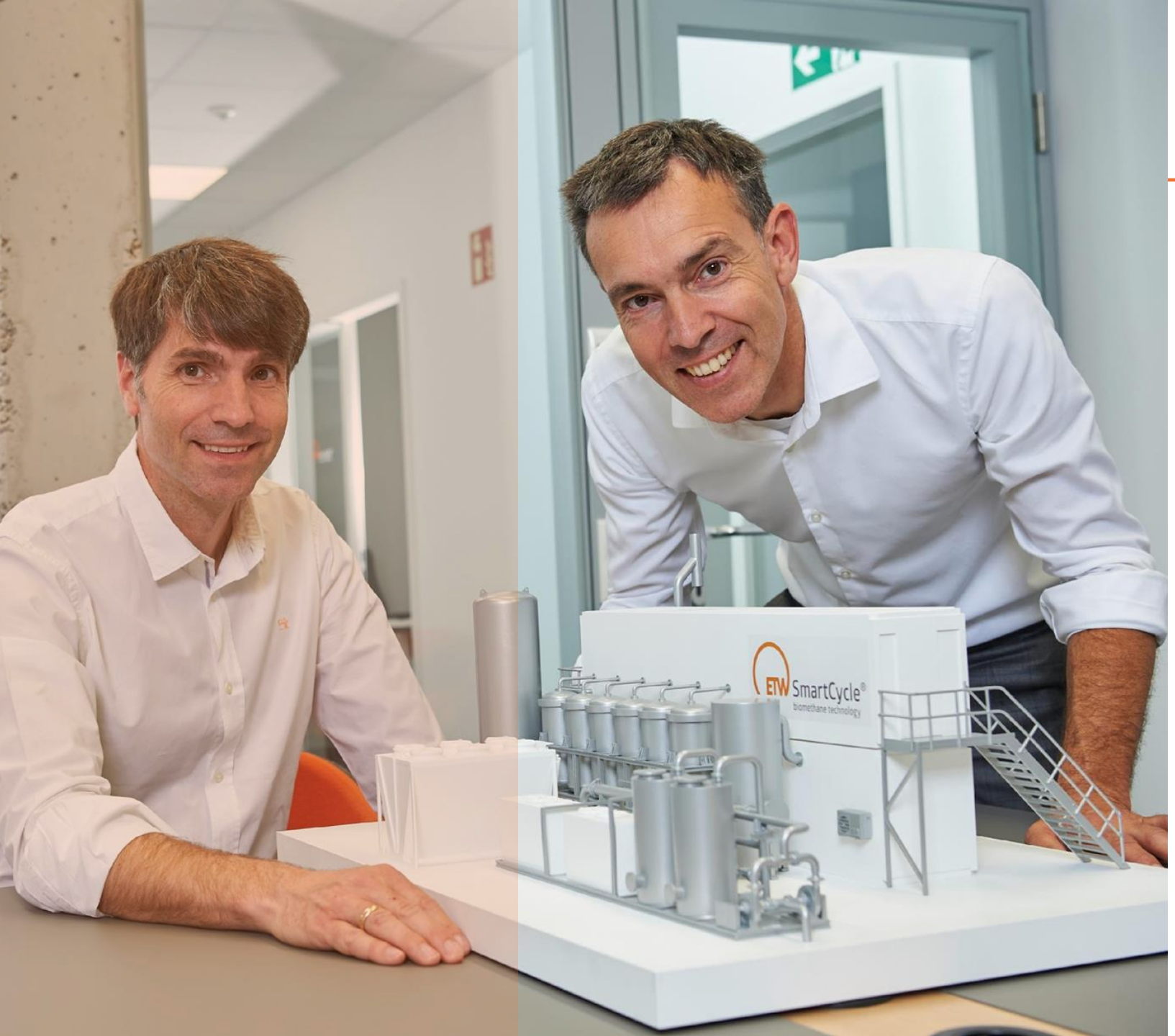
ETW ENERGIETECHNIK
renewable gas and power

From Landfill Gas to Renewable Natural Gas

PSA Upgrading Solutions for Decarbonization

Conference, 25th November 2025, Madrid

Transforming the Water and Waste Sectors



Introduction

Competence from a private entity

Over 25 years of experience in the utilization of renewable gases such as biogas, landfill gas, and sewage gas, as well as in fossil-fueled natural gas and coal mine gas cogeneration plants (CHP) and biogas upgrading facilities (biomethane plants)

Technology and innovation for a sustainable future

About the company

> 500 completed projects in Energy Technology Facilities

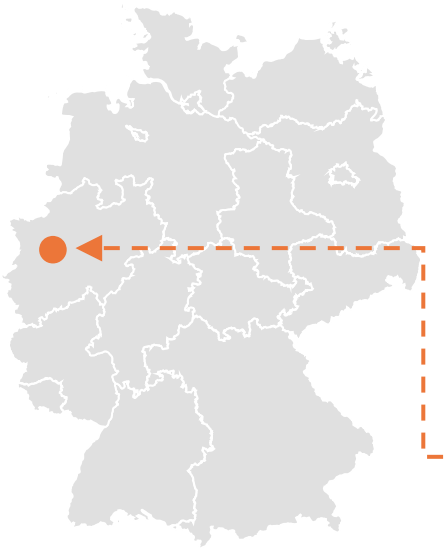
60.000 Nm^3/h sold biogas upgrading capacity

500 MW installed engine power

66 million € revenue

40 % international share

150 employees



Company headquarter & production
Moers, Nordrhein-Westfalen, Germany

Products & services

Cogeneration (CHP) units

400 – 4.500 kW el.

industrial applications & container solutons

MWM & MTU gas engines

Biomethane plants & LCO2

550 – 7.500 Nm3/h

ETW Smart Cycle® PSA Technology (Pressure Swing Adsorption)

ETW SmartCool®

benchmarked for energy efficiency

Diesel PowerTec

200 – 2.000 kVA

> 450 completed projects

industrial applications (+ 70 % in Ports)

MAN, MTU, Volvo Penta

Service

> 150.000 original spare parts in stock

routine maintenance, repairs, phone support & remote control

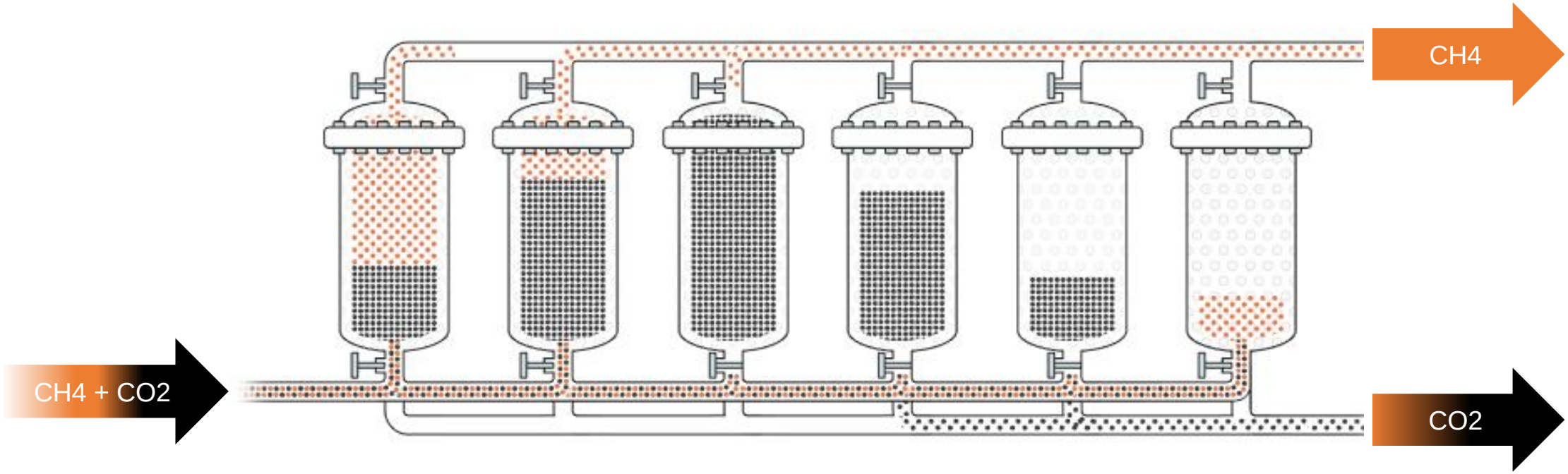
50 service technicians

300 systems under maintenance

Why PSA?

- State of the art in industrial applications since the 1970s.
- Numerous references for the purification of natural gas, hydrogen, oxygen, etc.
- Able to seperate nitrogen and oxygen
- Has replaced other technologies such as water scrubbing and chemical processes worldwide.
- Cost/benefit: Low energy consumption and robust technology.

Process description



FACTS

operating pressure: 3 bar

6-adsorption columns

adsorption – desorption using pressure swing principle

Biomethane quality: 95 – 99,5 %

PROCESS

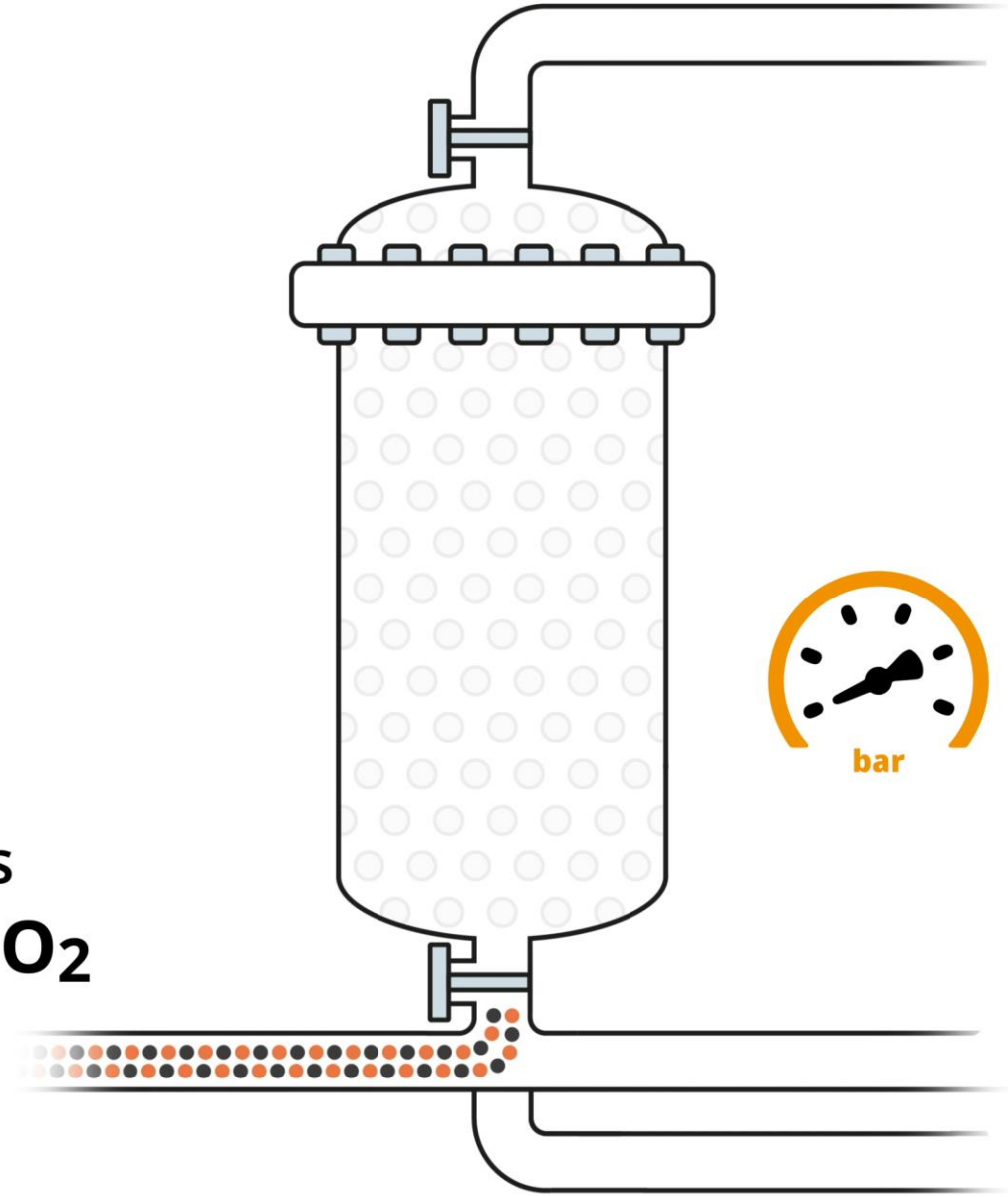
Biogas flows from buttom to top

adsorbent captures CO2 molecules

CH4 molecules has lower adsorption potential

cycle-time as the only control parameter

ETW SmartCycle®
biomethane technology



Biogas

CH_4 + CO_2

Adsorption potential

Hydrogen

Nitrogen/ Argon/ Oxygen

Carbon Monoxide

Methane (CH_4)

weak

Carbon Dioxide (CO_2)

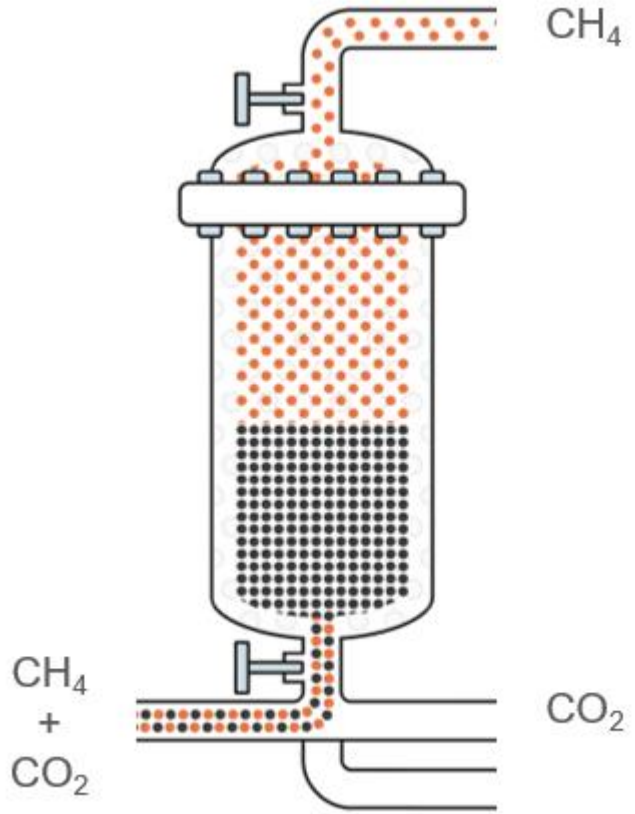
Propane/ Butane/ Ethane

Propylene/ Ethylene

Ammonia

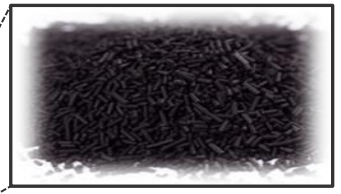
Hydrogen Sulfide

strong



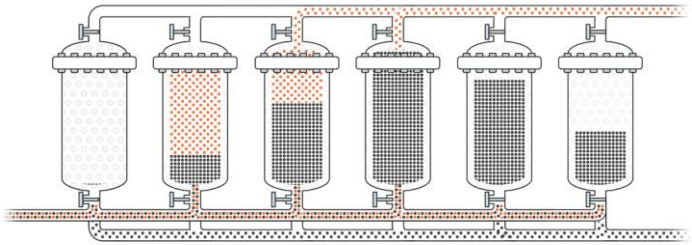
ETW Smart Cycle ® PSA

3 barg
No Oil in gas
Turn-down: 30-100%
Low OPEX



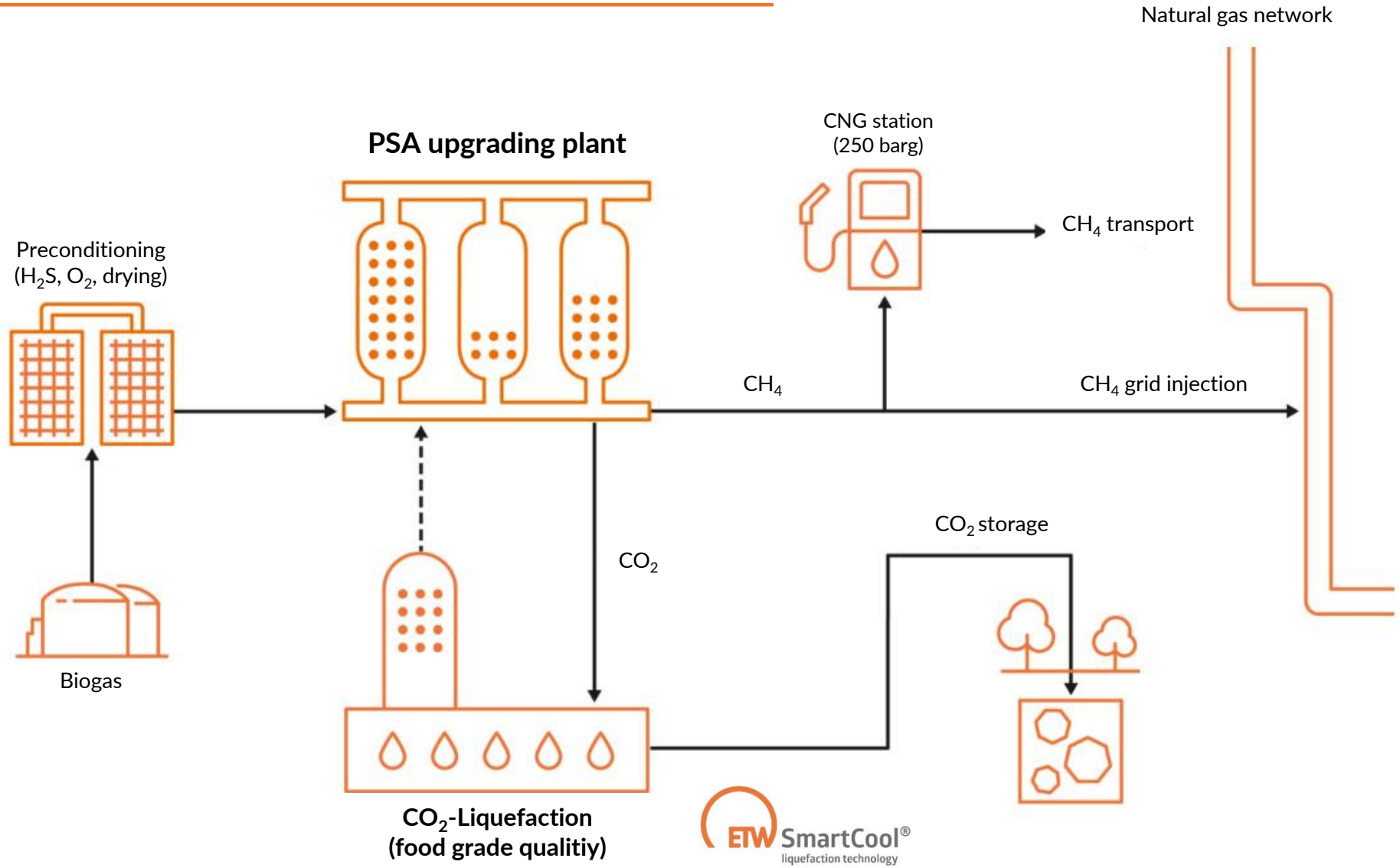
Robust design
Zero maintenance
No pressure losses
Lifetime > 20 years

Deep vacuum
continuous regeneration of Adsorbent
Low OPEX



Smart process control
Self-adapting speed
Stable Production in any situation
Low energy consumption
Best Availability (>97%)

Combination of PSA and LC02



Advantages of ETW SmartCycle PSA

- simple process with only one process step

- only one control parameter: cycle-time

- dry process at 3 bar

- best energy efficiency (0,25-0,3 kWh/Nm3) for Landfill gas applications

- > 99 % on-stream time (very high availability)

- wide range from 40–100% (good efficiency at partial load)

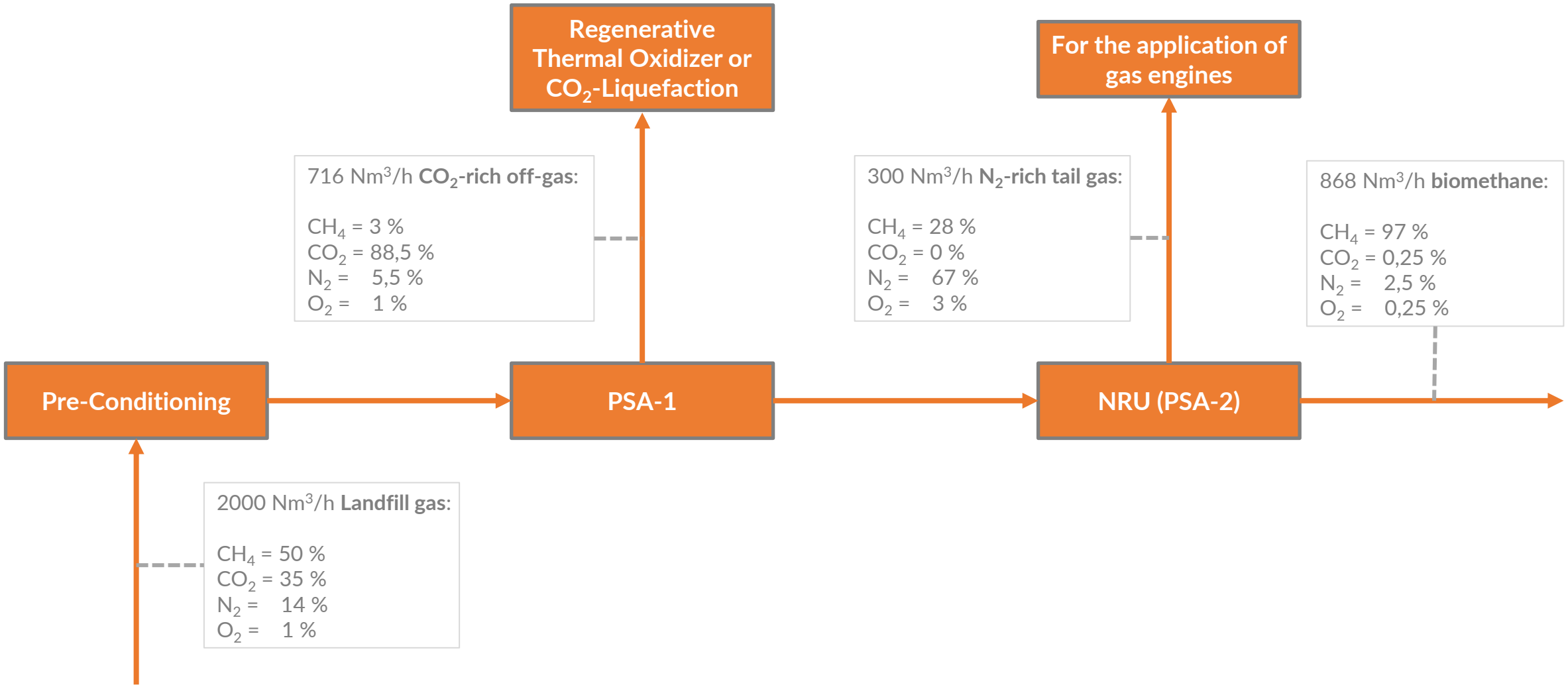
- chemical-free & zero water consumption

- fully automated process control

Challenges and Solutions of upgrading Landfill gas

Challenge ⚠	ETW-Solution / Technology 💡
High content of N2 and O2	Integration of a **N**itrogen **R**eduction **U**nit (NRU) – acts as a second PSA
Stronger Fluctuating gas composition and flow rate	**SmartCycle®** control system**:** Automatically adjusts cycle time and synchronizes adsorption/desorption
High siloxane and VOC contamination	Activated-carbon and siloxane **pre-filters**: Remove volatile VOC compounds to protect compressors and adsorbers
High content of H2S	Integrating a **pre-desulfurization** Unit (e.g. biological desulphurisation) upstream of the PSA

Upgrading Landfill gas – Example of a system with 2000 Nm^3/h



see today is the largest biomethane upgrading plant

TONISSIPOWER

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Conclusion

The upgrading of landfill gas presents challenges due to high nitrogen, oxygen and VOC loads.

The ETW-SmartCycle upgrading plant offers an efficient solution for upgrading Landfill gas to biomethane with a purity of up to 97%.

With a pressure level of just 3 bar(g), operating costs stay low (0.25–0.3 kWh/Nm^3), even with the dual PSA setup.

CH_4 recovery is above 90% without N_2 off-gas utilization, and can reach up to 95% when the N_2 residual stream is recovered for gas engine use.

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Thank you for your attentation!

IT´S NOT ENERGY UNLESS IT´S ORANGE

The energy transition is our greatest technological, economic and social task. Find out how to combat climate change with biomethane and carbon dioxide liquefaction technology by ETW: