Olefins from Syngas – Potential for bio-based applications
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Over 40,000 employees

Operating in 75 countries

Significant expansion in the Middle East, Russia and Asia over the last 5 years

Sales: € 11.98 billion

Net profit: € 1.23 billion

Approx. 30 % of Turn over associated with:
- Refinery
- Chemicals
- Metals
Lurgi is looking back on a 113 years history

- Lurgi was founded in **1897**
- Lurgi has a strong brand in the **worldwide** process industry
- 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 of the future** focussing on customized solutions for growing markets.
- The **technological leadership** is based mainly on proprietary technologies.
- Lurgi employs more than **1500** high qualified people worldwide.
Key challenge of today’s society: Supply fuels and chemicals in a sustainable manner

A balanced utilisation of various feed-stock material is the key to achieve today’s sustainability targets

Today’s question: What is the contribution of biomass in the context of “sustainable” chemistry focusing on the production of olefins
1. Excess capacity may peak at around 29 mmt in 2011-2013 and then gradually reduce to around 18 mmt by 2015
Propylene: Demand is driven by PP

Source: Lurgi Strategic Marketing June 2010, World Chemical Industry 2010, Fujian C.
Propylene: Shift in production technology

1. Excess of ethylene and new olefin conversion technologies may impact the supply situation significantly.
2. No clear prediction how the propylene gap will be closed.

Global Additional Demand 2008-2015: 34 Mt
Average annual growth rate (AAGR): ~ 4.5%
Additional supply from FCC = 13 MT

Source: Petrotech – India 2009
Options for bio-based olefin production

- Bio-Ethanol to Ethylene
  - Dehydration as conversion process
  - Reality in Brazil (due to low cost Bio-EtOH and growing ethylene demand)

- (Bio)-Syngas to higher olefins (via higher alcohols)

- (Bio)-Syngas to olefins (BASF-development)

- (Bio)-Syngas to light olefins through methanol
  1. Propylene and Ethylene (MTO)
  2. Propylene (MTP)

- Conversion of “bio-based” platform chemicals (C₅ – C₆)
One potential scenario:
Syngas & MeOH – the flexible dream team

Coal
Natural Gas
BioMass
Tar Sands etc.

Challenged by syngas generation and economy of scale

Chemicals
Propylene
DME
Fuels

Syngas

Methanol
Under implementation:

MTP® = Methanol to Propylene

1.667 Mt/a = 5000 t/d

Methanol

DME Pre-Reactor

Olefin Recycle

Water Recycle

MTP Reactors

(2 operating + 1 regenerating)

Fuel Gas

internal use

optional

Ethylene

20 kt/a

Propylene

474 kt/a

LPG

41 kt/a

Gasoline

185 kt/a

Process Water 935 kt/a

for internal use

1) Propylene Purity 99.6 wt. %
MTP® Process

Scale-Up

1st Pilot Plant  2nd Pilot Plant  Demo Unit at Statoil  Commercial Plant
MTP® Process

Polymer-Grade Quality

Polymerization Tests of MTP® propylene (at Borealis / Norway)

- MTP® propylene is of polymer-grade quality
- MTP® PP identical to standard PP

first PP cup made entirely from natural gas

31.03.03

15.05.03
In China: “CTP”

Methanol to Propylene to Polypropylene Complex based on 3-train coal gasification

EPC 2008
The challenge of biomass utilisation
“Energy density”

Energy density [GJ/m³]

Transportation Radius

- Straw: 1.5 (90%)
- Slurry: 20 (50%)
- Diesel: 36

Regional intermediate energy source

- 25 - 75 km
- 250 - 500 km (rail/barge)

Central syngas and fuel production

Pyrolysis/ Torrefaction
- • Entrained Flow
- • Fischer-Tropsch
- • MeOH

- Utilise the whole plant, not only the fruits (wood chips and straw, ...)
- BTL: Intermediate & supplementary step
- Economy of scale is limited by logistics
How to deliver the syngas: bioliq®: „The thermo / chemical route“

bioliq®-Process: Joint Development by FZK *) / Lurgi and sponsored by FNR*)

- How to deliver the syngas: bioliq®: „The thermo / chemical route“
- Fast Pyrolysis
- High Temp. Gasification
- Gas Cleaning
- Methanol
- Fischer Tropsch
- Decentralized Bio Syncrude Production
- Preferably from agricultural by products / energy plants
- Centralized Synfuels Production
- Storage & Transport
- CO₂ Removal in Rectisol wash: Negative CO₂ concept for biomass utilisation
- H₂S CO₂
- Chemicals / Synfuels
- Synfuels
- -SNG;
- -DME;
- -Hydrogen
- -Green Power
- *) FZK: Forschungszentrum Karlsruhe
- **) FNR: Fachagentur für Nachwachsende Rohstoffe
For the production of olefins from bio-based resources several routes are under development / implementation, i.e. they can be produced *in principle* from biomass.

As bulk olefin production is driven by economy of scale, bio-based processes might be constrained by logistics.

The production of specialty olefins from bio-based platform chemicals would allow full utilisation of the organic structures already synthesised by nature.
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