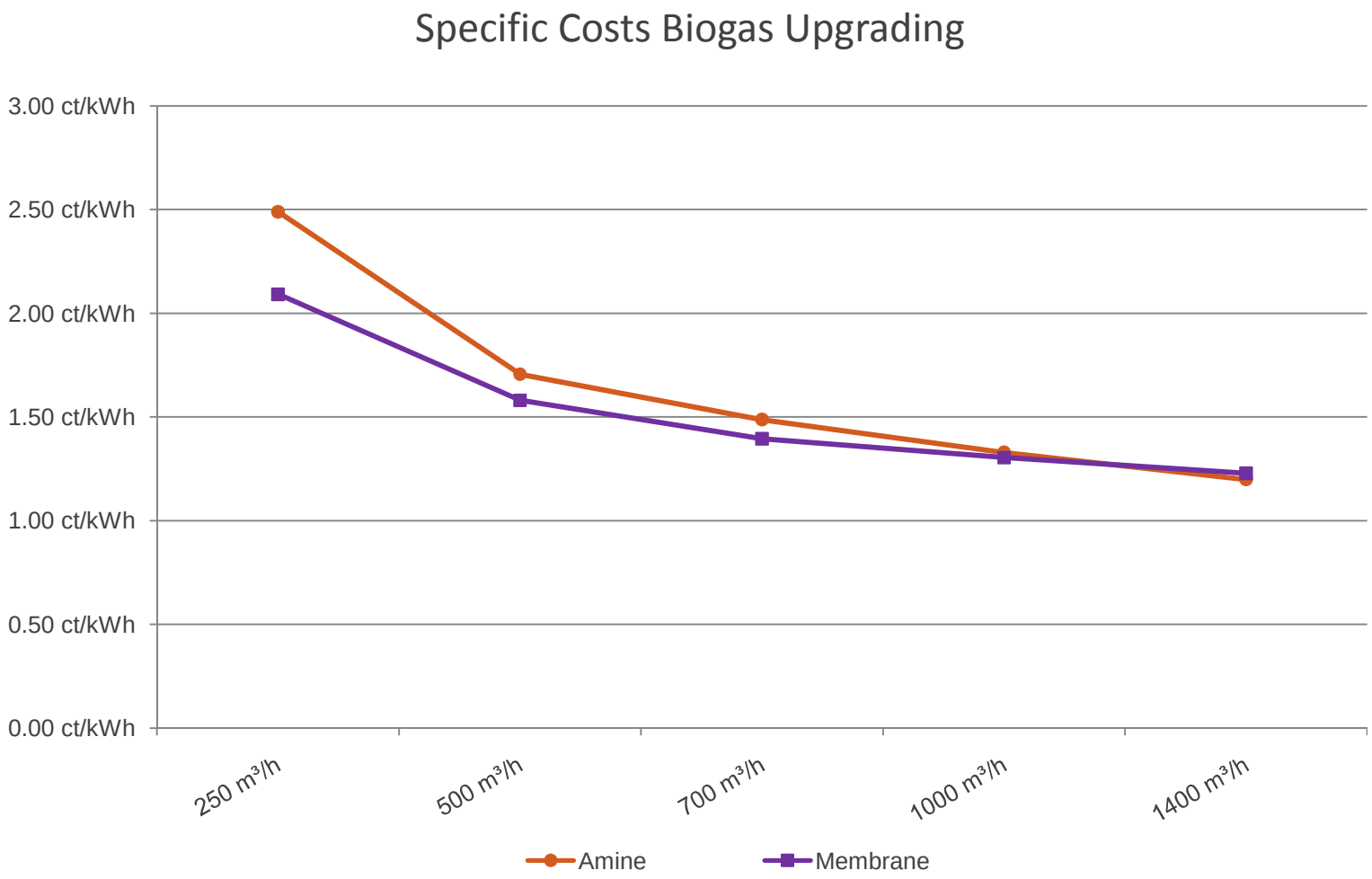

Thank you for your attention!

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