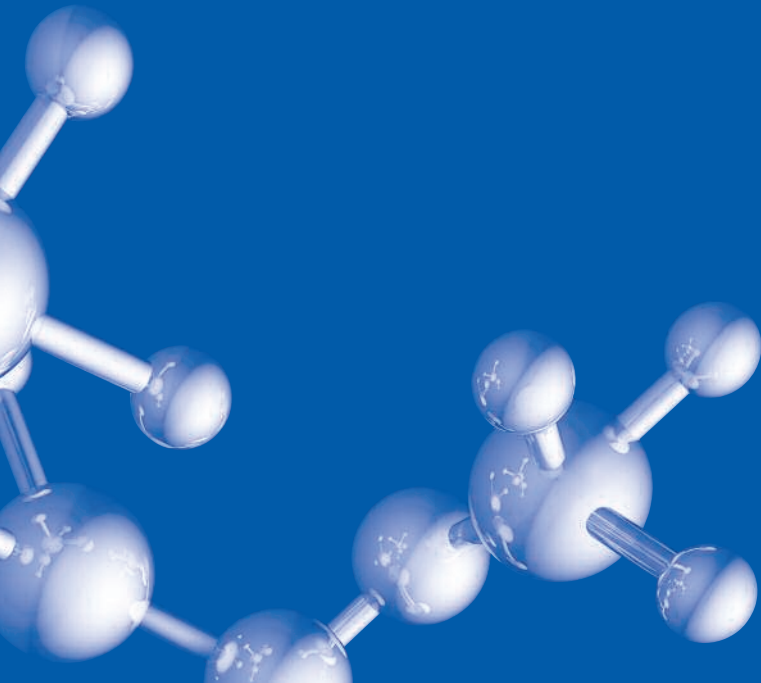
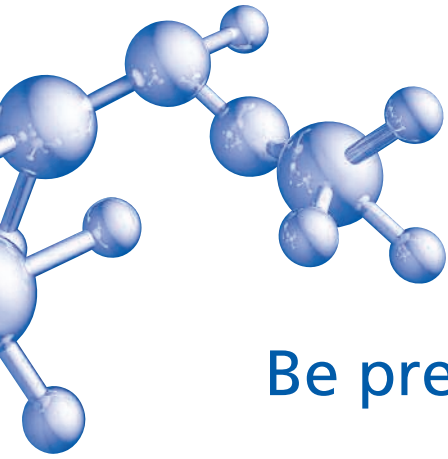




Refinery Future Challenge





Be prepared –

Every single step is essential
for success.



Intelligent Solutions to the Core

Nearly 1500 employees are working for Lurgi worldwide. More than 15 % are engaged in finding solutions for technical problems in the company's development and technology units. After all, each refinery has its own specific operating conditions that call for an intelligent integrated concept. The aspects of oil quality and consistency are discussed in cooperation with our chemical laboratory to optimize projects with state-of-the-art analysis methods and equipment.

Process optimizations require concrete numerical data, computer-assisted simulation results as well as commonsensible experience. This expertise is indispensable when a decision has to be made; Lurgi contributes to every project the know-how gathered in more than 50 years of refinery engineering.

Lurgi was successfully involved in the realization of hundreds of process plants worldwide which have been operating profitably for many years. Lurgi is an expert in the design and construction of both complete refinery complexes and individual plant units for the processing of crude oil and syncrudes. Furthermore, Lurgi designs and builds aromatics complexes and a very broad range of petrochemical plants downstream the refinery.

Complete Project Execution at the Customer's Premises

Execution centers around the world allow for a fast and efficient support of our customers in their respective country. Modern communication structures, fast know-how transfer and the complete services portfolio from engineering through to start-up support secure the success of our projects.

Scope of Services

Scope of Services Lurgi provides total technology solutions executed in full-service operating centers worldwide. The scope of services covers all aspects of project development from financing through to startup and operation. The following comprehensive services are on offer:

- Consulting
- Market Studies
- Feasibility Studies
- Product Marketing
- Financing
- Contracting
- Countertrade
- Global Sourcing

- Linear Programming – Investment Analysis
- Conceptual Studies
- Basic and Detail Engineering
- Value Engineering
- Authority Engineering
- Construction
- Operation and Maintenance
- Revamps/Retrofitting
- Maintenance
- Technical Service

In addition, Project Management Consultancy services are offered for providing comprehensive project management and associated services for a Refinery Project.



Positive development starts with the
right concept –

from Lurgi for your success.



Great Tools for your success

Get your study first

Lurgi uses modern Linear Programming Modeling Systems which provide the most economic refinery concept enabling refineries and petrochemical plants to meet today's planning challenges.

Best Design and Simulation Tools With a wide range of state-of-the-art process simulation tools, Lurgi provides best practices and recommendations on how you can increase efficiency and productivity of your plant by optimizing the process design.

Plant design, modernization and optimization are the key prerequisites for long-term successful and safe plant operation. The competitiveness of today's markets and the focus on energy efficiency

require improved heat-integrated process design. Energy and heat recovery optimization tools help to minimize the utility consumption of your plant. Lurgi applies dynamic simulation tools to analyze the safety and the control scheme of your plant and to design or debottleneck the flare & vent systems of your refinery. Integrated design tools for 2-D and 3-D modeling enable Lurgi to provide engineering packages faster and at high quality.

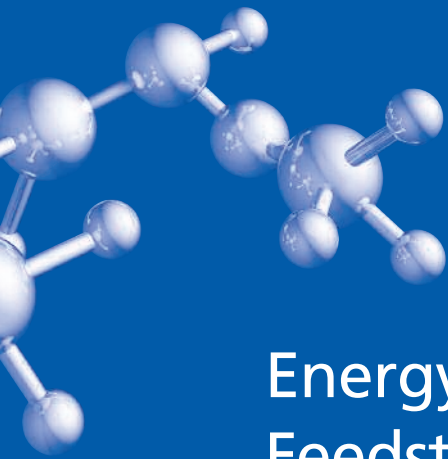
Inspection Authorities

Lurgi feels at home – all over the world. Based on our expertise, projects can be handled regardless of your location. Compliance with worldwide standards and guidelines is a matter of course.

Did you know that ...

- ... the first European (and worldwide) refinery was built in Jaslo, Poland in 1856 and the main products were kerosene and asphalt. The last European grassroots refinery was built in Leuna, Germany and Lurgi played a decisive role in its design and construction.
- ... there are more than 700 refineries worldwide (average capacity 140 Kbd). Lurgi's services and technologies for refineries and industrial plants have been used in more than 75 countries and since more than 100 years.
- ... refineries are big consumers of technical gases as O₂, H₂, N₂; the most clear synergy between Lurgi and Air Liquide is that whereas Air Liquide is a "selling gas" company, Lurgi owns the technology and the know-how for the processes that need these gases.





Energy Resources are not mere
Feedstock –

they are the Future



Lurgi's Concept: Independence of Specific Raw Materials and Across-the-Board Technologies Involvement

In this changing context it is important for the energy industry to have a competent partner it can rely on: Lurgi is that partner. In fact, we are in a position to offer essential proprietary technologies across the entire process chain and we integrate licensed technologies of third parties into fuels production complexes to yield products of impeccable quality.

Lurgi knows what it means to enhance an existing plant. Whether basic engineering, FEED engineering or a general revamp is needed, Lurgi provides comprehensive and competent advice as PMC – Project Management Consultancy – is an essential element of our business to ensure project reliability.

We are also aware of biomass as an alternative, regenerative component that can play a major role both today and in future. We are able to supply concepts, technologies and plants for the efficient conversion of biomass into essential products.

Lurgi commands vast experience in fuel production technologies. Thanks to its excellent competence Lurgi is in the best position to apply the conventional refinery technologies for the production and upgrading of synthetic fuels.

The refinery market is undergoing a process of change towards more efficient use of the raw materials which requires the continuous development of new technologies as well as the improvement of already existing ones. The need to fulfill the restrictive regulations in force with regard to sulfur concentrations, e.g. the EuroNorm 5 in Europe, and the approval of a mandatory biofuels additive quota are the driving forces. More efficient processes including the optimal use of the "bottoms of the barrel" to meet the requirements of new or existing plants are our goal.

As a result of increasing energy consumption, global energy demand will almost double until 2050; this implies a future change in raw material needs which will go hand in hand with a shift from almost exclusively oil-based fuel production towards synthetic fuels via synthesis gases. Natural gas, associated gas, coal, heavy residues and biomass will be the feedstock of choice for synthesis gas production.

For the automotive industry synthetic fuels will open up new opportunities for

optimized and highly efficient engines. Synthetic fuels are quasi sulfur-free and will lead to a reduction in greenhouse gases by 40 %. Thus excellent conditions will be created for meeting future emission control requirements.



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

has the resources and technology to make
things happen.



Lurgi's Technology Routes: An Overview

Lurgi possesses technologies and expertise for fuel production starting from all kinds of natural feed-stock containing carbon and hydrogen. Based on this Lurgi can provide concepts for both a conventional refinery and an integrated multi-resource fuel production site.

Conventional Refinery

Conversion technologies and hydrotreatment are the core processes of a conventional refinery and have a long history at Lurgi.

Syngas Route

Lurgi is very well positioned in the production of synthetic fuels via syngas. The corresponding technologies are the result of long-term development and are outstanding. This process line opens the access to high quality fuels, methanol and petrochemicals. New synthetic fuels/designer fuels via methanol are also an option in Lurgi's portfolio.

Fuels via Bio Resources

Bioethanol and Biodiesel/FAME are excellent blending components for gasoline and for diesel, respectively. Lurgi possesses the 1st generation technologies for synthesis from natural sources.

Furthermore Lurgi concepts integrate 2nd generation technologies like hydrogenation of fatty acids or fatty acid esters.

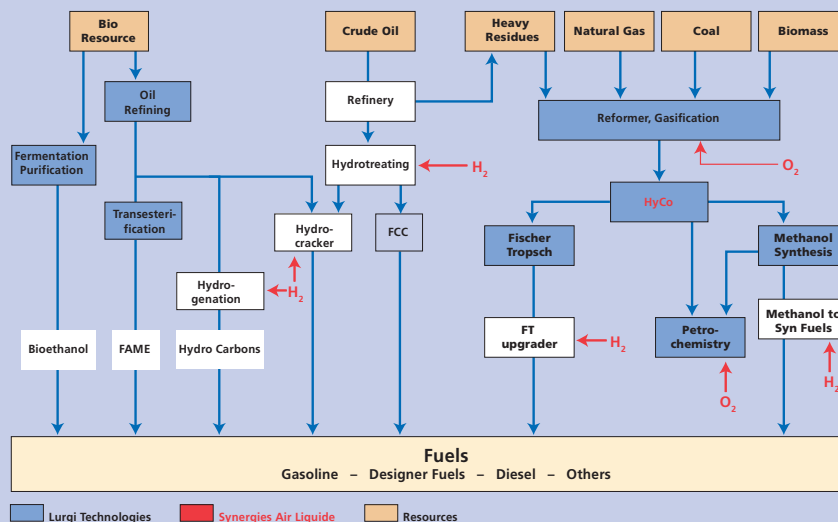
Hydrogen/Oxygen

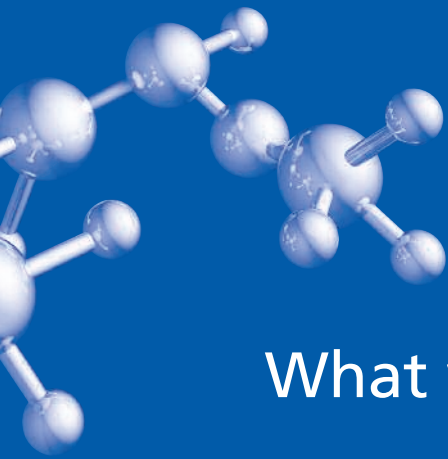
Cost efficient hydrogen/oxygen supply and management are essential for a modern refinery. Lurgi as a member of the Air Liquide Group can make use of excellent competencies in this business.

Purification/Separation Technologies

Appropriate purification/separation technologies are required to achieve all targets in terms of product quality and to meet environmental regulations.

Routes to Liquid Fuels





What we develop today ...

... will allow you to satisfy tomorrow's
demands.



Cutting-edge Technologies will Secure the Future

Lurgi has selectively developed its own proprietary technologies and combines them with complementary processes of others.

Hydrogen

The clients' unit concept will be optimized to meet any requirements for efficient and reliable hydrogen production at the specified purity. Lurgi commands the full range of experience in engineering hydrogen and steam reforming units based on various feedstocks. Natural gas, refinery gases, associated gases, naphtha, LPG or any mixture are used as process feedstock.

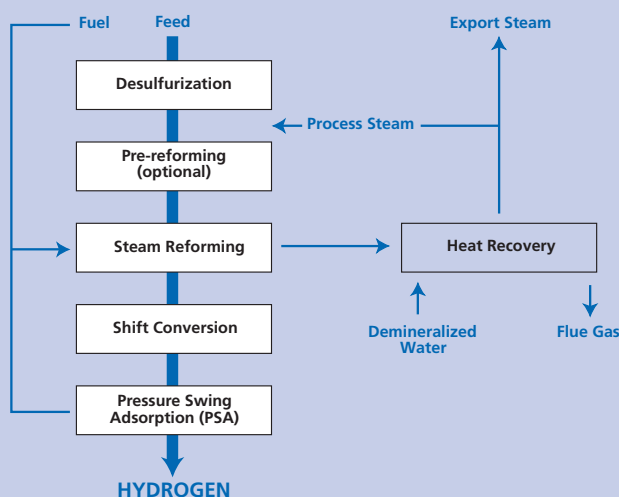
Advanced hydrogen management systems are the key to high unit efficiency and availability. Lurgi steam reforming units feature the most sophisticated control systems that can be found in this sector. They therefore reach exceptionally high on-stream factors.

Multi Purpose Gasification (MPG)

MPG is a mature process for converting refinery residues into clean synthesis gas with minimal environmental impact. Increasingly stringent environmental legislation dictates a reduction in sulfur content and/or the application of expensive flue gas treatment techniques when burning such residual fuels. MPG makes these measures dispensable. The declining demand for residual fuel oil and increasing demand for distillates are pushing refineries to look for alternative conversion processes of the heavy residues. MPG is such an alternative.

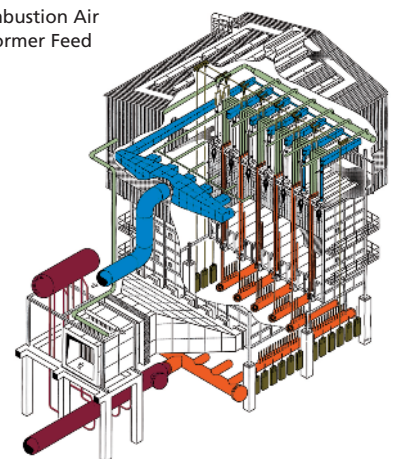
It will digest not only the traditional heavy refinery residues but also all kinds of other liquid and even solids-containing residues and combinations. The process enables the manufacture of a wide range of products including ammonia, methanol, hydrogen, carbon monoxide, oxo-alcohols and fuel gas.

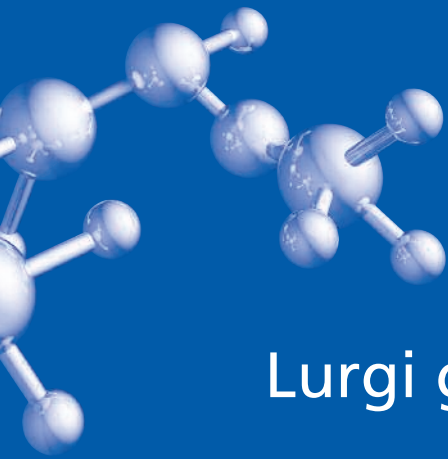
Hydrogen Route



Lurgi Reformer™

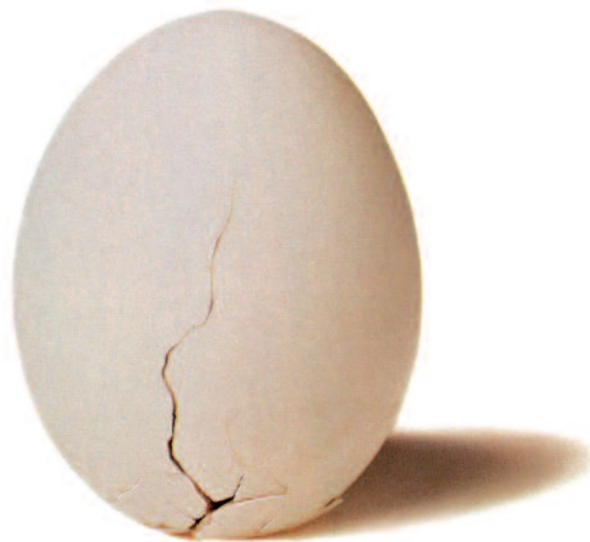
- Steam Generation
- Reformed Gas Collector
- Combustion Air
- Reformer Feed





Lurgi gets cracking: Hydrocracking.

When Lurgi gets cracking, no time or energy is lost.



Lurgi Rectisol® Process for Purifying Syngas

Lurgi's Rectisol process uses refrigerated methanol as the solvent for physical absorption.

The undesired components of the raw syngas, such as CO₂, H₂S, COS and the remaining sulfur compounds, HCN, NH₃, as well as nickel and iron carbonyls are physically absorbed from the raw syngas by the solvent. These components are then desorbed by reducing the pressure of the solvent, stripping and, if required, reboiling the solvent. The absorbed higher hydrocarbons are recovered in an additional extraction stage, if necessary.

The solubility of the different components to be removed varies considerably. This also applies to H₂S and CO₂ and allows selective removal of these components.

Sulfur Management

Lurgi offers sulfur technology ranging from Claus plant, tailgas treatment to sulfur degassing and in-

cineration. The sulfur recovery plants excel by efficiencies of up to 99.9 %. Besides the possibility of marketing the captured sulfur, intelligent sulfur management allows to meet evermore stringent emission control requirements. In the field of Claus and OxyClaus® technologies Lurgi is at the very top worldwide.

Biodiesel

Lurgi offers more than 20 years of experience in the transesterification of oils and fats to methyl esters. Our technology is characterized by a particularly reliable plant concept. In our process plants we refrain from using any centrifuges thereby achieving higher plant availability. High yields and low consumption are the main characteristics of our economic plant design. The glycerin that forms during the transesterification process can be converted to pharmaceutical grade glycerin. Lurgi engineers single-train plants with capacities in the range of 10,000 to 250,000 tons per year.

Conversion and Hydrotreatment

Lurgi can offer its proven experience and expertise combined with licensed technology of third parties. Among others Lurgi's experience in this field covers such key technologies as:

■ Hydrocracking:

Hydrocracking is used for the conversion of heavy hydrocarbons to lighter, cleaner and more valuable products. Sulfur and nitrogen compounds will be removed from the products. The middle distillates obtained are high value products and excellent blending components for the diesel oil pool as well. In addition, hydrogenated products are suitable as feed for ethylene crackers.

■ Fluidized Catalytic Cracking (FCC):

Fluidized catalytic cracking selectively converts hydrocarbon feeds to a variety of products: high octane number gasoline, distillate oils, olefins for alkylation or polymerization and LPG.

■ Hydrotreatment:

Hydrotreating improves the quality of straight run and cracked petroleum fractions ranging from light cuts (naphtha, kerosene, diesel) to vacuum gas oil by removal of sulfur and nitrogen and by hydrogenation of unsaturated compounds. Furthermore, hydrotreating of vacuum distillates with selective dewaxing for producing high grade lube oils.

To ensure future mobility,
we need all types of fuels,

but they must be clean and economic.



Bioethanol

Lurgi's specialist ethanol expertise has been used to plan and build plants from 50,000 to 300,000 t/a, and to expand and optimize existing production facilities. Lurgi is also specialized in the design and construction of plants associated with ethanol co-products and processes including protein extraction, distillers grains or biogas. Our Bioethanol technology is oriented towards a minimum consumption of utilities, in particular of energy and water.

Synthetic Fuels

With its Fischer-Tropsch technology, Lurgi offers a process for generating synthetic fuels from coal (Coal-to-Liquid), biomass (Biomass-to-Liquid) and natural gas (Gas-to-Liquid).

Lurgi's Fischer-Tropsch technology is an ultra-modern process involving a proprietary Fischer-Tropsch catalyst which Lurgi developed together with

StatoilHydro and PetroSA in the framework of the joint venture company GTL.F1 AG with registered office in Zurich and demonstrated in a semi-commercial scale plant which is the world's largest pilot plant of its kind.

Synthetic fuels generated with Lurgi's Fischer-Tropsch technology using biomass, coal and natural gas as feedstocks represent an alternative to petroleum-based fuels and are superior to petroleum-based diesel fuel in terms of combustion properties (high cetane number and high engine efficiency) and environmental compatibility (free from sulfur and aromatics).

Via synergies with Lurgi's technology portfolio it is possible to offer technical one-stop solutions. Lurgi is organized such that all processes from raw materials preparation to product purification can be supplied from a single source.



Lurgi



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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