Market Study: Propylene

(2nd edition)
Propylene is the second most important petrochemical feedstock: About 85 million tonnes of propylene were processed worldwide in 2013. Direct applications include besides the plastic polypropylene important chemicals such as propylene oxide, acrylonitrile, cumene, butyraldehyde, and acrylic acid. With this new market study, Ceresana offers transparency regarding the entire global market for propylene and propylene-derived products. It analyses important recent influential factors, e.g. the consequences of the shale gas boom in the USA and the increase of capacities in China.

**Stabilization of Prices**

A large share of global propylene output originates as by-product of ethylene manufacturing using steam cracking or is produced using catalytic cracking in refineries. As a result of an increasing use of ethane, steam crackers produce more ethylene and less propylene. But thanks to a more widespread use of on-purpose technologies, the supply situation on the propylene market is likely to relax. This development leads to a stabilization of prices for propylene. Worldwide revenues generated with propylene are expected to increase by 5.3% p.a. between 2013 and 2021, and thus at lower growth rates than in the previous eight years.

**Higher Production Potential by Propane Dehydrogenation**

The most important of the on-purpose technologies for the production of propylene is the dehydrogenation of propane (PDH technology). Given an increasing price differential between propylene and propane, this technology is becoming more profitable not only in countries with extensive gas resources. Both the USA and China will put several PDH plants on stream. Production potential for propylene will rise accordingly.

**Regional Differences in Supply Development**

Supported by the new PDH plants, propylene production in North America will rise significantly in the future after output fell between 2005 and 2013. The highest growth rates, on the other hand, we forecast for Eastern Europe, where development will be dominated by Russia, and the Middle East. Western Europe, however, will suffer the combined effects of increasing international pricing pressure and weak demand development: Ceresana is expecting a reduction of capacities and hence a decline of production volume.

**Increase of Output Independent of Crude Oil in China**

As a result of the limited Chinese crude oil resource, manufacturers of propylene are dependent on imports. Output of non-crude oil based propylene products is to be increased considerably in the future. In order to achieve this goal, new CTO (coal to olefins) and PDH plants will be put on stream. According to analyses of Ceresana, Chinese production will thus increase by up to 8% p.a. in upcoming years. Due to a rapid surge of demand, however, China will continue to import large amounts of propylene.

**Polypropylene (PP) Determining Demand for Propylene**

The by far largest share of global propylene output, about two thirds, is processed into polypropylene. Demand for this plastic is projected to increase by 3.7% p.a. until 2021 and will therefore dominate demand development on the propylene market. PP is one of the most versatile packaging materials. Other applications include fibers, textiles, vehicle parts, electrical devices and household goods.
Market Data

1.1 World
1.1.1 Demand
1.1.2 Revenues
1.1.3 Production and Capacities

1.2 Western Europe
1.3 Eastern Europe
1.4 North America
1.5 South America
1.6 Asia-Pacific
1.7 Middle East
1.8 Africa

Country Profiles

2.1 Western Europe
2.1.1 Austria
2.1.1.1 Demand and revenues
2.1.1.2 Production, capacities, and trade
2.1.2 Belgium
2.1.3 France
2.1.4 Germany
2.1.5 Italy
2.1.6 Spain
2.1.7 The Netherlands
2.1.8 United Kingdom
2.1.9 Rest of Western Europe

2.2 Eastern Europe
2.2.1 Czechia
2.2.2 Hungary
2.2.3 Poland
2.2.4 Russia
2.2.5 Turkey
2.2.6 Rest of Eastern Europe

2.3 North America
2.3.1 Canada and Mexico
2.3.2 USA

Chapter 1: Extensive market data for 7 regions and the world from 2005 to 2021:
- Demand
- Revenues
- Production
- Capacities

1.1.3 World – Production

At an AAGR of X%, worldwide production of propylene rose from X million tonnes in 2005 to a volume of X million tonnes in 2013. About X% of all propylene brought into circulation in 2013 was manufactured in Asia-Pacific; this region produced X million tonnes that year. Second largest producer was North America, followed by Western Europe.

We forecast that the on-purpose production of propylene will become much more important in the future. The most important role will be played by dehydrogenation of propane. Within the next few years, several countries, among them the USA and China, will put production plants based on this technology on stream. Production potential for propylene will rise accordingly.

The highest growth rate for the 2013 to 2021 period we forecast for Eastern Europe, but this is partly due to the currently rather low market volume. Asian-Pacific output is expected to rise by X% p.a. to approx. X million tonnes in 2021; hence, this region will gain further market shares.

Graph: Worldwide production of propylene between 2005 and 2021 in million tonnes

1.6.2 Asia-Pacific – Revenues

In 2013, Asia-Pacific processed about X million tonnes of propylene. Since 2005, market volume rose at an AAGR of X%. This region was the worldwide largest consumer of propylene in 2013.

Compared to other regions, we expect the Asian-Pacific market to continue to develop at high growth rates. We forecast demand for propylene to increase by X% p.a. between 2013 and 2021 and to amount to approx. X million tonnes at the end of this period. China is the largest individual market in this region; in 2013, its market volume of X million tonnes accounted for almost X% of total regional demand.

About US$X billion were generated with the sale of propylene in Asia-Pacific in 2013. We forecast the market value in this region to increase by, on average, X% p.a. to approx. US$X billion in 2021.

Graph: Revenues generated with propylene in Asia-Pacific from 2005 to 2021 in billion US$ and billion €

Chapter 1: Extensive market data for 7 regions and the world from 2005 to 2021:
- Western Europe
- Eastern Europe
- North America
- South America
- Asia-Pacific
- Middle East
- Africa
2.4 South America
2.4.1 Argentina
2.4.2 Brazil
2.4.3 Colombia
2.4.4 Rest of South America

2.5 Asia-Pacific
2.5.1 China
2.5.2 India
2.5.3 Indonesia
2.5.4 Japan
2.5.5 Malaysia
2.5.6 Taiwan
2.5.7 Thailand
2.5.8 Singapore
2.5.9 South Korea
2.5.10 Rest of Asia-Pacific

2.6 Middle East
2.6.1 Iran
2.6.2 Saudi Arabia
2.6.3 Rest of Middle East

2.7 Africa
2.7.1 South Africa
2.7.2 Rest of Africa

3 Applications
3.1 World
3.1.1 Polypropylene
3.1.2 Propylene oxide
3.1.3 Acrylonitrile
3.1.4 Butyraldehyde
3.1.5 Cumene
3.1.6 Acrylic acid
3.1.7 Other applications

3.2 Western Europe

3.3 Eastern Europe

3.4 North America

3.5 South America

3.6 Asia-Pacific

3.7 Middle East

3.8 Africa

2.4.2 Brazil

2.5.1 China

3.4 Applications – North America

North American demand for propylene rose to X million tonnes in 2013. Almost half of this amount, X million tonnes, were processed into PP. The production of propylene oxide consumed the second largest amount, followed by the segments acrylonitrile and cumene.

Chapter 2: Specific analyses and forecasts for 29 countries:
- Demand
- Production
- Trade
- Revenues
- Applications for propylene
- Existing and future capacities

Chapter 4: Detailed data on regional demand for propylene in:
- Polypropylene
- Propylene oxide
- Acrylonitrile
- Cumene
- Acrylic acid
- Butyraldehyde
- Other applications

We forecast demand on the part of producers of PP and propylene oxide to increase at above average growth rates. Consumption of propylene will rise by X% and X% p.a. respectively until 2021. An only low increase of about X% p.a. is expected for butyraldehyde. We forecast total demand to increase by, on average, X% p.a. in the upcoming eight year period. Accordingly, market volume will amount to approx. X tonnes of propylene in 2021.
4 Company Profiles

4.1 Western Europe
4.1.1 Austria (1 Producer)
4.1.2 Belgium (1)
4.1.3 France (2)
4.1.4 Germany (2)
4.1.5 Italy (1)
4.1.6 Spain (3)
4.1.7 Switzerland (1)
4.1.8 The Netherlands (2)
4.1.9 United Kingdom (1)

4.2 Eastern Europe
4.2.1 Hungary (1)
4.2.2 Poland (1)
4.2.3 Russia (6)
4.2.4 Serbia (1)
4.2.5 Turkey (1)

4.3 North America
4.3.1 Mexico (1)
4.3.2 USA (15)

4.4 South America
4.4.1 Brazil (2)
4.4.2 Colombia (1)
4.4.3 Venezuela (1)

4.5 Asia-Pacific
4.5.1 China (24)
4.5.2 India (9)
4.5.3 Indonesia (2)
4.5.4 Japan (8)
4.5.5 Malaysia (1)
4.5.6 South Korea (8)
4.5.7 Taiwan (2)
4.5.8 Thailand (2)
4.5.9 The Philippines (1)

4.6 Middle East
4.6.1 Azerbaijan (1)
4.6.2 Iran (1)
4.6.3 Israel (1)
4.6.4 Kazakhstan (1)
4.6.5 Kuwait (3)
4.6.6 Qatar (1)
4.6.7 Saudi Arabia (9)
4.6.8 United Arab Emirates (1)

4.7 Africa
4.7.1 Algeria (1)
4.7.2 Egypt (1)
4.7.3 Libya (1)
4.7.4 Nigeria (1)
4.7.5 South Africa (1)

5.1.4 Germany

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Financial Key Data
(in billion €)

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<th>Year</th>
<th>Turnover</th>
<th>Profit</th>
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<tbody>
<tr>
<td>2010</td>
<td>63.9</td>
<td>4.56</td>
</tr>
<tr>
<td>2011</td>
<td>73.5</td>
<td>6.19</td>
</tr>
<tr>
<td>2012</td>
<td>72.1</td>
<td>4.82</td>
</tr>
<tr>
<td>2013</td>
<td>74.0</td>
<td>4.84</td>
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General information about the company

Divisions, Product Range
- Chemicals: intermediates, mono- and di-olefins, ethylene, aromatics
- Performance products: dispersions & pigments, care chemicals, paper chemicals, performance chemicals
- Functional materials & solutions: catalysts, construction chemicals, performance materials, coatings
- Agriculture: crop protection
- Oil and gas

Profile Summary
BASF is the world’s leading chemical company. Its portfolio ranges from chemicals, plastics, performance products and agricultural products to oil and gas.

At the end of 2013, the company employed 112,206 people. The enterprise is listed on the stock exchanges in Frankfurt (BAS), London (BFA) and Zurich (AN). BASF was founded in 1865 in Mannheim and holds interests in more than 300 subsidiaries and affiliated companies.

Chapter 4: In-depth profiles for the world’s largest manufacturers, including BASF, Braskem, Enterprise Products, ExxonMobil, Formosa Plastics, LyondellBasell, Reliance Industries, Shell, Sinopec, Total and Valero Energy. (The profiles are assigned to the country in which the company is headquartered and include JVs and subsidiaries.)

Chapter 4: Data and facts on major producers, clearly arranged by:
- Contact details
- Turnover and profit
- Production sites including current and future capacities
- Profile summary
- Product details

Specific information about Propylene

Product Details
Because of cheap US gas, the joint venture company BASF Fina converts its naphtha based cracker into mixed cracker that also can use ethane, butane and propane as feedstock. In 2014, about 85% of the site was able to profit from cheap feedstock.

The PropanChem joint venture with Sonatrach imports propane from Algeria to process in its PDH unit. The obtained propylene is delivered to Basell Poliolefinas’s PP plants. Both the Antwerp and Ludwigshafen crackers and as well the BASF-YPC joint venture are using naphtha as feedstock.

Associated Companies
- Subsidiary: BASF Antwerpen N.V.
- Joint venture:
  - XXX
  - BASF SE (60%) and XXX (40%)
  - BASF SE (51%) and XXX (49%)
  - BASF SE (50%) and XXX (50%)

Site / Plant – Propylene (current)

<table>
<thead>
<tr>
<th>Site / Plant</th>
<th>Capacity (tonnes/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antwerp, Belgium</td>
<td>XXX</td>
</tr>
<tr>
<td>XXX</td>
<td>(00% of XXX)</td>
</tr>
<tr>
<td>XXX</td>
<td>(00% of XXX)</td>
</tr>
<tr>
<td>XXX</td>
<td>(00% of XXX)</td>
</tr>
<tr>
<td>Total Capacity (current)</td>
<td>XXX</td>
</tr>
</tbody>
</table>
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Adhesives - Europe  Plastic Containers - Europe
Adhesives - World Plastic Extrusion - World
Antioxidants - World Plastic Films - Europe
Automotive Coatings - World Plastic Films - World
Automotive Plastics - World Plastic Injection - World
Bags & Sacks - Europe Plastic Pipes - Europe
Bags & Sacks - World Plastic Pipes - World
Biocides - World Plastic Windows - World
Bioplastics - World Plasticizers - World
Bitumen - Europe Plastics - Europe
Butadiene - World Plastics - World
Butadiene Rubber (BR) - World Polyamide (PA6 & PA66) - World
Caps & Closures - Europe Polyethylene (HDPE) - World
Carbon Black - World Polyethylene (LDPE) - World
Catalysts - World Polyethylene (LLDPE) - World
Chelating Agents - World Polyethylene (PE) Pipes - World
Composites (CFRP & GFRP) - World Polypropylene - World
Construction Plastics - World Polystyrene - World
Corrugated/Solid Board/Carton - Europe Polystyrene & Expandable PS - World
Engineering Plastics - World Polyurethanes & Isocyanates - World
Ethylene - World Polyvinyl Chloride (PVC) - World
Expandable Polystyrene - World Printing Inks - Europe
Fillers - Europe Printing Inks - World
Fillers - World Propylene - World
Flame Retardants - World PUR - Adhesives & Sealants - World
Flexible Packaging - Europe PUR - Paints & Coatings - World
Food Packaging - Europe PVC Pipes - World
Hydrofluoric Acid & Fluorochem. - World Rigid Metal Packaging - Europe
Insulation Material - Europe Rigid Plastic Packaging - World
Insulation Material - World Silicones - World
Labels - Europe Solvents - World
Masterbatches - World Stabilizers - World
Paints & Varnishes - World Styrene - World
Paints & Varnishes - World Styrene-Butadiene Rubber (SBR) - World
Pigments - World Surfactants - World
Pipes - Europe Synthetic Rubber - World
Plastic Additives - World Thermoplastic Elastomers - World
Plastic Bottles - Europe Titanium Dioxide - World
Plastic Caps & Closures - Europe Windows & Doors - Europe
Plastic Caps & Closures - World