SA-TIED
Southern Africa – Towards Inclusive Economic Development

# Future-proofing the plastics value chain in Southern Africa

Liako Mofo

SA-TIED Working Paper #145 | November 2020

## About the project

### Southern Africa –Towards Inclusive Economic Development (SA-TIED)

SA-TIED is a unique collaboration between local and international research institutes and the government of South Africa. Its primary goal is to improve the interface between research and policy by producing cutting-edge research for inclusive growth and economic transformation in the southern African region. It is hoped that the SA-TIED programme will lead to greater institutional and individual capacities, improve database management and data analysis, and provide research outputs that assist in the formulation of evidence-based economic policy.

The collaboration is between the United Nations University World Institute for Development Economics Research (UNU-WIDER), the National Treasury of South Africa, the International Food Policy Research Institute (IFPRI), the Department of Monitoring, Planning, and Evaluation, the Department of Trade and Industry, South African Revenue Services, Trade and Industrial Policy Strategies, and other universities and institutes. It is funded by the National Treasury of South Africa, the Department of Trade and Industry of South Africa, the Delegation of the European Union to South Africa, IFPRI, and UNU-WIDER through the Institute's contributions from Finland, Sweden, and the United Kingdom to its research programme.



Corresponding author: liako@tips.org.za

WIDER Working Paper 2020/148

# Future-proofing the plastics value chain in Southern Africa

Liako Mofo*

November 2020

United Nations University World Institute for Development Economics Research

wider.unu.edu

**Abstract:** Plastics are ubiquitous across the region and play an important role in multiple industries. Most plastic products are based on a value chain that is grounded in petroleum refining, posing an environmental challenge. Plastic manufacturing in South Africa suffers from the high cost of polymers as inputs. Mozambique is endowed with large natural gas deposits. This research assesses the potential for the sustainable development of a plastics value chain in Southern Africa, with the aim of future-proofing the industry against changes in the petroleum space while bolstering growth in plastics manufacture and fostering a more equitable regional distribution of plastics activities. This study found that there is strong regional value chain potential between South Africa and Mozambique, with Mozambique producing natural gas feedstock and South Africa providing labour, capital, and technology. South African plastic manufacturers could also benefit from better input prices derived from better priced natural gas from Mozambique.

**Key words:** feedstock, polymers, plastic products, input prices, regional value chain

**JEL classification:** L65, O13, O14

**Acronyms and abbreviations:** at the end of the paper

**Acknowledgements:** This working paper is part of Workstream 6 on Regional Growth and Development within the project Southern Africa—Towards Inclusive Economic Development (SA-TIED), a three-year partnership between UNU-WIDER and the South African government aimed at improving the understanding of regional value chains and supporting industrialization in the Southern African Development Community (SADC) region. It is the second of two papers produced by Trade & Industrial Policy Strategies (TIPS) in year three of the project. TIPS acknowledges UNU-WIDER and the South African Department of Trade and Industry for their support.

---

* Trade & Industrial Policy Strategies (TIPS), Pretoria, South Africa, liako@tips.org.za

This study has been prepared within the UNU-WIDER project Southern Africa—Towards Inclusive Economic Development (SA-TIED).



Information and requests: publications@wider.unu.edu

ISSN 1798-7237 ISBN 978-92-9256-905-1

https://doi.org/10.35188/UNU-WIDER/2020/905-1

Typescript prepared by Mary Lukkonen.

# 1 Introduction

Plastics are ubiquitous across the region and play an important role in multiple industries, ranging from basic packaging to advanced manufacturing. The range and versatility of plastics mean the industry boasts a strong market among economies at all levels of development and with virtually any economic structure and serves as an important enabler for key sectors such as retail, agriculture, and manufacturing. In the Southern African Development Community (SADC) region, plastics are the fourth-largest category of manufacturing imports and account for 3.6 per cent of all non-petroleum imports. The reach of the industry is, however, expected to be even larger because of the integration of plastics into most traded goods, either through packaging or as components in manufactured products.

Most plastic products are based on a value chain that is grounded in petroleum refining. This reinforces the already significant environmental challenges inherent in plastics but also complicates the development of comprehensive value chains. The region's six refineries are all in South Africa, with no refining presence in the rest of the region. Many of these refineries are aging, and the unusual structure of integrated chemicals and energy company Sasol's coal-based petroleum refining process creates an imbalance of crucial plastic platform chemicals. The already unsteady basis for plastics in the region is threatened by likely future developments in the petrochemicals space, with new technologies, such as electricity vehicles, having the potential to force a costly shift in the productive structure of plastic inputs.

This research project assesses the potential for the *sustainable* development of plastic value chains in Southern Africa, with the aim of future-proofing the industry against changes in the petroleum space, while bolstering growth in plastics manufacture and fostering a more equitable regional distribution of plastic activities.

These aims require that the region put in place innovative policies that leverage identified challenges for new value chain development. Three basic approaches form the basis for the project:

a) *Basic processing:* Enable regional production of highly traded plastic commodities. As South Africa is an exporter of intermediary chemicals, resins, monomers, and polymers, it has a role to play in this regard.
b) *New sources for petroleum plastics:* Capture and trading of intermediate chemicals from the region's developing oil and gas market and the development of appropriately equipped manufacturing systems.
c) *Bioplastics*: Support for agro-processing for the development of bioplastics.

The project aims to achieve the following:

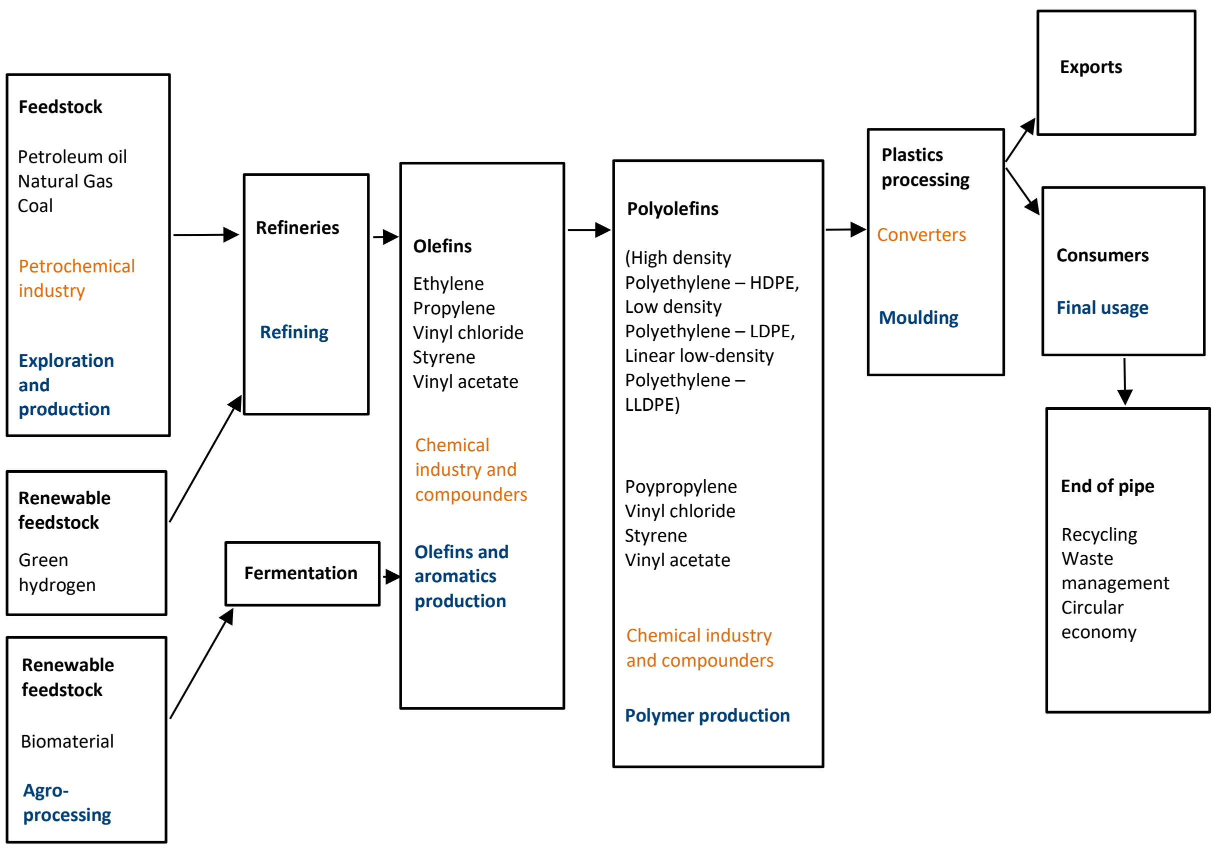
a) identify key challenges that the plastic industry faces and opportunities to grow the industry in the region;
b) identify activities that can be set up in the region for processing plastics to unlock growth of the industry;
c) future-proofing the industry against changes in the petroleum space;
d) identify alternative sources of feedstock and potential locations for new refineries;
e) come up with key policy interventions to unlock the opportunities identified.

## 2 Overview of the plastics value chain

Industrialization is fundamental to economic development. Countries develop by adding value to their products and industrializing, and rapidly growing economies tend to have rapidly growing manufacturing sectors. As such, industrial policy requires countries to look at moving up the value chain and producing more and more sophisticated products. The plastics sector is one of the sectors that is prioritized for job creation and economic growth, while ensuring environmental sustainability. This study looks at the opportunities that exist to grow and sustain the upstream plastics value chain to unlock opportunities in the downstream labour-[illegible] industries within the SADC[1] region.

The scope of the plastics value chain is highlighted in Figure 1, from upstream to downstream plastic production, to consumption level and end-of-pipe. The scope is elaborated in Section 2.1, showing the production and the performance of Southern Africa at different stages of the value chain.

Figure 1: Scope of the plastics value chain




Source: author's illustration based on information from Beare et al. (2014).

[1] The data in this paper refer only to continental SADC—that is, Angola, Botswana, the Democratic Republic of Congo, eSwatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Tanzania, Zambia, and Zimbabwe. It excludes the members that are islands—Mauritius, Madagascar, and the Seychelles.

## 2.1 Production

*Production of feedstock*

The upstream of the plastics value chain begins with feedstocks, which are raw materials used to manufacture basic chemicals. The chemicals are further processed to produce monomers and polymers, which are inputs to downstream plastic manufacturing. It is therefore impossible to discuss the growth of the plastics sector without discussing access to different quality feedstocks that result in different quality chemical feed streams. These impact the mix of basic chemicals produced and hence what inputs are available to increase the supply of plastic polymers as well as the growth potential of the plastics sector (Lowitt 2015).

Traditionally, feedstocks are crude oil, natural gas, and coal that are extracted and beneficiated from mining. However, environmental concerns have given impetus to developing feedstocks derived from renewable sources—usually biomass from agro-processing. Green hydrogen that is sourced from solar, wind, or water is an emerging source of feedstock in the developed world. The composition and quality and transportation of feedstocks determine the location, mix, and profitability of chemical production.

Transportation of inputs, intermediate outputs, and final goods is one of the factors that can lead to a country's constraints in the upstream of the plastics value chain. Coal is the easiest feedstock source to move geographically. Although bulky, a solid feedstock such as coal is considered a low hazard to move, and flammability, pressures, evaporation, spills, and contamination are not serious threats in the freight and cargo process. A liquid feedstock such as crude oil is the next easiest feedstock to transport, but flammability, spill risks, and vapour issues increase the costs of moving liquid feedstock and hence impact the input price of the feedstock. Natural gas is the most difficult form of feedstock to transport and requires pipelines that are expensive to build, secure, and maintain. As such, the agglomeration of chemical companies is intimately tied to resource location (Lowitt 2015).

Importantly, this means, from a South African chemical sector perspective, that any major upscaling of export activity of intermediate and finished chemical products is likely to be focused regionally in the Sub-Saharan area. A few products could meet the criteria for exports further abroad, but transportation constraints (particularly for liquids and gases) and the country's distance from key markets all suggest that the sector's future lies predominantly in the local and regional market.

**Coal.** For feedstock production, South Africa is the leading producer of coal in the SADC region, followed by Botswana. United Nations Statistics Division (2019) data show that production of coal in South Africa was generally constant from 2007 to 2016 with an average decline of 0.38 per cent over the nine years but recovered by 3.09 per cent from 247.7 million tons to 255.3 million tons in the same period. In South Africa, more coal mining activity takes place in Mpumalanga province than any other area because of its massive coal deposits. It produces around 80 per cent of the country's coal. The remaining 20 per cent of coal production is shared among the other provinces, including Gauteng, Eastern Cape, and KwaZulu-Natal. Coal is then sold to coal consumers that include Sasol, which uses coal as feedstock for chemical production, and power utility Eskom for electricity generation. This makes coal the major feedstock in chemical production in South Africa. South Africa's production of petrochemicals from the coal feedstock dates as far back as the colonial times when apartheid-related sanctions led to local demand that was developed around coal. Currently, 40 per cent of South Africa's liquid fuels are developed through coal gasification.

Basic chemicals are viewed as commodities. They are traded globally on a global commodity price basis to the extent that transportation is possible. South Africa's coal-based chemical sector with its access to poorer quality chemical feed streams is unable to compete globally in the basic chemical sector, although its transportation advantages for the South African and Sub-Saharan Africa region provide it with a relatively equal playing field (Lowitt 2015).

**Crude oil.** Angola is the largest producer of crude oil within the SADC region. It is the second-largest producer of crude oil in Africa and fourteenth in the world. EIA (2019) reports that Angola experienced an oil production boom between 2002 and 2008 when production at its deep-water fields began to take off. In South Africa, Sasol and petrol company Engen import and refine crude oil to produce petrochemical products. In 2018, as much as 88 per cent of crude oil was imported from three countries—Saudi Arabia (43 per cent), Nigeria (33 per cent), and Angola (12 per cent)—and these have been the leading exporters of crude oil to South Africa for over 15 years.

**Natural gas.** The major source of natural gas in SADC is Mozambique. Mozambique is reported to hold 150 trillion cubic feet (Tcf) of proven natural gas reserves as of 2018**,** which is going to move it from fourteenth in the 2015 data (100 Tcf) to the top four countries with natural gas deposits in the world. Natural gas deposits are also found in Angola, South Africa, and Tanzania.

Globally, natural gas is a growing source of petrochemical production, being valued for its lower carbon dioxide emissions relative to crude oil and coal. Prior to 2004, all the natural gas in South Africa was sourced from the Mossel Bay fields and was principally used to produce liquid fuels by PetroSA in Mossel Bay. In 2004, Sasol began importing natural gas from Mozambique, and this accounts for most of the natural gas sources in South Africa at present and the only source of natural gas imports. Sasol is further guaranteed access to gas through its co-ownership of pipelines. PetroSA still operates the third-largest gas-to-liquids (GTL) facility in the world at Mossel Bay (Montmasson-Clair and Patel n.d.).

*Feedstock exports*

Within the region, Angola is the largest exporter of crude oil, while Mozambique is the major exporter of natural gas. Both countries export mainly to South Africa. Around 100 per cent of the crude oil imported from the region by South Africa is from Angola, which accounted for about 11.97 per cent and 6.32 per cent of South Africa's imports of crude oil from the African continent and the rest of the world, respectively, in 2019. Seventy-five per cent of South African coal exports went to India (55 per cent), Pakistan (15 per cent), and the Republic of Korea (5 per cent) in 2019. Mozambique is the only importer of South African total coal exports in the region with two per cent.

*Global production of feedstock*

The British Plastics Federation (2019) highlights that the European Union mainly uses 4–6 per cent of oil and gas for producing polymers.

According to the EIA (2019), feedstock largely emanates from gas and crude oil naphtha. The abundant supply of natural gas in the United States has made natural gas liquids (NGLs) the preferred input for ethylene production. About 90 per cent of US ethylene production is sourced from ethane-rich NGLs.

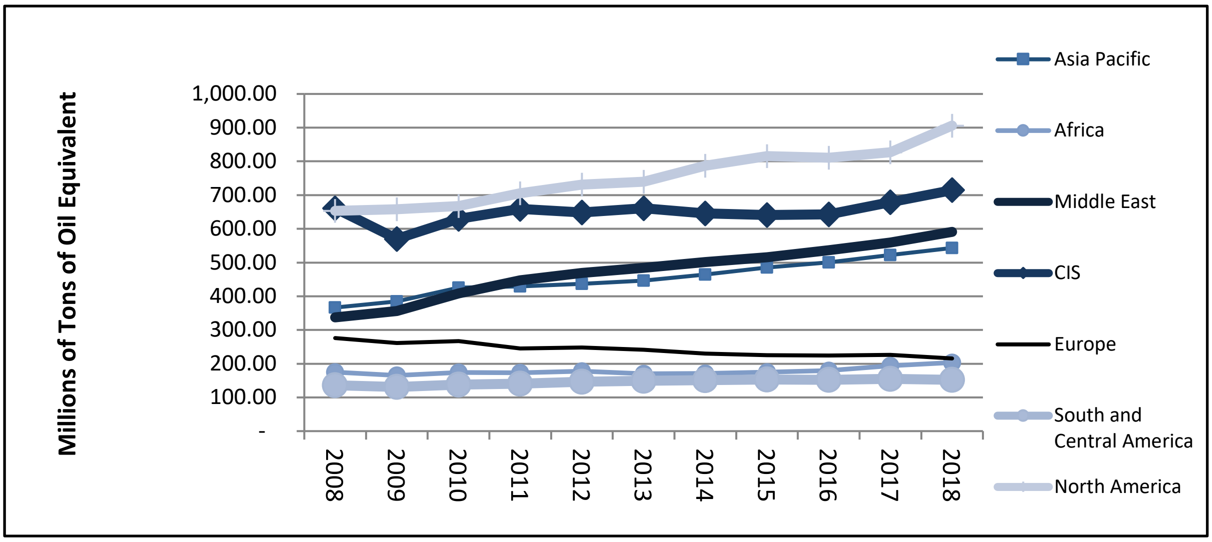
The Middle East uses large percentages of oil and then NGLs in ethylene production. In contrast, however, polymers produced in China, Japan, and the rest of southeast Asia are primarily made from coal, followed by NGLs.

For Africa, feedstock largely emanates from oil and liquefied natural gas (LNG); however, for South Africa, coal is a major feedstock.

Figures 2 and 3 illustrate raw material production by region. Producers of gas are led by North America with an annual growth rate of 2.6 percent, followed by the Commonwealth of Independent States (CIS) with 5.3 per cent, the Middle East with 5.7 per cent, Asia with 4 per cent, Africa with 4.8 per cent, South and Central America with -2 per cent, and Europe with -4 per cent between the years 2007 and 2017 (British Petroleum 2019). The United States produces 21 per cent of the world's feedstock, followed by the CIS region—mainly Russia—which produces 17.3 per cent of the world's gas. Africa, Nigeria, Egypt, and Algeria produce about 6 per cent of the world's share. All three hold the largest amounts of feedstocks within the continent. From an SADC regional perspective, gas resources are also existent in Mozambique in large volumes and in Angola, South Africa, and Tanzania in small volumes. These could potentially create new avenues for plastics feedstocks in SADC other than coal, which is a heavy pollutant.

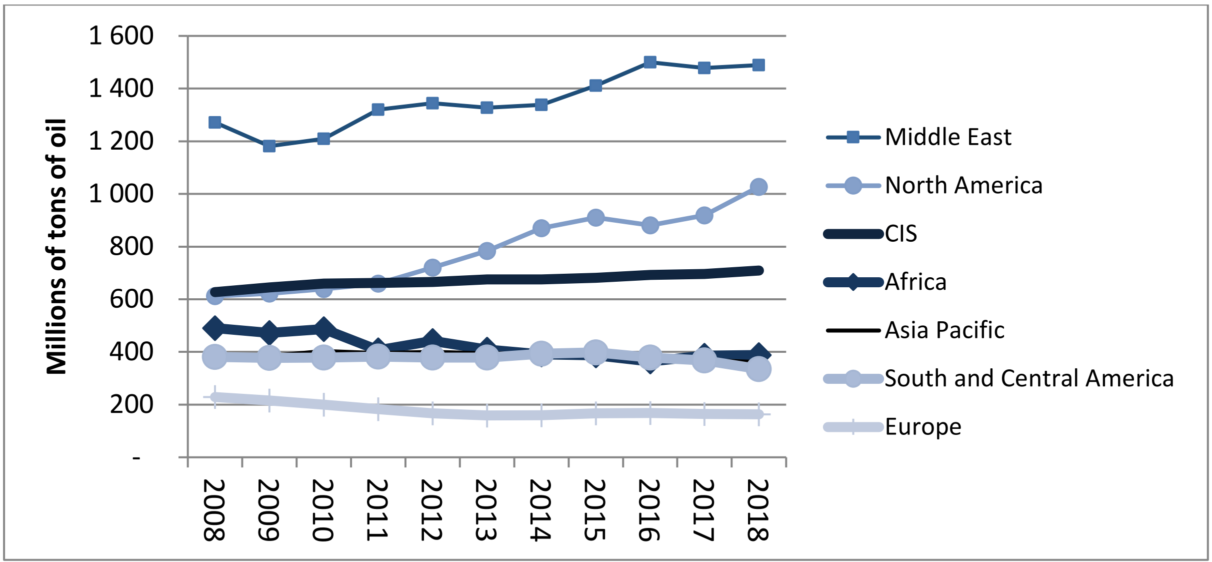
In terms of oil, the Middle East produces more than one billion tons of oil per year. Between 2007 and 2017, the Middle East's annual growth rate was 2.0 per cent. North America and the CIS were the world's second- and third-largest oil-producing regions with annual growth rates of 3.8 per cent and 1.1 per cent, respectively. Africa's oil production hovered around 462 million tons per year, though this has been declining at a rate of 2.3 per cent over the past decade.

Figure 2: Production of natural gas




Source: author's illustration based on data from British Petroleum (2019).

Figure 3: Global oil production by region




Source: author's illustration based on data from British Petroleum (2019).

*Renewable feedstock*

**Biomass.** Biomass provides an alternative feedstock and produces bioplastics. European Bioplastics (2016: 3) states that 'bioplastics are mostly made of carbohydrate-rich plants such as corn or sugar cane, so-called food crops, or first-generation feedstock. First generation feedstock is currently the most efficient for producing bioplastics, as it requires the least amount of land to grow and produces the highest yields'. However, there are food security concerns that land is being diverted from food production. European Bioplastics (2016: 3) further highlights:

> The bioplastics industry is also researching the use of non-food crops (second and third generation feedstock), such as cellulose, with a view to further its use for producing bioplastics materials. Innovative technologies are focusing on non-edible by-products of the production of food crops, which inevitably generates large amounts of cellulosic by-products such as straw, corn stover, or bagasse, which are usually left on the field where they biodegrade at a quantity much higher than is necessary to restore the soil carbon pool. Ideally, they are used to produce energy used for the conversion of feedstock.

Estimates by European Bioplastics (n.d.: para 3–4) show that:

> In 2019, the global production capacities of bioplastics amounted to 2.11 million tons. This translates to approximately 0.79 million hectares of land. Consequently, the surface required to grow sufficient feedstock for today's bioplastics production is less than 0.02 per cent of the global agricultural area of a total of 4.8 billion hectares… Based on current technological development around the growth of bioplastics, the bioplastics market is expected to reach 2.43 million tons by 2024, covering around 1.00 million hectares or approximately 0.02 per cent or less of the global agricultural area.

Biomass is not used a great deal in Africa, especially in the chemical industry, for production of biopolymers or in the plastics value chain. The potential for biopolymers is still being explored by polymer-producing countries such as South Africa. Currently, South Africa, through the Department of Science and Technology, is funding a Biocomposites Centre of Competence in

Port Elizabeth to produce biomaterial and a pilot biorefinery based in Durban, Kwazulu-Natal province, to process several biomass sources to produce a variety of products such as value-added chemicals, fuels, and agricultural products.

Biomass is used in the regional countries largely for production of biofuel and for domestic use and is not in any way involved with the production of biopolymers or bioplastics in countries such as Tanzania, Angola, Zambia, and Mozambique.

The production of biopolymers, however, is more expensive than crude polymers as it currently includes several costlier steps than the conventional crude-oil-based polymer production. The steps include fermentation, dehydration, and metathesis (ChemSystems 2012).

**Refineries.** The second stage of the value chain involves refining of crude oil, natural gas, and coal to obtain petrochemicals. These happen using different processes such as GTL for natural gas, coal-to-liquids (CTL) for coal, and oil refining. Renewable feedstock, especially biomaterial, is fermented to feed into the chemical industry. Products manufactured from the petrochemicals are olefins, such as ethylene and propylene, and polyolefins, such as polyethylene (PE) and polypropylene (PP). Within the SADC region, there are six established refineries and a pilot biorefinery in South Africa. Angola is also reported to have two refineries, though not engaged in producing plastic polymers.

Mozambique has made strides to construct its first refinery to try and curb its reliance on imports of oil and gas products. The state-owned entity Empresa Nacional de Hidrocarbonetos entered into a cooperation agreement with the Chinese National Petroleum Corporation for a refinery project in 2018 (AllAfrica 2018). The project is still at the feasibility stage (Graham 2019).

*Production of polymers*

Feedstocks from coal, gas, and oil are processed into petrochemicals that are further manufactured into various monomers and polymers that are converted into different types of plastic products. Polymer production is a by-product of the energy fuels. This means that the inputs for polymers, which are ethylene and propylene, are by-products of coal, petroleum, and natural gas production. Polymers are mainly used to make plastic products. It is estimated that polymers constitute about 80 per cent of the chemical industry's production output (TechnoFunc n.d.). Polymer manufacture is relatively capital intensive and is broadly characterized by economies of scale, significant transport costs, and a corresponding concentration of production.

Sasol dominates the upstream, producing over 200 chemicals, and is the leading producer of polymers in South Africa. Sasol is further vertically integrated with ownership of coal-mining operations in the inland regions. In addition, it has been the leading onshore natural-gas-producing company in Mozambique since 2004. Sasol processes gas in Temane in the Inhambane province, where over 2.6 trillion cubic feet of gas reserves have been discovered. The Republic of Mozambique Pipeline Company, a joint venture between Sasol, state company Companhia Mocambiçana de Gasoduto, and South African Gas Development Company, is the commercial operator of the 865-km gas pipeline transporting about 80 per cent of LNG to Sasol's South African operation in Secunda. The remaining 20 per cent is used for local power generation (Conradie 2019).

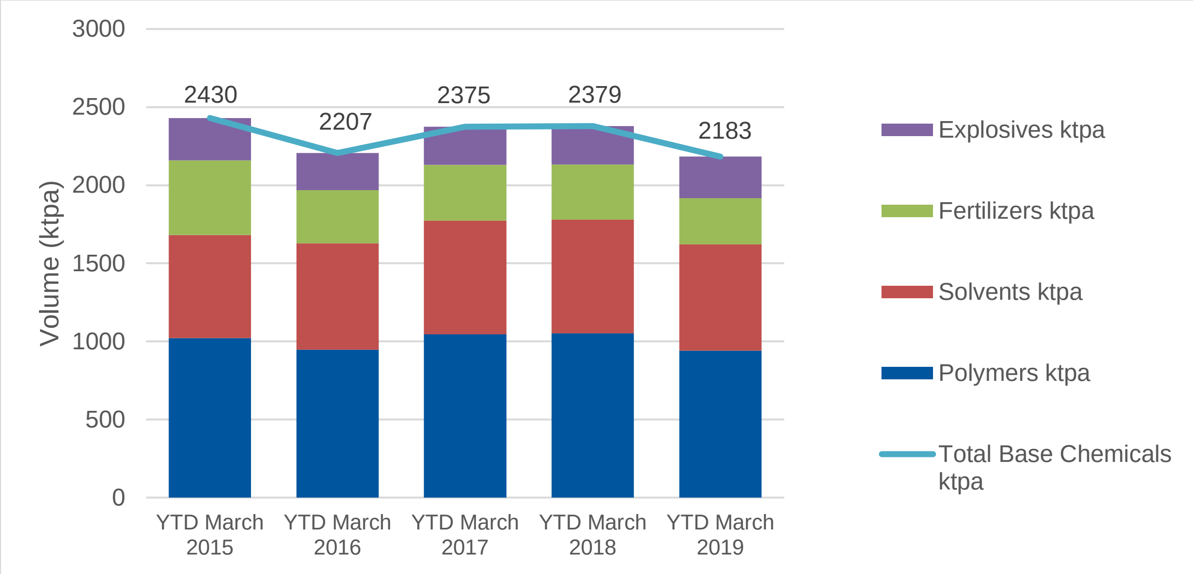
The petrochemical products produced from processing feedstock can be largely broken down into two broad groups—fuel products and chemicals. Chemicals consist of four groups—ammonia, aromatics, olefins, and methanol. Ammonia is used in the production of explosives and fertilizers. Aromatics refer to chemical products that are acquired through the catalytic reforming of naphtha and are used to manufacture products such as solvents, adhesives, and detergents. These products include benzene, toluene, and xylene. Olefins refer to chemical products that are produced through processes such as the steam cracking of ethane and propane and are used to manufacture products such as plastics, resins, elastomers, and lubricants. Finally, methanol is used as a principal additive in biofuels.

Sasol operates in the upstream, producing vital input chemicals that feed into downstream industries, and its success depends on the downstream sectors performing well and growing. Polymers are used as an input in the plastics industry. Sasol operates in a number of markets with varying competition intensities. It produces PP, PE, polyvinyl chloride (PVC), low-density polyethylene (LDPE), and linear low-density polyethylene (LLDPE) in significant volumes. Sasol's only competitor in the market for polypropylene is Safripol, where Sasol controls between 60 and 80 per cent of the market (CAC 2015). Around 57 per cent of Sasol's total production of chemicals goes to polymers (Sasol 2018). Safripol produces PP and high-density polyethylene (HDPE) at its facilities in Sasolburg and polyethylene terephthalate (PET) from imported chemicals at its plant in Durban. It has the capacity to manufacture 160 kt of HDPE, 120 kt of PP (19 per cent of Sasol's PP production), and 240 kt of PET per annum (Conradie 2019). Safripol relies on inputs of ethylene and propylene from Sasol to produce polyethylene and polypropylene.

Figure 4 shows the performance of Sasol's production of base chemicals in the last five years. It demonstrates that the total production of base chemicals by Sasol were in excess of two million tons per year and dominated by polymer and solvent production. Recent fluctuations in base chemical production have been because of a combination of operational impacts, demand fluctuations, and new investments. Between 2015 and 2016, base chemical sales volumes declined because of planned shutdowns, reduced mining, and fertilizer demand. The 2017 rise in sales volumes were attributed to increased demand for polymers and added production capacity[2]. The subsequent declines in base chemical production in 2018 and 2019 were because of unplanned disruptions by Eskom as well as the building of base chemical stocks for Sasol's HDPE joint venture in the United States.

[2] These refer to the C3 Expansion project and improved performance from the Superflex Catalytic Cracker plant. See Sasol (2018).

Figure 4: Production of base chemicals, 2015–19 financial years



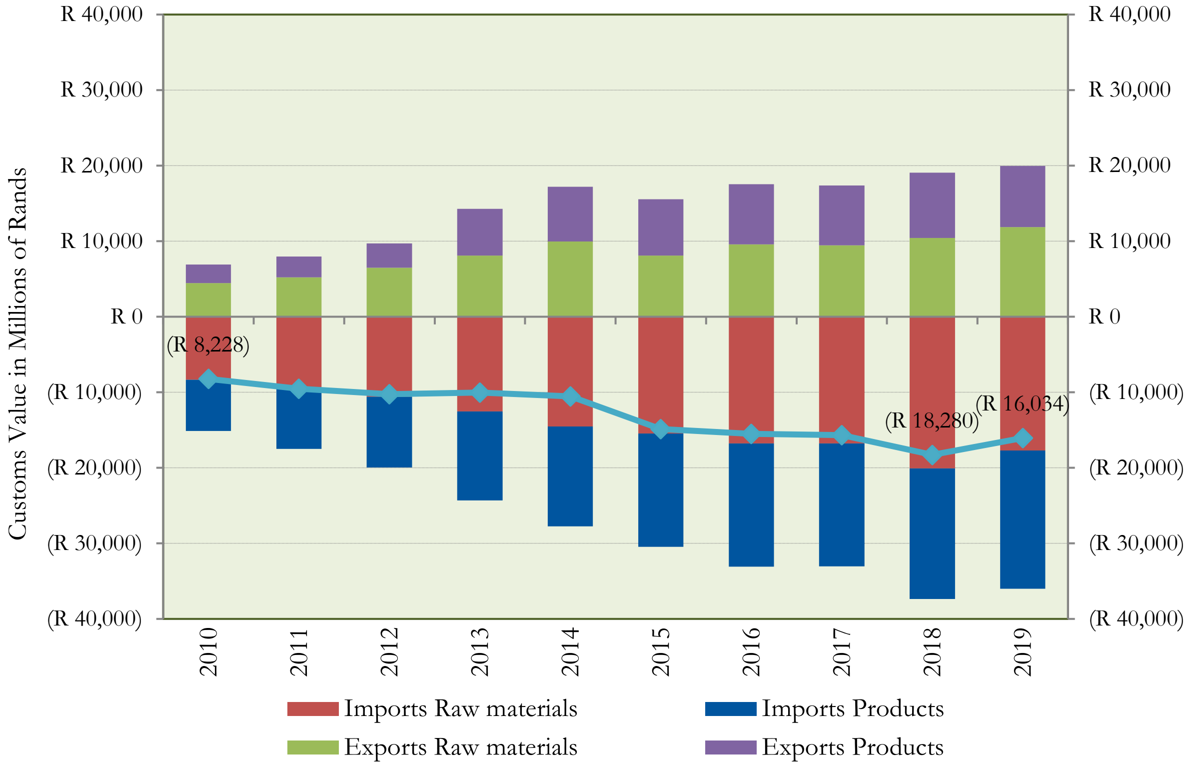

Source: author's calculations based on production and sale metrics for the nine months ending 31 March for the respective years (2015, 2016, 2017, 2018, and 2019) from Sasol (2020).

The upstream is arguably competitive in the production of polymers, particularly propylene and polypropylene. It gains its competitiveness from low-cost chemical feedstocks produced from coal and natural gas. However, the upstream competitive advantages realized in polypropylene are not translated into the competitive performance of downstream plastic manufacturers in export markets or against imports.

Overall, polypropylene is the only polymer that is currently produced in abundance and, as a result, accounts for most of the primary plastic exports and is identified by the government as one of the key pillars of South Africa's industrialization growth (Garisch 2016). The shortage of ethylene monomer has led to limited production of polyethylene. Similarly, volumes of LDPE, LLDPE, and HDPE produced do not meet the local demand. As such, the shortages in local consumption of polymers are met by imports. The polyvinyl chloride plant is dated, and any vinyl growth will have to be technologically driven. Opportunities with other raw materials will necessitate a joint venture with an international polymer supplier to ensure a steady supply of polymers. Generally, South Africa imports polymers when specific grades are not locally produced, when seasonal shortages are experienced, and to have a second supplier account. Large quantities of finished and semi-finished plastic products are also imported as well as products made from the very same polymers that are exported (Pretorious n.d.).

Even though South Africa is a large producer of polymers, especially in the region, it registers a negative trade balance. It had a deficit of ZAR16.0 billion in 2019, which accounted for 22.9 per cent of an estimated ZAR70.0 billion total value of the domestic industry, as illustrated in Figure 5. Polymers of ethylene are the largest contributors to the deficit.

Figure 5: Trade balance of plastic materials HS39




Source: author's adaptation from Pretorious (n.d.).

More than 30 different materials are used by the converting industry to manufacture a whole range of products, from single-use packaging items to engineering components designed to last 30 or more years. About 53 per cent of all polymers in South Africa goes to packaging (Plastics SA 2018). For usage in the downstream, commodity polymers constitute 86 per cent of the total domestic converting industry, while moulding powders, resins, and engineering polymers contribute 0.5 per cent, 4.8 per cent, and 8.7 per cent, respectively (Pretorious n.d.).

**Global production of polymers and monomers.** Globally, the largest category of polymers for plastics is PP, which is used for packaging and labelling. About 70 million tons of PP is produced annually. Next are LDPE—used for manufacturing various containers, dispensing bottles, washing bottles, tubing, plastic parts for computer components, and various moulded laboratory equipment. Its most common use is in plastic bags. HDPE is used for containers for milk, motor oil, shampoos and conditioners, soap bottles, detergents, and bleaches. About 115 million tons are produced for LDPE and HDPE.

PVC is used for piping and siding, blood bags, and tubing to wire and cable insulation and for windshield system components. It comprises about 40 million tons of global plastics output. PET comprises 35 million tons and is mainly used for fibres for clothing (polyester), containers for liquids and foods, thermoforming for manufacturing, and in combination with glass fibre for engineering resins. Almost 60 per cent of PET goes to textiles and 30 per cent for plastic bottles.

*Production of plastics*

There are about 1,800 plastic manufacturing companies in South Africa, predominantly small, medium, and micro enterprises (SMMEs). They use specialized equipment to process plastics into desired products through different kinds of processes such as injection moulding, extrusion, and blow moulding. Local as well as imported raw materials are manufactured for utilization in a wide range of needs in various products, applications, and sectors, cutting across building and construction, electrical and electronics, automotive, agriculture, furniture and household goods, mechanical engineering, and medical. The plastic products are either consumed domestically or exported for intermediate or final use. Beyond final use, the plastic products are disposed or recycled for continued use in different products. In 2016, the plastic sector in South Africa represented about 1.9 per cent of gross domestic product (GDP) and around 16.5 per cent of the manufacturing sector with a contribution of approximately ZAR76 billion to the economy (Department of Trade and Industry 2018). Plastic manufacturing allows for entry of SMMEs because of its low economies of scale. It employs around 60,000 people in South Africa.

At the regional level, data on plastics production are not available, but it is believed that plastics are in all SADC countries based on the presence of plastics firms in different countries. Continentally, according to the Plastics – the Facts 2018 report (PlasticsEurope 2018), the Middle East and Africa produced 7.1 per cent, or 24.7 Mt, of the world's plastic materials in 2017. Nigeria, Egypt, and South Africa account for almost all primary plastics production in Africa and for about 50 per cent of the continent's primary plastics demand. Factors driving demand for plastic products are a growing middle class, the development of organized retailing, infrastructure development, and increasing urbanization. In global terms, the South African plastics industry is significantly small—less than 0.5 per cent.

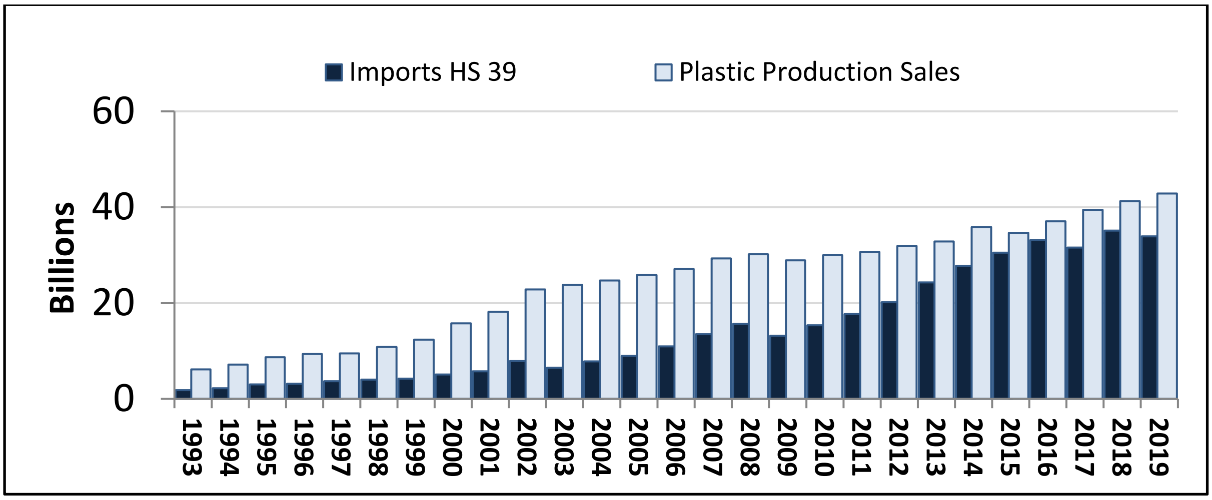
*Prices of polymers and performance of the plastics industry*

Industrial policy requires us to look at moving up the value chain and producing more and more sophisticated products. The input materials that are used for industrial development and the prices need to be appropriate to unlock the downstream opportunities. South Africa has a lot of capabilities in producing a range of polymers and basic plastic products. However, there are blockages to growing the industry. One of the key blockages is with the pricing of propylene and polypropylene as inputs to downstream plastics manufacturing.

Sasol serves both the local and the international markets with the supply of polymers. Its products, propylene and polypropylene, are commodity monomers and polymers. Sasol's commodity pricing of the polymers, monomers, and solvents that tracks the international market chemical prices, and benchmarking, presents itself as import parity pricing. This has been a binding constraint to the growth of plastics manufacturing in South Africa for years.

For plastic conversion, major costs are associated with polypropylene as a major input into production. Its price has a bearing on the price and competitiveness of the domestic production of a variety of plastic products. Figure 6 illustrates the performance of plastic manufacturing against imports. Plastic manufacturing had been growing until 2002; then it stagnated around the 2002 levels and has not actually demonstrated significant growth beyond 2002. Instead, the industry experienced an influx of imports. Plastic manufacturing sales grew by 85.6 per cent from 2002 to 2019 while imports grew rapidly in the same period and accounted for a 330.8 per cent increase. Manufacturing sales increased by an average of around 16 per cent per annum from 1994 to 2002 and increased by an average of only four per cent from 2003 to 2019.

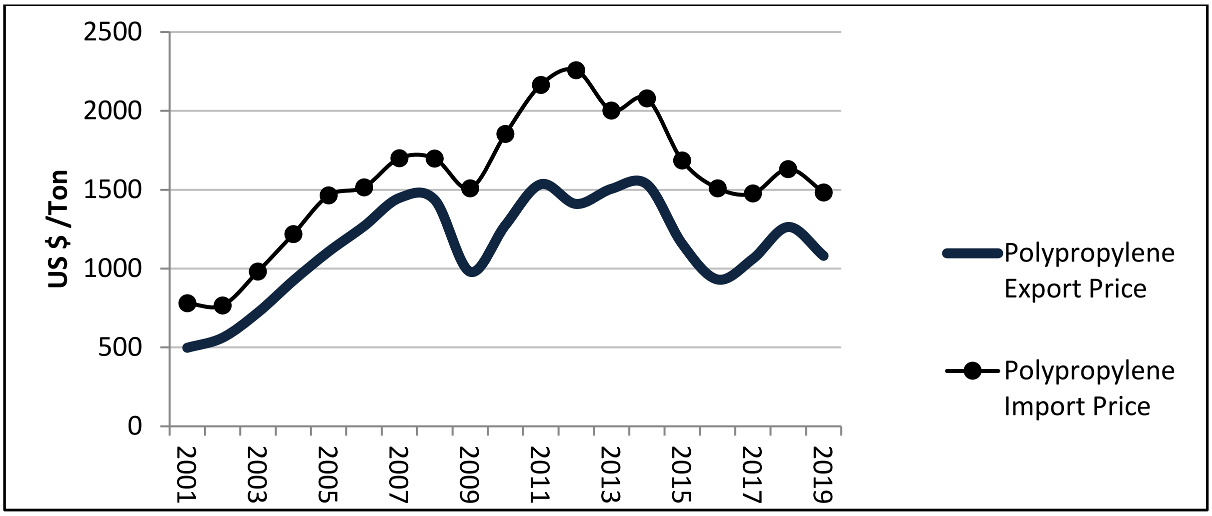
Figure 6: South Africa plastic manufacturing sales and imports in Rands




Source: author's calculations based on data from Quantec (2020).

A number of problems emanated from the pricing of inputs for the plastic conversion sector. First, despite being one the lowest cost producers of polymers as primary inputs for plastic manufacturing and polypropylene being identified as one of the industrial growth drivers in the country, South Africa's plastic conversion has been underperforming relative to its global peers. Second, polymers were charged at import parity locally, but more than 50 per cent of domestic production was exported at lower prices. Third, a study by the Centre for Competition, Regulation, and Economic Development (CCRED) found that the cost of polymers was by far the largest cost for plastic firms at 40–60 per cent and impacted heavily on price competitiveness of plastic convertors. It also found that local polymers were 20 per cent higher than European prices, while the main input costs were 25 per cent lower (Nair et al. 2014). Moreover, the cost of feedstock in South Africa was 25 per cent lower. And lastly, the low margins in the plastic conversion sector compromised the firms' ability to invest in up-to-date equipment, thereby missing out on opportunities for innovation and development for the domestic manufacture of downstream plastic goods. The plastics sector performance has been far below what is required if South Africa is to grow, diversify the industrial base, and create employment (Beare et al. 2014), and because of this, local companies operating in the plastics sector have no influence on the global prices and they cannot pass on the fluctuations of input costs to the end user (Garisch 2016).

Figure 7: Import and export price of polypropylene




Source: author's calculations based on data from Trade Map (2019).

It is reported that the prices of polypropylene were much lower than those in China and India between 1994 and 2000. Beyond 2000, South Africa's polypropylene prices were relatively higher. In addition, the plastics sector grew by six per cent per annum from 1994 to 2002 because of trade liberalization and declined thereafter (CCRED 2016). It is argued that Sasol changed its pricing model, charging import parity prices for polymers around 2000–02, resulting in a difference of around 20–30 per cent between local and export prices, and that was the defining moment for South Africa's plastics sector. Figure 7 illustrates high prices of imports relative to exports from 2001 to 2019, registering a difference as high as 62 per cent between the import and export prices of polypropylene in 2016. Furthermore, consumption of plastics in the sectors that highly integrate plastic products, such as packaging, automotive, and construction, has been stagnant at around 55 per cent, 17 per cent, and 5 per cent, respectively, between 2009 and 2020 (Euromap 2016).

According to Malikane et al. (2000: 33):

> Pricing at import-parity levels means that South African manufacturers of products from polymers pay prices which are greater (due to transport costs and tariffs) than manufacturers in many competing countries, which can import polymers from a closer source or buy domestically at more competitive prices. It also implies that plastics manufacturers are in a better position from a price-competitiveness point of view if their main input is not produced by a domestic firm as, in this case, no import tariff would be charged.

Therefore, there is no cost advantage for local manufacturers to use a locally manufactured input. This is demonstrated by an increasing trade deficit, which reflects loss of local market share to imports and weakening competitiveness.

As stated by Nair et al. (2014: 3), 'the post-1994 industrial policy clearly identified an objective to retain and increase the natural resource advantage that South Africa has, and to encourage the transfer of that natural resource advantage through to the growth of downstream, higher value-added and labour intensive industries'. In this case, the plastic industry has not benefitted much from the coal feedstock opportunity as the natural resource that South Africa possesses. Competitive input prices for South African plastic manufacturers would allow for gains through value addition locally rather than internationally, leading to growth and investment in the sector.

## 2.2 Opportunities for a regional value chain

With regional integration, and most importantly for the regional value chain, South Africa can obtain competitively (better) priced and more appropriate natural gas feedstock from Mozambique to unlock its plastics industry. In addition, Mozambique can benefit by moving up the value chain from natural gas to the next stage of processing. However, that requires a stable market, which could be South Africa.

Natural gas has gained much priority because of the environmental significance regarding its cleanness and efficiency and low carbon emission compared to other energy sources such as crude oil and coal. As such, Sasol plans to shift from coal to natural gas, imported from Mozambique, to reduce its emissions intensity. This will likely reduce its demand for coal, provided additional gas supply is secured, within an effective regulatory framework.

Recent discoveries of LNG in Mozambique have revealed 150 trillion cubic feet of gas, which has the potential to lift Mozambique from the current fourteenth place to fourth place as the world's largest LNG producer after the United States, Qatar, and Australia. Huge energy opportunities can be unleashed from the onshore megaprojects, and those can be beneficiated for plastic inputs in the region, particularly in South Africa and Mozambique itself—moving up the value chain to the next level of processing, along with the policy of ensuring that natural resources extracted enhance the downstream job, creating industries. It is reported that the first gas is expected in 2024 from the projects that are expected to yield over 12 million tons per year in the Mozambique LNG basin and over 15 million tons annually in the Ruvuma LNG plant. Experts estimate long-term growth in production capacity in excess of 90 million tons of natural gas, equal to around three million barrels of oil per day (Creamer 2019).

It is further estimated that the final investment decisions could be around US$128 billion by 2025, which is nine times more than Mozambique's current GDP. These discoveries present themselves as potentially one of the region's largest industrial development offerings with both direct and indirect prospects for South Africa. More importantly, for the plastics value chain, it is reported that there are opportunities for competitive LNG ex-ship prices for South Africa (Creamer 2019). This offers huge potential for increased LNG feedstock to South Africa's upstream plastic processing as LNG is an important input into polymer production. This could benefit the plastic conversion sector through a reduced cost of raw materials, assisting in levelling the playing field for plastic manufacturers. Furthermore, if South Africa increases its imports of natural gas feedstock from Mozambique, not only will this increase economic activity in South Africa, it will also have a multiplier effect in Mozambique. It creates a vast number of other opportunities in terms of spillovers to other sectors of the economy. For instance, South Africa could export goods and services to Mozambique and investors could form companies in partnership with Mozambique nationals.

An abundance of feedstock creates a comparative advantage for Mozambique. Mozambique can move up the value chain by establishing a plant to serve its energy needs and the plastic industry. There is great potential for cost-effective processing of polymers because of the plant being established close to input sources and value being added to the natural gas resource within the country. However, for this to happen, Mozambique needs a market for its polymers. South Africa provides a robust market for Mozambique. This is even more important for the regional value chain in that South Africa can leverage on its substantial technological and productive capacity embodied in plant, skills, and institutions with spillover effects, generating know-how, innovation, and resilience for the economy as a whole, to establish a competitive plastics industry in Mozambique.

The abundance of natural gas in Mozambique opens up numerous opportunities that can improve the economy and the socio-economic status of the country. Since 2004, the Government of Mozambique has had in its plans to construct a petrochemical industry and GTL, based on the gas from the Rovuma Basin and further development in the province of Inhambane. Furthermore, the Government of Mozambique has demonstrated willingness to develop the chemical industry through its abundant natural gas resources in its Natural Gas Master Plan (Cabinet Council 2014). It is a potential avenue that can improve industrialization through upstream and downstream manufacturing of plastics.

The 2014 Mozambique Gas Master Plan (Cabinet Council 2014) elaborates on the mega-projects and allocation policy that prioritizes the production of base chemicals through setting up methanol projects for production of methanol and various sub-products such as plastics, paints and varnishes, and resins and olefins projects aimed at producing polyethylene and polypropylene targeting the international market demand. Implementation of these projects has great potential to generate additional tax revenue for the country.

Globally, the development of Mozambique's offshore gas reserves will benefit from an increase in global LNG demand emanating from China's policy shift from energy/power policy from coal to gas. This has led to many of China's economic sectors increasingly shifting their demand towards gas. It is from these developments that the International Agency Energy terms China as 'the emergent giant of gas demand' (Sassda n.d.).

The Southern Africa Stainless Steel Development Association estimates a 98 per cent increase in global gas demand, from 319 metric tons per annum in 2018 to 632 metric tons per annum in 2040. Furthermore, it is expected that the gas will be produced at low cost because of its high quality that will require less refining.

*Policy support/environment*

Policy support exists for beneficiation of natural gas resources to enhance the plastics value chain and other industries in Mozambique. South Africa also recognizes the gains it can derive from Mozambique's natural gas. As a result, it has put in place supportive measures to harness the benefit. The following are the policy and incentives to spur economic activity around natural gas and the plastics value chain.

At the regional level, the SADC regional office is in the process of developing the SADC Regional Gas Master Plan to guide exploitation of the natural gas resources that exist in the region.

In South Africa, the Export Credit Insurance Company has put aside an insurance guarantee of €600 against commercial and political risks to encourage South African exports of goods and services to emerging natural gas projects in Mozambique. This is to support the investment in Mozambique of twice as much (€1.2 billion), with South African local content exports to increase South Africa's presence in opportunities surrounding Mozambique's natural gas. Power generation is one of the sectors that is hoped to grow from Mozambique's latest discoveries of natural gas (Frey 2019). This is one of the commitments towards job creation in South Africa from the Job Summit.

In support of Mozambique's development strategy, the current African Development Bank's Country Strategy Paper 2018–2022 (AfDB 2018: 9) highlights that:

> The most promising path to industrialization relies on upscaling agro-processing and the deepening of agriculture value chains, but also light industries (e.g., textile,

packaging, basic consumer goods, plastics) to competitively substitute imports, as well as throughout the downstream of the natural gas value chain. Deeper integration between regions and the removal of barriers to trade and improve access to local and regional markets would further foster the environment for industrialization.

Over time, the Government of Mozambique has adopted several policy instruments and strategies with a view of promoting the development and sustainable use of energy resources of the country. Other policies and strategies that prioritize the chemical and plastics industries in development of the country include: The Energy Policy of 1998; Renewable Energy Policy of 2009; Policy and Strategy for Biofuels of 2009; Strategy for the Development of the Natural Gas Market in Mozambique of 2009; Energy Strategy of 2009; Industrial Policy and Strategy of 2007 (the review of which started in 2015); Strategy for the Development of Small and Medium Enterprises in Mozambique of 2007; The Integrated Programme for Reforms in the Professional Training; Strategic Plan for the Development of Agriculture; Environmental Strategy for Sustainable Development of 2007; and the strategy for the concession of oil operation areas of 2009 (Cabinet Council 2014). The legal and regulatory framework also enables the growth of the priority sectors.

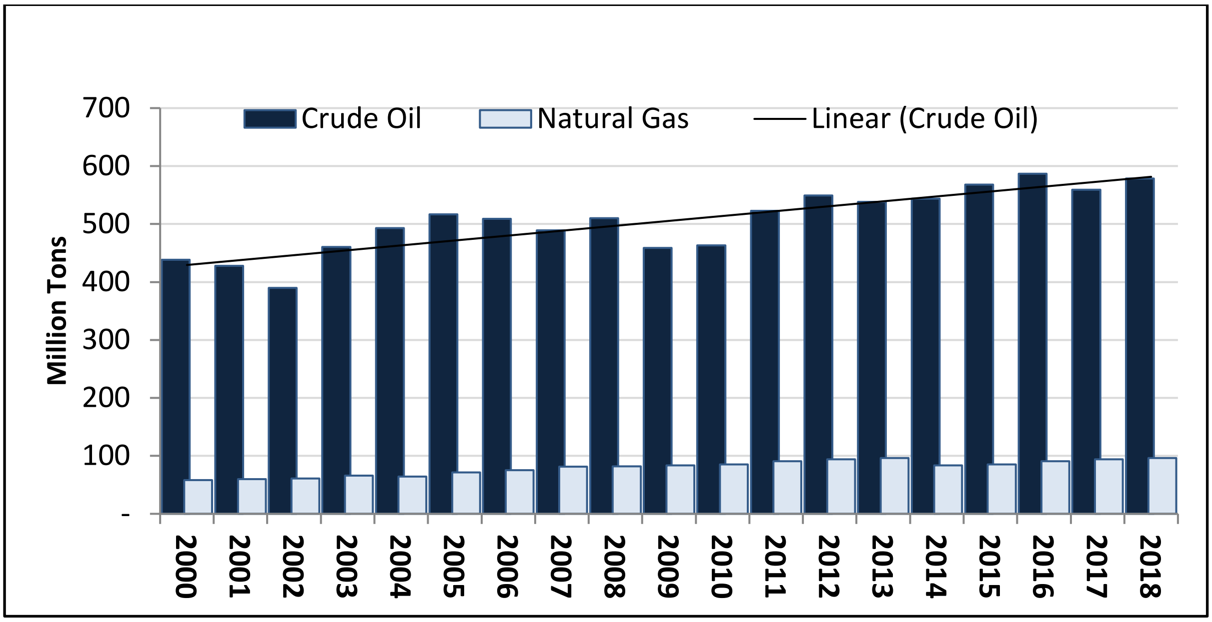
# 3 Case study: Saudi Arabia—Middle East and Saudi Arabia lessons for a plastic upstream value chain in the SADC region

One of the world's largest producers of chemicals and polymers is the Middle East, in particular Saudi Arabia. Compared to rival counterparts Europe and North America, 'the Middle East has access to plentiful and inexpensive resources. For gas-based feedstock's ethane and LPG, the Middle East producers have a cost advantage of as much as 30 per cent and 90 per cent, respectively,' as stated by Horncastle et al. (2015: 5). Figures 8 and 9 demonstrate the growth in feedstock over the 18 years from 2000 to 2018.

In the past, the Middle East has leveraged its advantages to have a stake in chemicals and polymer production. Particularly for Saudi Arabia, its chemical and plastics industry implemented three major endeavours that leveraged its natural resources: the master gas system, the industrial development of strategic towns (Jubail and Yunbu), and the creation of a chemical manufacturing company, Saudi Basic Industries Corporation (SABIC). These were largely driven by: a) technology and know-how; b) proximity to growth markets; and c) access to feedstocks and finance and the level of internal institution integration.

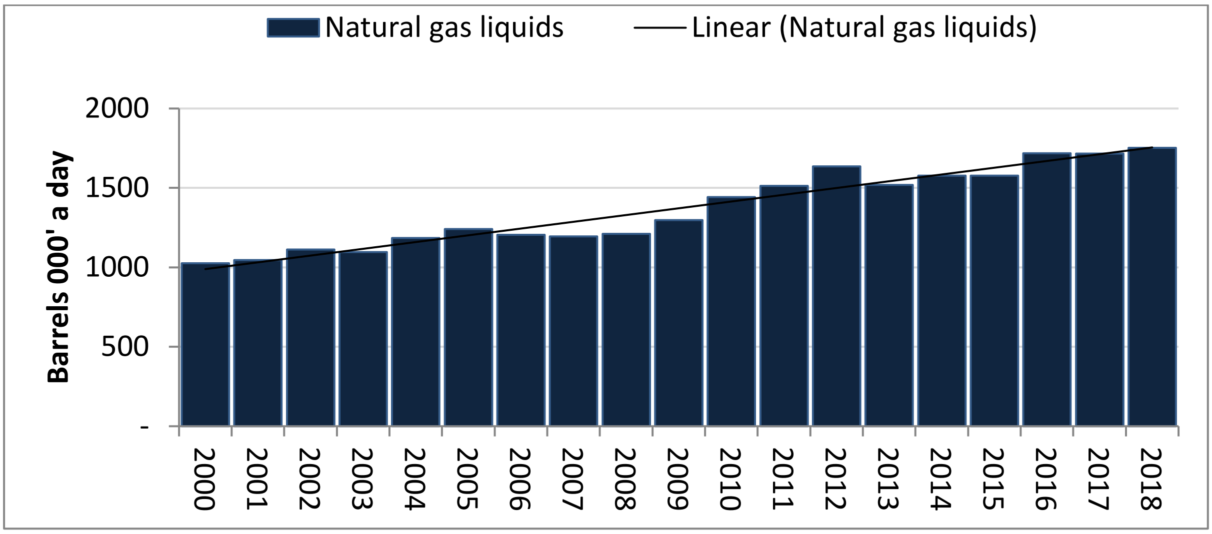
In addition, being a member of the Gulf Petrochemicals and Chemicals Association (GPCA) has exposed Saudi Arabia and Middle East countries to inter-regional business partnerships and services from other regional companies that cut across banks, suppliers of raw material, and consulting firms. According to Horncastle et al. (2015: 5), 'the Middle East relatively enjoys favourable logistical access to fast-growing basic chemical markets within Asia. Over the years, as Middle East companies achieved downstream integration and moved into at least semi-specialty chemical production, they managed to eliminate production in Europe by directly delivering polymers to customers in Asia'.

Figure 8: Production of feedstock in Saudi Arabia




Source: author's compilation based on information from British Petroleum (2019). Production and Consumption of Energy Sources. Excel Sheet downloaded 21 November 2019.

Figure 9: Production of natural gas liquids in Saudi Arabia

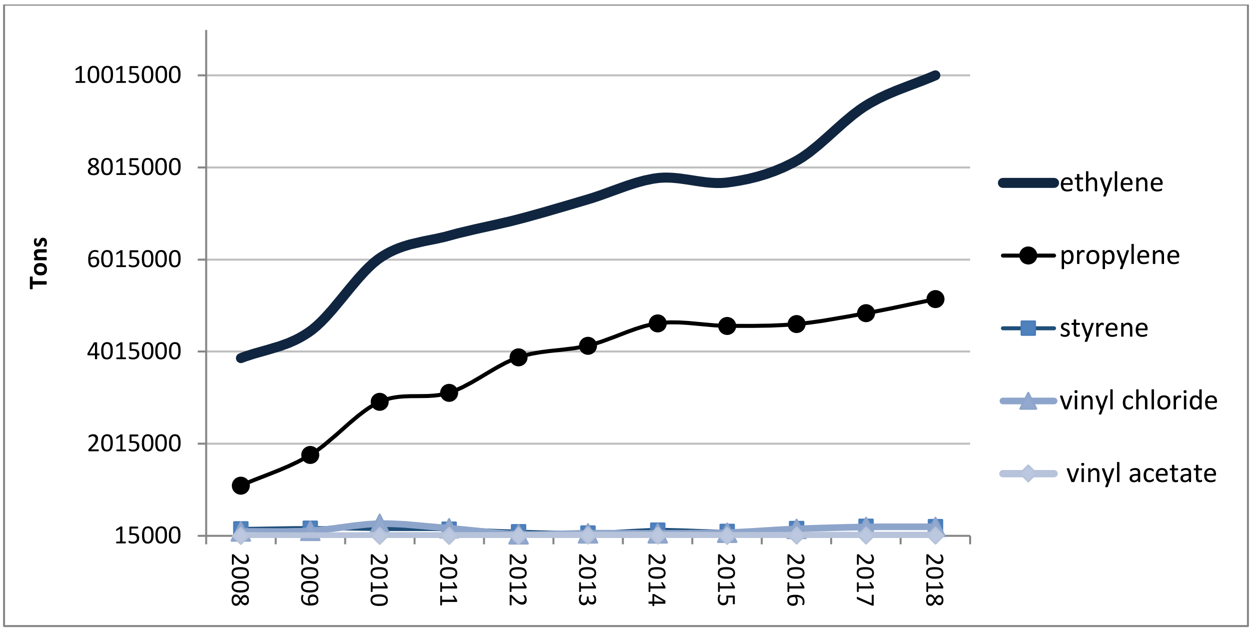



Source: author's compilation based on information from British Petroleum (2019). Production and Consumption of Energy Sources. Excel Sheet downloaded 21 November 2019.

### 3.1 Trade

Figure 10 affirms rapid growth in trade of polymers enjoyed by Saudi Arabia over a 10-year period. Polymers of ethylene are the largest exported, demonstrating growth of 159 per cent from 2008 to 2018. Polymers of propylene follow with an increase of 365 per cent during the same period.

Figure 10: Saudi Arabia exports of polymers in tons




Source: author's compilation based on information from Trade Map (2019). Saudi Arabia Exports of Polymers HS 3901-3905. www.trademap.org.

### 3.2 Enablers of Saudi Arabia's growth of chemicals and polymers

Five drivers of the chemical and plastics industry in Saudi Arabia—compared to other global champions such as North America, Europe, and Asia—are technology, proximity to growth of markets, access to feedstock, access to cash and debt, and level of internal integration.

Alfaro et al. (2016: 9) demonstrated that in terms of technology and know-how, Saudi producers have initially leveraged foreign partners for technology through licensing manufacturing technologies. The approach in approximately the past decade has been joint ventures that account for 60 per cent of current production capacity across the chemical and plastics producers. The joint ventures have allowed for access to shared risks, skills transfer, exposure to technology, and more importantly, research and development.

Compared to China, India, North America, and Europe, Saudi players have benefited from access to significant sources of financing in the form of both equity and debt. This has to a large extent been driven by the revenues from oil exports that provide substantial liquidity in the market. Most of the revenues are geared towards building capacity of the firms. In addition, larger players are able to make adequate amounts to revenues to fund investments and growth.

Alfaro et al. (2016) note the nature of Saudi Arabia's extent of integration of production assets across the chemical's value chain is a significant source of competitiveness. Improved integration certainly reduces production costs such as transportation costs, and increased cooperation between institutions allows for shared mutual benefits.

In terms of access to feedstock, Saudi Arabia is the largest holder of proved oil reserves in the world with approximately 16 per cent of reserves. It also has the fifth-largest natural gas reserves following countries such as Russia, Qatar, United States, and Iran. As such, the state enjoys a natural comparative advantage in feedstock supply. In terms of endowments, as a member of the GPCA, Saudi leverages from these markets as well as from its location in the Arabian Gulf, which provides access to key global trading routes. According to Alfaro et al. (2016: 1), 'Saudi Arabia has

2,640 km of coastline on the Persian Gulf and the Red Sea, which together capture a significant share of the global maritime trade'.

### 3.3 Targeted industrial policy by Saudi Arabia

As noted, the key policy instruments for Saudi Arabia are the master gas system (MGS), the industrial development of strategic towns (Jubail and Yunbu), and the establishment of SABIC.

Saudi Arabia engaged in a cost-effective and highly efficient MGS that productively made use of the strategic towns of Jubail and Yunbu. The Saudi Kingdom maximized on the opportunity of the high reserves of natural gas to save the oil for high value addition activities and capitalize on environmentally cleaner natural gas for growing the petrochemical industry. In addition, its position at the coast, which was at the source of feedstock, was a strategic cost saver.

Saudi Arabia managed to move up the value chain by transitioning from associated gas in the 1970s to non-associated gas in the 1980s to develop the chemicals industry. With the large natural gas reserves in excess of 288 trillion cubic feet, Saudi Arabia produces wet gas that has yielded significant amounts of chemicals such as ethane, propane, and butanes. Gerlowski and Othman (2014: 65) highlight that:

> 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 was established in 1976 to produce value-added products such as chemicals, fertilizers, and polymers. It attracted investment through various joint ventures with Saudi companies and international companies. It has progressively grown and positioned itself among the top three world producers of chemicals and polymers—specifically, as the major producer of ethylene glycol and methanol, the third-largest producer of polyethylene, and the fourth-largest producer of polypropylene and polyolefins globally. Furthermore, the abundance of methane and ethane enabled Saudi Arabia to provide incentives for local production of chemicals through competitive prices. This necessitated the development of ethylene and its polymer products such as HDPE, LDPE, and LLDPE.

Drawing from Gerlowski and Othman (2014: 68):

> To remain competitive the government of Saudi Arabia initiated an industrial-clusters programme to focus investment and growth in five key industries: automotive, minerals and metals, plastics and packaging, solar energy and home appliances. These five sectors were chosen due to their huge potential for growth, and rely on the Kingdom's abundant raw materials, natural resources, and energy. Each of the clusters chosen relies on chemicals in some way. The programme to develop the plastics and packaging cluster includes seven conversion projects related to the following:
>
> a) personal care products (bottles, tubes, containers and caps, and other pumps and sprays);
>
> b) pharmaceutical packaging products (bottles, blister packs, inhalers, and syringes);

c) caps and closures (with both standard shapes and complex shapes, such as tamper-proof and sports-bottle tops);

d) bi-oriented polypropylene;

e) film (transparent and metallized bags for foods);

f) barrier films (bags and pouches, chemicals packaging); and

g) medical and pharmaceutical packaging.

# 4 Feedstock options for Southern Africa

## 4.1 Feedstock from Angola

Angola is rich with crude oil and could be considered for moving up the value chain to processing polymers. In fact, Angola's reindustrialization plan indicates the country's willingness to embark on chemical and plastics value chain investments. However, because of high greenhouse gas (GHG) emissions and the harmful impact on the environment associated with crude oil, it cannot be considered as a sustainable feedstock option in the plastic industry. New investments may not be viable as it is believed that reductions in carbon footprints could likely reduce the market for petroleum-based products.

## 4.2 Alternative feedstock

According to the United Nations Conference on Trade and Development (UNCTAD) (2011: 8), 'environment-related concerns should be at the heart of all strategies to develop productive capacities along (the lines of policy framework that promotes the sustainable management of natural capital and ecosystems and helps adapt to and mitigate the effects of climate change) and growth should not be decoupled from high and increasing levels of carbon emissions'. Future-proofing the plastics industry from petroleum effects therefore means that countries have to look at environmentally friendly sources of inputs. Biomass emerges as an alternative option that provides fewer GHG emissions that can be explored.

Feedstock for biomaterial also allows for inclusive economic growth as it supports a rural agrarian economy because the crops can be farmed everywhere. The choice of a suitable crop for use in biochemical processing depends on its sustainability in all forms, such as environmentally—the impact on land and water; socially—its effects on food security; and economically—whether it contributes to poverty reduction.

South Africa recognizes the importance of biofeedstock as an alternative to fossil-fuel-based feedstock. However, it is only at research stages as far as biofeedstock is concerned. As a result, no proper niches have been identified. Biomaterial research efforts in the country are primarily driven by the Centre for Scientific and Industrial Research (CSIR) and a collection of university initiatives, with overarching support from the Department of Science and Technology (DST). The DST has two approaches to its research. One is a group that aims at producing biomaterials and has established the Biocomposites Centre of Competence in Port Elizabeth. The other one involves biorefinery pilot projects that are geared towards processing various biomass sources to produce as a variety of products such as value-added chemicals, fuels, and agricultural products. The private sector is also involved but at a lesser magnitude on primary technology development or prototypes (Wood and Deonarain 2019).

The Biocomposites Centre of Competence is a 4,300-m$^2$ establishment that focuses on creating biomaterials derived from 'natural fibres such as flax, hemp, kenaf and agave; thermoplastic and thermoset resins; as well as biopolymers such as soy protein, polylactic acid and polyfurfuryl alcohol. The mechanical, thermal, thermo-mechanical and fire-retardant properties of fibre-reinforced composites are optimised for application in the automotive and aerospace industries' (Anandjiwala n.d.). The Biocomposites Centre of Competence works with various clients and partners in areas, such as airspace, autos, retailing, trains, and academia, in different initiatives, such as interior panels for airplanes; biopolymers for housing; packaging; and interior panels for train carriages (Wood and Deonarain 2019).

In addition, the CSIR opened the ZAR37.5 million Biorefinery Industry Development Facility (BIDF) in Durban in 2017, which aims to serve as a venue for piloting and upscaling technologies. The BIDF is one part of a large work plan aimed at creating biorefineries, with the DST targeting refineries in five areas: forestry, sugar, algae, non-food crop plant oils, and microbial biorefineries based in rural areas. This biorefinery work is supported by several additional initiatives, such as the creation of a biorefinery research consortium, involving the CSIR, bioenterprise Sekolong Sa Dimelana, Tshwane University of Technology, and the University of the Witwatersrand (Arnoldi 2018).

### 4.3 New feedstock

A new potential feedstock that South Africa has not yet ventured into is green hydrogen. The IEA (2019: 168–9) recognizes that:

> There is now a greater focus on the deep emission reductions that hydrogen can help deliver, a wider recognition that hydrogen can help to achieve a broad range of policy objectives, a growing awareness that hydrogen can complement expected high levels of renewables in various important ways, and a growing body of experience with low-carbon technologies across the board on which governments and investors alike can draw. […] Targets and existing and planned projects around the world show that the speed of deployment in coming years is expected to vary widely between sectors. Some, such as aviation, shipping, iron and steel and chemicals, have very high levels of potential future demand for hydrogen and hydrogen-based fuels and face few competitors from other low-carbon technologies.

Globally, some developed countries are moving towards green hydrogen feedstock in an attempt to decarbonize different sectors within their economies. In addition, these countries push towards positioning themselves as the leading exporters of green hydrogen in the globe. The top 10 countries that have already made investments in green hydrogen production for different applications are Japan, which is by far the leading country in green hydrogen use, Canada, China, Australia, France, Germany, Norway, South Korea, United Kingdom, and the United States.

Studies are underway in South Africa to explore the feasibility of the green hydrogen feedstock for utilization in South African industries.

### 4.4 Analysis of the strengths, weaknesses, opportunities, and threats (SWOT) of polymer production in Southern Africa

In order to understand the competitive advantage that Southern Africa has in the regional plastics value chain, the SWOT analysis was explored in Table 1.

Table 1: SWOT of polymers in Southern Africa

| Strengths | Weaknesses |
|---|---|
| • The polymer and plastic products manufacturing industry is well established.<br>• Access to raw materials because of abundant gas reserves.<br>• Wide range of end users, with plastic products used in most sectors of the economy.<br>• The industry is committed to sustainable development and to reducing its environmental footprint.<br>• Technology available in South Africa. | • Only Sasol produces ethylene and propylene, the raw materials for polyethylene and polypropylene manufacturing, and Safripol produces polypropylene to a lesser extent.<br>• A shortage of skilled employees.<br>• A lack of advanced manufacturing practices and the slow upgrading of technology in the downstream.<br>• A general lack of research and development in plastic products manufacturing.<br>• Energy-intensive production processes make producers vulnerable to high electricity costs. |
| **Opportunities** | **Threats** |
| • Increased use of plastic products in several sectors of the economy.<br>• The governments of South Africa and Mozambique consider the polymers and plastic products industry a priority industry.<br>• Increasing demand for plastic products in the African market, driven by a growing middle class, the development of organized retailing, infrastructure development, and increasing urbanization. | • Increasing cost of electricity, water, transport, input materials, and labour.<br>• Growing concerns about plastic products' impacts on the environment.<br>• Depressed domestic demand because of low GDP growth.<br>• Increasing imports of polymers and plastic products.<br>• Relatively small size of the regional markets. |

Source: author's elaboration.

## 5 Learnings for regional industrial policy (conclusions and recommendations)

In conclusion, the following have been observed from the study:

- Other than natural gas as a potential source of feedstock for production of polymers, the study could not find any other viable feedstock that can future-proof the industry against the impact of coal and petroleum. This is because the region has not yet established a strong supply of renewable feedstock that could relieve the dependence on fossil fuels. Globally, the future of the industry is a mixture of biomass and green hydrogen. However, there is no anecdotal evidence of that in the region, particularly in South Africa as a regional pioneer.
- An abundance of natural gas feedstock, and the conducive policy instruments in place for production of chemicals and enhancement of the plastic value chain, proves Mozambique to be the only viable country for increased production of chemicals and polymers in the region. Capital costs for establishing new plants are high and unaffordable for the country as these require external investment, which in the long run could prove beneficial and cost-effective to produce chemicals, and to start beneficiation where the feedstock is. Sharing factors of production across the region would mean that South Africa provides labour, capital, and the technology required.
- The ubiquity of plastics and integration of plastic products in different sectors means consumers cannot do without them. However, as much as it would make sense to increase productivity of plastic products in the regional countries (excluding South Africa), the market for plastics in the region is still very small. Increases in production of polymers in Mozambique therefore cannot go beyond South Africa. In this case, the South African plastic manufacturers would benefit

from better priced polymers derived from better priced natural gas from Mozambique and lowering the price of a significant input into the plastics production process. A more price-competitive South African plastics industry will also benefit from increased exports of plastic products.

- A strong upstream regional value chain seems likely between South Africa and Mozambique but unlikely between SADC as a whole—with inputs for polymers clustered in Mozambique and plastics production, investment resources, and appropriate skills in South Africa. The size of the regional market means that the value chain will mostly benefit through increased exports internationally.
- It would be important to look into import substitution and production of competitively priced polymers in the region. The relatively small market makes it difficult for Southern Africa to have a significant plastics value chain within the region and contribute significantly without exporting globally.

## References


AfDB (2018). 'Mozambique Country Strategy Paper 2018-2022'. Mozambique: African Development Bank.

Alfaro, L., Y. Aloadah, G. ElKhoury, and F. Bashir (2016). 'Upgrading the Saudi Chemical Cluster'. Available at: https://www.isc.hbs.edu/resources/courses/moc-course-at-harvard/Documents/pdf/student-projects/Saudi%20Arabia%20Chemicals%202016.pdf (accessed 29 September 2020).

AllAfrica (2018). 'Mozambique: ENH Plans to Build a Gas Refinery'. Available at: https://allafrica.com/stories/201805150099.html (accessed 29 September 2020).

Anandjiwala, R. (n.d.). 'CSIR Facilities Geared to Support the Biocomposites Centre of Competence'. Port Elizabeth, South Africa: Council for Scientific and Industrial Research.

Arnoldi, M. (2018). 'DST Bolsters Biomass Industry with New Consortium'. *Engineering News*. Available at: https://www.engineeringnews.co.za/article/dst-bolsters-biomass-industry-with-new-consortium-2018-09-20 (accessed 29 September 2020).

Beare, M., P. Mondliwa, G. Robb, and S. Roberts (2014). 'Report for the Plastics Conversion Industry Strategy.' Johannesburg: Centre for Competition, Regulation, and Economic Development.

British Petroleum (2019). 'Production and Consumption of Energy Sources'. Excel Sheet downloaded 21 November 2019. Available at: https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html.

British Plastics Federation (2019). 'Oil Consumption'. Available at: https://www.bpf.co.uk/press/oil_consumption.aspx (accessed January 2020).

Cabinet Council (2014). *Natural Gas Master Plan*. Maputo: Republic of Mozambique.

CAC (2015). 'Case No: 131/CAC/Jun14'. Bloemfontein, South Africa: Competition Appeal Court of South Africa.

CCRED (2016). 'GTAC Winter School: Industrial and Competition Policy on Plastics'. Johannesburg: Centre for Competition, Regulation and Economic Development.

ChemSystems (2012). 'Plants to Plastics Can Nature Compete in Commodity Polymers?' New York: ChemSystems Prospectus. https://www.nexantsubscriptions.com/file/42393/download?token=dh1ATqKY

Conradie, A. (2019). 'Manufacture of Plastic and Plastic Products'. Port Elizabeth: Who Owns Whom. https://www.whoownswhom.co.za/store/info/4773

Creamer, T. (2019). 'Planets Aligning for SA Firms as Huge Mozambique Gas Projects Get Moving'. *Engineering News*. Available at: https://m.engineeringnews.co.za/article/planets-aligning-for-sa-firms-as-huge-mozambique-gas-projects-get-moving-2019-11-22-1/rep_id:4433 (accessed November 2019).

Department of Trade and Industry (2018). 'Industrial Policy Action Plan 2018/19 – 2020/21'. Pretoria, South Africa: Department of Trade and Industry.

EIA (2019). 'Background Reference: Angola.' Washington, DC: U.S. Energy Information Administration. https://www.eia.gov/international/content/analysis/countries_long/Angola/background.htm

Euromap (2016). 'Plastics Resin Production and Consumption in 63 Countries Worldwide 2009-2020'. Frankfurt: Euromap.

European Bioplastics (2016). 'Biobased Plastics – Fostering a Resource Efficient Circular Economy'. Available at: https://docs.european-Bioplastics.org/2016/publications/fs/EUBP_fs_renewable_resources.pdf (accessed April 2020).

European Bioplastics (n.d.). 'Renewable Feedstock'. Available at: https://www.european-bioplastics.org/bioplastics/feedstock/ (accessed April 2020).

Frey, A. (2019). 'South Africa Eyes €600 Million in Exports to Mozambique Gas Sector'. Maputo, Mozambique: Club of Mozambique.

Garisch, C. (2016). 'A Study of Innovation Culture and Capability in the South African Plastics Industry'. Johannesburg: MerSeta Plastic Chamber Research.

Gerlowski, E., and A. Othman (2014). 'Saudi Arabia's Chemicals Industry Continues to Grow'. American Institute of Engineers. Available at: https://www.aiche.org/resources/publications/cep/2014/august/saudi-arabias-chemicals-industry-continues-grow (accessed 29 September 2020).

Graham, M. (2019). 'Is Mozambique the World's Next Great Energy Superpower?' Blog. Fircroft. Available at: https://www.fircroft.com/blogs/is-mozambique-the-worlds-next-great-energy-superpower-92962314572.

Horncastle, A., M. Morawietz, J. Rotering, and R. Van den Heuvel (2015). 'Future of Chemicals II & Middle East Challenges'. Strategy&. Available at: https://www.strategyand.pwc.com/gx/en/insights/2002-2013/future-of-chemicals/future-of-chemicals-part-ii.pdf (accessed 5 October 2020).

IEA (2019). 'The Future of Hydrogen'. Japan: International Energy Agency.

Lowitt, S. (2015). 'A View of the Chemical Sector'. Pretoria, South Africa: Trade & Industrial Policy Strategies.

Malikane, C., S. Roberts, and N. Sikhweni (2000). 'Competition and Market Structure in the Plastics Sector: A Preliminary Analysis'. Johannesburg: University of the Witwatersrand.

Montmasson-Clair, G., and M. Patel (n.d.). 'Petrochemical Value Chain and Climate-Compatible Development in South Africa'. Presented to Chemical and Allied Industries Association. Trade & Industrial Policy Strategies. Pretoria, South Africa. *Unpublished.*

Nair, R., P. Mondliwa, and S. Roberts (2014). 'Excessive Pricing Verdict in Sasol Polymers Case'. Johannesburg: Centre for Competition, Regulation and Economic Development.

PlasticsEurope (2018). 'Plastics the Facts – 2018'. Brussels: PlasticsEurope. https://www.plasticseurope.org/application/files/6315/4510/9658/Plastics_the_facts_2018_AF_web.pdf

Plastics SA (2018). '2017/18 Annual Review'. Midrand, South Africa: Plastics SA. Available at: https://www.plasticsinfo.co.za/wp-content/uploads/2019/09/Plastics_SA-AR-2017_18-100pages-96dpi.pdf (accessed January 2020).

Pretorious, A. (n.d.). 'Plastics Master Plan'. Pretoria, South Africa: Department of Trade, Industry and Competition. *Unpublished*.

Quantec (2020). 'EasyData'. Available at: https://www.quantec.co.za/easydata/ (accessed May 2020).

Sasol (2018). 'Value Through Focus and Discipline'. Sandton, South Africa: Sasol Limited.

Sasol (2020). 'Business Performance Metrics'. Available at: www.sasol.com/investor-centre/financial-reporting/business-performance-metrics (accessed 13 October 2020).

Southern Africa Stainless Steel Development Association (Sassda) (n.d.). 'Mozambique's $128 Billion Gas Project Could be a Lifeline for SA Stainless Steel'. Available at: https://sassda.co.za/mozambiques-128-billion-gas-project-could-be-a-lifeline-for-sa-stainless/ (accessed February 2020).

TechnoFunc (n.d.). 'Business Model and Value Chain of Chemicals Industry'. Available at: https://www.technofunc.com/index.php/domain-knowledge/item/business-model-value-chain-of-chemicals-industry (accessed 5 October 2020).

Trade Map (2019). 'Saudi Arabia Exports of Polymers HS 3101-3905'. Available at: www.trademap.org. (accessed February 2020).

UNCTAD (2011). 'Development of Productive Capacities and Trade: The Key to Inclusive and Sustainable Growth'. Istanbul: UN-CEB Cluster on Trade and Productive Capacity, United Nations Committee on Trade and Development.

United Nations Statistics Division (2019). 'Open Data for Africa'. Available at http://dataportal.opendataforafrica.org/tppeckb/un-industrial-commodity-statistics-database (accessed November 2019).

Wood, C., and Deonarain, B. (2019). 'Developing a Biomaterials Industry in South Africa: Action Plan and Implementation Strategy'. Partnership for Action on Green Economy. Pretoria: Green Economy.

**Acronyms and abbreviations**

| | |
|---|---|
| BIDF | Biorefinery Industry Development Facility |
| CIS | Commonwealth of Independent States |
| CCRED | Centre for Competition, Regulation, and Economic Development |
| CSIR | Centre for Scientific and Industrial Research |
| CTL | Coal-to-Liquids |
| DST | Department of Science and Technology |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gas |
| GPCA | Gulf Petrochemicals and Chemicals Association |
| GTL | Gas-to-Liquids |
| HDPE | High-Density Polyethylene |
| LDPE | Low-Density Polyethylene |
| LLDPE | Linear Low-Density Polyethylene |
| LNG | Liquefied Natural Gas |
| MGS | Master Gas System (Saudi Arabia) |
| NGL | Natural Gas Liquids |
| PE | Polyethylene |
| PET | Polyethylene Terephthalate |
| PP | Polypropylene |
| PVC | Polyvinyl Chloride |
| SABIC | Saudi Basic Industries Corporation |
| SADC | Southern African Development Community |
| SMMEs | Small, Medium, and Micro Enterprises |
| Tcf | Trillion Cubic Feet |
| UNCTAD | United Nations Conference on Trade and Development |