

Saudi Arabia's Chemicals Industry Continues to Grow

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Abundant and competitively priced petroleum feedstock has spurred massive growth in Saudi Arabia's chemicals industry over the past five decades. As the Kingdom faces competition from neighboring countries, it will diversify to ensure further growth.

Saudi Arabia is well known as the world's leading producer and exporter of crude oil. However, many people do not realize that Saudi Arabia is also one of the world's largest producers and exporters of chemicals and polymers. The chemicals industry relies on the tremendous amount of hydrocarbons in the Kingdom, including gases and liquids associated with crude oil production and methane production (referred to as associated gases and associated liquids). Leading international companies such as Saudi Arabian Basic Industry Co. (SABIC), Petro Rabigh, Tasnee, and others, which are publically traded on Tadawul, the Saudi stock exchange, have produced excellent results for their shareholders.

Saudi Arabia's chemicals industry came into existence much later than those in other countries. While the Kingdom's abundant reserves of petroleum feedstock made it a favorable location for chemicals production, it did not yet have the infrastructure — *e.g.*, the interconnecting pipelines already available in North America and Europe — to distribute large quantities of feedstock around the country. Once this infrastructure was built (discussed later in the article), the chemicals industry experienced rapid growth and is today a significant player in the global chemicals market.

This article provides an overview of Saudi Arabia's chemicals industry, with a focus on the transformation of

the Kingdom's crude oil production into a full portfolio of chemical products. In addition, it discusses how Saudi Arabia will move forward in the future.

The start of a chemicals industry

Saudi Arabia's entrance into the world chemicals industry can be traced back to three endeavors: the creation of the master gas system; the industrialization of two underdeveloped, coastal fishing villages (Jubail and Yanbu); and the formation of SABIC.

Master gas system. In the early development of Saudi Arabia's energy resources, most of the natural gas production was associated with crude oil production. At that time, the majority of the gas was flared at the oil wells and was not used for its heating value or as a feedstock for chemical production. In the early 1970s, Saudi Aramco undertook a very ambitious project to create a pipeline network, known as the master gas system (MGS), to distribute the previously unutilized gas throughout the Kingdom (Figure 1). Completed in 1982, this effort provided sufficient quantities of natural gas to begin developing a chemicals industry (1).

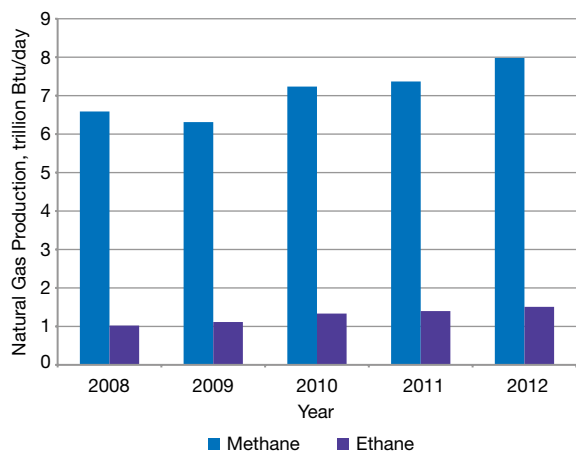
In the latter half of the 1980s, gas production from associated wells was supplemented with Saudi Arabia's nonassociated gas resources. The gas system now consists of over 60 gas-oil separation plants in Khurais, Safaniya,



▲ **Figure 1.** Jubail and Yanbu are the largest chemicals production sites in Saudi Arabia.

Ghawar, and Zuluf; three gas processing plants in Barri, Shedgum, and Uthmaniyah; the east-west natural gas (methane) pipeline from Shadqam to Yanbu; and two gas-fractionation plants in Yanbu and Juaymah (2).

Today, Saudi Arabia has proven natural gas reserves of 288 trillion cubic feet (Tcf) and ranks fifth in the world behind Russia, Iran, Qatar, and the U.S. Much of the gas that is produced today is wet gas, which in addition to methane contains various amounts of ethane, propane, and butanes,



▲ **Figure 2.** Saudi Aramco's production of natural gas has increased over the 2008–2012 period. Gas produced in Saudi Arabia is wet, meaning that in addition to methane and ethane, it also contains natural gas liquids (NGLs) — i.e., propane and butane.

In the 1970s, Saudi Aramco built a pipeline network to distribute previously unused gas throughout the Kingdom.

the latter two comprising natural gas liquids (NGLs). In 2012, Saudi Aramco produced 10.7 billion scfd of gases (7.98 trillion Btu/day of methane and 1.509 trillion Btu/day of ethane) and 1.32 million bbl/day of NGL. Saudi Aramco's increasing production over the past five years is depicted in Figure 2 (3).

Jubail and Yanbu. At about the same time as the MGS was being built, the Saudi Arabian government designated Jubail and Yanbu (both coastal, underdeveloped villages) as the sites for two industrial cities, and in 1975 established the Royal Commission for Jubail and Yanbu to oversee and manage the development of petrochemicals and energy operations in these two cities. Jubail is now one of the largest chemical production areas in the world.

SABIC. In September 1976, SABIC was created by royal decree to produce valued-added products (chemicals, fertilizers, and polymers) from crude oil for export. The intent was to establish the Kingdom's position in the chemicals industry and to attract investments by international oil companies to form joint ventures in Saudi Arabia.

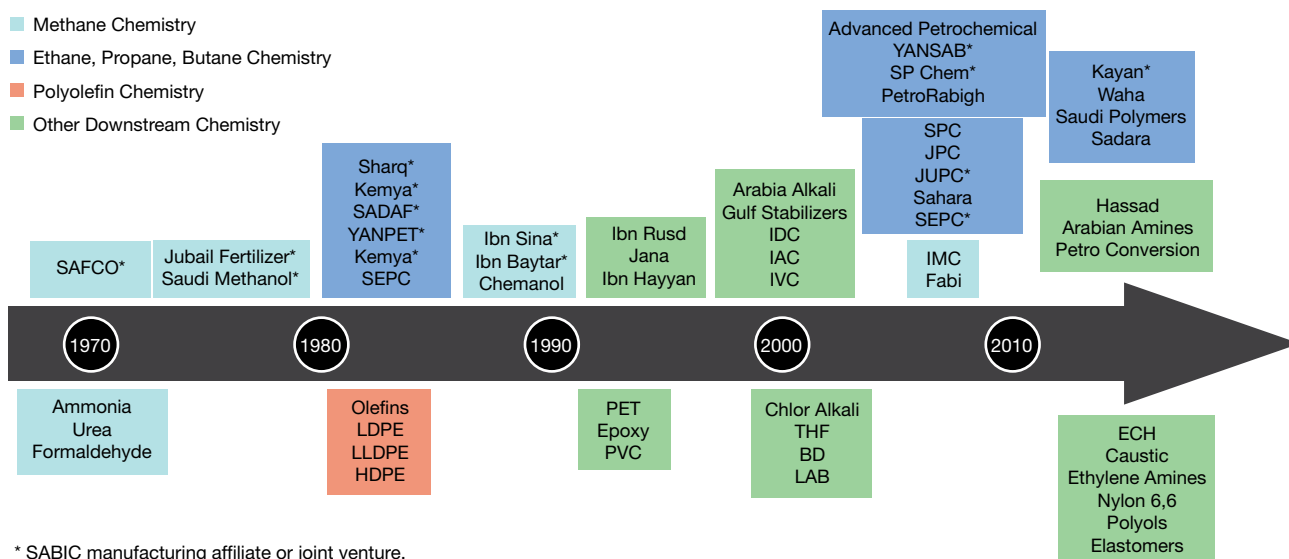
Since its creation, SABIC has formed numerous joint ventures (the first of which, with Saudi Methanol, began production in 1983) and established many affiliates. Now the largest producer of chemicals in Saudi Arabia and fifth in the world (Table 1), SABIC consists of approximately 20 world-scale manufacturing companies, the majority of which are in Saudi Arabia. It is the world's largest producer of ethylene glycol and methanol, the third-largest producer of polyethylene, and the fourth-largest producer of polypropylene and polyolefins.

Table 1. SABIC ranks fifth among the top 10 chemical companies in the world.	
Company	2012 Sales, US\$ billion
BASF	95.1
Sinopec	64.9
ExxonMobil	60.9
Dow Chemical	56.8
SABIC	50.4
Shell	45.8
LyondellBasell	45.3
DuPont	34.8
Mitsubishi	32.8
INEOS	29.9

Source: (4).

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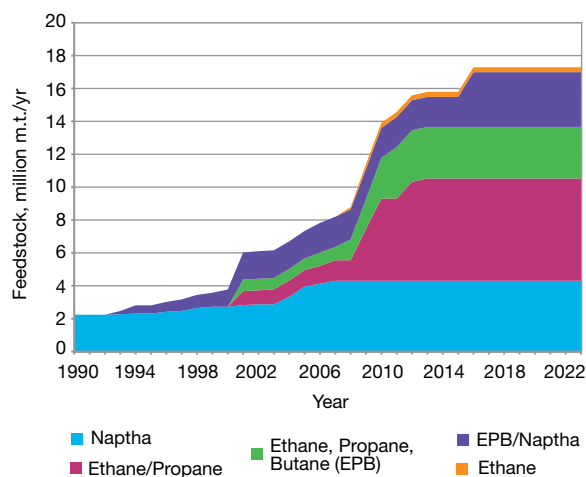
* SABIC manufacturing affiliate or joint venture.

▲ **Figure 3.** This timeline illustrates the development of the chemicals industry in Saudi Arabia, as new companies and joint ventures were formed (top) to produce a variety of chemicals (bottom).

Development of a chemicals industry

As the MGS became a reality in Saudi Arabia, the Ministry of Petroleum and Mineral Resources became the regulator of the gases and liquids and set the prices to incentivize industrial growth in Saudi Arabia. The Ministry set constant, attractive prices for methane and ethane, as these two light gases were in great abundance in Saudi Arabia and are at the heart of the chemicals it produces.

The initial investments (in the early 1970s) were based on methane chemistry, as this feedstock was abundant. The key products at that time were methanol, ammonia, urea, and formaldehyde produced by companies that included



▲ **Figure 4.** Saudi Arabia's chemicals industry was initially based on methane chemistry, but soon expanded to include chemicals based on ethane, propane, and butane feedstocks. Source: (4).

Jubail Fertilizer (a 50-50 joint venture of SABIC and Taiwan Fertilizer Co.) and Saudi Methanol (a 50-50 joint venture of SABIC and a consortium of Japanese companies led by Mitsubishi Gas Chemical Co.).

As the industry developed, so did the portfolio of products (Figure 3). In the 1980s, the master gas system was expanded to include new pipelines to deliver pure ethane. With this expansion, SABIC and other companies (primarily SABIC affiliates and joint ventures) were formed to develop the ethane-to-ethylene value chain and its derivative products. These companies built large industrial complexes with world-scale (at the time) steam crackers with ethylene capacities of about 1 million m.t./yr. These steam crackers also produced associated first-derivative products, including polyethylene (high-density polyethylene [HDPE], low-density polyethylene [LDPE], and linear low-density polyethylene [LLDPE]) and glycols (monoethylene glycol [MEG], diethylene glycol [DEG], and triethylene glycol [TEG]).

The cracker projects eventually were upgraded to handle mixed feedstocks of ethane, propane, and butane (Figure 4). These crackers produced more C3 and C4 derivatives, which can be used in the production of polypropylene, polyols, acrylic acid chains, epoxy resins, and other higher-value products. Over these five decades, Saudi Arabia has grown to have a complete portfolio of petrochemical products.

Leading Saudi Arabian chemical companies

Table 2 lists the top 11 chemical companies in Saudi Arabia ranked by their 2012 sales.

SABIC is one of the top three chemicals and polymer producers in the world. As a global manufacturer, SABIC

Table 2. Chemical companies in Saudi Arabia ranked by 2012 sales.

Company	2012 Sales, US\$ millions
SABIC	50,407
Petro Rabigh	16,536
Tasnee	4,779
Saudi Kayan	2,529
Yanbu National Petrochemical Co.	2,480
Saudi Industrial Investment Group	1,482
Safco	1,328
Sipchem	1,046
Advanced Petrochemicals	659
Alujain	563
Sahara Petrochemicals	412

Source: (6).

has assets in Saudi Arabia to produce polyolefins and basic chemicals such as MEG; in Europe to produce basic and advanced polymers, as well as assets from the former DSM to produce chemicals; and in North America to produce high-performance products with SABIC IP (formerly GE Plastics).

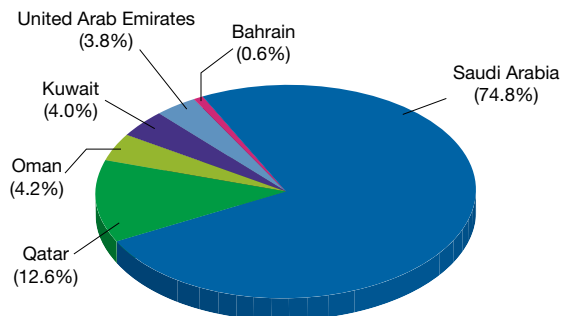
Petro Rabigh consists of an integrated refinery and steam cracker owned jointly by Saudi Aramco and Sumitomo Chemical. The company's chemical products consist of LLDPE, HDPE, copolymer polypropylene (PP), impact polypropylene, MEG, and propylene oxide (PO). Refinery products include liquefied petroleum gas (LPG), naphtha, gasoline, fuel oil, and diesel. Petro Rabigh is currently evaluating an expansion of its cracker and chemical product production base.

Tasnee is an independent company based in Jubail. It produces HDPE, LDPE, PP, acrylic acid, titanium dioxide (TiO₂), chlorine, and chlorine derivatives.

Saudi Kayan Petrochemical Co., an affiliate of SABIC, operates a 1.5-million m.t./yr steam cracker. It produces HDPE, LDPE, PP, MEG, cumene, phenol, acetone, benzene, polycarbonate, ethanol amines, ethoxylates, butanols, and natural detergent alcohols.

Yansab National Petrochemical Co., established in the industrial city of Yanbu, operates a 1.3-million m.t./yr cracker. It produces MEG, HDPE, LLDPE, butenes, MTBE, benzene, and toluene. Yansab is also an affiliate of SABIC.

Sadara (not listed in Table 2 because it is currently under construction) is a joint venture of Saudi Aramco and Dow Chemical formed to construct a world-scale integrated chemicals complex in Jubail. When completed, it will be the largest chemical complex ever built at one time. Encompassing 26 manufacturing plants, the integrated complex will have flexible steam-cracking capabilities and produce more than 3 million m.t./yr of high-value performance plastics and



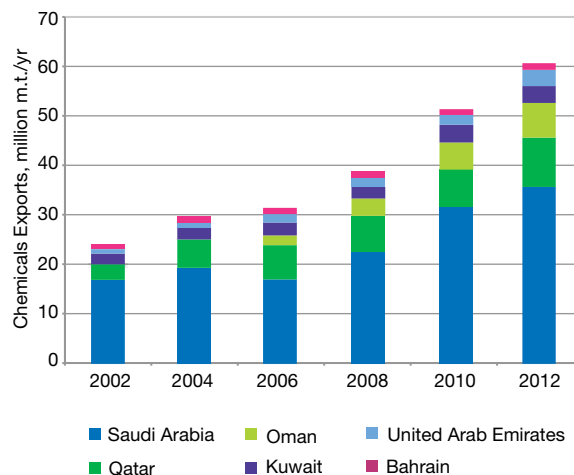
▲ **Figure 5.** In 2012, Saudi Arabia's chemicals industry accounted for close to 75% of chemical sales from all of the GCC countries. This tally includes sales of petrochemicals (basic chemicals, intermediates, and downstream chemicals), polymers, fertilizers, and inorganic chemicals. Source: (8).

specialty chemical products. Major product families include amines, glycol ethers, isocyanates, polyether polyols, propylene glycol, polyethylene, and polyolefin elastomers. Sadara's first production units will come online in the second half of 2015, and all units are expected to be operating in 2016 (7).

Saudi Arabia's chemicals industry today

The total chemical sales for the Gulf Cooperation Council (GCC) countries in 2012 were about US\$81.7 billion, with Saudi Arabia chemicals accounting for almost 75% of the total sales for the GCC countries (Figure 5).

In 2012, Saudi Arabia's chemicals exports were about 35.8 million m.t., which accounted for 59% of the total GCC countries' export volume (Figure 6). While the Kingdom continues to be the largest regional exporter of chemicals, its share of the total GCC chemical exports has dropped significantly over the past decade — from 70% in 2002 to 59% in 2012 — as the other GCC countries increased their shipments. Saudi Arabia's chemicals exports over the past



▲ **Figure 6.** The GCC countries continue to grow their chemicals export industries. Source: (8).

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decade were mainly polymers (particularly primary plastics), as well as fertilizers and chemicals (8).

As a result of the aggressive expansion that has taken place in the chemicals industry in the GCC region, the direct employment by the industry grew at an annual rate of 13.5% from 2008 to 2012. In 2012 alone, direct employment grew by 18% compared to 2011. Saudi Arabia is the largest employer, with 55% of the regional workforce in the chemicals sector (76,500 employees). Since 2008, the industry employment in Saudi Arabia has grown on average by 12.7% per year, which is slightly lower than the overall GCC employment growth during the same period.

The future of Saudi Arabia's chemicals industry

Based on its very successful recent history, Saudi Arabia is continuing to expand hydrocarbon and gas production into the future. Neighboring countries such as Qatar, Kuwait, and United Arab Emirates (UAE) provide competition for investment in the region, as they also have abundant hydrocarbons that are available at attractive prices. To remain competitive in this changing landscape, the Saudi Arabian government has initiated an industrial-clusters program to focus investment and growth in five key industries: minerals and metals, automotive, plastics and packaging, home appliances, and solar energy (9).

These five sectors were chosen because they have huge potential for growth, and rely on the Kingdom's abundant natural resources, raw materials, and energy. Each of the clusters relies in some way on chemicals:

- minerals and metals processing requires processing fluids that are oil- and chemical-based to produce high-quality products
- automobile makers use increasing amounts of plastics and composites in vehicles to reduce weight as well as for the necessary components (tires, etc.)
- home appliances require advanced polymers, such as acrylonitrile butadiene styrene (ABS) and nylon for casings and other assorted components
- solar panels contain polymers, such as ethylene vinyl acetate (EVA) film
- the packaging sector requires a polymer-conversion industry.

The program to develop the plastics and packaging cluster includes six conversion projects related to personal care products (e.g., tubes, bottles, containers and caps, and other pumps and sprays), pharmaceutical packaging products (e.g., bottles, blister packs, inhalers, and syringes), caps and closures (with both standard shapes and complex shapes, such as tamper-proof and sports-bottle tops), bi-oriented polypropylene (BOPP) film (e.g., transparent and metallized bags for foods), barrier films (e.g., bags and pouches, chemicals packaging, and medical and pharmaceutical packaging), and general-

purpose films (e.g., blown and cast film for food packaging).

The government is attracting new and old industry participants to invest in the Kingdom by providing advice, statistics, market research, assistance in developing a business case, and access to relevant government agencies and companies, as well as identifying locations, suppliers, and staff.

Saudi Arabia will continue to grow and expand its chemicals industry into the future. Much of the growth will be in commodity chemicals and polymers made from low-cost oil- and gas-derived feedstocks. The industry is also expected to grow horizontally into various conversion industries, driven by the government's industrial-clusters program (9).

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