BASF Antwerp: Chemical Verbund production in the heart of Europe

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BASF’s Verbund site Antwerp

- ... is the second-largest Verbund site of BASF
- ... has competitive advantages through unique Verbund site integration
- ... is continuously improving cost structures by technological and operational excellence
- ... has lean and reliable logistics
- ... supplies into growth markets
1 | BASF’s Antwerp site at a glance
2 | Leveraging Verbund advantages
3 | Positioned for further growth
Global Verbund sites of BASF

Antwerp is BASF’s second-largest Verbund site
BASF Antwerp – Ideally located in the heart of Europe
The Benelux chemical cluster
BASF Antwerp: Supplier and customers at arm’s length

Shell
Shin-Etsu
LyondellBasell
Dow
Exxon Mobil
Huntsman
LyondellBasell
Dow
Bayer
Lanxess
Borealis
Ineos
Total
BP Chemical
Versalis

Exxon Mobil
Shell
ELLBA
Ineos
Exxon Mobil
Sabic
Celanese
Borealis
Ineos
Dow
Solvay/SolVin

Propylene pipeline
Ethylene pipeline
# BASF Verbund site Antwerp at a glance

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>~€7 billion in 2014</td>
</tr>
<tr>
<td>Site area</td>
<td>6 km²</td>
</tr>
<tr>
<td>Production facilities</td>
<td>more than 50 production plants</td>
</tr>
<tr>
<td>Investments*</td>
<td>~€150 million/a</td>
</tr>
<tr>
<td>Sales volumes</td>
<td>7.6 million metric tons</td>
</tr>
<tr>
<td>Volume handled</td>
<td>15 million metric tons</td>
</tr>
<tr>
<td>Employees BASF</td>
<td>~3,100</td>
</tr>
</tbody>
</table>
Safety first
Maintain focus on safe behavior

LTI frequency rate*

*Lost Time Injuries (LTI) per 1 million hours worked

Industry Belgium*

Chemical industry Belgium*

VIBNA**

BASF site Antwerp***

BASF Antwerp: Good safety track-record versus industry benchmarks

* As from 2005, based on data from Fund of Occupational Accidents.
** VIBNA: Association of Industrial Companies in Northern Antwerp.
*** As from 2011, including Styrolution Belgium N.V. and EuroChem Antwerpen N.V.
Antwerp’s contribution to BASF segments
Involved in BASF’s core chemical activities

- Chemicals
  - Petrochemicals
  - Monomers
  - Intermediates
- Performance Products
  - Care Chemicals
  - Performance Chemicals
  - Dispersions & Pigments
  - Nutrition & Health
- Functional Materials & Solutions
  - Performance Materials
  - Construction Chemicals
  - Coatings
  - Catalysts
- Agricultural Solutions
  - Crop Protection
- Oil & Gas
  - Oil & Gas

Antwerp
Antwerp’s contribution to BASF segments

Key products

**Chemicals**
- Petrochemicals
  - Ethylene
  - Propylene
  - Benzene
  - Acrylic acid
- Monomers
  - MDI
  - Ammonia
  - Caprolactam
- Intermediates
  - Amines
  - Formaldehyde

**Performance Products**
- Care Chemicals
  - Superabsorbents
  - Surfactants
-性能化学品
  - Polyisobutylene

**Functional Materials & Solutions**
- Performance Materials
  - Polyether polyols

**Agricultural Solutions**

**Oil & Gas**

BASF Investor Visit Antwerp, June 24, 2015
Contribution to BASF Group sales 2014

BASF Antwerp generates about 1/10 of BASF Group 3rd party sales

- Antwerp: ~€7 bn (9%)
- Rest of BASF: 91% (~€74 bn*)

Sales in € million

- Chemicals
- Performance Products
- Functional Materials & Solutions
- Other

* Incl. Oil and Gas and Agricultural Solutions.
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We add value as one company
Production Verbund – What is it?
A unique concept and competitive advantage of BASF

- The Verbund is all about intelligent interlinking of production plants, energy flows and infrastructure
- It allows BASF to reduce its raw material and energy use
- >€1 billion of global annual cost savings through Verbund
Verbund Simulation
Verbund means efficiency and flexibility – if steered intelligently

Verbund simulator enables
- Optimized operations
- Efficient utilization of assets
- Management of value chains

Verbund proved flexible in 2008 / 2009 crisis
- Capacity reductions
- Flexible placement of people
- Retained profitability
- Flying start out of the crisis

Verbund does allow for portfolio changes
- e.g. fertilizers, styrenics

Demand forecast along BASF value chains

Optimized production plan management
Verbund generates >€1 bn p.a. global cost savings*, supports sustainability
A competitive advantage of BASF

- **Energy Verbund**: >€300 million annual cost savings globally
- **Logistics Verbund**: >€600 million annual cost savings globally
- **Infrastructure Verbund**: >€100 million annual cost savings globally

BASF Antwerp
- Production of 80% of the entire energy demand from processes. Reduction of 2.4 million metric tons of CO₂
- Combi terminal saves 150,000 truck loads (equalling 300,000 metric tons of CO₂)
- Shared use of on-site facilities (e.g. fire department, security, waste water treatment)

* Savings include only tangible synergies.
BASF Antwerp – Energy Verbund
State-of-the-art energy efficiency

Verbund of energy-producing and energy-consuming processes reduces net energy demand
BASF Antwerp – Logistics Verbund
Reliable and lean logistics

Road
12%

Train
3%

Ship
56%

Pipeline
29%

15 million metric tons*

Continuously improving logistics:
Costs, reliability, lead time, sustainability

* Volume handled in/out 2014
BASF Antwerp – Infrastructure Verbund
Effective use of common infrastructure

Cost savings through joint use of infrastructure and utilities
Most of the cracker output in Antwerp is used for downstream value capture

Cracker products
- Ethylene
- Propylene
- Butadiene
- Raffinates
- Benzene

Value chains of the BASF Verbund

Merchant Market
Verbund site Antwerp – Key value chains
Creating synergies along the value chain

Steamcracker

Ethylene

- Ethylene oxide
  - Ethylene glycol
  - Surfactants
  - Ethanol amine
  - Ethylene amine

Propylene

- Acrylic acid
  - Acrylates
  - Pure acrylic acid
  - Superabsorbents

Benzene

- Nitrobenzene
  - Nitric acid
- Aniline
  - Hydrogen
  - Formaldehyde
  - MDI
  - Phosgene
MDI – Key value chain
Integrated world-scale plant

MDI (Methylene diphenyl diisocyanate) + Polyether polyols = Rigid & microcellular polyurethane foams

MDI is mainly used captively; further value capture by BASF polyurethane systems
MDI – Product applications
Supplying into growth markets

Key facts
- MDI demand expected to grow significant above GDP (2013-2020)
- Growth driven by:
  - Increasing demand for energy efficiency
  - Increasing standard of living (e.g. footwear, furniture, performance textiles)
  - Transportation and construction
MDI production – Cost excellence
Continuous process improvements in MDI

Increased real capacity by incremental process innovations

Process improvement program MDI/Antwerp

- Target:
  - Increase production output by continuous process improvement via incremental steps
  
- Expected benefits:
  - Increased sales
  - Production cost* reduction

Annual EBIT improvement: ~ €50 million/a

* Production cost = Personnel, maintenance and energy cost (inflation-adjusted).
MDI production – Cost excellence
Continuous process improvements in MDI

Strong increase of production output in the last decade

Process improvement program 2000-2013
MDI/Antwerp
- Target:
  - Increase production output by continuous process improvement via incremental steps
- Achieved benefits:
  - Increased sales
  - Production cost* reduction

Measures implemented since 2000 have led to an EBIT improvement of now >€200 million/a

* Production cost = Personnel, maintenance and energy cost (inflation-adjusted).
Acrylic acid – Key value chain
Value chain contributes cash flow of approx. €1 billion*

Each value chain step represents a potential merchant market outlet

* BASF Group 2012.
Acrylic acid – Product applications
Supplying into growth markets

Key facts

- Acrylic acid demand expected to grow above GDP (2013-2020)
- Growth driven by emerging markets; rising middle class leads to increased demand for diapers, coatings & paints, adhesives, construction, textiles

About 2/3 of BASF’s acrylic acid is used captively
Acrylic acid – Technology
Leveraging the BASF technology Verbund

Focused R&D to continuously improve acrylic acid process

- Highly selective and efficient process catalysts
- Proprietary technology for new process
  - Higher yield
  - Lower energy consumption
  - Lower investment costs
- In addition, four radically new processes being investigated in research; one based on renewable raw materials
Acrylic acid – Cost excellence
Leading technology strengthens profitability

Acrylic acid production technology benchmark
Industry average costs = 100; normalized

BASF with best-in-class acrylic acid process

Continuous improvement productivity
-
- Smart capacity increase by run-time extension and higher throughput
-
- Innovation and improvement ideas come from all production sites and are quickly implemented

BASF Investor Visit Antwerp, June 24, 2015  Source: BASF estimate.
BASF Antwerp – Hydrogen peroxide-based propylene oxide plant
First world-scale HPPO plant*

Propylene oxide production without any by-products, except water

* Partnership between BASF, Solvay and Dow Chemicals
Butadiene extraction plant
Successful startup September 2014

Key facts

- Production capacity of 155,000 metric tons p.a.
- Strengthening of Antwerp Verbund site
- Securing BASF’s internal supply of butadiene in Europe
- Taking advantage of merchant market opportunities
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► … is positioned for further growth
150 years

BASF

We create chemistry