

Biogas Upgrading System

90%~99% biomethane recovery based on PRISM® Membrane Separators



Modular and scalable biogas upgrading unit
12,000m³/day to 20,000m³/day capacity

Biogas is a renewable energy produced during anaerobic digestion. Composed entirely of methane and carbon dioxide, biogas can be efficiently converted into biomethane through purification processes.

Biomethane is an ethical energy source that can replace fossil natural gas.



Biogas is the production of CH_4 from anaerobic digestion of farm wastes, manure, or municipal waste. Biogas contains high percentage of CO_2 , H_2S , and other impurities which need to be removed to make the methane commercially viable. The purified biomethane is used to generate heat and electricity, compressed for powering vehicles, or fed directly into the natural gas grid for resale.

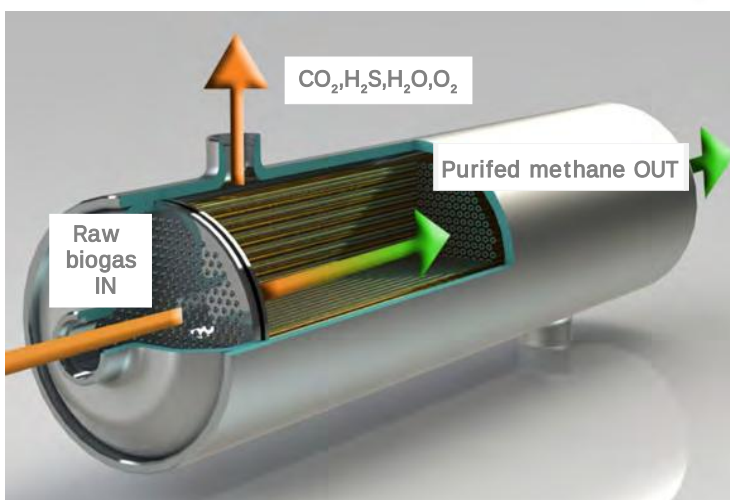
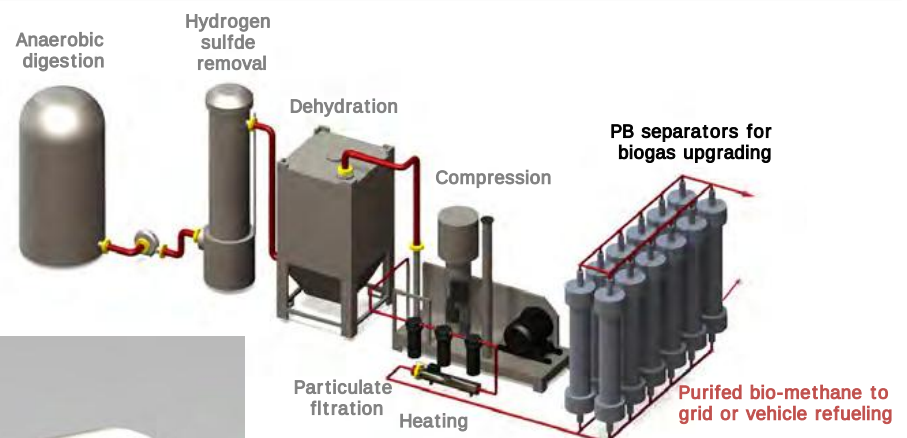
Air Products' PRISM separators use proprietary hollow fiber membranes to selectively remove unwanted elements from biogas streams produced during the anaerobic digestion process. Thousands of tiny hollow fibers are spun from polymers in Air Products' state-of-the-art production facility and assembled into durable and lightweight aluminum casings for biogas upgrading.

When biogas is fed into the PB series membrane separator under pressure, the unwanted gas molecules are selectively removed. This results in a purified stream of biomethane which is ready for industrial use and does not require secondary chemical scrubbing solutions.

Typical biogas process flow

PRISM® PB Series Membrane

For illustration purposes only.
Components not to scale.
Pretreatment options vary by application



PRISM® membrane separators for biogas upgrading contain thousands of tiny hollow fibers. Smaller gas molecules, like carbon dioxide and water vapor, diffuse through the membrane walls while the larger methane molecules are transported the length of the tube and exit from the end of the module.

Scala integrates the PRISM's PB series membrane separators into the biogas upgrading units to recovery biomethane for at 90% ~ 99% for commercial resell or inject CNG grids. These units are designed to generate renewable energy from agricultural or industrial wates.



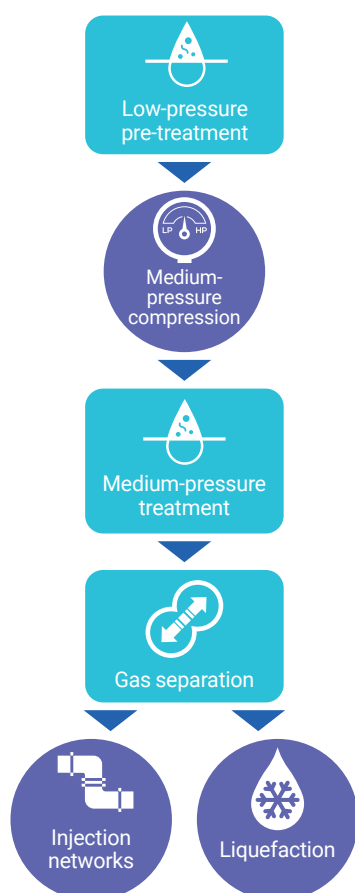
Biogas purification/upgrading unit is a system which upgrades biogas produced from biomass landfill to commercially variable high purity methane (CH₄), normally 95~99%. The process consists of raw biogas compression, desulfication, filtration and purification. With Scala's all-in-one biogas upgrading system, one step biogas upgrading is possible. Our manufacturing plant for biogas upgrading machines occupies room

of 12,000 square meters. In this plant we produce biogas upgrading units in 20FT or 40FT standard containers for easy installation and delivery. Apart from these said biogas upgrading units, we also manufacture water scrubbing tower, biogas filters, dry desulfurization towers, etc. Ever since the year of 2019, Scala has been working with renewable energy giants to build modular biogas upgrading units for

CNG and LNG production. Thanks to PRISM's membrane separators, Scala is able to utilize this robust technology into our biogas purification containers which are designed to process raw biogas at daily flow rates ranging from 12,000 m³ to 20,000 m³

Modular biogas upgrading unit up to 20,000 Nm³/Day

Operating principle



A membrane separator technology-based biogas upgrading unit includes air compressor, refrigeration dryer and desiccant dryer, along with coalescing and precision filters. After heating, biogas will feed to membrane separators for 90%-99% purification. All the components are installed within a fully explosion-proof container to ensure safe and reliable operation.



Key benefits

- High reliability and availability
- Low power consumption
- Low operating costs and optimized TCO
- Full range of services and maintenance
- Modular units (extension of the biogas treatment capacity)
- Simple and quick installation
- Small footprint
- Biomethane injection into the low pressure or high pressure network

Additional modules:

- Desulfurization unit
- Biogas Pre-treatment

Related services

- Preventive and curative maintenance
- Remote maintenance
- Hotline 24/7
- Spare parts
- Operating support and expertise
- Training

Biogas upgrading units range

Raw biogas treatment capacity (Nm³/Hr)

200	
300	JWMD98N-500
400	
500	
600	JWMD98N-625
625	
700	
840	JWMD98N-840
1,000	
1,250	
1,500	JWMD98N-625 x 2 unit
1,640	
	JWMD98N-840 x 2 unit

Our broad product range offers a solution to diverse project types, such as:

- Agricultural
- Waste water treatment
- Municipal solid wastes
- Biowastes
- Industrial & agroindustrial
- Multi feedstock

High performances:

- Methane recovery rate > 99%
- Electrical consumption < 0.25 to 0.31 kWh/Nm³ of biogas



Compared to other technology, membrane separation offers many advantages on power consumption, recovery rate, impurity removal, service life and operation convenience. PRISM PA membrane separators are expected to bring 10-15 years economy return for 1 time investment.



Advantages

High-purity biomethane: Upgrading increases the methane concentration to over 97%, allowing it to be used as a direct substitute for natural gas.

Robust construction: PRISM membrane modules are engineered to operate in harsh environments, typically over 10-15 years.

Scalability: Technologies with PRISM membrane-based upgrader offers compact, modular designs that can be scaled to fit the specific biogas production volume of a plant.

Easy production cycling: PRISM membrane separators are ready for processing instantly, and do not require lengthy start-up or shutdown preparations.

Resists ammonia vapor & hydrogen sulfide: PRISM membranes are engineered to tolerate many impurities that cripple other systems. These undesirable elements are selectively removed and vented off in the biogas upgrading systems permeate stream without affecting the system performance.

Great value: Compared to other technologies, membranes require a very small capital investment to begin processing.

Simple to operate: PRISM Membrane separators are passive technology and have no moving parts. Complex monitoring equipment is not necessary.

Competing technologies

Wash water scrubbing:

Raw biogas is fed into a column of water where the CO_2 and methane dissolve into the water. This saturated water is then fed into a flash tank where the pressure is reduced, the methane strips off, and the CO_2 departs with the water.

Polyethylene glycol absorption:

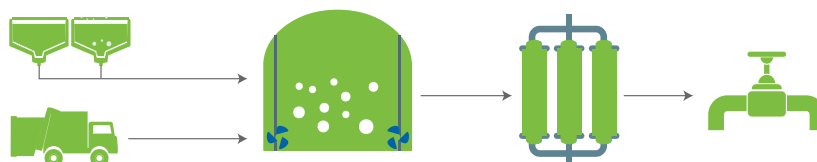
Similar to water scrubbing method with polyethylene glycol as the liquid contactor.

Carbon molecular sieves:

Biogas is fed into reaction chambers which are filled with a carbon sieve under pressure. The CO_2 and H_2S molecules are adsorbed into the carbon sieve. The methane flows to an adjacent chamber with reduced pressure. A vacuum strips the first column of the unwanted molecules, and the pressure swing cycle repeats. It's known as PSA.

Membrane separation:

Biogas is compressed and fed into modules which contain thousands of porous, hollow fiber membranes. Fast gases permeate the membrane walls while slow gases exit the hollow tube.



Specifications

For illustration purposes only.
Components not to scale.
Pretreatment options vary by application

JWMD98N-840

Biogas Flow Rate	m ³ /Hr	840
Biogas Temperature	°C	25-55°C
Biogas Pressure	mPa	1.0-1.6
Working Pressure	mPa	1.0-1.5
CH ₄	%	55-75%
CO ₂	%	20-45%
H ₂ S	PPM	20
Methane Upgrde Purity	%	90-99.5
Natural Gas Purity	%	85-99.5
Calorific Value		34-37MJ/M3
Compressor Power		250kW
Compressor Container	L12 x W2.5 x H2.95m	
Separator Container	L12 x W2.5 x H2.95m	
Membrane Lifespan	Years	10~15

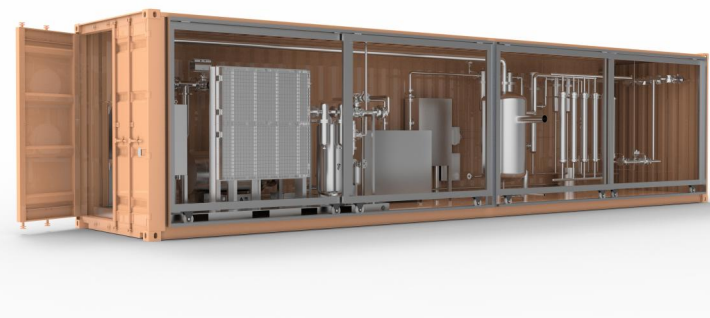
20,000 Nm³/Day



JWMD98N-625

Biogas Flow Rate	m ³ /Hr	625
Biogas Temperature	°C	25-55°C
Biogas Pressure	mPa	1.0-1.6
Working Pressure	mPa	1.0-1.5
CH ₄	%	55-75%
CO ₂	%	20-45%
H ₂ S	PPM	20
Methane Upgrde Purity	%	90-99.5
Natural Gas Purity	%	85-99.5
Calorific Value		34-37MJ/M3
Compressor Power		185kW
Compressor Container	L6 x W2.5 x H2.95m	
Separator Container	L12 x W2.5 x H2.95m	
Membrane Lifespan	Years	10~15

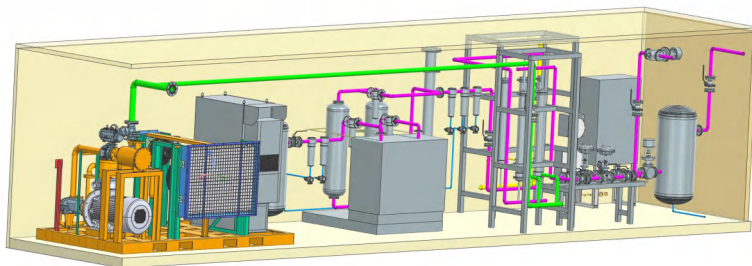
15,000 Nm³/Day



JWMD98N-500

Biogas Flow Rate	m ³ /Hr	500
Biogas Temperature	°C	25-55°C
Biogas Pressure	mPa	1.0-1.6
Working Pressure	mPa	1.0-1.5
CH ₄	%	55-75%
CO ₂	%	20-45%
H ₂ S	PPM	20
Methane Upgrde Purity	%	90-99.5
Natural Gas Purity	%	85-99.5
Calorific Value		34-37MJ/M3
Compressor Power		160kW
Compressor Container	L6 x W2.5 x H2.95m	
Separator Container	L12 x W2.5 x H2.95m	
Membrane Lifespan	Years	10~15

12,000 Nm³/Day





References

Hubei, CHINA

Owner	Pioneer New Energy
Flow Rate	400Nm ³ /Hr
CH ₄ Purity	50%
Upgrading Purity	95%
CH ₄ Recovery Rate	80%
Membrane QTY	10
Selling	CNG
Project Year	2019

9,600 Nm³/Day



Xiang Yang, CHINA

Owner	Xiangyang Power LTD
Flow Rate	600Nm ³ /Hr
CH ₄ Purity	72%
Upgrading Purity	95%
CH ₄ Recovery Rate	95%
Membrane QTY	15
Selling	CNG
Project Year	2020

15,000 Nm³/Day



Hebei, CHINA

Owner	Kangchuang Bio Energy
Flow Rate	840Nm ³ /Hr
CH ₄ Purity	66%
Upgrading Purity	96%
CH ₄ Recovery Rate	96%
Membrane QTY	12
Selling	CNG
Project Year	2022

20,000 Nm³/Day



VIETNAM

Biogas source	Cassava starch wastewater
Flow Rate	410Nm ³ /Hr
CH ₄ Purity	55%
Upgrading Purity	96-99%
CH ₄ Recovery Rate	98%
Membrane QTY	10
Selling	KY LONG CNG
Project Year	2024

10,000 Nm³/Day



References

Shandong, CHINA	
Ower	Yili Dairy
Flow Rate	500Nm³/Hr
CH4 Purity	55%
Upgrading Purity	96%
CH4 Recovery Rate	98%
Membrane QTY	12
Selling	CNG Grid
Project Year	2025



Fujian, CHINA	
Owner	Fujian Sunner Gruop
Flow Rate	1,670Nm³/Hr
CH4 Purity	52%
Upgrading Purity	96-98%
CH4 Recovery Rate	96%
Membrane QTY	24
Selling	Huarun CNG Grid
Project Year	2025



Shanxi, CHINA	
Owner	BFBF Bio Energy
Flow Rate	210Nm³/Hr
CH4 Purity	60%
Upgrading Purity	96-98%
CH4 Recovery Rate	96%
Membrane QTY	5
Selling	Jincheng CNG Grid
Project Year	2025



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An original equipment manufacturer of on site liquid nitrogen generators based advanced GM coldhead technology, cryogenic equipment and biogas upgrading units based on PRISM® membrane separators. We are able to provide OEM services.