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THE END OF SAUDI ARABIA'S ADDICTION TO OIL

DOWNSTREAM INDUSTRIAL DEVELOPMENT

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Cover photo: Reuters/Zuhair Al-Traifi. A large banner shows Saudi Vision for 2030 before the arrival of Saudi King Salman at the inauguration of several energy projects in Ras Al Khair, Saudi Arabia, November 29, 2016.

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EXECUTIVE SUMMARY

Saudi Arabia's leadership recently introduced an ambitious plan called Vision 2030 to move the country away from oil and toward a more diversified, modern economy. Fortunately, the economy is already much more diversified than is often reported, a fact obscured by the very high price of oil from 2000 to 2014. Since the mid-1970s, the Kingdom has developed chemical, metal, and fertilizer industries that are among the most advanced in the world. Most of these industries have been built on the natural advantages of Saudi Arabia: low-cost energy, large mineral resources, access to plentiful capital, and proximity to the huge markets of Asia.

This paper reviews the existing downstream industries in the public and private sectors, and what has made them so successful thus far, including sophisticated financing, state support, joint ventures with well-known foreign partners, and world trade agreements. It also evaluates whether this industrial base can be put on steroids to fulfill the expectations of Vision 2030 in light of many of the challenges the Kingdom faces, such as the dependence of the private sector on foreign workers, and the societal changes implied by reducing the state's dependence on oil income, which ultimately will have to result in the state becoming dependent on the people.

INTRODUCTION

Hidden behind the constant bad news concerning the Middle East—civil wars, vast flows of refugees, and nasty sectarian tensions—lies a profound shift occurring within the societies of the Gulf driven by economic development. The Gulf countries are well-known for being large producers and exporters of crude oil and natural gas. However, less well-known is that they have been making substantial efforts since the mid-1970s to become less dependent on the mere production of oil and grow into more broadly based industrial powers in their own right.

Of course, with the price of crude going from $1.21 per barrel (/b) in 1970 to over $120/b in 2012, the push to move away from oil has been less than successful. Societies have become accustomed to significant subsidies of all sorts, excellent salaries and bonuses in the public sector, large corporate cash flows, and state budgets that have provided the means to allow the Gulf Cooperation Council (GCC) countries[1] to import over twenty million foreign workers to build national infrastructures and provide world-class services.

However, the easy life of the early twenty-first century is under attack. The Gulf is addicted to oil, and this addiction resulted in a major hangover when prices declined to the $30/b range in 2015 and have remained in the $40 to $50/b range ever since. In addition, there are considerable tensions between the GCC and Iran. Proxy wars are wasting the countries' resources. At the same time, the GCC states are under attack from religious extremists within their own countries. Finally, the large youth bulges, with half of the populations below the age of twenty-five,[2] caused in great part by the greatly improved health conditions of the past forty years (a by-product of oil income), have to be properly handled.

To ease social tensions building across the Gulf countries due to high unemployment rates among the youth, those under thirty will need to replace the foreign workers that have been hired to bring the region rapidly into the modern world. On the one hand, this shift will likely change the type and reduce the quality of services to which the populations of the Gulf have grown accustomed, provoking an increase in the cost of living for everyone. On the other hand, the youth provide a font of creativity and entrepreneurship, which have often been stifled by established groups and privileges. Women, mainly in Saudi Arabia, have been equally suppressed and kept out of the workforce in the name of "modesty" to satisfy the religious establishment, while cheap foreign labor was available to fill the gap. Governments need to address these tensions to ensure that the countries of the Gulf remain stable and can actually cope with the demands of the twenty-first century.

Saudi Arabia has recently begun to take significant steps to address these issues. On April 26, 2016, Deputy Crown Prince Mohamed bin Salman (MbS) released a blueprint for the next several years called Vision 2030. Saudi Arabia's Vision 2030 maximizes the country's natural advantages in low-cost energy, substantial mining resources, and plentiful capital to accelerate downstream sector[3] development, while addressing the country's societal tensions.

The Gulf countries have known since the 1970s that their only significant assets are low-cost plentiful energy, easy access to capital, and an ambitious vision of themselves and their role in the world. Saudi Arabia, in particular, views itself as the center of the Islamic world, but also as the center of the global energy market and the silk route between Asia and Europe/the Americas. Hence, the Kingdom is taking the cards it has been dealt and is maximizing its natural advantages, namely low-cost energy, substantial mining resources, and plentiful capital. Thus, the industries downstream from oil and mining have become the main potential sources of income, pride, and hope for the economy of Saudi Arabia and those of the rest of the Gulf countries.

As explained by MbS to TV network Al Arabiya, Saudi Arabia's Vision 2030 is based on three pillars:

1 The Gulf Cooperation Council consists of all Persian Gulf countries except for Iraq: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

2 Mohamad Bazzi, "Saudi Arabia Faces Many Threats, and Iran Isn't at the Top of the List," Reuters, May 28, 2015, http://blogs.reuters.com/great-debate/2015/05/28/why-the-biggest-threat-to-saudi-arabia-isnt-iran/.

3 "Downstream" in this paper refers to all transformations of the carbon molecules obtained from the extraction of crude oil and natural gas. Hence, downstream includes the extensive refining of crude oil and the separation of the various gases from the natural gases. It also covers the manufacturing of products made from the refined products. The resulting products are themselves used as raw material for further productions and so on down the manufacturing chain until they are used by the public. For example, naphtha is produced from crude oil. Naphtha is then further refined into numerous products including ethylene, which is then ultimately made into plastics used by all industries and households.

1. A vision of the future rooted in Islam and Islamic values

2. Becoming a "global investment power house," which will promote a "thriving economy" independent from crude oil and be achieved by

    a. enacting major reforms and spurring development in the education system;

    b. boosting small and medium-sized enterprises;

    c. providing equal opportunity for all Saudis;

    d. significantly increasing in the role of women in the economy; and

    e. emphasizing developing and finding the right people for the task, even if it means bringing in foreigners temporarily, though it is clear that in due course locals will replace foreigners.

3. Ensuring the Kingdom is the center of the silk route and is

    a. the bridge between Europe and the Far East; and

    b. the epicenter of trade and the gateway to the world.

To paraphrase MbS, Vision 2030 seeks to stop the country's addiction to crude oil and reduce fossil fuels' contribution to state revenues to less than 50 percent from 85 percent today. The main impetus of the plan, however, is to address the concerns of the country's youth and help resolve the societal tensions between those under thirty, who comprise 70 percent of the population, and those who currently control the economy. Two of the key goals of the plan are to 1) decrease unemployment from 11.6 percent to 7 percent by 2030, which means reducing youth unemployment from perhaps 25 percent to the 7 percent mentioned by MbS, and 2) bring employment among women to 40 percent of the workforce in both the private and the public sectors. Both of these expectations also assume that Saudis, men and women, will replace a great portion of the foreign workforce by 2030.

To accomplish this, Vision 2030 is planning to create jobs for young Saudis, support young entrepreneurs, and limit the stranglehold on society by some of the established powers, like the religious establishment and the royal family. The plan calls for developing mining, manufacturing, and related services as well as religious tourism and the manufacturing of military supplies. Much of this growth will occur downstream from the country's oil and gas production. Instead of merely exporting crude oil, the downstream industries will transform it into high-value products, which in turn can create high-value employment, and ultimately allow the country to stop depending on the sale of just one commodity. In 2015, consulting firm McKinsey & Company wrote a report on the Saudi economy and its potential, which was used as a base for the Vision 2030 plan.[4] In the report, McKinsey focused on developing areas of the economy in which Saudi Arabia has a natural advantage, principally downstream activities like chemicals and mining that depend on low-cost energy. The report also recommended increasing the use of the Public Investment Fund, a state-run financial institution that focuses on industrial development.

All these goals are rooted in the existing structures of the economy and industrial development. They do, however, also imply many of the established powers, whether royal or religious, will need to make some major changes, and engrained traditions in society will need to adapt.

Naturally, these changes constitute a very tall order. Revenues from crude oil provide the state with 85 percent of its income. Moreover, those who control the economy are well ensconced and receive a large part of the state's income through obscure practices on contracts that limit or choke the young. Vision 2030 is de facto an organized effort to force society to accept that those under thirty must take over, or else see the country become a minor player in the Asian continent. In other words, developing the industries downstream from crude oil and natural gas will bring the country into the twenty-first century. In due course, this development will require a change in state-citizen relations, whereby the people ultimately fund the state, through taxes and more civil participation, rather than the state funding the people, through subsidies and a bloated bureaucracy. To achieve these goals, Vision 2030 builds on the existing downstream economy, but now puts the effort on steroids—at the risk of increasing societal tensions during the transition.

4 McKinsey & Company, *Saudi Arabia Beyond Oil: The Investment and Productivity Transformation*, McKinsey Global Institute, 2015.

THE DOWNSTREAM INDUSTRIES TODAY

THE REFINING INDUSTRY

Refining has become a major part of Saudi Arabia's energy production. Saudi Arabia's state-run oil company, Saudi Aramco, now has enough refining capacity to give it a "base load"[5] of demand for over half of its crude oil production and is slated to increase this base load further with the addition of new refineries both at home and abroad.

Saudi Arabia's production of crude oil in 2016 has varied between 10.26 and 10.55 million barrels per day (b/d), but it exports only 7.51 million b/d. The balance is used internally for two main purposes. One is to burn crude to run electricity plants, especially when demand peaks in the summer—an amount of 886,000 b/d[6] in the first half of 2016.[7] The other is for use in the Kingdom's refineries. In 2016, the output of the refineries was 2.7 million b/d after partially drawing on the stocks. The Kingdom uses 1.3 million b/d internally and exports 1.4 million b/d of various refined products, such as gasoline, diesel, naphtha, and fuel oil.

The Kingdom has nine refineries with a total capacity of 2.9 million b/d. Five of the refineries are 100 percent owned by Saudi Aramco and four are in fifty-fifty joint ventures with foreign partners. The latest refinery to come on stream is the 400,000 b/d YasRef in Yanbu in partnership with Sinopec of China, which ramped up its production in 2016. In 2015, SATORP, a $14 billion, 400,000 b/d refinery in a joint venture with Total, also started producing at capacity. The other two partly foreign-owned refineries are fifty-fifty joint ventures with Shell (SASREF) and ExxonMobil (SAMREF).[8]

Naturally, refining adds value to the crude. The export of 1.4 million b/d of products contributes substantially to the overall income of Saudi Aramco. Refining is also valuable in that it creates some employment for Saudis, beyond just exploiting crude reserves. The actual refineries have relatively few employees, but the industry employs a good number of persons in maintenance and ancillary services provided by the private sector to the refineries.

Saudi Aramco is now building another 400,000 b/d refinery in Jazan near the Yemeni border. This refinery, expected to open in 2018, will produce not only products for local consumption and exports, but also naphtha for downstream use, mainly in a large chemical complex in a joint venture with SABIC.[9] The refinery is 100 percent owned by Saudi Aramco. It appears that no foreign companies volunteered to invest in this venture. Perhaps the foreign investors thought the location was not the most economically attractive as the crude feedstock must be shipped from the harbor of Ras Tanura on the Gulf through the Straits of Hormuz and Bab El Mandeb, unlike all the other Saudi-based refineries, which are linked to the crude oil fields by pipeline. More likely though, the foreign companies may have been concerned about being too close to the Yemeni battleground.

On the other hand, the purpose of the Jazan refinery is twofold: 1) to bring employment to the region by establishing a major downstream chemical center close to the refinery, and 2) to create a developed and industrial belt near the border to better protect it. Ultimately, the Saudi government is banking on the possibility that a chemical hub downstream from a green field refinery will attract many investors.

Equally important to Saudi Aramco is the policy of establishing a number of refineries overseas. Saudi Aramco has three refineries in the United States and operates one in Korea, one in China, and two in Japan. It is building a 370,000 b/d refinery in Indonesia in a joint venture with Pertamina.

However, Saudi Aramco's present slate of refining capacity overseas is about to change. Saudi Aramco's partner in Motiva, a joint venture in the United States that operates three refineries, is Shell Oil. It appears that the two partners in this fifty-fifty venture have decided to go their own ways. Shell Oil will likely end up with two 230,000 b/d refineries, while Saudi Aramco will

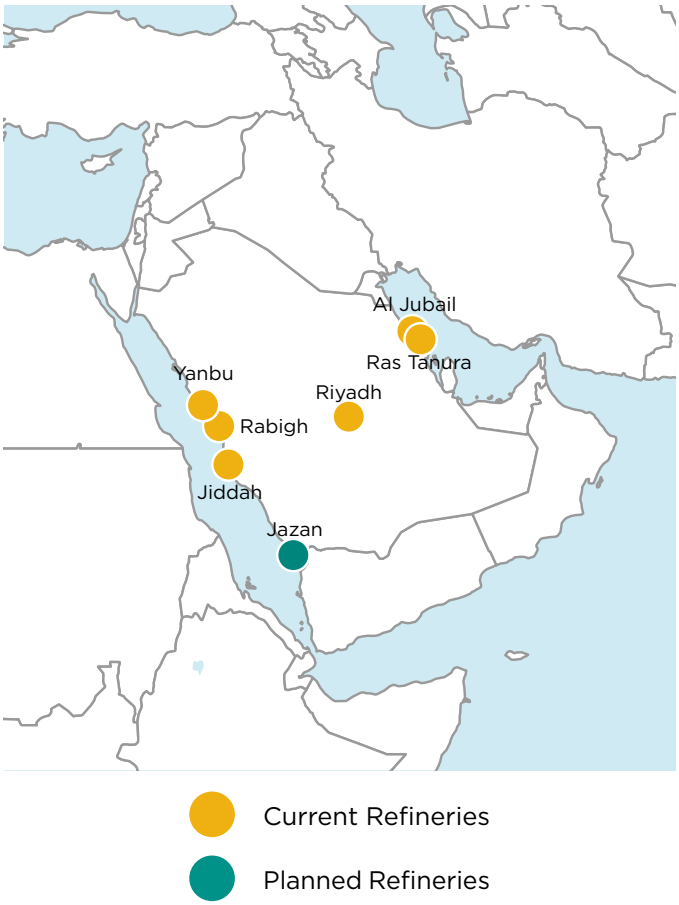
5 Base load, here, means the amount of oil put through the refining process, which allows Saudi Aramco to maintain production at the most efficient level.

6 The amount of crude burning is something Saudi Arabia would like to bring down to naught as it is both polluting and inefficient. As Saudi Aramco finds and processes more dry natural gas, it is confident it can switch most of the electricity generation to natural gas.

7 Middle East Economic Survey (MEES), August 19, 2016, 7.

8 MEES, Vol. 59, No. 36, September 9, 2016; MEES, Vol. 59, No. 29, July 22, 2016.

9 SABIC is the Saudi Basic Industries Corporation, the largest chemical company in Saudi Arabia and often ranked second-largest in the world. SABIC is discussed further in the paper.



keep the 600,000 b/d refinery in Port Arthur, Texas.[10] This refinery is the largest in the United States and is able to take heavy crudes, which can come from Saudi Arabia. Unlike easily refined light crudes, the process of refining heavy crude is more complex, but it also helps consume more of the Kingdom's lower-revenue heavy crudes. At this time, Saudi Aramco is also bidding for a 276,000 b/d refinery in Port Arthur, Texas. This refinery is presently owned by LyondellBasell and specializes in taking heavy crudes and making products mostly for the chemical industry, which would fit very well in Saudi Aramco's portfolio of refineries. Saudi Aramco is also currently negotiating to establish a 400,000 b/d refinery and chemical hub on the west coast of India.[11] In sum, the total capacity of the overseas refineries in

10 MEES, "Aramco Eyes Houston Refining Hub as Motiva Break-Up Advances," September 9, 2016.

11 Saudi Aramco was bidding to purchase the Essar refinery from the Indian Ruia family. However, in October 2016, Saudi Aramco lost out to a bid of $13 billion offer by Rosneft, the large Russian oil company, pushed personally by President Vladimir Putin. Saudi Aramco is now contemplating establishing a green field refinery and chemical downstream center on the same coast of India. See Dmitry Zhdannikov, Nidhi Verma, and Katya Golubkova, "Exclusive: Oil Wars - How Kremlin's $13 Billion Indian Deal Almost Fell Apart," Reuters, November 16, 2016, http://www.reuters.com/article/us-russia-india-saudi-oil-idUSKBN13B083.

Table 1. Saudi Aramco Refineries around the world

Saudi Aramco Refineries in Saudi Arabia				
Refinery	In Thousands of Barrels per Day	Start-Up	Aramco Percent Ownership	Partner
Ras Tanura	550	1945	100	
Jiddah	90	1967	100	
Riyadh	120	1974	100	
Yanbu	240	1983	100	
Samref, Yanbu	400	1984	50	Shell
Sasref, Jubail	305	1984	50	ExxonMobil
Petro Rabigh, Rabigh	400	2009	37.5	Sumitomo
Satorp, Jubail	400	2015	62.5	Total
Yasref, Yanbu	400	2016	62.5	Sinopec
Total Capacity	**2,905**			
Jazan (early 2018)	400	2018	100	
Total Capacity	**3,305**			
Saudi Aramco Refineries Overseas				
Port Arthur, USA*	600		50	Shell
Convent, USA*	230		50	Shell
Norco, USA*	235		50	Shell
Ulsan, Korea	669		63.4	S-Oil
Yokkaichi, Japan	250		14.96	Showa Shell
Yamaguchi, Japan	120		14.96	Showa Shell
Keihin, Japan	70		14.96	Showa Shell
Fujian, China	240		25	Sinopec, ExxonMobil
Total Operating	**2,414**			
Total Current Capacity	**5,313**			
Indonesia (2022)	370		50	Pertamina
Port Arthur (under negotiation)	260		100	

* The three refineries in the United States are held in joint venture with Shell; however, the joint venture is being dissolved. It is expected that Saudi Aramco will keep 100 percent ownership of the Port Arthur refinery and Shell will retain 100 percent ownership of the Convent and Norco refineries.

Sources: MEES, September 9, 2016, Vol. 59, No. 36 and MEES, July 22, 2016, Vol. 59, No. 29.

Saudi Aramco's portfolio is 2.4 million b/d[12] and this capacity could increase to 3.1 million b/d within two to three years.

Altogether, Saudi Aramco's refining capacity, now at 5.3 million b/d, is likely to reach 6 million b/d shortly. Considering total exports are 7.5 million b/d today, it is interesting to see that Saudi Aramco appears to be following a precise business plan, the main tenet of which is to establish a baseload of demand for its crude production that will

- guarantee the Kingdom can expand value-adding production beyond crude oil;
- provide a market for its less profitable crudes, mostly heavy or mid-heavy Arabian crudes, which when refined in modern refineries give these crudes a major cost advantage;
- ensure Saudi Arabia has a market for its crude oil regardless of the competition in the crude markets from other producers, be they OPEC (Organization of the Petroleum Exporting Countries), Russia, or the United States; and
- allow the refineries to export products to places with little refining capacity, such as Egypt, other African countries, a number of Asian countries, or where refineries are very inefficient.

THE CHEMICAL INDUSTRY

Long before Deputy Crown Prince Mohamed bin Salman's announcement on April 26, 2016, of his grand plan of Vision 2030, which seeks, in part, to get Saudi Arabia unhooked from what he characterized as the Kingdom's "addiction" to crude oil,[13] many in the Kingdom had been pushing to diversify the economy. In 1974, under the direction of then Minister of Finance Mr. AbalKhail and two prominent advisers to the king, Mr. Khalid Al-Gosaibi and Mr. Mohamed Al Zamil, some fundamental decisions were made that influenced Saudi development until now and established the foundation for Vision 2030.

The first and perhaps most important decision pushed by these technocrats was that Saudi Arabia should gather the natural gas associated with crude oil production and use it exclusively for the development of the Kingdom. No gas was to be exported. Instead, they believed it should be used to generate electricity and desalinated water and as feedstock for chemical manufacturing.

To achieve this vision, Saudi Arabia established the Saudi Arabian Basic Industries Corporation (SABIC) in 1976 to focus on chemicals and fertilizers. The Kingdom also established state-run financial institutions, like the Saudi Industrial Development Fund (SIDF) and the Public Investment Fund (PIF), which specialize in industrial development. The latter will potentially become the largest sovereign fund in the world when it becomes the main shareholder of Saudi Aramco as planned under Vision 2030.[14]

"No gas was to be exported. Instead, [Saudi technocrats] believed it should be used to generate electricity and desalinated water and as feedstock for chemical manufacturing."

SABIC

In 1982, SABIC became a public-private partnership (PPP). It floated 30 percent of its shares to the public at large, including 5 percent to non-Saudi citizens of Gulf Cooperation Council countries. Floating the shares on the then newly created Tadawul stock exchange in 2007 in Riyadh helped establish a real financial market in the Kingdom.

In the early part of its existence, SABIC knew it had to rely on foreign partners for technology, know-how, and marketing. It established fourteen joint ventures with the likes of ExxonMobil, Taiwan Fertilizers, and Shell (for a full list, see appendix). In due course, SABIC developed its own technologies and expertise. It also built its own marketing teams and understanding of the highly technical aspects of the sales efforts. In the early history of the company, sales were arranged directly by the partners, but over the years SABIC took over most of the marketing of its products.

In 2007, SABIC acquired 100 percent of the advanced plastics division of General Electric for $11.6 billion, and thus became one of the world leaders in plastics for the transportation industry, with plants in thirty-two countries. It also acquired the ethylene production

12 Jeddah Chamber, "Saudi Arabian Sector Report – Oil and Gas 2015," www.jeg.org.sa.

13 Andrew Scott Cooper, "Saudi Arabia's First Step Is Admitting It Has an Oil Problem," *Foreign Policy*, June 7, 2016.

14 Jean-François Seznec, "Saudi Arabia's Sell Off of Aramco: Risk or Opportunity?" Bulletin of Atomic Scientists, Vol. 72, No. 6, October 4, 2016, 378-383.

assets of Huntsman and DSM in Europe, becoming the largest producer of ethylene in Europe with plants in the United Kingdom, Germany, and Ireland.

Today, SABIC has forty thousand employees worldwide, sales of $39.5 billion (in 2015), and assets of $87.5 billion.[15] It is increasingly developing its own technology and seldom goes into joint ventures, unless needed to acquire a new technology or competency. Today, SABIC is a market leader in key products such as ethylene, ethylene glycol, methanol, methyl tertiary butyl ether (MTBE), polyethylene, engineering plastics, and their derivatives. SABIC is the world's third largest producer of polyethylene and polypropylene and the world's largest producer of mono-ethylene glycol, MTBE, granular urea, polycarbonate, and polyphenylene.

The company is organized along five main divisions—chemicals, innovative plastics, metals, polymers, and agri-nutrients—and operates twenty-three subsidiaries in fifty countries.

The metals division is the least chemically oriented division of the company. It operates one of the largest direct reduction steel lines in the world with a capacity of 2.8 million tons per year. It produces steel slabs, rods, and re-bars for the construction industry and a rolling mill next to the main plant.[16] The direct reduction technology, developed in Germany, takes pelletized iron ore, piles it up, and reduces it into steel by the injection of natural gas. The process is gas intensive, but allows the company to bypass the traditional step of making pig iron from ore and then steel from pig iron. The products are sold in the Kingdom and among its neighbors. The lore is that the Burj Khalifa in Dubai was built using Saudi steel products.

The Gulf, rich in cheap energy, does have other steel plants, mainly in Qatar, which has access to plentiful natural gas. None of the Gulf steel producers has access to its own iron ore. Therefore, producers depend on supply from the main producers of pelletized iron ore, such as Vale of Brazil or BHP Billiton[17] of Australia. So, while the Gulf is endowed with low-cost energy, it is still not in full control of its own steel industry.

The chemicals division accounts for about 89 percent of the company's total sales, while fertilizers account for only 3.9 percent and metals around 7.2 percent. Fertilizers constitute only 3.8 percent of SABIC's overall assets of $87.5 billion. Hence, even though fertilizers and metals, especially fertilizers, add substantial profits to the company, their relatively small shares of SABIC's overall assets could make them appear to be less important to SABIC's overall business.

In May 2007, SABIC took 30 percent financial control and full management of a Saudi company called Kayan, which had been formed to develop chemicals, such as ethylene, propylene, and glycols, but which mainly focuses on propane-based advanced chemicals like ethanolamines and various polycarbonates. Today, though Kayan shares are traded on the stock market in Riyadh, its technology, marketing, and product developments are entirely controlled by SABIC.[18]

Within Saudi Arabia, SABIC has developed products based on natural gas, including methane, ethane, propane, and butane, while Saudi Aramco has focused on products made from "liquids," i.e., products that use derivatives of naphtha or liquid petroleum gas produced in the Saudi Aramco refineries as a base feedstock. However, SABIC has been able to use liquids as feedstock for its developments abroad. The ethylene and downstream productions of SABIC in Europe are based on locally purchased hydrocarbon molecules derived from both natural gas and refined oil. The same applies to SABIC's plant in Tianjin, China, where it purchases its feedstock from the local refineries.[19] SABIC today has research centers in the United States, China, and Europe, as well as in Saudi Arabia, which produce numerous patents used in the industry.

WTO Issues in the Chemical Industry

In the early years of the twenty-first century, the Saudi government realized it could not compete in the world of chemicals without being part of the World Trade Organization (WTO). Many countries, especially in the European Union, accused the Saudis of unfairly subsidizing Saudi chemical industries by giving them access to extremely low natural gas feedstock. Naturally, the argument was that SABIC could get methane and ethane at $0.75 per million British thermal units (/mbtu), while the Europeans

15 For comparison, BASF, the largest chemical company in the world, has a capitalization of about $79.94 billion (€71.75 billion) and 2015 sales of about €76.6 billion. SABIC's capitalization on June 11, 2016, was $70.588 billion on a share price of $22.40.

16 SABIC, *New Challenges, New Opportunities*: *Annual Report 2015* (Riyadh, Saudi Arabia, 2016), https://www.sabic.com/me/en/newsandmediarelations/publications/overview_annual_report.

17 BHP Billiton has a joint venture in Brazil called Samarco, which produces 3.5 million ts/y of iron pellets.

18 MEES, "Saudi Kayan IPO Closes Oversubscribed," May 14, 2007.

19 "SABIC and Sinopec Invest in Polycarbonate Plant with 260 Kilo Metric Tonnes Capacity in China," SABIC, May 17, 2011, https://www.sabic.com/me/en/newsandmediarelations/news/2011/20110517--SABIC-and-Sinopec-invest-in-polycarbonate-plant-with-260-kilo-metric-tonnes-capacity-in-C.

Representatives present Vision 2030 alongside the United Nations General Assembly in September 2016. *Photo credit*: United Nations Development Programme/Flickr.

were paying $8/mbtu.[20] The Saudis' answer was that their "natural comparative advantage"—the essence of arguments for free trade and WTO's economic philosophy—was in fact their ability to produce gas at almost zero cost, since it was merely a by-product of their production of crude oil, and would otherwise be flared and therefore lost. To counter the Europeans, Saudi Arabia launched an extensive, global marketing effort to convince the world of its natural comparative advantage.

Part of the problem was that SABIC was indeed buying methane and ethane at $0.75/mbtu, the lowest cost in the world for both gases. SABIC and other Saudi producers could also buy natural gas liquids, like propane and butane, at a cost, computed by Saudi Aramco, equal to the market price of these gases on the Tokyo stock exchange minus 30 percent. The European manufacturers of propane-based products held this to be an unfair subsidy to production that endangered the European producers in their own markets. The Saudi negotiators at the WTO agreed to provide the same pricing to any user of propane and butane in Saudi Arabia, regardless of nationality, thereby putting everyone on an even field.

Saudi Aramco's Entry into the Chemical Business

Had the negotiations with the European countries not come to a satisfactory conclusion, the WTO may have rejected Saudi Arabia's application. Understanding this was risky, Saudi Arabia decided to diversify from its use of low-cost natural gas as feedstock as a precaution, to ensure the development of its chemical industry if the country was not granted admittance to the WTO. Indeed, had Saudi Arabia not been made part of the WTO, it could have been sued in WTO court by any producer and would have had no recourse or ability to defend its views about its basic natural advantage. Any WTO country could have raised tariffs prohibitively against SABIC products, accusing it of having access to highly subsidized prices from the Saudi state oil company.

20 "Henry Hub Natural Gas Spot Price (Dollars per Million Btu)," US Energy Information Administration, October 13, 2016.

On the other hand, when Saudi Aramco takes its crude oil, refines it, and uses the refined products to make chemicals, it is doing nothing different from ExxonMobil, Shell Oil, or Total. These companies merely transfer oil and products to their own plants downstream. They cannot be deemed to be subsidizing these plants, while if they sold feedstock at a large discount to a company like SABIC, they would, thus making them liable to trade suits by competitors. Of course, the cost of pumping oil in the Kingdom is the lowest in the world and thus the transfer price to the chemical plants is equally the lowest in the world, but without arguments from onlookers over subsidies.

Hence, Saudi Aramco's leadership decided to develop a large chemicals division in parallel to SABIC. Since Saudi Aramco did not have the institutional knowledge to grow this industry, it negotiated two large joint ventures to take naphtha directly out of their refineries and transform the resultant products (ethane, propane, butane, benzene, toluene, etc.) into advanced chemicals.

Saudi Aramco entered into a joint venture with Sumitomo of Japan in 2006 to establish a large integrated refinery and chemical hub. To this effect, Saudi Aramco transferred its Rabigh refinery to the joint venture, which then became known as Petro Rabigh. This joint venture, established in the town of Rabigh, takes the products from the refinery and transforms them into various polymers and a slew of chemicals, which are marketed mainly in China by Sumitomo. The joint venture was formed in 2006, and shares to the public were floated on the stock exchange starting in 2008. Operations began in 2009 and capacity is now being doubled.

Saudi Aramco also negotiated a $20 billion joint venture with Dow Chemical to create the SADARA Chemical Company, which started production in 2015-2016. It has five main lines of products using feedstock from natural gas, benzene, toluene, fuel oil, and naphtha[21] to create advanced chemicals like glycols, di-isocyanates, and polyethylenes.[22] Some of these products, like MDI, an aniline derivative, are extremely difficult and dangerous to manufacture. Their production will be a first in the Middle East and will open the door to many downstream ventures in the Middle East and Asia. MDI, for example, is an isocyanate, which is the base of urethanes, a product widely used worldwide for making very hard plastics used in construction, and for things like rigid insulation and hard shell protection products, such as helmets, in manufacturing. It is a global market that is growing at 22 percent per year and expected to do so at least until 2021.[23]

> "[T]he cost of pumping oil in the Kingdom is the lowest in the world and thus the transfer price to the chemical plants is equally the lowest in the world"

Once Saudi Arabia was accepted into the WTO in December 2007, the difference between the source of feedstock to the chemical industry became moot. As the WTO agreements were signed, Saudi Arabia was able to sell feedstock to any Saudi domiciled manufacturer at "cost plus a fair profit."[24] Now both SABIC and Saudi Aramco could use natural gas and refinery products, as long as the price they paid for feedstock was the same as that of other producers in the Kingdom, foreign or local. On the other hand, it also implied that SABIC and Saudi Aramco could now compete on ethylene and propylene lines and downstream product sales.

Joining the WTO also meant that SADARA, the huge Dow Chemical project, was no longer forced to focus on just producing chemicals from petroleum liquids provided online from Saudi Aramco's refinery in Ras Tanura, but could also use natural gas–based products like ethane or propane and, thus, like SABIC, benefit from the very low price of natural gases in Saudi Arabia. Today, SADARA, which was going to be integrated into the Ras Tanura refinery, has relocated to the much more efficient and spacious area of Jubail. Even though base prices for natural gas have increased in the Kingdom in line with the substantial cuts in subsidies that took effect on January 11, 2016,[25] it is acquiring methane at $1.25/mbtu and ethane at $1.75/mbtu.[26] It is also now able to get naphtha coming

21 MEES, "Sadara Starts Up Second PE Unit: Commissioning 'Going Well,'" May 6, 2016.

22 "Products," Sadara.com.

23 IHS Chemical Week, October 10, 2016, http://www.chemweek.com/sections/cover_story/82706.html.

24 World Trade Organization, "Report of the Working Party on the Accession of the Kingdom of Saudi Arabia to the World Trade Organization," November 1, 2005.

25 MEES, Vol. 59, No. 1, January 8, 2016, 18.

26 Interestingly, even though the Kingdom argued for years that the cost of producing methane and ethane was not subsidized, even at $0.75/mbtu, the main users have accepted the increase without problems. This may be because the new pricing structure benefits Saudi Aramco and ultimately the Kingdom's

from the new Total-Saudi Aramco refinery, SATORP, which recently started production nearby.

Under Vision 2030, Saudi Aramco is slated to extensively develop downstream chemical activity and will start growing it overseas. At this time, as mentioned above, it is bidding for a refinery in Port Arthur, Texas, presently owned by LyondellBasell (a highly reputed chemical manufacturer) which is focused on refining heavy crude into products mainly used for chemical transformation.

Saudi Aramco and SABIC are presently evaluating whether to invest in a new process developed by SABIC to produce various chemicals directly from crude oil. The process would allow for the production of carbon-based chemicals without having to go through a crude oil refining process, which would not only save money, but also reduce carbon dioxide (CO2) and heat emissions.

THE FERTILIZER INDUSTRY

According to the Gulf Petrochemicals and Chemicals Association's[27] Fertilizer Indicator report, Saudi Arabia is the largest fertilizer exporter in the GCC region, with exports of urea, ammonia, and diammonium phosphate (DAP) amounting to 6.4 million tons per year (ts/y), growing at an annual rate of 7.6 percent in the past decade.[28]

The industry is responsible for creating ten thousand direct jobs and thirty thousand indirect jobs, of which approximately 55 percent are held by Saudi nationals. The Saudi fertilizer industry generates $3 billion in sales revenue, accounting for 47 percent of sales of the regional fertilizer industry as a whole.[29]

The main players in the fertilizer industry are SABIC and Ma'aden.

SABIC

SABIC produces fertilizers through three subsidiaries: SAFCO; Al-Baytar, which it owns through a joint venture with Saudi state funds; and Al-Bayroni, a joint venture with Taiwan Fertilizers. The three companies take natural gas and transform methane into methanol, which is then transformed into ammonia, urea, and prilled urea. The companies also produce MTBE, a gasoline additive, banned in the United States but used in many countries to reduce air pollution. These products are sold worldwide. SABIC is also in a joint venture with Ma'aden, the state-controlled mining company, to produce a high-value-added fertilizer, diammonium phosphate.

SABIC's affiliate SAFCO just started a urea plant, which uses CO2 as feedstock. The plant has an annual production capacity of 1.1 million tons of urea and compresses around fifteen hundred tons of raw CO2 per day, which is then piped to make urea. This is the world's largest carbon dioxide capturing plant, and one of the very few that exist.[30]

At present, 26 percent of the fertilizer products produced in Saudi Arabia consist of ammonia, 28 percent consist of urea (both of which are produced by SABIC), and 22 percent consist of DAP and monoammonium phosphate (MAP).

Ma'aden

Ma'aden was originally started in 1997 to develop the gold mines of the Hijaz. Today, however, it has grown into a large conglomerate that went from merely mining to going downstream from mining into very large industrial productions. Ma'aden today mines bauxite, which is used to create aluminum, and phosphate, which is used to create fertilizer. It owns and operates the mines as well as the plants that transform the ores into aluminum and fertilizer.

Ma'aden Phosphate Company (MPC)

"Saudi Arabia hosts one of the largest known but still underdeveloped phosphate rock deposits in the world, spread across the entire northern section of the Kingdom. The Kingdom's reserves are estimated at around 956 million tons of phosphate rock in a number of deposits: Al Jalamid, Umm Wu'al, Al Amud, Quraymiz, Thaniyat Turayf and As Sanam, each with potential for commercial development."[31] At present, Ma'aden exploits a mine located at Al Jalamid in Northern Arabia, which is linked by a fifteen hundred–kilometer railroad to the industrial zone and harbor of Ras al-Khair (RaK), north of Jubail on the Gulf, built especially for Ma'aden.

MPC is a $5.5 billion joint venture owned 70 percent by Ma'aden and 30 percent by SABIC. The RaK site

treasury.

27 The Gulf Petrochemicals and Chemicals Association is a trade group that includes all the chemical and fertilizer producers in the Gulf Cooperation Council.

28 "KSA Dominates Regional Fertilizer Production: GPCA," Thomson Reuters Zawya, September 5, 2016, http://ae.zawya.com/saudi-arabia/en/story/KSA_dominates_regional_fertilizer_production_GPCA-ZAWYA20160905043609/.

29 Ibid.

30 MEES, "GCC Fertilizers Capacity Hits 41Mn T/Y, but Feedstock Crunch Awaits," September 18, 2015.

31 "KSA Dominates Regional Fertilizer Production: GPCA," Thomson Reuters Zawya, September 5, 2016.

includes a phosphoric acid plant, a sulfuric acid plant, an ammonia plant, a DAP granulation plant, and a co-generation and desalination plant.

SABIC receives methane from Saudi Aramco in RaK by pipeline from Abqaiq,[32] the head of all the Saudi pipelines. The methane is transformed into ammonia by SABIC, on behalf of Ma'aden in the ammonia plant in RaK. The ammonia is then mixed with the phosphoric acid (P2O5) produced by Ma'aden, also in RaK, and the resulting product, a fertilizer called DAP[33] is then shipped worldwide. The P2O5 itself is made in RaK from the rock phosphate received by rail from the Al-Jalamid mines in Northern Arabia and transformed by the addition of sulfuric acid, itself made from sulfur provided by Saudi Aramco. The sulfur mixed with water is highly exothermic so that a great deal of the energy used in RaK is self-generated. Ma'aden now produces about three million tons annually of DAP. It thus can sell P2O5 or DAP depending on market conditions. Most of Ma'aden's markets are in South and Far East Asia.

Ma'aden's Wa'ad al Shammal Phosphate Company (MWSPC)

Ma'aden has been contracted by the Saudi state to develop a large industrial area near Turayf, in Wa'ad al Shammal. Work has started in the area. The industrial area will exploit the nearby Khabra phosphate reserves. Ma'aden is planning to mine 16 million ts/y of phosphate and "beneficiate" it (the industry term for "resize and clean") into rock phosphate using local underground water. Ma'aden will also bring in sulfur and gas to make sulfuric acid and ammonia. Wa'ad al Shammal will then produce phosphoric acid and sodium triphosphate. These products will be shipped by railroad to Ras al-Khair where the phosphoric acid will be mixed with ammonia produced by the MPC venture; the company will use the existing DAP line to increase production to 6 million ts/y, which will make Saudi Arabia one of the largest producers of DAP in the world. The Saudi Ports Authority is expected to build three dedicated piers to export products from Wa'ad al Shammal. The total project is expected to cost about $7 billion.

The MWSPC project is run by a joint venture between Ma'aden (60 percent), SABIC (25 percent), and Mosaic Corporation (15 percent).[34] Ma'aden has disclosed that SABIC and Mosaic each paid a fee of $373 million to participate in the project, showing their commitment, as well as that of the Saudi state, to quickly bring the project to fruition.

The project is not just a play on downstream production. Just like the late King Abdullah pushed Saudi Aramco and SABIC to build a large industrial city near the Yemeni border to better secure it, this new city in Wa'ad al Shammal, which is very close to both the Iraqi and Jordanian borders, can secure the northern border of the Kingdom against potential incursions from Iraq and Syria.

Ma'aden is also exploring for potash in Kaf and Hawaza in the north of the country. Potential discoveries of potash would give Ma'aden another great advantage in the fertilizer markets.

Ma'aden Aluminum Company and Ma'aden Rolling Company

Ma'aden and Alcoa of the United States established two joint ventures for the production and rolling of aluminum: Ma'aden Aluminum Company (MAC) and Ma'aden Rolling Company (MRC). Both use bauxite from the mines in Az Zabirah; the caustic soda available from the brine produced by the desalination plants; and, of course, the very low-cost electricity produced with methane from Saudi Aramco, now sold to utilities for $1.25/mbtu. The bauxite mines have a maximum capacity of 3.5 million tons,[35] which can be shipped by rail to RaK and transformed first into alumina and then into aluminum in the smelter, which has a capacity of 850,000 ts/y.

As is the case for all aluminum companies, Ma'aden's main costs of production include those for mining; making alumina from bauxite, caustic soda, and electricity; and smelting aluminum using carbon anodes and huge amounts of electricity. Though, of course, the Saudi cost for generating electricity is one of the lowest in the world. Furthermore, the cost of caustic soda, which is mixed with bauxite and refined by electric currents, is minimal as it is itself produced from the electrolysis of brine, a major by-product of the desalination plants in the Gulf. Alcoa stated in 2015

32 Abqaiq is where most of the crude oil production pipelines from the wells is gathered and the crude oil de-gased, cleaned, and made ready for export or use in the local refineries. The gas itself, 95 percent methane, is treated to separate the heavier gases from the methane. The heavier gases, like ethane, propane, and butane, are used separately to produce numerous chemicals.

33 Ma'aden can also produce variants of this product, mostly monoammonium phosphate, or MAP.

34 Mosaic Corporation is based in Florida, United States. It is one of the largest manufacturer of fertilizers in the world.

35 Most of the factual information presented here can be found in the statements and annual reports of Ma'aden at http://www.maaden.com.sa/en/investor/investor.

that the production costs in RaK are the lowest in the world.[36]

Ma'aden has a 74.9 percent stake in both MAC and MAR and Alcoa owns the remainder in each. Ma'aden has the same stake in the bauxite extraction and alumina plant; the remaining 25.1 percent is split sixty-forty in a joint venture between Alcoa and Alumina Ltd. The Chlor-Alkali plant, which produces the caustic soda needed to transform bauxite into alumina, is owned through a fifty-fifty joint venture between Ma'aden and Sahara Petrochemicals, a private firm traded on the stock exchange in Riyadh. The overall project is estimated to cost $10.8 billion.

36 "Chairman's Letter," *2015 Annual Report*, Alcoa Inc.

PRIVATE SECTOR COMPANIES

Aluminum production is particularly significant for the Kingdom's future development, as it can encourage the creation of numerous smaller companies that will transform aluminum into a wide variety of products used in the automobile and construction industries, among others.

Many Saudis, some say over 50 percent, own shares on the stock exchange (the Tadawul) in Riyadh. The public owns 30 percent of SABIC's shares and 45 percent of Ma'aden's; the public also has significant minority-level ownership of the affiliates of these two companies and those of Saudi Aramco. Every initial public offering (IPO) that involves Saudi Aramco, SABIC, or Ma'aden is usual vastly oversold. It is also interesting to note that IPOs in the Kingdom are structured so that by and large they will be sold to a large number of small shareholders, avoiding the takeover of industries by rich groups.[37] Foreign companies are not presently allowed to float shares on the Tadawul, but many of the Saudi companies have entered into joint ventures with foreign partners to get access to technology and to reassure investors that a well-known foreign company will also provide proper management and knowledge of the world market for whatever product is being planned.

A large proportion of the public in the Kingdom has bought shares in the state-controlled companies and has, by and large, received good dividends, except from Ma'aden, which does not pay them. The Saudis who buy their shares at the time of most IPOs do see their Saudi Riyal (SR) 10 per share[38] investment increase by many multiples. Hence, the public at large is familiar with the industries downstream from petroleum, gas, and mining. The private sector, especially the important merchant families, have benefitted from the public's familiarity with the downstream sector to form a number of medium-sized and large industrial firms and fund them in part on the Tadawul. These companies are not as large as the state-led ones, but can be substantial by most standards.

A leading private company is Tasnee. The company was established in 1985 as Saudi Arabia's first non-state-owned industrial company, with the aim of advancing the country's economic diversification. Tasnee is basically a holding company for various ventures with other chemical investors. It has consolidated sales of over $4 billion per year. Tasnee controls a number of companies and affiliates:

- Advanced Minerals Industries produces 500,000 ts/y of titanium dioxide (a paint pigment)—one of the largest productions in the world—and 235,000 ts/y of high-purity iron
- Tasnee & Sahara Olefins Company, which invests in other chemical producers
- Saudi Acrylic Acid Company, which operates in acrylic acid and derivatives. The company is also in joint venture with Evonik Industries of Germany. The joint venture produces 80,000 ts/y of super absorbent polymers (SAPs); SAPs are very advanced polymers used mostly in diapers and water retention products
- Rowad International Geosynthetics Co. Ltd., which manufactures polyethylene-based woven products for the construction industry
- Tasnee also owns a car battery plant, a related lead smelter, a chemical plant inspection company (in a joint venture with TÜV of Turkey), and a wire plant[39]

Another interesting company is SIIG (Saudi Industrial Investment Group) with sales of about $2 billion in 2015. SIIG is a venture capital group, which invests funds from some of the most important merchant families in the Kingdom. The company mainly owns two joint ventures with Chevron Phillips, which produce aromatics, benzene, cyclohexane, gasoline blends, and styrene. All these products transform base feedstocks provided by Saudi Aramco's refineries into complex intermediary products that can be used in the Kingdom as feedstock to further downstream production or for export.

37 As shown in the footnote below, everyone who signs up for shares will get some, albeit often a percentage of what they asked for. Hence, anyone who could seek to corner the market on a given IPO will be stymied by the sheer number of requests.

38 IPOs in the Kingdom sell shares at SR10/share. When an IPO is announced, potential buyers list their interest with their banks. Usually the requests total a multiple of the stated IPO amount. The issuer will then distribute to the public only a proportion of the requested shares divided by the multiple of the overselling. In other words, if a potential investor wants one thousand shares and the IPO is oversubscribed ten times, the investor will get only one hundred shares.

39 "Products and Services," Tasnee, http://www.tasnee.com/en/Pages/default.aspx.

Tasnee Petrochemical Plant in Saudi Arabia. *Photo credit*: Secl/Wikimedia.

Many large merchant families have been aggressively increasing their involvement in downstream companies. Among the most notable is the Al Zamil family from the east coast of the Kingdom, which operates under the Zamil Group heading. They run a number of subsidiaries, usually in joint ventures with foreign partners. Many of their ventures are privately held, though some are traded on the stock market in Riyadh. One example is Sipchem, which manufactures many products, including methanol, butanediol, acetic acid, vinyl acetate, and numerous polymer products. Another is Sahara Petrochemicals, which invests in other chemical firms like Al Waha petrochemical company, and the Saudi Ethylene and Polyethylene Company, which is in a joint venture with Ma'aden to make caustic soda for the alumina plant. The Zamil Group is involved in four large chemical and plastic transformers as well as in the manufacturing of numerous building materials, steel buildings, and air conditioning. Al Zamil is also in joint venture with Huntsman of the United States to produce very sophisticated chemicals like epoxy from ethyleneamines.

It is worth noting that some foreign firms are very active in partnering with private sector firms in Saudi Arabia. Perhaps the main example is Huntsman Corporation, which produces advanced chemicals in the Kingdom with partners like NAMA for epoxy, Zamil mentioned above, or polyurethanes with BCI in Dammam.

On the east coast, well-known families are also involved in major industrial ventures. The Alireza family, for example, controls a number of factories, including a large propane dehydrogenation facility and the largest copper cable and fiber-optics plant in the region. The Juffali Group, better known as the Mercedes agents in the Kingdom, owns plants that make Styrofoam, insulation materials, and styrene latex, among other materials.

There are hundreds of smaller companies throughout the Kingdom, usually entirely family owned, that make plastic implements from the resins made by SABIC or the other large producers of intermediate products.

Attached in the appendix is a list of some of the products made by the companies traded on the stock exchange that deal in downstream products. Some are 100% owned and run by the private sector, and some are run by the state but jointly owned by the state and the public.

This list elicits a few points:

1-The entire industry, including crude oil, chemicals, fertilizers, and the downstream sector, is run without input or interference by the royal family. The companies traded on the Tadawul have no princes on staff or even on their boards of directors. The only exception is SABIC, whose chairman is part of the royal family, but who is strongly supported by very competent engineers. Industrial development in the downstream sector has strong support among the technocratic structures and the people. Thus, they are unlikely to be seen by the public as tools of enrichment by royals. Of course, the same applies to the management of Saudi Aramco, which is also independent from the royal family.[40]

2-The overall performance of the downstream sector is already strong. The total sales of the industrial chemical and fertilizer companies traded on the Tadawul were $84 billion in 2014, when prices for chemicals and fertilizers were high, and $60.7 billion in 2015. It is interesting to note that for the same two years, total sales of crude oil and associated products in the Kingdom were in the neighborhood of $310 billion and $156 billion.[41] In other words, during the downturn in oil prices, the importance of crude oil relative to downstream products (exclusive of refinery sales) declined substantially. Indeed, in 2014 the ratio of downstream products to oil sales was 27 percent; the ratio increased to 38.9 percent in 2015.

The relative strength of the non-crude oil sector is not of great succor for the state, which, except for some dividends, gets very little from industrial sales—though it can take a large sum, perhaps 80 percent, in taxes and royalties from Saudi Aramco's crude oil and products sales. Thus, even if the relative share of downstream sales increases substantially in the near future, the state will not be able to obtain significantly more funds to run itself, unless, of course, it starts charging income tax on both state and non-state industrial companies.

3-The downstream sector, by itself, is not a huge creator of jobs for Saudis. Eighty-five percent of the private sector to this day is manned by non-Saudis, while the state-controlled sector is 85 percent Saudi. New investments by the private sector in chemicals, fertilizers, and metal will be of great importance to the country, if it can be done with mainly Saudi participants. Saudi Aramco and SABIC have shown how "Saudization" can be done successfully. However, they have done so at great expense and effort. The private sector may not be as willing to hire, train, and offer young Saudis salaries that compete with those of Saudi Aramco, when they can get good people that work at wages that have to be competitive with those of Reliance Industries of India, the largest oil company in South Asia. No young Saudis will accept work unless they can make sufficient wages to start and provide for their families. Such increases in salaries could help reduce unemployment among Saudi youth, but would indeed create inflationary pressures in the Kingdom.

40 One should note that ownership of the downstream companies traded on the stock exchange is quite transparent, even if in some cases the majority of shares belong to the state. The state's shares are usually held through the Public Investment Fund (PIF). The PIF, until its metamorphosis into a sovereign wealth fund that is expected to hold the shares of Saudi Aramco at the time of privatization next year, was fully controlled by the Ministry of Finance, itself has always been headed by a non-royal person. All companies traded on the stock exchange are required to provide audited statements and disclose their main shareholders. Hence, this structure requires transparency. An important benefit is that it allows the state to keep its assets separate from potential encroaching by the royal family.

41 Estimated by the writer to include crude oil, liquids, and natural gas liquids at $100/b on an average of 8.5 million b/d in 2014 and at $45/b on 9.5 million b/d in 2015.

FINANCING THE DOWNSTREAM INDUSTRY

The present and future success of the development of downstream industrial production has been greatly helped by the financing institutions and structures used to fund the companies. The largest companies in the Kingdom, like Ma'aden, SABIC, and some of the Saudi Aramco downstream companies, are ventures between the state and the public, and thus are public-private partnerships. These firms have mastered how to blend sophisticated structures that include suppliers' credit from the countries selling the equipment; loans from the local state funds, like the Public Investment Fund, now slated to become the shareholder of Saudi Aramco; or loans and sometimes equity from the General Organization for Social Insurance (GOSI).[42] The projects have also managed to arrange syndications of lenders that include the Saudi Industrial Fund, international commercial banks, local banks, and the rapidly growing Islamic financial institutions. This mix of financing is indeed very difficult to put together as the interests of each institution, even those within the state structure, differ in terms of interests, demands, and profit motivations. As is the case with all large international financial syndicates, the institutions have to negotiate joint inter-creditor agreements, which detail the rights and responsibilities of all lenders, regardless of their nature. Oftentimes, these creditor agreements are harder to finalize than the actual investments.

SAUDI ARAMCO'S PETRO RABIGH

An example of this sophisticated financial arrangement is seen in the funding of Rabigh Refining and Petrochemical Company (Petro Rabigh). The company is a joint venture between Saudi Aramco and Sumitomo of Japan and was established in 2006 as a $9.6 billion venture to take over one of Saudi Aramco's refineries and use some of the products, especially naphtha, to transform them into polyethylene, HDPE, MEG, PP, PO, among many others,[43] and various polyols,[44] all mainly for export to the Far East. However, in January 2008 the venture broke the mold of pure state control when it went public. The IPO was a resounding success, with 4.5 million Saudi citizens buying shares in the company. Thus, Petro Rabigh became a PPP.

The table below, based on the IPO document, shows that Sumitomo and Saudi Aramco have equal participation in both shareholding and subordinated loans. Sumitomo provided technology and know-how and shepherded 25 percent of the project in suppliers' credits, i.e., a guarantee by the Japan Bank for International Cooperation, or JBIC, of loans to sellers of Japanese equipment. There is, however, little doubt that Saudi Aramco holds the real control. Indeed, the Saudi side of the financing includes the Saudi Aramco shares, as well as 50 percent of the subordinated loan, and the loans from PIF and GOSI, which are both owned by the state. Furthermore, the IPO was floated to a very large number of Saudis, who undoubtedly rely on Saudi Aramco to represent their interests.

The commercial banks, for their part, represented 24 percent of the total financing. Two-thirds of this funding was syndicated between local and international banks, and the balance by Islamic financial institutions located in Saudi Arabia and Bahrain. From a credit standpoint, Petro Rabigh could show the banks that its debt-to-equity ratio was about 1.2 to 1, thus very conservative and in line with most very large chemical companies in the world. Consequently, and also due to the excellent ratings of its two main partners, the company was able to borrow at low margins, and raise the funds in a very short time. This structure became a model, with some tweaking, used to fund most of the other large downstream projects in the Kingdom.

Saudi Aramco has established two ventures since then that have raised billions from the markets. SATORP, a joint venture between Total of France and Saudi Aramco, is one. It raised $14 billion between the equity of the shareholders and large sums borrowed as sukuk[45] in the Islamic bond market and from the international banks. The company has not yet issued shares to the public, but this is likely to happen after Saudi Aramco gets privatized.

Similarly, SADARA, the joint venture between Dow Chemical (35 percent) and Saudi Aramco (65 percent)

42 GOSI is a pension fund managed by the state. It receives contributions monthly from every employee of all firms in Saudi Arabia, and pays out pensions when employees retire. It is very similar to the US Social Security Administration.

43 HDPE = High Density PolyEthylene, MEG = MonoEthylene Glycol, PP = PolyPropylene, PO = Polyethylene Oxide.

44 See "Overview," Petro Rabigh, http://petrorabigh.com/en/Overview.aspx.

45 Sukuk are Islamic bonds that are designed in specifically sharia-compliant terms.

Table 2. Petro Rabigh Financing Structure

Source	US$ Millions	SR Millions	%
Equity Funding			
Saudi Aramco or Affiliates Equity Subscription	876	3,285	8.87
Sumitomo Chemical or Affiliates Equity Subscription	876	3,285	8.87
Subordinated Loans from Founding Shareholders and Pre-completion Net Revenue	1,069	4,009	10.83
IPO Proceeds (Net of IPO Expenses)	1,211	4,541	12.27
Total Equity, Subordinated Loans, and IPO Proceeds	**4,032**	**15,120**	**40.84**
Commercial Debt Funding			
Japan Bank for International Cooperation Overseas Investment Loan (OIL)	2,500	9,375	25.32
PIF Facility	1,000	3,750	10.13
Commercial Facility by International, Regional, or Local Lenders	1,740	6,525	17.63
Islamic Facility by Local and Regional Islamic Banks	600	2,250	6.08
Total Senior Debt	**5,840**	**21,900**	**59.16**
Total Funds	**9,872**	**37,020**	**100.00**

Sources: "Prospectus: Rabigh Refining & Petrochemical Company," Petro Rabigh, December 16, 2007, http://www.petrorabigh.com/en/petrorabigh_e_prospectus.pdf.

discussed earlier, has raised over $20 billion between international banks and equity partners to fund the project. It is expected that Saudi Aramco will cede 30 percent of the company's equity to the public, to structure SADARA into a true PPP.

Saudi Aramco itself is presently undergoing a major financial transformation. Its privatization was announced late in 2015, and it is expected to actually take place in 2018. It is probable[46] that the company's ownership will be transferred to the PIF, thereby making it the largest state investment fund in the world, with 5 percent of Saudi Aramco floated to the public. Thus, in the future, more and more projects undertaken by Saudi Aramco will be funded as PPPs with PIF as the state funding vehicle and private investors, perhaps even including foreign investors in line with the opening of the stock market in Riyadh.

SABIC'S FINANCING

A main strength of SABIC has been its ability to structure its capital and borrowing. It seems that SABIC tries to put up little capital in its ventures, structures itself as a PPP but keeps control of the operations, and maintains a conservative debt-to-equity ratio, while 30 percent of the shares are held by Saudi households.

Shareholders are partial to SABIC. First, the company has had a policy of paying substantial dividends. Second, its shareholders have made a good return on the original price of their share issue. Because of the Saudi IPO format, the public pays only the face value of the shares—in the case of SABIC, SR10/share—while the market value, which has been hurt by the decline in chemical prices in the world, was still at SR84.5 in October 2016. In the past ten years, shareholders who bought their shares at each IPO issuance at SR10/share have received an average return of 31 percent per year on their investment, plus a capital gain of 8.5 to 1 if they were to sell their shares today. Therefore, it is safe to think that small investors do seek to take advantage of every good IPO, holding the shares to collect excellent dividends, and expecting capital gains should they sell.

46 See Jean-François Seznec, *Saudi Energy Changes: The End of the Rentier State* (Washington, DC: Atlantic Council, March 2016) and Jean-François Seznec, *Privatization of Saudi Aramco: A Path to Good Governance,* New Atlanticist Blog, Atlantic Council, January 11, 2016, http://www.atlanticcouncil.org/blogs/new-atlanticist/privatization-of-saudi-aramco-a-path-to-good-governance.

SABIC's popularity with investors has carried through to its affiliates; it has allowed it to float shares very successfully for affiliated companies like Yansab, Saudi Kayan, and SAFCO, all of which are controlled by SABIC, but financed separately.

SABIC's ability to raise funds for itself and for its affiliates allows it to keep a low leverage, in line with most world chemical companies. In 2015, the average ratio of liabilities to equity over the past ten years was 0.56, down from 0.61 in 2014 in spite of paying up to 50 percent of its net earnings in dividends. This gives SABIC a major advantage in borrowing funds from the world markets and has earned it a Standard & Poor's rating of A+.

SABIC's affiliates often borrow independently from the parent company, using complex international syndications with long tenors at attractive rates. SABIC works closely with major international banks, like HSBC, to organize suppliers' credit; loans from state organizations, like PIF and SIDF, which lend money at low rates; long-term syndicated facilities; and Islamic financing for periods of up to twenty years.

Increasingly, SABIC uses sukuk to finance its acquisitions and its investments within the Kingdom. SABIC's sukuk were first issued in 2002 to finance the purchase of the ethylene assets in Europe, mentioned earlier. The company prepaid the bonds, probably to take advantage of the lower interest rates available in the markets at the time of repayment. Sukuk are the only tradable debt instrument in the Gulf and are popular with Gulf investors.

MA'ADEN'S FINANCING

Ma'aden floated 40 percent of its capital on the stock market in Saudi Arabia. Today Ma'aden's stock is actively bought and sold. A further investment incentive for lenders is the involvement of the large state funds, like PIF and GOSI, as minor shareholders in Ma'aden and as major lenders, along with the SIDF, in both Ma'aden and the joint ventures producing phosphate and aluminum. The widely held perception that Ma'aden is run efficiently by its managers, most coming from the state's excellent technocratic structure, allows Ma'aden to leverage itself more than most mining companies. Today, Ma'aden runs a balance sheet showing total assets of $16.3 billion with only $6.01 billion in capital. Furthermore, unlike

"A series of interrelated joint ventures has allowed Ma'aden to maximize its control with a minimum of expended capital."

SABIC, Ma'aden does not pay dividends in spite of usually showing modest profits. It seems as though Ma'aden, like many hi-tech companies in the West, expects investors to count on major future growth (in Ma'aden's case, in phosphates and aluminum) as a sufficient incentive to invest.

A series of interrelated joint ventures has allowed Ma'aden to maximize its control with a minimum of expended capital. As these affiliates, like MPC or MAC discussed earlier, grow, their capital needs will increase. Thus, one can expect they will float shares on the Riyadh stock exchange and borrow money independently from the parent company and without recourse to it, just like Saudi Aramco and SABIC are doing.

Of course, PPPs are quite favored by the public. Rightly or wrongly, the public believes the state takes on the investment risk, not personal investors. Most people will think, probably rightly, that should the companies suffer a major downturn or loss that the state will support them and somehow take care of the small shareholders. Hence, IPOs by state-owned companies that float shares on the Tadawul usually get greatly oversubscribed.

Non-state companies may have less success raising funds than the SABICs and Petro Rabighs of the Kingdom as their risk will be perceived more as falling on the individual investor, rather than on the state, thus requiring higher interest rates. Nevertheless, they have had no difficulty in selling shares to the public. Firms founded by well-known trading families, especially if in joint venture with well-respected foreign companies, will usually be able to hold very successful IPOs. By the same token, the non-state companies will be able to borrow money easily from the highly liquid banks of the Kingdom and the rest of the Gulf. The use of sukuk for long-term industry financing is also quite prominent.

DOWNSTREAM INDUSTRIES AND VISION 2030

Chemicals, mining, and the Public Investment Fund will see a lot of growth and development as a result of Vision 2030. The following are the expected changes in these areas:

CHEMICALS

Investments in chemicals, both basic and advanced, will continue and accelerate mainly through SABIC, but also increasingly through Saudi Aramco. The template for these investments is the format developed by SADARA, the $20 billion joint investment between Saudi Aramco and Dow Chemicals. SADARA is in the process of ramping up production and is expected to create a large number of new companies that will take the chemicals produced by the joint venture and transform them into substances appropriate for various markets—in the Kingdom, the region, and for export further afield.

MINING

The plan sees mining as one of the most important industries slated for development. It projects mining will add 90,000 jobs by 2020 to the 250,000 presently in this sector. In fact, the McKinsey report used as a basis for Vision 2030 states that the mining industry in the Kingdom could comprise 500,000 jobs.

The actual mining of resources like phosphate does not produce many jobs. The production of DAP—now at about 2.8 million ts/y and slated to increase to 6 million when Wa'ad al Shammal comes on stream—will not create the ninety thousand new jobs required. The jobs to be created will principally have to come from downstream manufacturing related to bauxite and other products[47] mentioned in the McKinsey report. It seems that the plan takes mining in a very broad sense. For example, the bauxite listed in the report gets transformed into aluminum, and creates relatively few jobs. However, the transformation of aluminum into myriad products creates many.

The McKinsey report provides some financial goals to develop the mining industry, estimating that investment needs exceed $200 billion.[48] It continues: "This includes more than $100 billion in new project investment opportunities in phosphate, aluminum, bauxite, and other minerals, in addition to another $100 billion in investments in existing capacity."[49] It is not clear which minerals will be emphasized, but new investments will likely go toward developing the phosphate industry, both upstream and downstream from it.

Interestingly, as mentioned by MbS, the mining sector may become open to participation by the private sector. If this were the case, the three aluminum joint ventures with Alcoa (MAC, MRC, MBAC)[50] and the DAP production at MAC and MWSPC[51] may be privatized in whole or in part, or new ventures may be started independently from the Ma'aden structure.

THE PUBLIC INVESTMENT FUND

One of the engines of growth will be the PIF; while it is already a major fund, it will become much larger when it takes over Saudi Aramco and sells 5 percent of Saudi Aramco's shares to the public. PIF is already getting prepared to grow rapidly. It has signed an agreement with SoftBank of Japan to establish a $100 billion investment fund[52] that will be based in London and focus on industrial participation. It is beginning to make investments in technology companies, like Uber, to bring such technology in the Kingdom. One can expect that PIF will be a major investor in all important joint ventures in Saudi Arabia in the near future.

47 "silica, gypsum, limestone, kaolin, and magnesite, for use as fertilizers as well as in construction, transportation, and packaging." See McKinsey & Company, *Saudi Arabia Beyond Oil*, 49.

48 Ibid., 47.

49 Ibid., 48.

50 MAC stands for Ma'aden Aluminum Company, MRC for Ma'aden Rolling Company, and MBAC for Ma'aden Bauxite & Alumina Company.

51 MPC—70 percent owned by Ma'aden, 30 percent by SABIC—stands for Ma'aden Phosphate Company. MWSPC stands for Ma'aden Wa'ad al Shammal Phosphate Company, the joint venture between Ma'aden, Mosaic Co., and SABIC.

52 Alexander Martin, Alec Macfarlane, and Margherita Stancati, "SoftBank and Saudi Arabia Team Up for $100 Billion Tech Fund," *Wall Street Journal*, October, 14, 2016, http://www.wsj.com/articles/softbank-group-launches-investment-fund-1476398189.

CONCLUSION

Of course, Vision 2030 is not likely to succeed without trials. Its very ambitious nature is forcing major changes to the country's societal structures. Indeed, faced with an important decline in revenue, the state is incurring a very large budget deficit, expected to be $68 billion in 2016, exclusive of the very high cost of the Yemen war. Hence, perhaps the most important part of Vision 2030 is the unstated policy that the people can no longer depend on the state as their main provider, but that in reverse the state now will depend on the people to survive.

Even though this paper argues that the economic change proposed in the Kingdom is an evolution from an already existing strong downstream base, albeit put on steroids, the social changes required to achieve the ambitious goals of Vision 2030 are more revolutionary. Some of the major established interests that until now have leeched off the state will lose their "cash cow." Indeed, the population will see, and has already begun to see, some important changes. Subsidies have been cut, civil servants' bonuses have been cancelled, many of the privileges of the royal family have been suppressed, and the religious establishment's influence is being curbed drastically. Naturally, curbing the royal family's and the Salafi religious establishment's privileges in particular are especially necessary to ensure that everyone feels that he/she will be impacted by the changes fairly and equally. Undoubtedly, there is strong opposition by some of these privileged classes. They will not give in easily and could try to sabotage the plan. The main strength of the plan is that it has the support of the technocrats who control both the finances and the economy. It also has support of the leadership of the king and MbS. And, significantly, it has the support of the 70 percent of the population that is below age thirty and wants the country to move into the twenty-first century.

ABOUT THE AUTHOR

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APPENDIX

Table 3. List of SABIC's Partnerships and Investments

Name	Location	SABIC % Ownership	Partnership	Products
Alba	Bahrain	20.00%	State of Bahrain-77%, Brenton Investments-3%	Aluminum
Al-Bayroni	Al-Jubail, KSA	50.00%	Taiwan Fertilizer-50%	Fertilizers
Ar-Razi	Al-Jubail, KSA	50.00%	Japanese consortium led by Mitsubishi Gas Chemical Co.-50%	Chemical-Grade Methanol
GARMCO	Bahrain	31.3%	Kuwait-16.9%, Bahrain-38.4%, Iraq-4.1%, Oman-2.0%, Qatar-2.1%, and Gulf Investment Corporation-5.2%	Aluminum
Gas	Al-Jubail, KSA	70.00%	Saudi Arabian private-sector companies-30%	Oxygen, Nitrogen, Argon, Krypton, Xenon
GPIC	Bahrain	33.30%	Petrochem Industries Company of Kuwait-33.3%, Bahrain-33.3%	Methanol and Fertilizers
Hadeed	Al-Jubail, KSA	100.00%	None	Steel Products
Ibn Al-Baytar	Al-Jubail, KSA	50.00%	SAFCO-50%	Fertilizers
Ibn Rushd	Yanbu, KSA	45.19%	Saudi Arabian private sector companies-21.3%, PIF-33.51%	Aromatics, PTA, PET, Bottle-Grade Chips, Acetic Acid
Ibn Sina	Al-Jubail, KSA	50.00%	CTE-(Elwood Insurance Ltd.-25%, Texas Eastern Arabian Ltd.-25%)	Chemical-Grade Methanol, MTBE
Ibn Zahr	Al-Jubail, KSA	80.00%	Ecofuel Italy-10%, APICORP-10%	MTBE and Polypropylene
Kemya	Al-Jubail, KSA	50.00%	ExxonMobil-50%	Polyethylene and Ethylene
Petrokemya	Al-Jubail, KSA	100.00%	None	Ethylene, Polystyrene, Butene -1, Propylene
Sadaf	Al-Jubail, KSA	50.00%	Shell Chemicals Arabia LLC-50%	Ethylene, Ethanol, Styrene, Caustic Soda
SAFCO	Al-Jubail, KSA	42.99%	GOSI & Public Pension Agency-15.4%, Public Shareholders-41.61%	Fertilizers
SABIC Innovative Plastics	Bay St. Louis, Mississippi USA	100.00%	None	CYCOLAC, CYCOLOY, GELOY Resins
SABIC Innovative Plastics	Bergen op Zoom, Netherlands	100.00%	None	LEXAN, XENOY, NORYL, NORYL GTX, VALOX Resins, Lexan Sheet and Film
SABIC Innovative Plastics	Burksville Alabama, USA	100.00%	None	LEXAN Resin
SABIC Innovative Plastics	Cartagena, Spain	100.00%	None	LEXAN, EXTEM, ULTEM, CYCOLOY resins

SABIC Innovative Plastics	Mt. Vernon, Indiana USA	100.00%	None	LEXAN, CYCOLOY, ULTEM, VALOX, XENOY, XYLEX, SUPEC, SILTEM resins, LEXAN sheet and film, and ILLUNINEX display film
SABIC Innovative Plastics	Ottawa Illinois, USA	100.00%	None	CYCOLAC, CYCOLOY, GELOY resins
SABIC Innovative Plastics	Selkirk, New York, USA	100.00%	None	PPO Resin, NORYL, NORYL, PRX, NORYL GTX resins, HIPS
SABIC Innovative Plastics	Washington, West Virginia, USA	100.00%	None	CYCOLAC, CYCOLOY, GELOY resins
SABIC Innovative Plastics	Wixom, Michigan USA	100.00%	None	PC automotive glazing
SABIC Petrochemicals B.V.	Geleen, Netherlands	100.00%	None	HDPE, LDPE, LLDPE, Polypropylene, ethylene, propulene, butadiene, MTBE/ETBE, benzene, gasoline
SABIC UK Petrochemicals Ltd	Teesside, UK	100.00%	None	Ethylene, propylene, benzene cyclohexane, LDPE
SABIC Polyolefine GmbH	Gelsenkirchen, Germany	100.00%	None	HDPE, LLDPE, Polypropylene
SAMAC	Al-Jubail, KSA	50.00%	Mitsubishi Rayon Company-50%	MMA and PMMA
SSTPC	Tianjin, China	50.00%	SINOPEC (China Petroleum & Chemical Corp.)-50%	Ethylene, Propylene, Polyethylene (HDPE, LLDPE) Polypropylene
Saudi Kayan	Al-Jubail, KSA	35.00%	Public Shareholders-65%	Ethylene, Propylene, Polyethylene (HDPE, LLDPE) Polypropylene
Sharq	Al-Jubail, KSA	50.00%	Japanese consortium led by Mitsubishi Gas Chemical Co.-50%	Ethylene, Propylene, Aromatics, Ethylene Glycol
Shrouq	Al-Jubail, KSA	50.00%	ASAHI Kasei Chemicals Corp.-30%, Mitsubishi Copr.-20%	Chemicals
SOCC	Al-Jubail, KSA	50.00%	Saudi Specialty Chemicals Company, Albermarle Netherlands BV-50%	Tri-ethyl Aluminum (TEAL)
Specialty Chem	Al-Jubail, KSA	100.00%	None	TPO/PP Compounds, TP/PC Compounds, PC/ABS Compounds
SSNC	Singapore	50.00%	SK Global Chemical-50%	mLLDPE, POP, POE
United	Al-Jubail, KSA	75.00%	Pension Fund-15%, GOSI-10%	Ethylene, Polyethylene, EG LAO
Yanpet	Yanbu, KSA	50.00%	Mobil Yanbu Petrochem Co. (ExxonMobil Affiliate)-50%	Ethylene, Polyethylene, EG, Polypropylene
Yansab	Yanbu, KSA	51.00%	Public Shareholders-49%	Ethylene, Propylene, EG, LLDPE, HDPE

Table 4. Sales of all Publicly Traded Industries Involved in Downstream Sector in Saudi Arabia

Company Name	Sales 2015 $ Millions	Sales 2014 $ Millions	Sales 2013 $ Millions	Products
Chemanol	$204.27	$235.91	$233.07	Formaldehyde Products
Petrochem	$1,947.73	$2,095.60	$1,182.93	Petrochemical Polymers
SABIC*	$39,489.33	$50,165.87	$50,408.27	Chemicals, Polymers, Agri-nutrients, Metals
SAFCO*	$921.87	$1,188.29	$1,130.67	Urea and Ammonia
Tasnee	$4,984.53	$1,188.29	$4,852.80	Titanium and Petrochemical Downstream
Alujain	$400.00	$568.72	$500.27	Mining, Metals, and Energy
Nama Chemicals	$122.67	$180.00	$198.40	Epoxy, Caustic Soda, Chlorine Products
SIIG	$1,960.53	$2,095.60	$1,182.93	Polymers
Sahara Petrochemical	$378.67	$506.13	$634.13	Propylene, Polypropylene, Polyethylene
YANSAB*	$1,842.93	$2,536.27	$2,494.13	Ethylene, Polyethylene, Propylene, Polypropylene
Sipchem	$937.07	$1,099.84	$1,068.00	Methanol, Butanediol
Advanced	$633.87	$809.71	$742.67	Polymers
Saudi Kayan*	$2,126.93	$3,102.93	$5,160.80	Ethylene products, Propylene
Petro Rabigh*	$5,737.87	$14,463.15	$13,492.80	Polymers
MA'ADEN*	$2,921.60	$2,877.60	$1,612.53	Mining and Metals
Spimaco	$466.67	$392.00	$345.60	Pharmaceutical and Medical Supplies
Saudi Chemical	$645.60	$662.40	$606.67	Explosives
Total Sales, All Companies	$65,722	$84,168	$85,847	

* Indicates state majority ownership or de facto control

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