



Gas-to-Chemicals

Monetize Natural Gas Differently ...
... with Clean Conversion



A good business partner is experienced,
flexible, future oriented

and has the resources and technology
to make things happen.



Lurgi: Experience and vision

These days the decision making process for large petrochemical investments has become particularly difficult having to contend with the volatility of feedstock pricing, financing doubts, fickle end-markets, competitive pressures, environmental considerations and insufficient information. How can one take these leaps and land safely? It is possible, provided you have a strong technological partner that will help you achieve your goals.

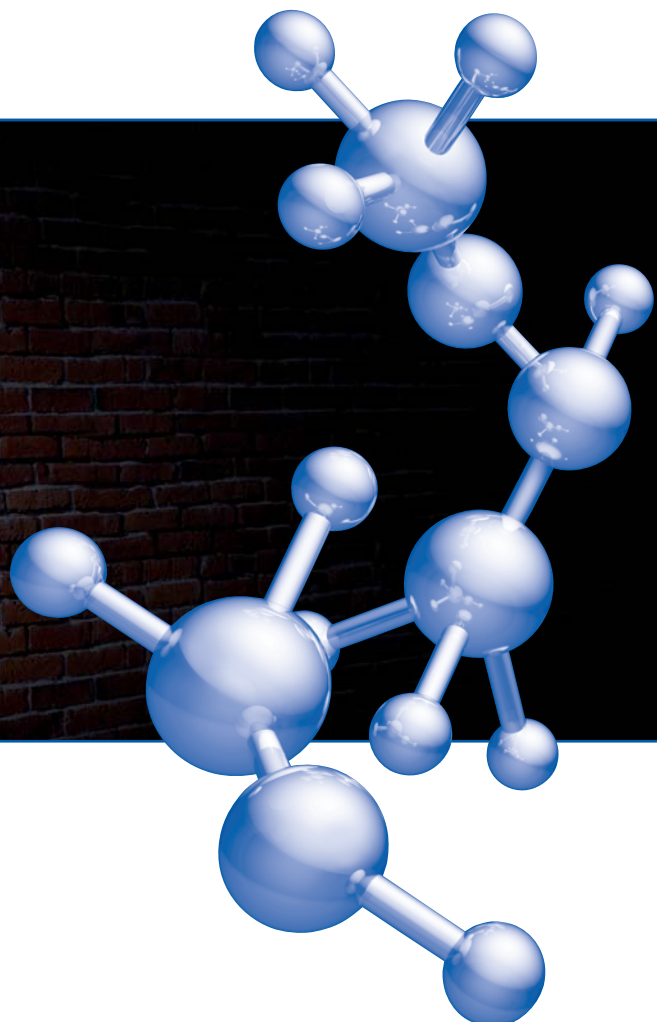
As the market leader in the field of gas-to-chemicals Lurgi knows exactly what is required. Our plants are unmatched in terms of efficiency and longevity. Our innovative technologies and integrated technical solutions set the standards in your business. This makes us a reliable and trusted partner for our clients.

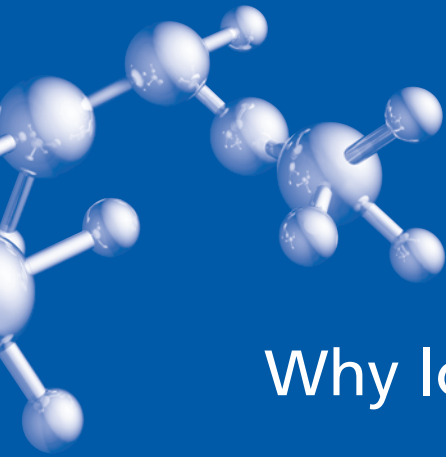
Lurgi is able to offer a competent single-source service in all project phases, i.e. from project devel-

opment through to the turnkey delivery of plants. Our customers receive responsible direct contacts, process reliability and bankable results. It is no sheer coincidence that our experience, technologies and project reliability are decisive factors for your success.

Now, as a member of the AIR LIQUIDE Group, our resources are focused on developing technologically seamless solutions for your projects. You benefit from AIR LIQUIDE's and Lurgi's combined experience and technological developments in the fields of process technology and engineering. These have been honed for at least 100 years in each company and we are renowned as committed and successful technology partners.

Petrochemical plants designed and integrated by Lurgi offer a future well worth your long-term investment.





Why look for new approaches

when we have already built them?



Gas – for large plants “the” alternative amongst many

Tomorrow’s world is characterized by a thirst for raw materials and finished products. Supplying these demands requires individual, tailor made, but economically attractive and environmentally sound process solutions.

Whether natural gas, associated gas, coal gas or biomass gas – these raw materials are invariably processed with a high degree of economy and for specific purposes. The natural gas route has a competitive edge in certain geographies. It is available, clean and flexible.

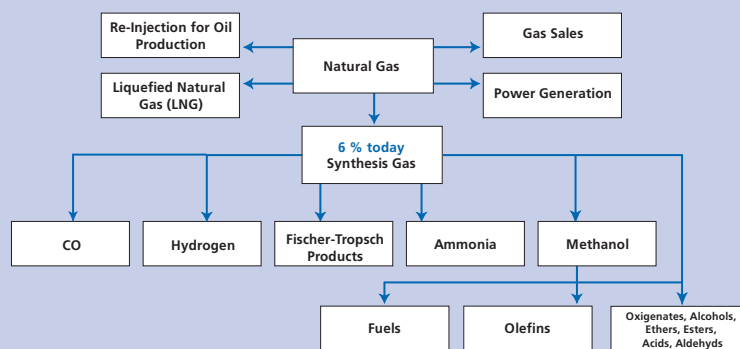
Clean raw material

Natural gas is the cleanest possible feedstock for your methanol and derivative products. Not only is it the easiest to prepare from the well, i.e. removal of sulfur and other contaminants with OmniSulf®, but when compared to higher carbon fossil fuels or coal, it emits significantly less carbon dioxide to the atmosphere.

Clean products

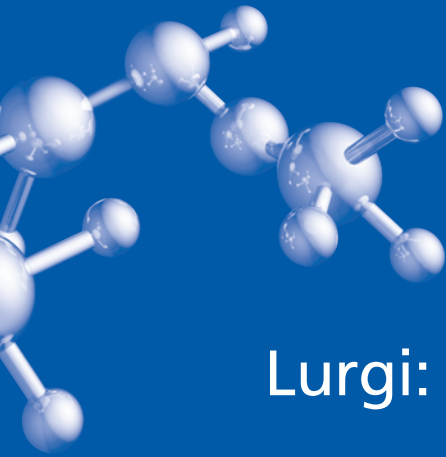
A clean feedstock yields clean products! Methanol from the Lurgi MegaMethanol® and DME (dimethyl ether) from Lurgi MegaDME® processes are free from sulfur, impurities and contaminants enabling broad application, from commodity production to specialty chemicals production to power generation.

Gas to petrochemicals and fuels will rise substantially by 2030



As little as 6 vol. % of natural gas extracted per year (3,100 billion m³) is monetized into the production of petrochemicals and fuels.





Lurgi: A partner with technologies

that reduce risks and increase profits.



More flexibility – more future

The first step on the route from natural gas to petrochemicals is the production of synthesis gas, through to hydrogen and/or carbon monoxide. This key material opens the door to methanol or synthetic fuels production.

One processing step of the synthesis gas – Lurgi MegaMethanol® production – is already economically attractive for conventional markets and its low production cost can also open the gate to new

venues as an environmentally friendly energy carrier for gas and turbine power plants. The downstream processing of methanol can further boost its attractiveness for the production of DME via the Lurgi MegaDME® process and propylene via Lurgi's MTP® process.

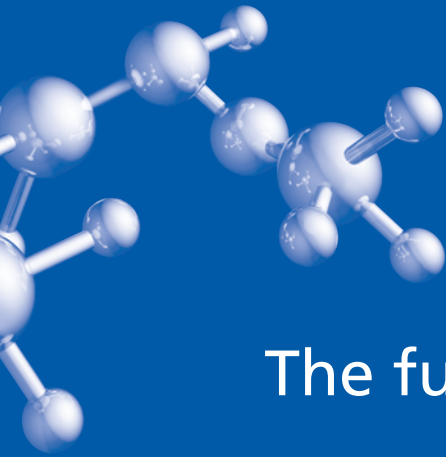
An alternative route via GTL.F1's Fischer-Tropsch synthesis converts synthesis gas to transportation fuels that meet ever stringent environmental and product performance specifications.

The total fuels market was 12,000 MTOE (Million Tonnes of Oil Equivalent) in 2009 and it is expected to increase to 17,000 MTOE by 2030. Oil consumption will rise to 86.4 million barrels per day in 2010 and it is expected to increase to 106 million barrels per day by 2030.

Scarcity of cheap oil resources, growing traffic volume and increasing worldwide prosperity are forcing the energy sector to search for alternative energy sources and new technologies. Energy carriers such as methanol, dimethyl ether or synthetic fuels can be produced on the basis of Lurgi processes at costs competitive to crude pricing.

The plastic market volume is 300 million t/a
Its predicted growth is 5-6 %/a

The plastics market is experiencing steady growth due to improving production processes and new applications. These have displaced traditional materials like paper, wood or metal. Polypropylene demand illustrates the versatility of plastics.



The future needs our attention

and an ideal raw material.



The stuff from which the future is made

Lurgi's gas route processes produce synthesis gas, methanol, DME, propylene and Fischer-Tropsch based synthetic fuels selectively, at a high yield and of excellent quality!

Technology leaps in the abovementioned processes have drastically cut production costs. Technological advancement ensures that your projects remain economically robust and environmentally clean.

■ Synthetic fuel

Lurgi is able to offer optimized gas-to-liquids (GTL) concepts for the production of transportation fuels. These are based on a proprietary Fischer-Tropsch technology developed by its joint venture company, GTL.F1, with PetroSA and StatoilHydro as partners.

■ Methanol

Within the past 10 years, Lurgi has reduced production costs by more than half with the introduction of the Lurgi MegaMethanol® technology!

■ DME

With the Lurgi MegaDME® technology, dimethyl ether can achieve the final breakthrough as an energy carrier, chemical intermediate and transportation fuel.

■ Propylene

Lurgi's Methanol-to-Propylene technology allows the low cost production of propylene. Today, it can be achieved at less than 400 US\$/t when current market prices range between 800 and 1,000 US\$/t!

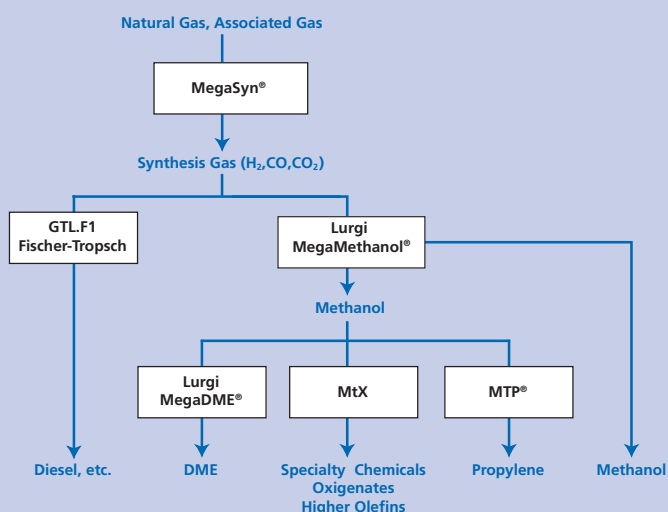
■ Other processes for specialty chemicals

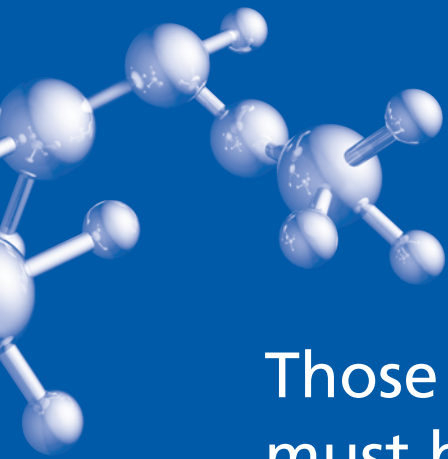
Lurgi is developing new Methanol-to-Product (MtX) routes that will complement the production processes of aromatics and higher olefins.

■ Carbon dioxide

In conjunction with AIR LIQUIDE, Lurgi is developing carbon dioxide reduction and reuse processes, within the perspective of gas to chemicals technologies. Capture and purification technologies are being optimized and business models introduced.

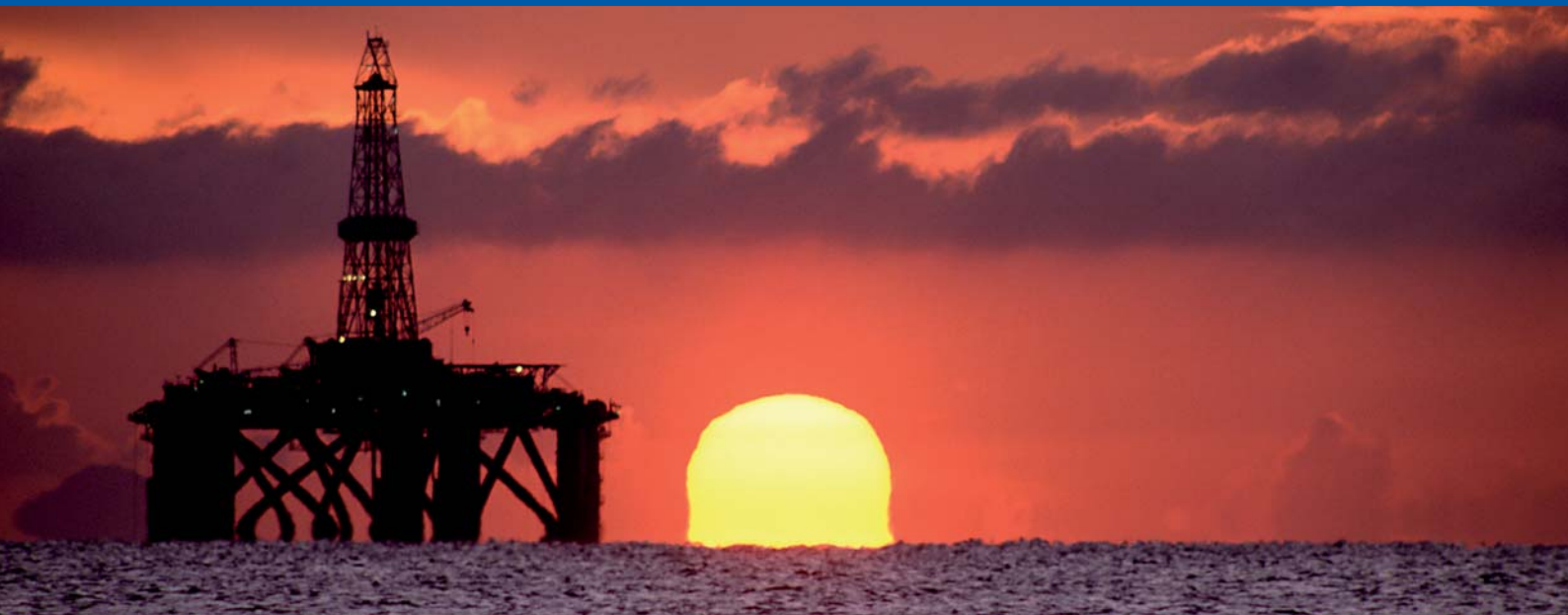
Range of products from gas





Those looking to secure their success
must be open to innovation

and hold fast to reliability.



Take advantage of the economies of scale with Lurgi's Mega technologies.

MegaSyn®

Synthesis gas is the starting material for all downstream syntheses. The specific advantages of the patented Lurgi MegaSyn® process using gaseous feedstocks lie in its high capacity design at low specific capital costs. High production capacity, i.e. up to 1.5 million Nm³/h per train, at high operating pressure is key to MegaSyn's® excellent economics.

Lurgi MegaMethanol®

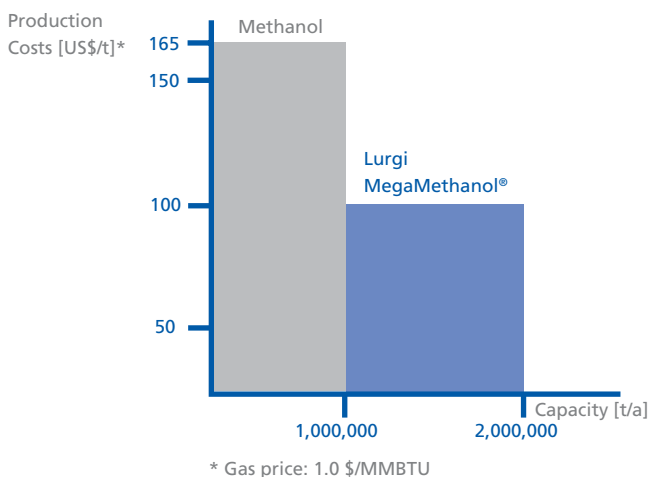
Lurgi has improved the economics of methanol production with the successful implementation of the MegaMethanol technology. At a single train capacity greater than 5,000 t/d, production costs of less than 100 US\$/t can be achieved. Robust and bankable economics enable plant owners to weather competition and economic cycles.

Lurgi's Product Management teams can also help you determine if markets should be entered. New applications, such as power generation or gasoline blending can now be envisioned for geographic markets devoid of fossil fuel resources or requiring energy diversification.

Lurgi MegaDME®

MegaDME® is a readily available technology that supplements LPG production. It is used in countries in deficit of cooking fuels or diesel. It can be fully integrated within the Lurgi MegaMethanol® process or it can also be built independently where market conditions warrant.

Lurgi MegaMethanol®



MegaSyn®

- Natural gas as a flexible raw material source
- Low CO₂ emissions
- High process pressure (80 bar)
- High capacity (800,000 to 1.5 million Nm³/h)
- Low maintenance costs

Lurgi MegaMethanol®

- High flexibility with respect to synthesis gas composition
- High energy efficiency
- Low capital and production costs
- High capacity (more than 2 million t/a)

Lurgi MegaDME®

- Readily available and can be integrated as an extension of Lurgi MegaMethanol®
- Low production cost
- High capacity (up to more than 1.5 million t/a with a single train)





Drive future markets

with the right technology.



Methanol as an energy carrier

Conventionally produced methanol is too expensive to be used in gas turbine power plants. With Lurgi's MegaMethanol® technology this hurdle can be overcome. In certain countries, the addition of methanol into gasoline further diversifies their transport fuel purchases from the vagaries of oil pricing. The benefits of using methanol in either market are:

- Less emissions, be they NO_x, SO_x or CO₂, and
- Simple storage and handling.

Lurgi MegaDME®

DME can be an alternative to or supplement conventional LPG or diesel fuel or it can become a feedstock for power generation in gas turbines or chemicals production. These applications are possible if based on large production facilities that achieve economies of scale and competitive product prices.

DME is:

- An attractive energy carrier, especially as a complement to LPG,

- A high-purity diesel substitute, and
- A flexible chemical feedstock for propylene production.

Methanol-to-Propylene (MTP®)

Lurgi's MTP® technology supplements conventional propylene production to meet market requirements. The process:

- Has a high carbon and energy efficiency,
- Offers distinctly higher yield

Lurgi's technologies and project experience enable you to access attractive new markets in a timely fashion at competitive conditions. Capital costs have been reduced through integrated plant engineering. Operating costs have been optimized through minimization of feedstock, energy consumption and carbon dioxide emissions as well as and by-product recovery and re-utilization.

Nonetheless, these innovative technologies are based on proven processes.

Lurgi has acquired excellent expertise during many years of development, engineering, construction and through customer operation of gas based processing plants. The first Mega plant successfully and reliably went on stream in 2004. Other Mega plants went into operation in 2005, 2008 and 2009. Two more Mega plants are expected to be operational by 2010.

Repeat orders placed by our customers attest to our technologies and expertise.



compared to steam crackers (65 % versus 30 %),

- Uses a simple and stable zeolite catalyst and,
- Has been commercially proven: Two large units are being built in China. Each will produce 470,000 t/a of propylene.

Fischer-Tropsch

Fischer-Tropsch diesel is of superior quality and is a solution to monetize natural gas and

meet stringent diesel fuel specifications. The product has the potential to garner market premiums over conventional diesel.

Fischer-Tropsch naphtha is an excellent feedstock for the petrochemical industry, e.g., boosting ethylene yield on steam crackers by approximately 10 %. Together with our OmniSulf® and MegaSyn® technologies and integrated upgrading unit for Fischer-

Tropsch wax, Lurgi can offer expertise for the complete GTL value chain.

Its features are:

- A low temperature Fischer-Tropsch process based on the proprietary state of the art slurry bubble column reactor and cobalt catalyst and,
- Successful operation in the largest semi-commercial demonstration plant of its kind.

We do not define ourselves in terms of success.

We secure it with more research and development.



A stake in innovative technology with Lurgi processes, ...

Lurgi is continuously developing its gas route technologies. We are investigating ways to further monetize gas via methanol into the production of aromatics and higher olefins.

The latest project in the development pipeline is the High Pressure Partial Oxidation technology (HP-POX) for syngas production.

Engineering integration of Lurgi and AIR LIQUIDE processes, be they cryogenic, adsorption and permeation also bear future successes.

Minimizing energy consumption will continue to be one of our primary objectives; curbing operating costs and carbon dioxide emissions.

... your clean conversion partner



Lurgi



Lurgi is a leading technology company operating worldwide in the fields of process engineering and plant contracting. The strength of Lurgi lies in innovative technologies focusing on customized solutions for growth markets.

The technological leadership is based on proprietary processes and exclusively licensed technologies. Our markets include gas-to-chemicals via synthesis gas, methanol, synthetic fuels, petrochemicals and polymers, refinery technologies and renewable resources.

Lurgi is a member of the Air Liquide Group.

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