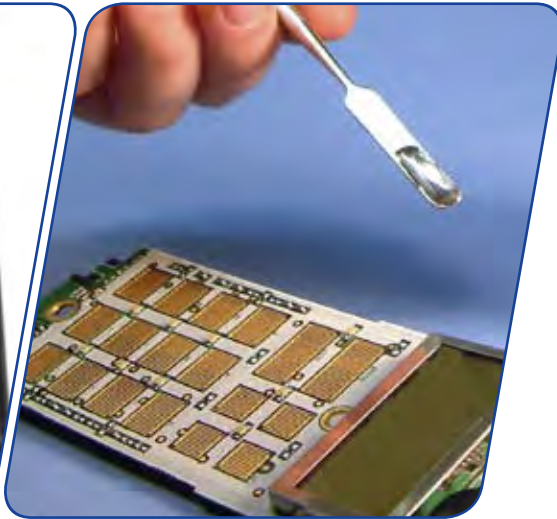


Market Study: Silicones

(2nd edition)



Dear readers,

Nowadays, information is available at the push of a button, always, and in overwhelming amounts. But what is the best way to find the crucial data amongst all that information? That is why several thousand companies use the knowledge of our employees. Based on their extensive experience, they provide decisive data for the benefit of their customers. The clearly arranged and practice-oriented studies of Ceresana offer precise analyses and well-founded forecasts - also for your markets!

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Yours faithfully, Oliver Kutsch

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- **Gain new customers**
Our studies show who potential new customers are and where you can find them
- **Locate new procurement markets**
Recognize better or alternative sources of supply
- **Improve your understanding of your competitors**
Who exactly are your competitors - and what are their strengths and weaknesses
- **Obtain a more detailed picture of your segment**
Learn which time is the best for entering or leaving a market
- **Have a look at the future**
Find out if new investments and technologies are worthwhile and how to gain access to future markets. We also show possible market scenarios
- **Recognize opportunities and risks**
Identify opportunities & risks on your target markets in time

This study is useful for:

- Producers, traders, and processors of silicones
- Companies of the industries: Construction, automotive, E&E, medical technology, cosmetics, textiles, paper, chemicals, plastics, and engineering
- Associations and institutes
- Executive board, technology and production, strategic planning, R&D, market research, marketing, sales and distribution, procurement

In this brochure you will find the following information:

- An introduction on page 3
- A summary of the table of contents on page 4
- Following this, there are example pages from the study
- Please use the form on the last page to easily order your study or a free reading sample!

Silicones are indispensable in many industries. These plastics are used for various products, from pacifiers to computer keyboards. Based on quartz sand via the production of silicon metal, complex chemical processes yield a wide variety of different silicone compounds. The most important ones are silicone elastomers, silicone oils and silicone resins. Application areas are construction, automotive, electrical and electronics, medical technology, cosmetics, textiles, and paper. The market research institute Ceresana analyzed this lucrative, rapidly growing market already for the second time: Global revenues generated with silicones rose by 4.2% per year since 2008; in 2016, about USD 15.5 billion were reached. Ceresana expects the silicone market to increase further by 4.0% p.a. until 2024.

Growth Engine Automotive Industry

A decisive advantage for manufacturers of silicones is the variety of sales markets: Demand is distributed evenly among several large sectors. In the construction industry, silicones are mainly used as sealants, adhesives, and in coatings. The electronic industry applies silicones mainly to protect electronic components from extreme heat, moisture, salt, corrosion, and contamination. For example, computers, telephones, and LED lights contain silicones and the application areas are gradually expanded. Silicone demand in the automotive segment will presumably register similarly high growth rates in

the upcoming eight years as in the electrical and electronics industry. Innovative projects such as hybrid and electric vehicles or autonomous vehicles will support this growth.

Sealing and Insulation

The majority of the global production of silicones is accounted for by silicone elastomers which are, for example, used in seals, electrical insulations or baking tins. A distinction is made between solid and liquid silicone rubber. Especially because of the large E&E industry, Asia-Pacific consumes a disproportionately large amount of silicone elastomers. In Western Europe and North America, revenues generated with elastomers are slightly higher than revenues generated with silicone oils. Silicone resins that are for example used for paints and varnishes have so far been accounting for a much smaller market share in all regions, but are likely to develop at sound growth rates in the future.

Asia-Pacific Continues to Be on the Growth Path

Given the massive increase of capacity in China, Asia-Pacific became the worldwide largest manufacturer of silicones in the past years. Ceresana expects the production in this region to continue to grow. Western Europe ranks second, followed by North America. Asia-Pacific accounted for more than half of the worldwide silicone output in 2016. China is the largest consumer of silicones worldwide. The gap to the second and third largest sales markets, Western Europe and North America, is

likely to continue to widen in the future. Yet, established industrialized countries report a higher market value compared to silicone demand, as China tends to consume cheaper products instead of high-end specialty silicones.

The Study in Brief:

Chapter 1 provides a presentation and analysis of the global market for silicones – including forecasts up to 2024: Demand in tonnes, revenues per product type, total revenues, and production volume will be depicted, split by world regions. This chapter will also include a concise and precise summary of the most important facts regarding production and characteristics of silicones and individual product types.

Chapter 2 is a detailed analysis of total demand, revenues generated with silicones as well as market value in construction, E&E, automotive, health care and cosmetics as well as in other applications.

Chapter 3 offers a well-grounded analysis of various applications of silicones: Data on demand and sales development, split by the seven world regions Western Europe, Eastern Europe, North America, South America, Asia-Pacific, the Middle East, and Africa are given. Chapter 4 provides 49 profiles of the largest manufacturers of silicones, clearly arranged according to contact details, revenues, profit, product range, production sites, profile summary, product types, and applications.

1 Market Data

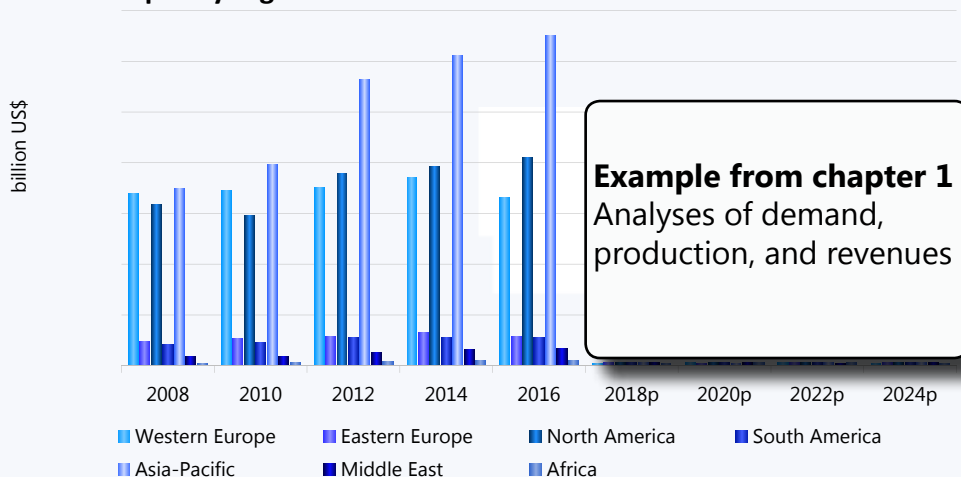
- 1.1 World
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 - 1.1.2 Revenues
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Global revenues generated with silicones from 2008 to 2024 – split by regions

Ceresana



2.4.2 Other South America

2.5 Asia-Pacific

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- 2.5.2 India
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 - 3.1.2 Electrical & Electronics
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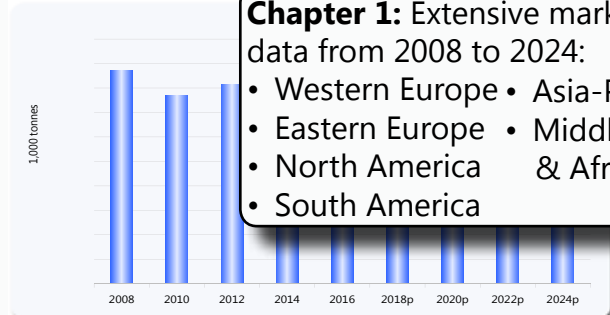
4 Company Profiles

- 4.1 Western Europe
 - Belgium (1 Producer)
 - Finland (1)
 - France (3)
 - Germany (5)
 - Switzerland (2)
 - The Netherlands (1)
- 4.2 North America
 - Canada (3)
 - Mexico (1)
 - USA (22)
- 4.3 Asia-Pacific
 - China (6)
 - Japan (2)
 - Singapore (1)
 - South Korea (1)

1.2 Western Europe

1.2.3 Production

About X tonnes of silicones were produced in 2016. Accounting for a share of X % of total West European output in 2016, Germany is the largest producer of silicones in this region. The United Kingdom and France ranked second and third. We expect output in Germany to continue to increase by X % p.a. until 2024 while development in the other countries is anticipated to be less dynamic.



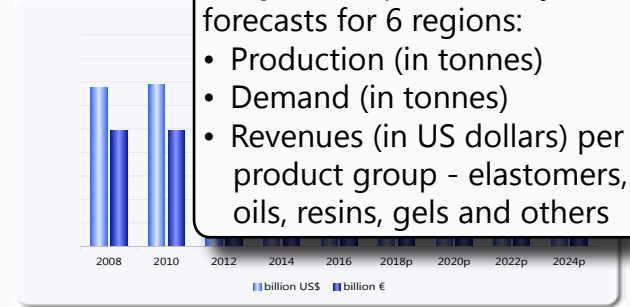
Graph: Production of silicones in Western Europe from 2008 to 2024

Country	Company
X	X
X	X
X	X
X	X
X	X
X	X

Table: Most important manufacturers of silicones headquartered in Western Europe and their product base

1.2.2 Revenues per Product Group

Silicone revenues in Western Europe amounted to USD X billion in 2016. We forecast market value to increase at a growth rate of X% p.a. during the next eight years. The highest revenues in 2016 were generated with elastomers; market volume amounted to USD X billion. Revenues generated with oils ranked second at a close distance. The lowest development of revenues of the next eight years is forecast for the segment resins as well as for gels and others.



Graph: Revenues generated with silicones in Western Europe from 2008 to 2024 in billion USD and billion EUR

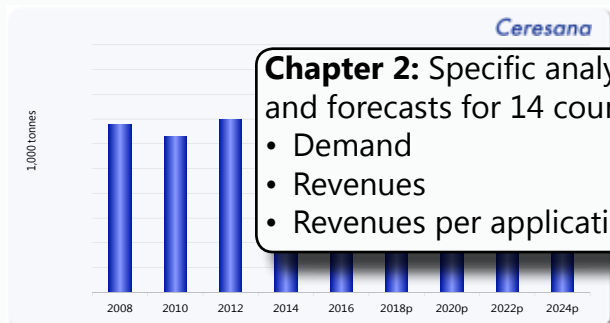
in billion USD	2008	2010	2012	2014	2016	2018p	2020p	2022p	2024p	2016-2024
Elastomers	X	X	X	X	X	X	X	X	X	X% p.a.
Oils	X	X	X	X	X	X	X	X	X	X% p.a.
Resins	X	X	X	X	X	X	X	X	X	X% p.a.
Gels and Others	X	X	X	X	X	X	X	X	X	X% p.a.
Total	X	X	X	X	X	X	X	X	X	X% p.a.

Table: Revenues generated with silicones in Western Europe from 2008 to 2024 – split by product groups

2.3.2 USA

2.3.2.1 Demand and Revenues

In 2016, about X tonnes of silicones were consumed. The USA are the worldwide largest sales market for silicones. We expect demand to increase to X tonnes in 2024. Compared to 2016, this constitutes an average increase of X% per year. The market for silicones was worth USD X billion in 2016. Until 2024, market value is likely to increase to approx. USD X billion. Compared to 2016, this constitutes an increase of, on average, X% per year.



Graph: Demand for silicones in the USA from 2008 to 2024

2.3.2.2 Revenues per Application

Revenues generated with silicones in the sector health care and cosmetics amounted to about USD X million in 2016 which was the largest share. Revenues in the segment automotive ranked second. The construction industry will account for the lowest increase in demand by X% p.a. in the upcoming eight years. We forecast all other applications to experience sound growth until 2024.

in million USD	2008	2010	2012	2014	2016	2018p	2020p	2022p	2024p	2016-2024
Construction	X	X	X	X	X	X	X	X	X	X% p.a.
Electrical and Electronics	X	X	X	X	X	X	X	X	X	X% p.a.
Automotive	X	X	X	X	X	X	X	X	X	X% p.a.
Health Care and Cosmetics	X	X	X	X	X	X	X	X	X	X% p.a.
Other Applications	X	X	X	X	X	X	X	X	X	X% p.a.
Total	X	X	X	X	X	X	X	X	X	X% p.a.

Table: Revenues generated with silicones in the USA from 2008 to 2024 in million USD – split by applications

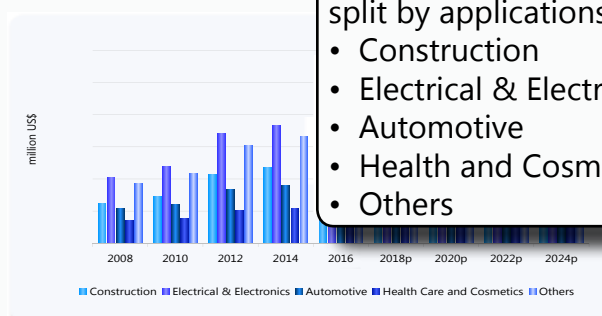
Due to a positive income development and a rising employment rate, we forecast increasing investments and beginnings of new constructions in the US-American building construction in 2017. Thus, the building construction sector will continue with the upswing of the past years. This development has positive effects on the demand for silicones in the segment construction. Civil engineering developed more weakly than building construction in 2015 and almost stagnated. On the one hand, there were only moderate investments in 2016, on the other hand, expenses rose compared to the previous year. The investment campaign that was announced by the new US President Donald Trump could lead to another updraft in infrastructure construction. Especially the transport infrastructure will be able to profit from this measure. Already before the change of government, investments of about USD 300 billion were granted for this sector until 2020. We assume that for the financing of new projects, the PPP models will be increasingly counted on. Water supply and sewage disposal will presumably also be treated predominantly in the future. The sewage infrastructure of the USA is outdated at many places. There are estimates that almost USD 1,000 billion have to be invested in the old crumbling pipeline systems of the whole water management to grant full functionality for the upcoming two decades. Environmental aspects play an important role during increasingly frequently occurring heavy rainfalls when sewage systems overflow and polluted water enters natural waters.

3.6 Asia-Pacific - Applications

Of the X million tonnes of silicones that were used in the Asia-Pacific region in 2016, the segment electrical & electronics accounted for the largest share with around X%. Registering a market volume of X million tonnes, the construction industry ranked second.

Chapter 3: Revenues split by applications:

- Construction
- Electrical & Electronics
- Automotive
- Health and Cosmetics
- Others



Graph: Revenues generated with silicones in Asia-Pacific from 2008 to 2024 in million USD – split by applications

in 1.000 tonnes	2008	2010	2012	2014	2016	2018p	2020p	2022p	2024p	2016-2024
Construction	X	X	X	X	X	X	X	X	X	X% p.a.
Electrical and Electronics	X	X	X	X	X	X	X	X	X	X% p.a.
Automotive	X	X	X	X	X	X	X	X	X	X% p.a.
Health Care and Cosmetics	X	X	X	X	X	X	X	X	X	X% p.a.
Other	X	X	X	X	X	X	X	X	X	X% p.a.
Total	X	X	X	X	X	X	X	X	X	X% p.a.

Table: Demand for silicones in Asia-Pacific from 2008 to 2024 – split by applications

The highest relative increase at an average rate of X% p.a. during the next eight years is forecast for the segments automotive and health care and cosmetics. The segment other applications is also anticipated to develop at dynamic rates, increasing demand at an AAGR of X%. We forecast total regional market volume to rise at an average rate of X% p.a. in the upcoming eight years and market volume to amount to approx. X million tonnes of silicones in 2024.

3.6.1 Construction

In 2016, almost USD X billion were generated with silicones for the construction industry. China reported the highest market value that year, totaling USD X million.

in million USD	2008	2010	2012	2014	2016	2018p	2020p	2022p	2024p	2016-2024
China	X	X	X	X	X	X	X	X	X	X% p.a.
India	X	X	X	X	X	X	X	X	X	X% p.a.
Japan	X	X	X	X	X	X	X	X	X	X% p.a.
South Korea	X	X	X	X	X	X	X	X	X	X% p.a.
Other	X	X	X	X	X	X	X	X	X	X% p.a.
Total	X	X	X	X	X	X	X	X	X	X% p.a.

Table: Demand for silicones in construction in Asia-Pacific from 2008 to 2024 – split by major countries

We forecast a growth rate of X% p.a. for India; thus, this country will see the highest relative increase until 2024. Yet, processors in China are also likely to see revenues generated with silicones rise notably. We forecast total market value to increase by, on average, X% p.a. in the upcoming eight years and to amount to approx. USD X billion.

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Financial Key Data (in billion CHF)

Year	Net Profit	Revenues
2015	0,23	5,81
2014	0,24	6,12
2013	0,32	6,08
2012	0,20	6,04

General Information about the Company

Divisions, Product Range
 The company operates in the following four business divisions:

- Care Chemicals
- Catalysis
- Natural Resources
- Plastics & Coatings

Production Sites
 The company and its subsidiaries operate more than 120 production sites that are located on five continents.

Profile Summary
 Clariant was founded in 1995 as a spin-off of the chemical company Sandoz which was established in 1886 in Basel. As a company for specialty chemicals, Clariant offers consumer solutions for many industries.

revenues in 2015 originated in EMEA, 24% in Asia and Pacific, 18% in North America, and 18% in Latin America.

At the end of 2015, the company employed about 17,213 people. Clariant is listed on the SIX Swiss Exchange. In 2015, total assets amounted to approx. CHF 7.5 billion.

3 acquisitions and 1 sale took place in 2015. The latter was the disposal of the energy storage segment to Johnson Matthey. The acquisitions included part of the Vivimed Labs Limited personal care portfolio, the Swedish de-icing specialist Aerochem AB, and the remaining parts of the Companhia Brasileira de Bentonita.

The quality and environmental management systems of Clariant are ISO 9001 and ISO 14001 certified. Additionally, the company is certified according to OHSAS 18001.

In November 2016, Clariant announced the expansion of its Personal Care portfolio with organic UV filters and formulation components. This was made possible by the acquisition of the Indian company Vivimed Labs Limited.

Specific Information about Silicones

Clariant International Ltd. provides high-performance, organic silicone concentrates, silicone emulsions, and silicone tensides for several industrial applications. Silicones are listed as defoamers and are offered under the brand name XL Sil.

- XL Sil silicone emulsions are suitable for different industrial applications and for applications with food contact. The products are chemically inert and do not cause a discoloration during the processing. XL Sil E silicone emulsions are suitable as solubilizing agent in molding, extrusion, lamination, and casting of rubber, plastics, and metals. Furthermore, XL Sil E silicone emulsions can be used in polishes as well as in fabric conditioners and lubricants, forge and printing solubilizing agents, and leather, glass, and vinyl cleaning agents.
- XL Sil P silicone liquids or polydimethylsiloxan liquids are offered in different viscosities. These liquids have the INCI indication Dimeticon and are suitable for a variety of personal care products. XL Sil P silicone liquids are used as lubricants, solubilizing agents, and defoamers.

Chapter 4: Data and facts on 49 producers, clearly arranged by:

- Financial key data
- Production sites
- Profile summary
- Product details

Chapter 4: Detailed profiles of the most important manufacturers, such as China National Bluestar, Dow Corning, Evonik, Momentive Performance Materials, Shin-Etsu Chemical, and Wacker Chemie.

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- Plasticizers
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- Propylene - China
- Propylene - USA
- Solvents
- Stabilizers

- Styrene
- Surfactants
- Titanium Dioxide
- Toluene
- Urea
- Xylene

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- Composites
- Compounds
- Engineering Plastics
- Expandable Polystyrene
- Masterbatches
- Plastics - Europe
- Plastics - World
- Polyamide - PA6 & PA66
- Polyethylene - HDPE
- Polyethylene - LDPE
- Polyethylene - LLDPE
- Polypropylene
- Polystyrene
- Polyurethanes & Isocyanates
- Polyvinyl Chloride
- Silicones
- Synthetic Rubber
- Thermoplastic Elastomers

Industry

- 3D Printing - World
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- Adhesives - World

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- Bitumen - Europe
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- Insulation Materials - Europe
- Insulation Materials - World
- Paints & Varnishes - Europe
- Paints & Varnishes - World
- Pipes - Europe
- Plastic Extrusion - World
- Plastic Injection - World
- Plastic Pipes - Europe
- Plastic Pipes - World
- Plastic Windows - World
- Printing Inks - World

Packaging

- Bags & Sacks - Europe
- Bags & Sacks - World
- Caps & Closures - Europe
- Corrugated, Solid Board & Carton - Eur.
- Flexible Packaging - Europe
- Food Packaging - Europe
- Labels - Europe
- Plastic Bottles - Europe
- Plastic Caps & Closures - Europe
- Plastic Caps & Closures - World
- Plastic Containers - World
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- Plastic Films - World
- Rigid Metal Packaging - Europe

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