UGS | VERDANT PROCESS SYSTEMS
UNCONVENTIONAL GAS SOLUTIONS

About Unconventional Gas Solutions

Where we come from

Since 2013 UGS has been providing innovative gas separation systems to both traditional and renewable energy companies. Our leadership team has delivered solutions for demanding applications all over the world.

Where we are

We deliver better solutions for the Energy Transition. UGS is focusing over 100 years of combined experience on solutions for renewable gas processing.

Where we are going

Our Mission: to be the leading provider of safe & reliable gas processing systems for the Energy Transition.

AMERICAN BIOGAS COUNCIL
EBA European Biogas Association
Canadian Biogas Association
RENEWABLE NATURAL GAS
CIB CONSORZIO ITALIANO BIOGAS
upebi

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Leadership Team

Marc Straub

President

Dipl. Ing. (Master) Process Engineering from Tübingen in Germany. 30 years experience in Gas Separation, Generation and Compression in the field of R&D, Manufacturing, Project Management, Sales and Process Design utilizing PSA and Membrane technologies. Most recently as VP of Technology and General Manager Membranes at GENERON IGS in Pittsburg, CA.

George Paul

CEO

George brings more than 30 years of engineering, technology and leadership in complex gas separations engineering and business development. He is a globally recognized expert in membranes, adsorption, compression, refrigeration, catalytic processes, metallurgy and fabrication. He has designed, bult and commissioned Syngas units, Ammonia plants, Acid gas treatment units and natural gas processing facilities around the world..

Dr. Ben Bikson

Chief Technology Officer

Dr. Bikson is the globally recognized leader in membrane technologies and associated applications. Ben has founded and sold two technology platforms/membrane businesses to Air Liquide including the technologies used in most cleantech applications by the global leader in membrane technologies. Ben leads all R&D efforts within UGS. Ben holds nearly a hundred patents in membrane technology.

Vladimir Shulmeister

Member of the board
UGS Europe

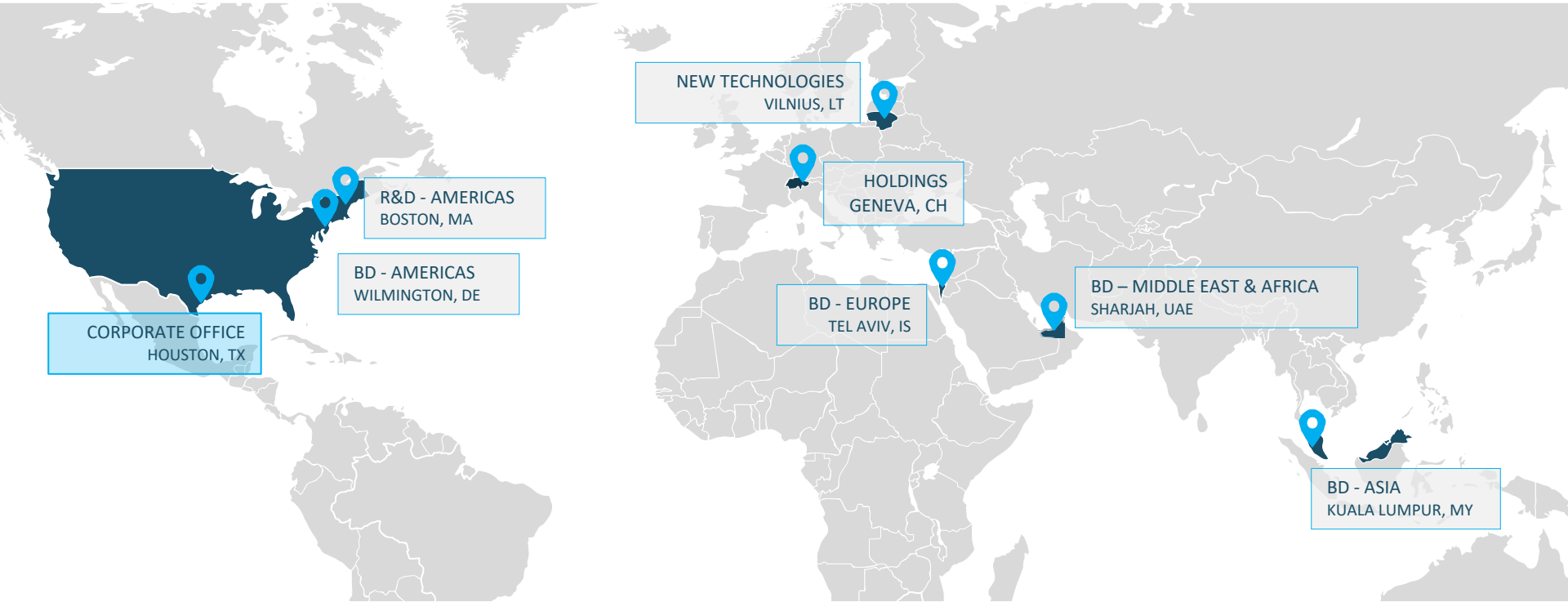
Mechanical Engineer (machine building at Nikolaev Shipbuilding Institute, Ukraine), Ph.D. in Material Science in 1998 (Delft, The Netherlands). Was working at DSM Research (The Netherlands) and specialised in modelling of mechanical properties of composite materials. Has extensive international operational and strategic management experience at financial, production and trading companies.

Michael Gulyansky

Member of the board
UGS Europe

Engineer-Physicist, Ph.D. Founder and Chairman of Grasys since 2000, Founder and Director of Porogen Corp. (Boston, Massachusetts) from 2008 to 2015. 21 years experience in management and business development, engineering and manufacturing of gas separation equipment. 15 years expertise in new membranes development from material science to industrial scale.

Global Network



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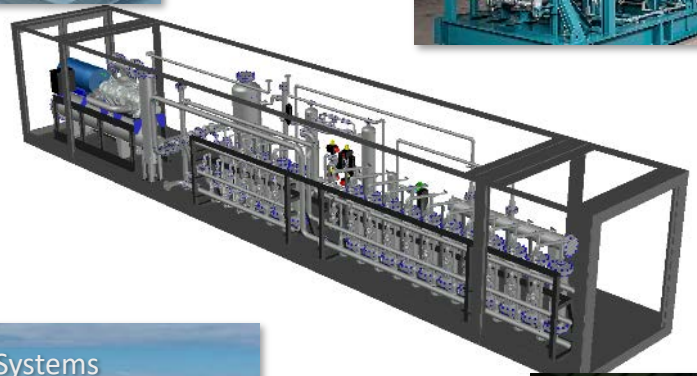
UGS Difference

We don’t sell systems.

We engineer solutions to your problems.

UGS is an emerging leader in the design & fabrication of gas separation technology packages for the Energy Transition.

- **Hundreds of years** of combined experience in process design, engineering & packaging
- **World-class membrane experts.**
  - Technology and Manufacturing
  - Applications and Markets
- **Key experiences:**
  - Biogas
  - Natural Gas
  - Hydrogen
  - Helium
  - Nitrogen
  - Offshore/Onshore
  - Membranes
  - Cryogenics
  - PSA/TSA/VSA/VPSA
  - Amine



UGS Engineering Capabilities

Custom-Engineered Solutions

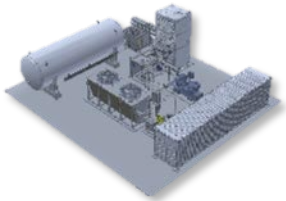
UGS develops solutions tailored to address constraints while meeting project goals:

- Demanding Specifications
- Carbon Intensity
- Methane Recovery
- Project Return
- OPEX/CAPEX tradeoffs

Recent Examples:

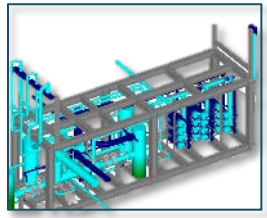
- Tail-gas methane recovery
- Existing site NRU diagnosis & enhancement.
- Acid gas compression and H2S+CO2 removal with HP Dehydration
- CO2 Liquefaction of tail-gas stream
- Fracked gas cleanup containing high N2

Process Modeling & Design

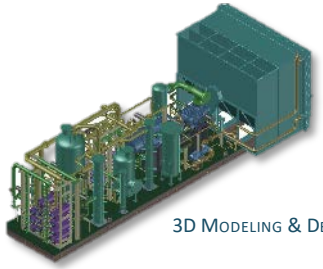


Package & Plant Engineering

Equipment Selection & Design

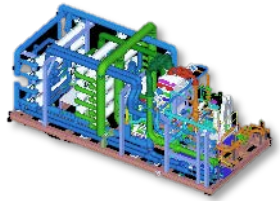


Engineering Analysis & Design Modification

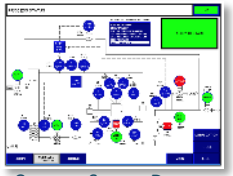


3D Modeling & Detailing

Commissioning & Customer Training



Material Selection & Piping Engineering



Control System Design & Philosophy

Fabrication Assembly & Testing

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Biogas / RNG

Application: Biogas capture & utilization from digesters, landfills, or wastewater.

Recovery: Up to **99.7%**

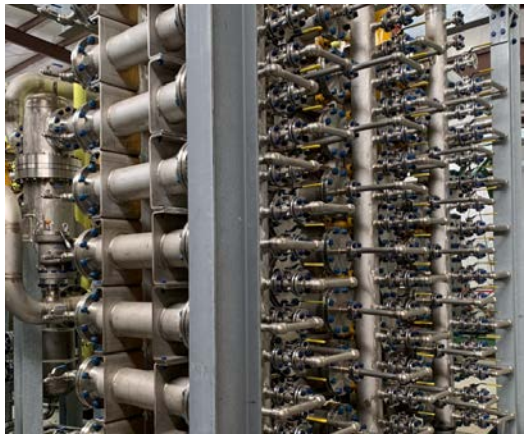
Technologies: Membrane, PSA, TSA, CATOX

Removal of:

CO_2 Siloxanes VOCs
H_2S N_2 H_2O O_2

Product Range:

- **Complete Upgrading Plants**
- Pre-treatment Packages
- Feed, Booster & Product Compressor Packages
- De-Oxygenation Units
- Nitrogen Rejection Units (VPSA)
- CO_2 upgrading & liquefaction units
- Gas Compression, CNG or Liquefaction (LNG)
- Custom unit processes



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Hydrogen

Hydrogen is a critical resource. It is used in ammonia production to help feed the world and is considered the fuel of the future for cars, trucks, and even large ships and aircraft.

Technologies: SMR, WGS, PSA, Membrane

Product Range:

- H2 Production Units: 1-100 TPD
- H2 Compression & Storage Units
- Syngas Processing/Off gas Processing-H2 recovery, H2/CO enrichment

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Examples of UGS Quality

Examples of UGS Quality

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Landfill Gas Upgrading

Underutilized Gas-Production potential in Poland and Europe

- THG Quote in Europe

- Renewable Energy Directive (RED III)

- Climate Target Plan (CTP)

Degassing of landfill sites by voivodships in 2014 (GUS – Central Statistical Office, "Environment 2015")

	Number of landfill of which municipal wastes sites with degassing installation	Number of installation with gas*						
		escaping to the atmosphere	neutralised by burning					
			without energy recovery		with energy recovery			
			in singular burners	in collective torch	thermal	electric	quantity of energy produced	
							thermal in GJ*	electric in MWh*
POLAND	342	159	59	82	16	62	81414,7	148348,2

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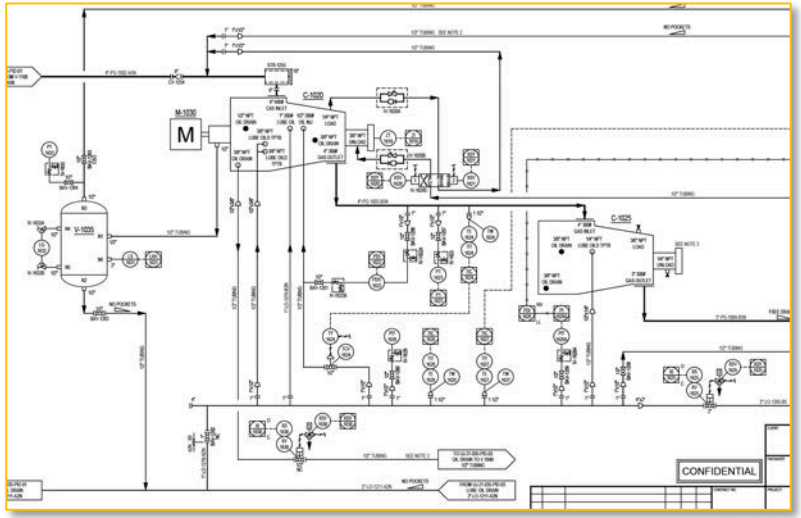
UGS Advantages – Superior Equipment Selection

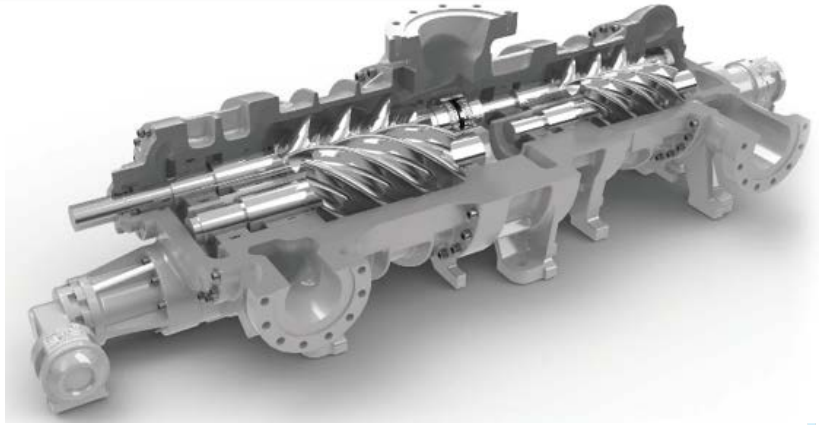
Feed Compression Systems:

- 2 stage tandem screw compressors: **Allows for up to 60% energy savings vs single stage compression.**

- Cast Steel with TPTB and Oil injection control – Prevents Wet H2S-SSC Embrittlement, Oil Dilution for high reliability: API 619 3yr Operation, eliminate oil leaks

- Slide valve capacity control providing 0-100% turndown when used with recycle





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Landfill Gas Upgrading

Unit design: Two stage membrane system for removal of CO2, & VPSA NRU

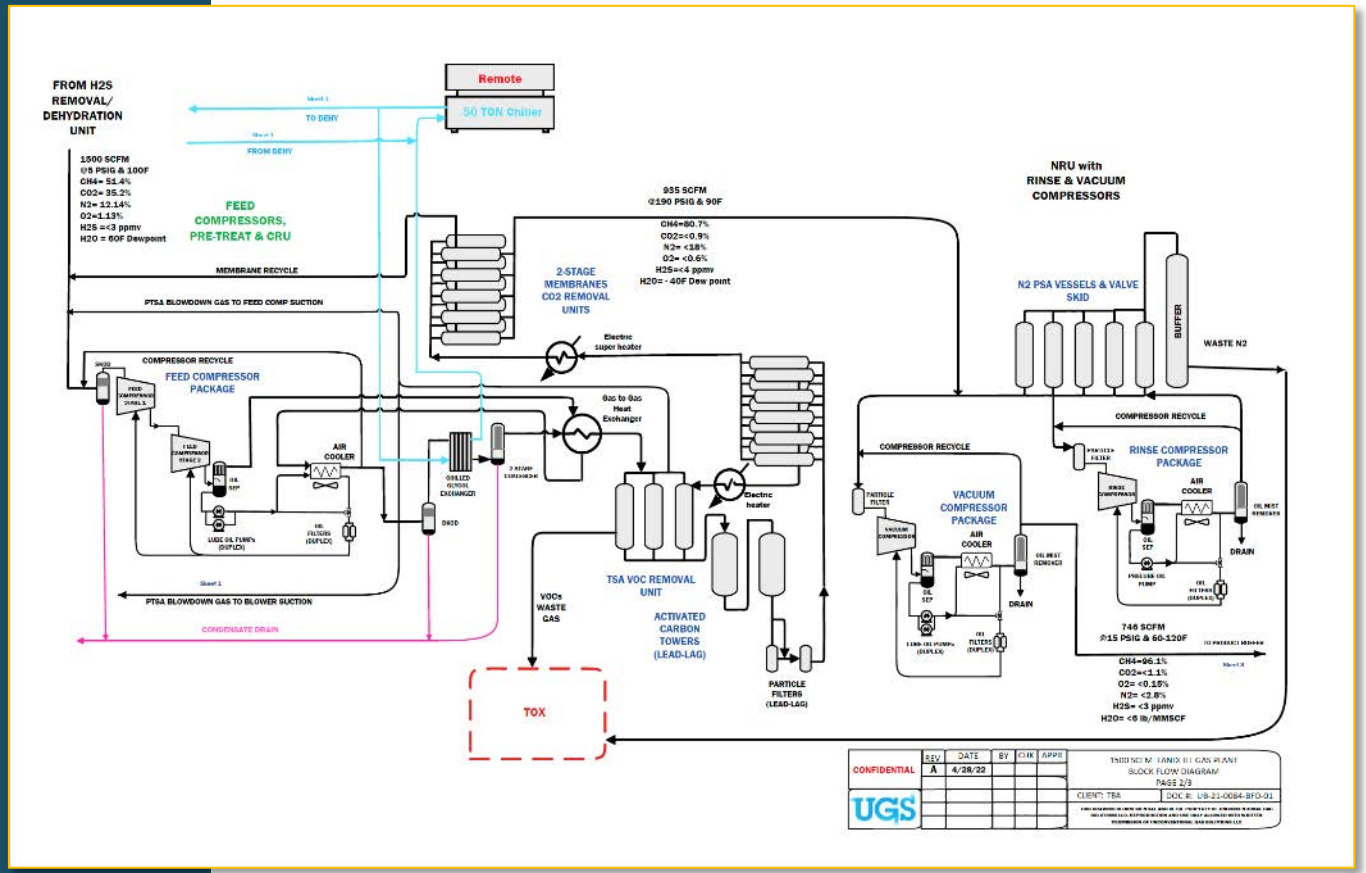
Typical overall CH4 Recovery: 90-94%

Technologies:

Membrane & VPSA

Special considerations:

- Power saving two stage feed gas compression
- Oil dilution control
- Emission control
- Capacity modulation



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Biomethane De-Oxygenation

Unit design: High temperature Catalyst De-oxygenation unit with Special stainless steel construction and API 619 blower

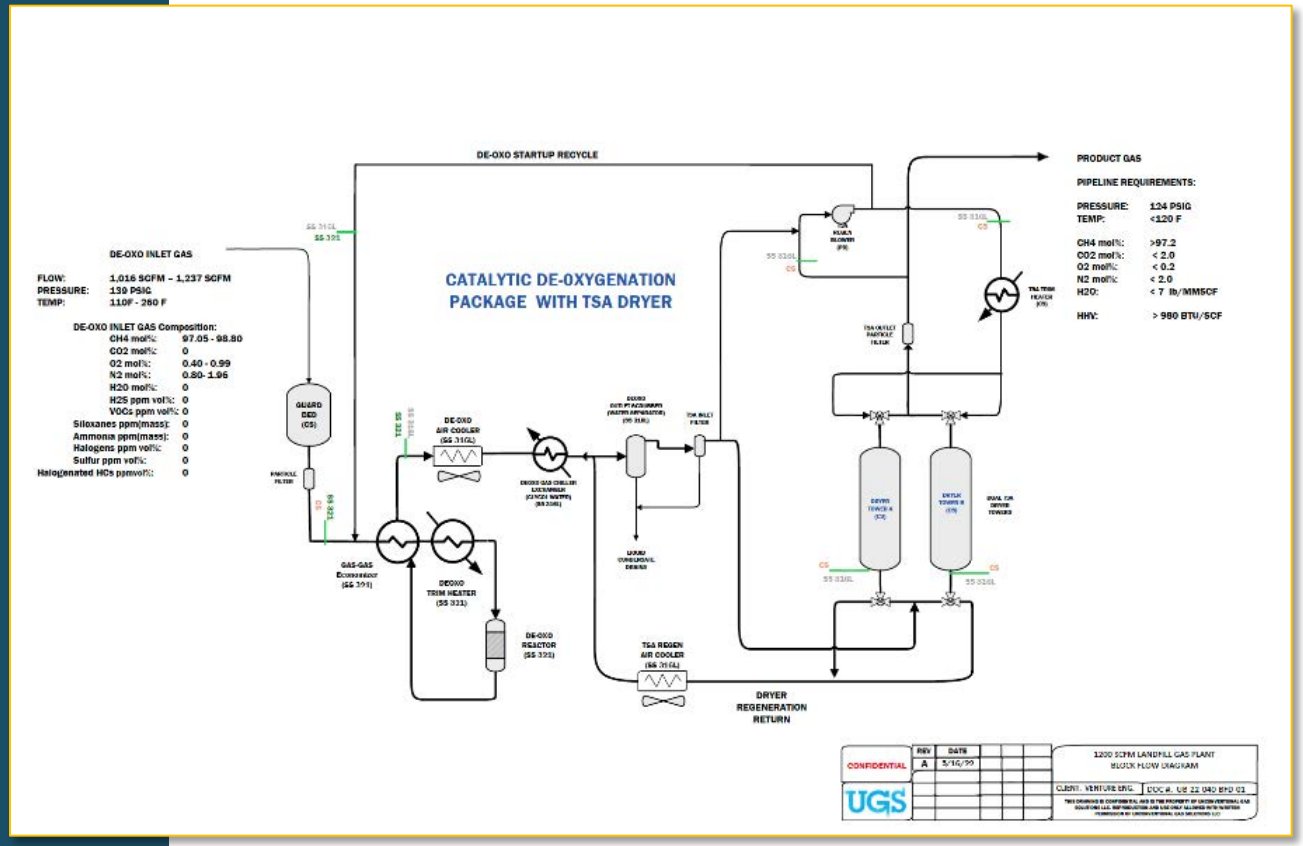
Technologies:

CATOX

Special considerations:

- Titanium stabilized SS construction for high temperature equipment, to prevent CSS from halogens and halogenated HC and Weld decay from condensates

- High temperature catalyst operation to eliminate masking problems due to trace contaminants



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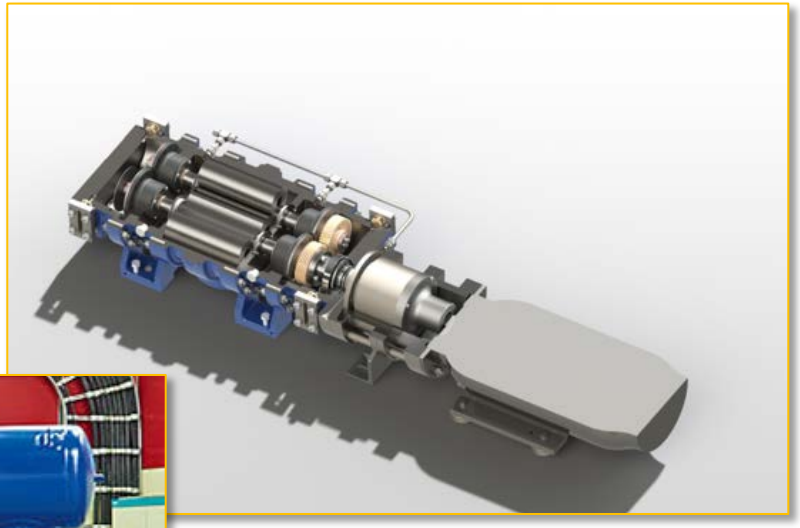
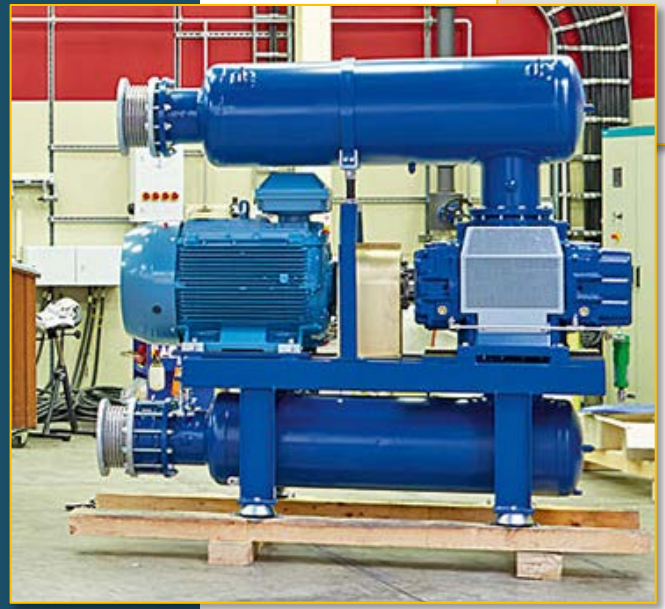
Biomethane De-oxygenation– Equipment & Component Design & Selection

Startup and Regen Blower :

- API 619 PD blower, fully rated pressure casing & Magnetic seal drive
- Prevents high DP failure and seal failure. 3 years of continuous service as per API 619 mandates
- OSAH 1910; NEC; NFPA; NEMA, ATEX rated.
  - Certified explosion proof Casing
  - Gas tight casing seals
  - Corrosion protection coatings/stainless materials





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Digester Gas Upgrading

Underutilized Gas-Production potential in Poland and Europe

- THG Quote in Europe

- Renewable Energy Directive (RED III)

- Climate Target Plan (CTP)

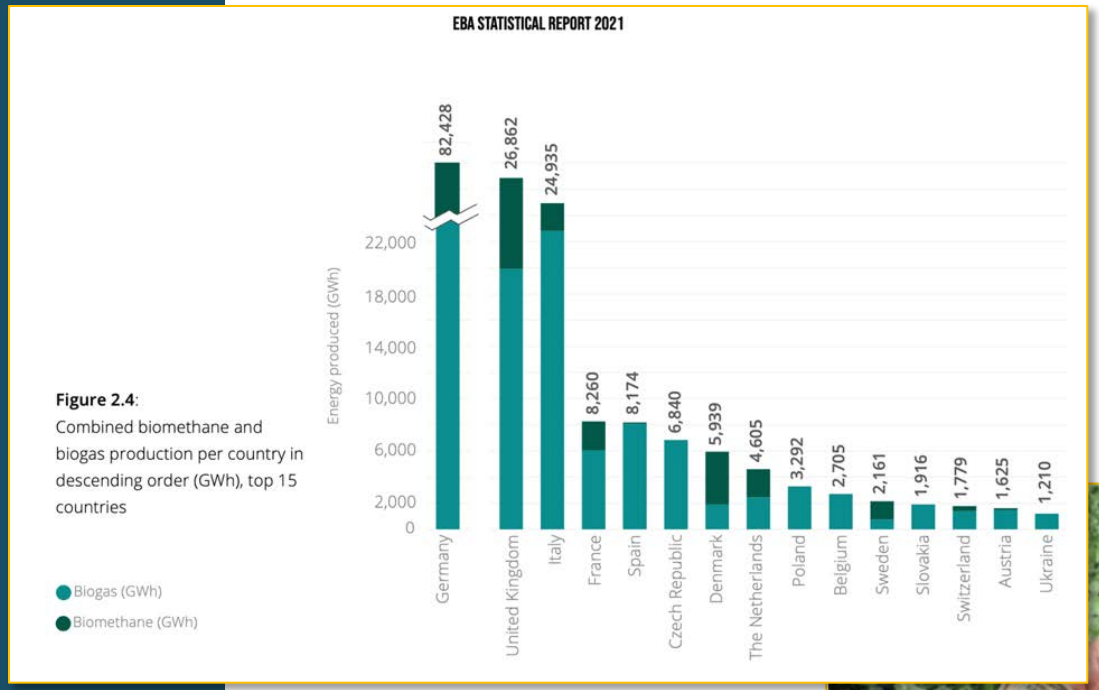

Figure 2.4:
Combined biomethane and biogas production per country in descending order (GWh), top 15 countries

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Digester Gas Upgrading

Two stage membrane system for removal of H2S & CO2

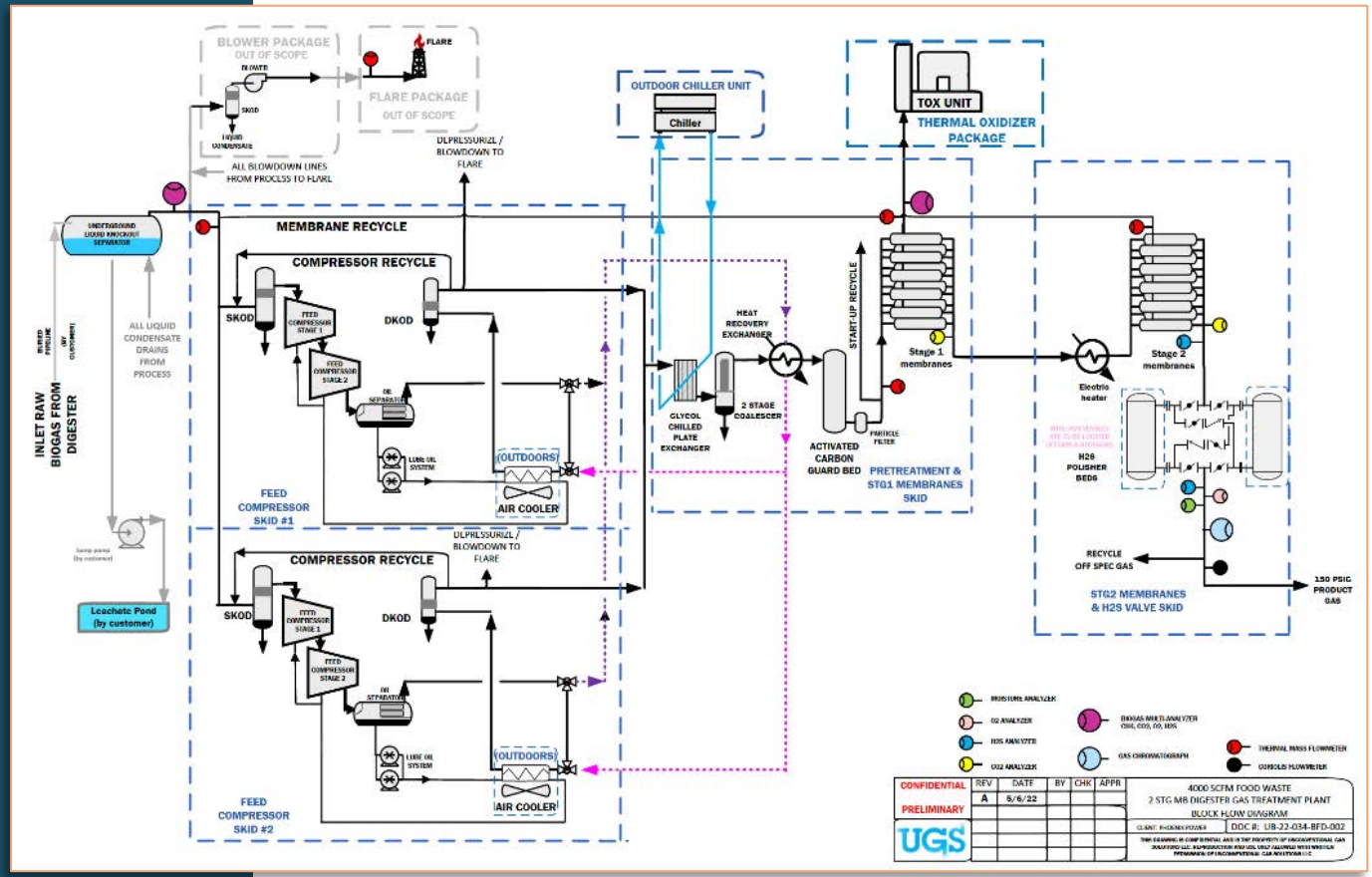
Typical CH4 Recovery:
96-98%

Technologies:
Membrane & H2S Polishing

Special considerations:

- Acid gas compression
- Oil dilution control
- H2 Embrittlement prevention
- Emission control
- Capacity modulation

Example with Redundant Feed Compression



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Digester Gas Upgrading

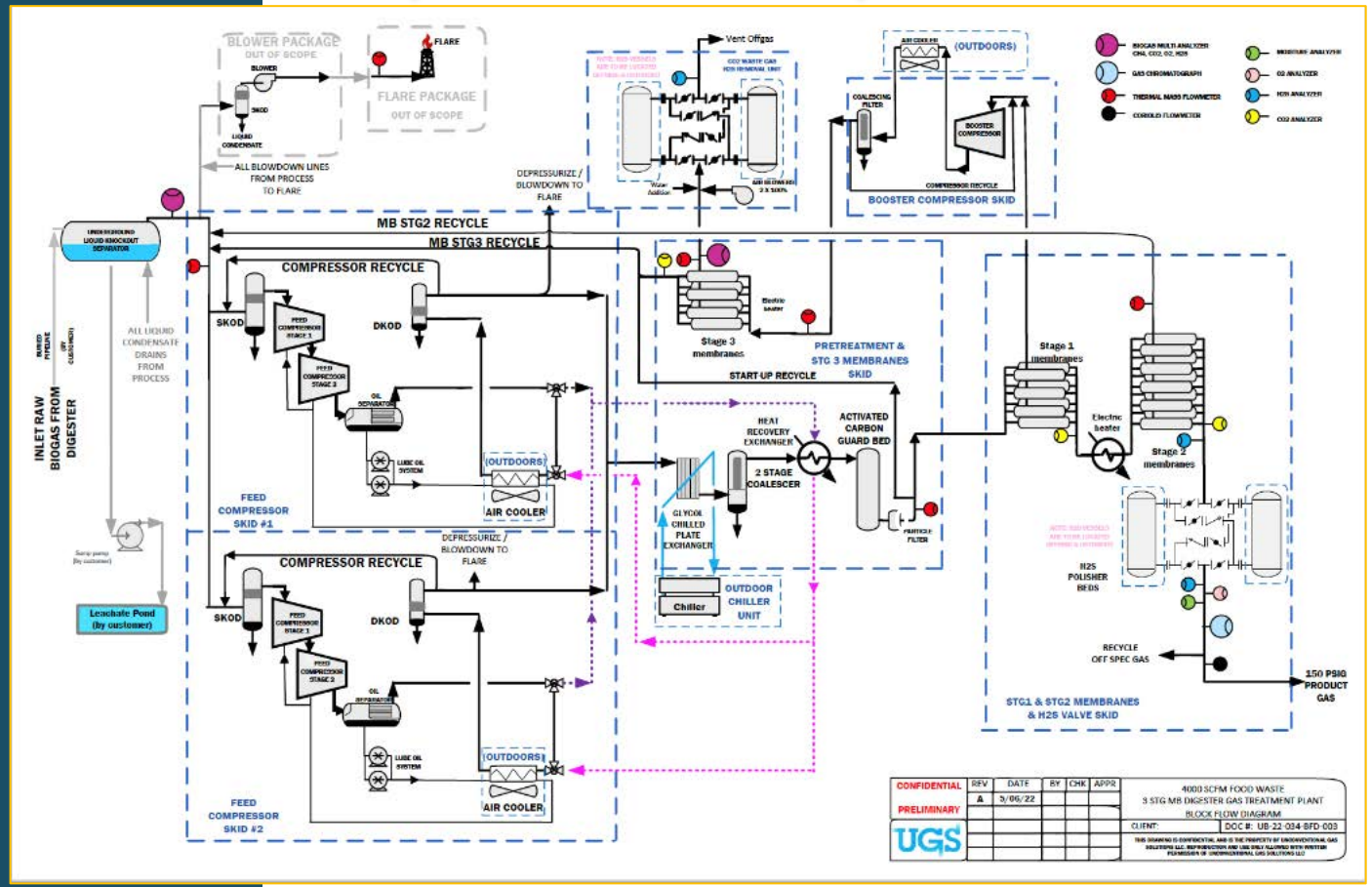
Three stage membrane system for removal of H2S & CO2

Typical CH4 Recovery:
>99%

Technologies:
Membrane & H2S Polishing

Special considerations:
- Acid gas compression
- Oil dilution control
- H2 Embrittlement prevention
- Emission control
- Capacity modulation
- Zero fuel gas usage

Example with Redundant Feed Compression



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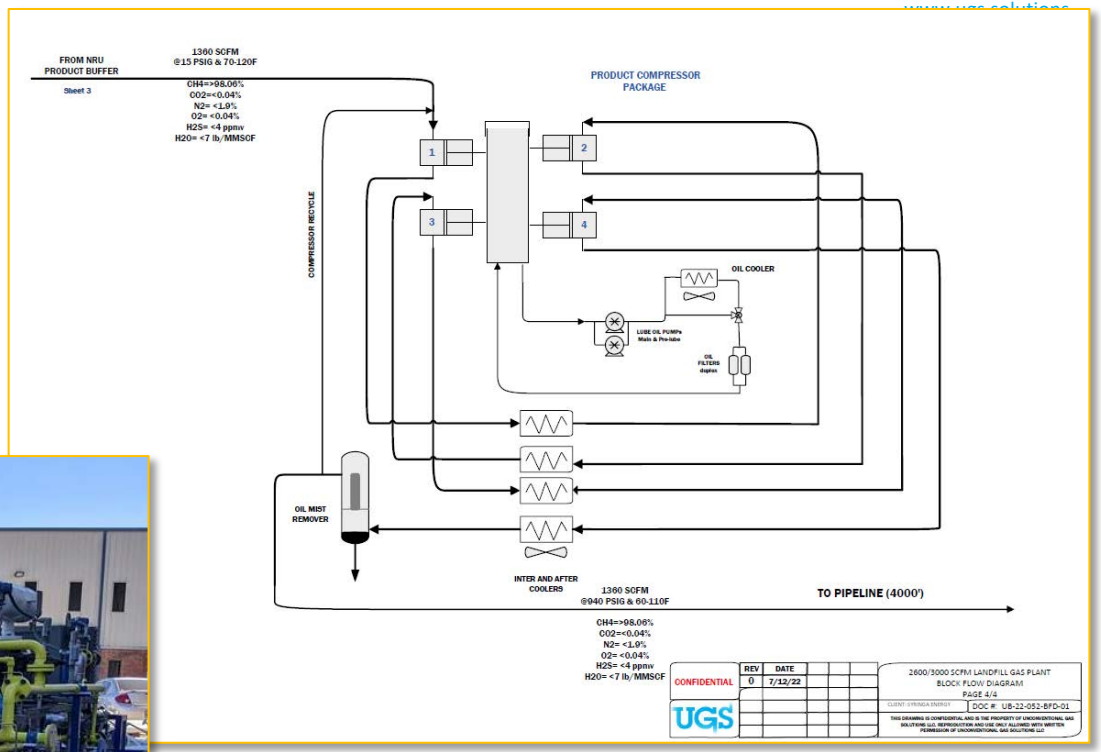
Product Gas Compression: >4500psi Recip-compressor for CNG/LNG/Pipeline

Product Comp. Talking Points



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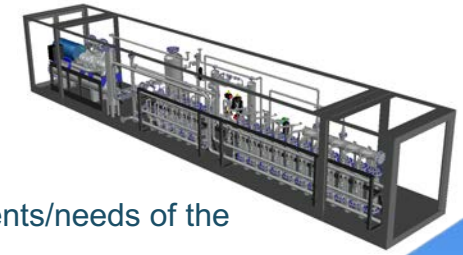
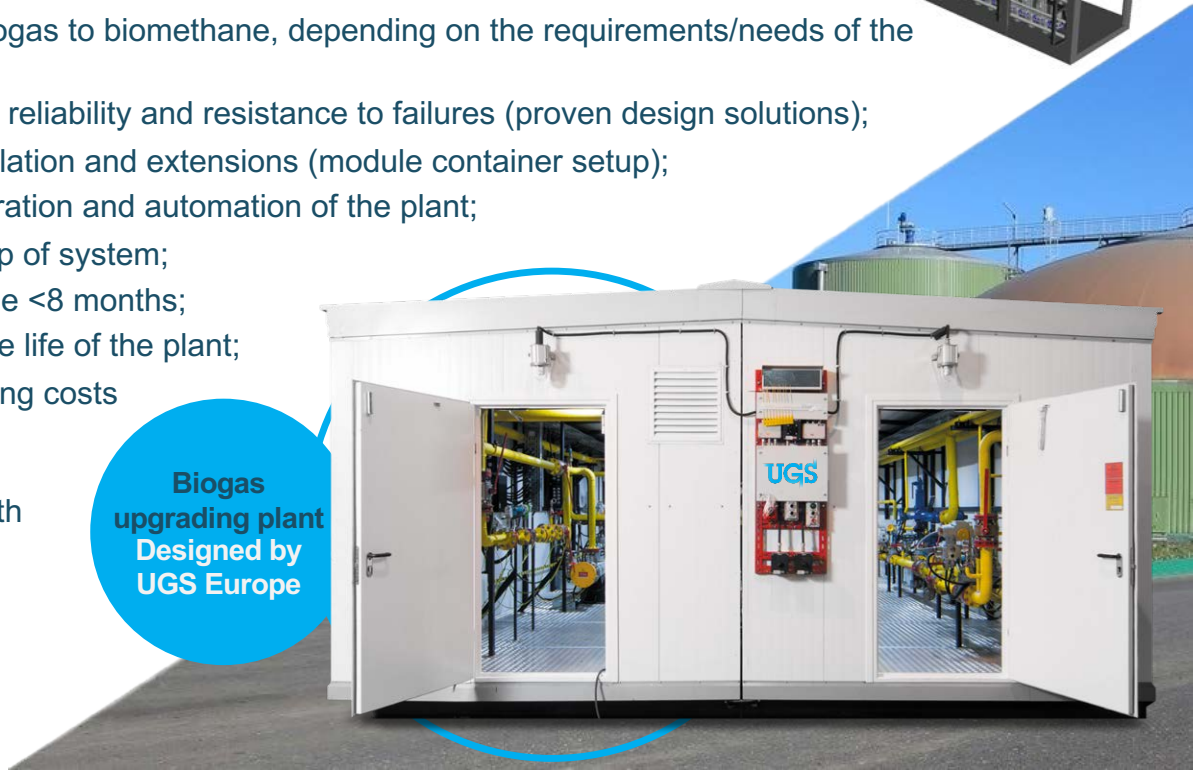
Biogas upgrading plant
Manufactured by UGS Europe



- Upgrade biogas to biomethane, depending on the requirements/needs of the consumer;
- Operational reliability and resistance to failures (proven design solutions);
- Quick installation and extensions (module container setup);
- Simple operation and automation of the plant;
- Fast start-up of system;
- Delivery time <8 months;
- Long service life of the plant;
- Low operating costs
- 1 year mechanical warranty with optional prolonged guarantees



QUESTIONS?

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