

Natural Gas Conditioning

Lurgi Sulfur Management



A good business partner is experienced,
flexible, future oriented and

has the resources and technology to
make things happen.



Tomorrow's world is characterized by a gigantic thirst for raw materials. Varying geographic distribution and the most diverse raw materials require individual and tailor-made solutions. The gas route has acquired a competitive edge: it generates added value, is profitable and boasts the flexibility required to take the lead in dynamic markets. This is of significance for natural gas producers and processors in the same way as for manufacturers of petrochemicals from oil. Investors, who primarily seek an attractive return on their capital, are also drawing benefits from innovative technologies.

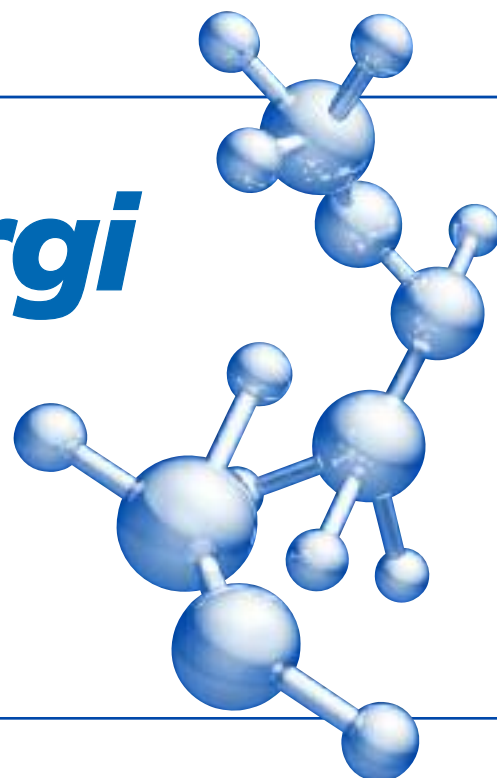
Lurgi has a long term experience in chemical treatment of natural gas worldwide. Based on the knowledge of the requirements and processes available ⁽¹⁾ Lurgi uses the most efficient and modern technologies and created own technology packages which are permanently updated. These key technologies open the product route for various gas usages like LNG, pipeline gas, energy or downstream processing technologies.

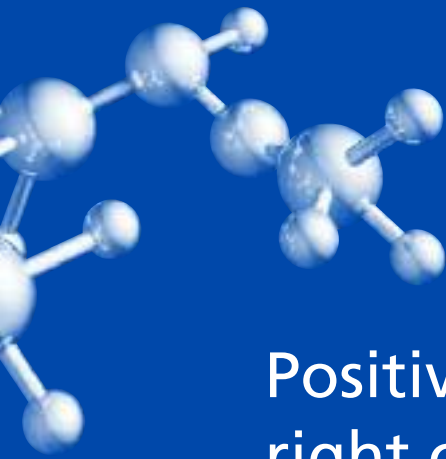
Contents	
Natural Gas Conditioning	5
– OmniSulf®	
Claus Technologies	9
– Claus	
– OxyClaus	
Tail Gas Technologies	11
– LTGT®	
– SubDewpoint Processes (MAXISULF®, SULFREEN®, HydroSulfreen® ...)	
Sulfur Degassing	13
– Aquisulf®	
Special Sulfur Concepts	13
– Emission-free	
Recovery Rates and Cost Factors	15
References	15

⁽¹⁾ NEHB, WOLFGANG (Lurgi GmbH): Sulfur, ULLMANN'S Encyclopedia of Industrial Chemistry, WILEY-VCH Verlag GmbH Co. KGaA, Weinheim 2006



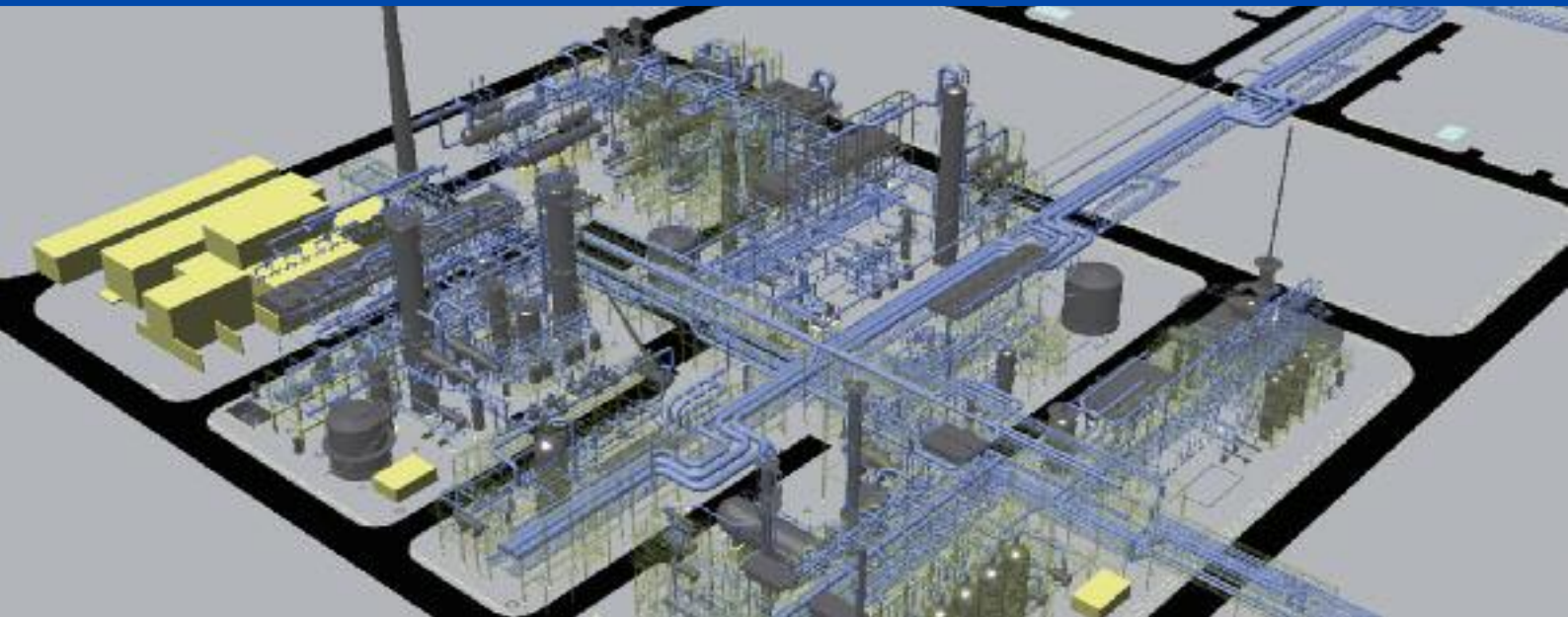
Lurgi





Positive development starts with the
right concept

– from Lurgi for your success.



Natural Gas Conditioning

Natural gas is the fastest growing primary energy source. The use of natural gas is expected to almost double between 1999 and 2020, providing a relatively clean fuel for the worldwide energy demand. All sulfur components and, in part, CO₂ have to be removed before natural gas is liquefied (LNG), fed to a pipeline, or used as a feedstock for the production of base chemicals such as methanol or fertilizers. OmniSulf® comprises technologies from BASF and Lurgi to meet specifications according to process requirements and/or environmental regulations. It is based on Lurgi's proprietary know-how as a technology licensor and engineering contractor.

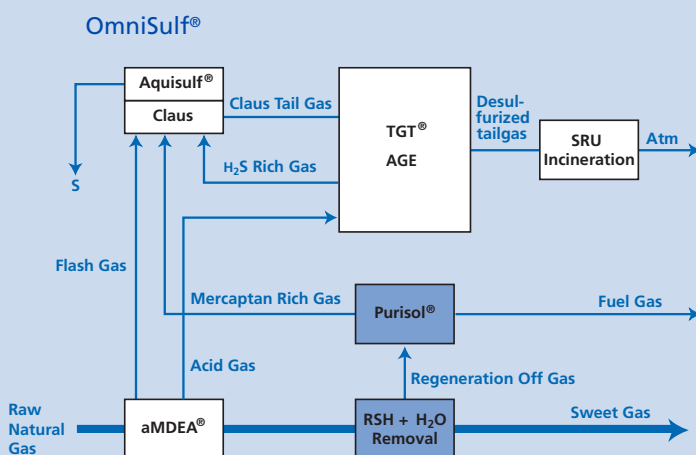
OmniSulf®

One-stop shop for natural gas treating Lurgi's overall Natural Gas Treating Concept is based on the

following Proprietary Processes for natural gas treating. Lurgi has developed an innovative concept, the OmniSulf® process.

Lurgi SRU consisting of:

- Claus
- AGE
- LTGT®
- Incineration
- AQUISULF
- Activated MDEA (aMDEA® of BASF) – acid gas removal (H₂S, COS, CO₂)
- Molecular Sieve (removing H₂O, mercaptans) producing dry sweet gas according to clients specifications
- Lurgi's Purisol® unit (recovering the hydrocarbons out of the molsieve regeneration gas, separating the mercaptans)



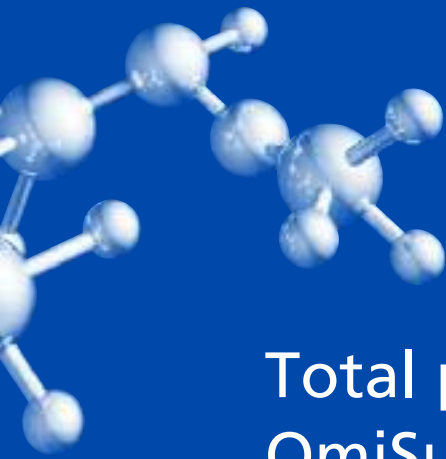
■ = Optional units depending on well gas composition

The need for Natural Gas Treating

- Natural gas consumption is increasing worldwide
- Growing demand for LNG / pipeline gas
- Deteriorating natural gas quality
- Increasingly stringent gas quality requirements

Advantages of OmniSulf® Integrated Natural Gas Treating Concept

- Single source responsibility
- One licensor
- No interfaces
- Overall guarantees
- Tailor-made process arrangement
- fulfilling most stringent environmental regulations

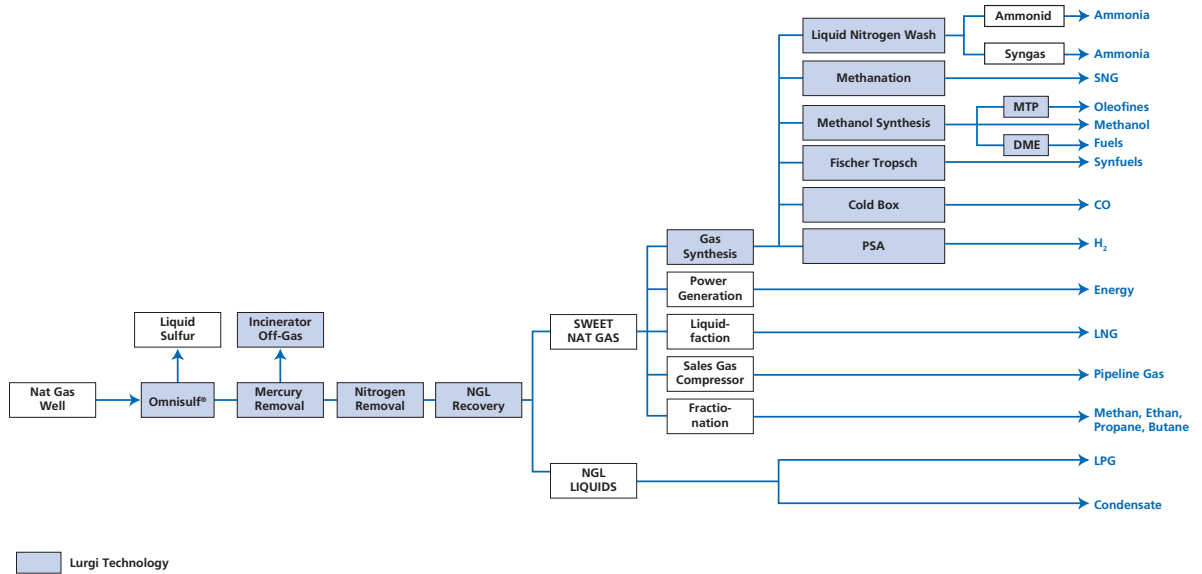


Total process guarantee backs up
OmiSulf®'s

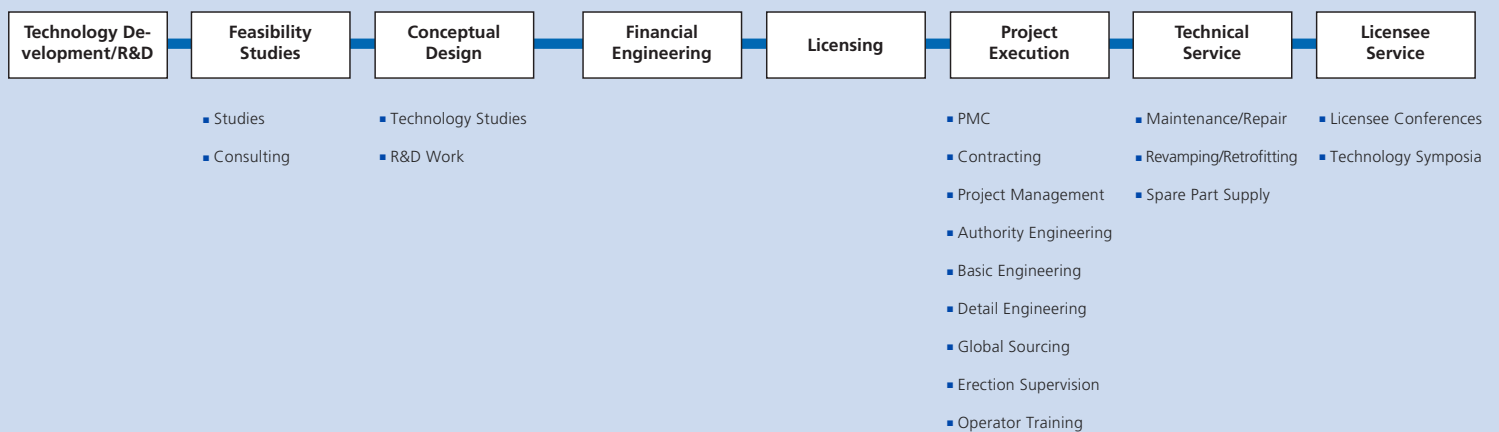
excellent safety and reliability.

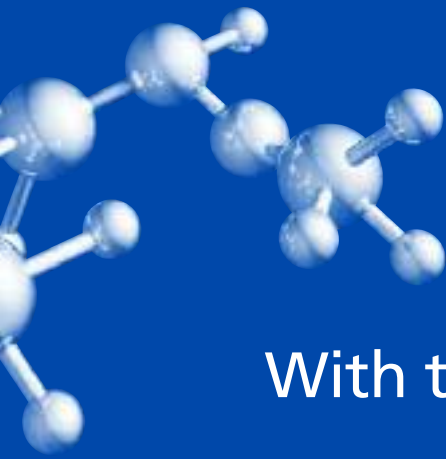


YOUR Opportunities with Omnisulf®



Scope of Lurgi





With the right technology

a lot of doors can be opened.



Claus Technologies

Claus Process

The Claus process continues to be the most widely used process worldwide for the conversion of H₂S to sulfur. The requirements to be met by Claus plants are dictated by the operating conditions of modern, flexible refineries and natural gas plants and increasingly stringent emission control regulations.

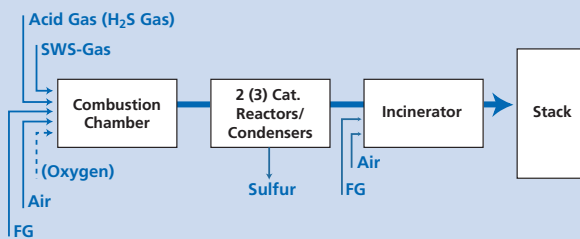
Advantages of the Lurgi Claus Process

- High efficient reliable burner system including ammonia/RSH destruction
- Lurgi own technologies for recovery rates 96.0 – 99.9%

OxyClaus® Process

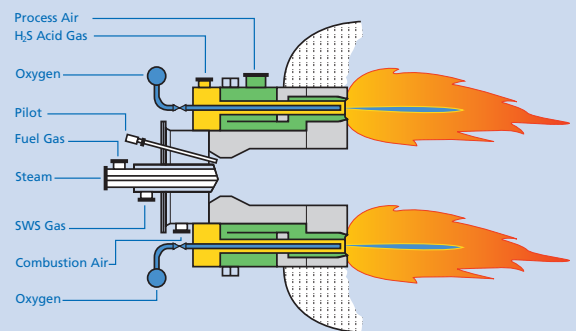
Advantages of the OxyClaus® Process

- Capacity boosting of existing Claus and tail gas units.
- Significant reduction in capital investment when building new Claus and tail gas units.
- Processing of feed gases with both high and low hydrogen sulfide contents (20–100 vol %).
- Flexible processing when handling temporarily high or low amounts of hydrogen sulfide by automatic change over from air to oxygen operation and vice versa.
- Processing of Claus gases with elevated hydrocarbon contents.
- Complete combustion of ammonia contained in ammonia-laden sour water stripper offgases.



	Catalytic Stages	Sulfur Recovery Rate
Claus	2	96 % – 97 %
Claus	3	97 % – 98 %

Lurgi Claus Process



OxyClaus® Process



Our contribution to clean energy is ...

... cleaning energy.



Tail Gas Technologies

Sub-dewpoint Tail Gas Technologies SULFREEN®, MaxiSulf®, HydroSulfreen® for Sulfur Recovery Rates of 99.0 – 99.6 %

A very efficient and low-budget sub-dewpoint tail gas treatment is the Sulfreen process. The SULFREEN process is a catalytic tail gas process which has been successfully employed in more than 45 Sulfur recovery units. This SULFREEN process permits sulfur yields to be boosted to 99.0 – 99.6 %.

Advantages of the SULFREEN® Processes

- Continuation of catalytical Claus process
- No chemicals/solvents needed
- Increase of sulfur recovery rate step by step by using existing SULFREEN equipment and just adding more catalytical stages.

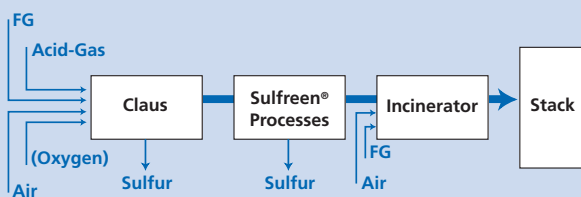
Lurgi Tail Gas Treating LTGT® for Sulfur Recovery Rate (99.9 %)

Hydrogenation and water condensation have to be followed by a (usually) selective chemical absorption process to remove the remaining H₂S and return it to the Claus feed gas.

Advantages of Selective Chemical Adsorption (LTGT®)

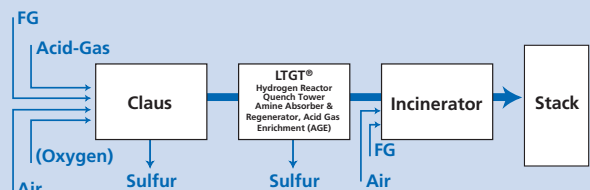
- Possibility of using existing solvent regeneration units
- Very low sulfur concentration in the offgas
- Optimized H₂S/CO₂ selectivity leads to small recycle to Claus unit
- Low pressure drop
- Good availability of the solvent MDEA

Lurgi Sub-dewpoint Process (SULFREEN®, MaxiSulf®, HydroSulfreen®)

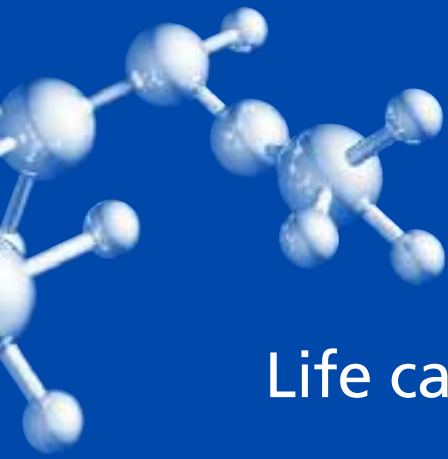


	Catalytic Stages	Sulfur Recovery Rate
Sulfreen®	2	99.0 %
HydroSulfreen®	3	99.6 %

LTGT®-Lurgi Tail Gas Treatment Technology



Recovery Rate 99,9 %+



Life can be easy:

Take the advantages of Lurgi
processes.



Sulfur Degassing

Sulfur Degassing Process AQUISULF®

For liquid sulfur degassing, Lurgi uses the AQUISULF process bringing residual H₂S down to less than 10 ppm by weight.

Special Sulfur Concepts

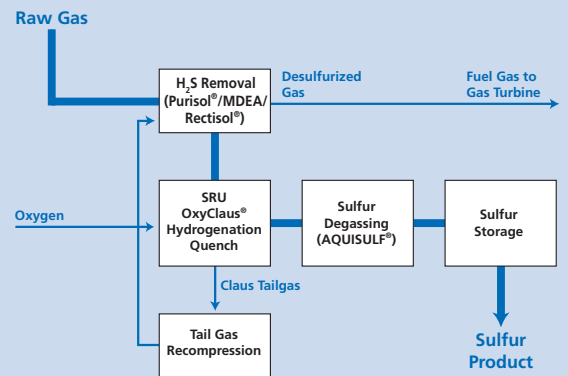
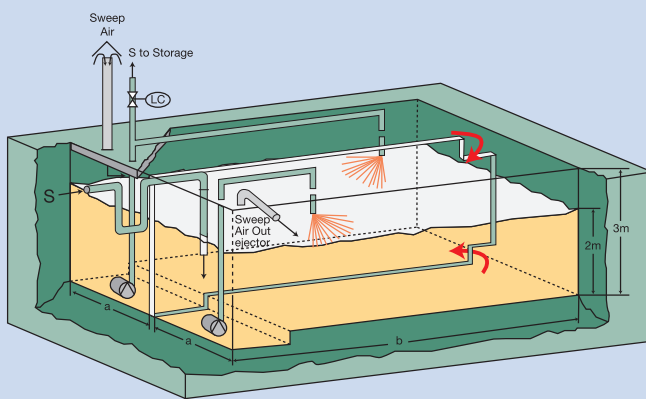
Emission-free SRU

For residual H₂S levels below 10 vol. ppm, Lurgi offers a process combination in which the process gases leaving the Claus plant is directed to an absorber stage in the upstream gas purification unit, where its H₂S content is reduced to below

10 ppm. First of its kind concept (Lurgi's Emission free SRU); start up in 2002 in Italy.

Advantages of Emission-free SRU

- Lower investment cost due to the use of oxygen (OxyClaus®) and due to reduction of number of equipments
- No sulfur emissions from SRU
- Recycle of process gas results in reduction of sulfur emissions to atmosphere in overall complex
- Higher efficiency in energy production section in IGCC due to higher gas volume



Lurgi Emission-free SRU Option

Why look for new approaches

when we already built them?



Recovery Rates and Cost Factors

Approximate SRU cost depending on recovery
(minimum 50 % vol. H₂S in feed gas to Claus)

References Status: 2010

We have contracted:

- 6 trains according to OmniSulf® concept are in operation respectively under design/execution.
- more than 170 Claus plants, having sulfur capacities per train from 4 t/d up to 1,000 t/d
- more than 40 OxyClaus® processes (sulfur capacities per train: 4 t/d up to 270 t/d)
- more than 60 tail gas treating processes (sulfur capacities per train from 4 t/d up to 1,000 t/d)
- contracts have been signed for more than 50 Aquisulf® sulfur degassing units having total degassing capacities from 20 t/d up to 3,600 t/d

Lurgi Sulfur Technology	Recovery in %	Cost Factor in %
Claus 2cs, (2 catalytic stages)	96.0 – 97.0	100
Claus 3cs, (3 catalytic stages)	97.0 – 98.0	110
Claus 2cs + SULFREEN®	99.0 – 99.2	135
Claus 3cs + SULFREEN®	99.2 – 99.5	145
Claus 2cs + HYDROSULFREEN®	99.5 – 99.7	155
Claus 2cs + LTGT® using existing regeneration unit	99.8 – 99.9+	165
Claus 2cs + LTGT® incl. regeneration	99.8 – 99.9+	185
Emission-free Claus	100	165



Lurgi is a leading technology company operating worldwide in the fields of process engineering and plant contracting. Based on syngas, hydrogen production and clean conversion technologies for fuels or chemicals Lurgi offers innovative solutions that allow the operation of environmentally compatible plants with clean and energy-efficient production processes.

Its technological leadership is based on proprietary and exclusively licensed technologies which aim to convert all carbon energy resources (oil, coal, natural gas, biomass, etc.) in clean products.

Lurgi is a member of the Air Liquide Group.

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