



TRADE AND INDUSTRY CHAMBER

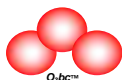
**FUND FOR RESEARCH INTO INDUSTRIAL DEVELOPMENT,
GROWTH AND EQUITY (FRIDGE)**

**A STUDY ON THE IMPACT OF UPSTREAM PRICING PRACTICES IN THE CHEMICAL
SECTOR ON THE DEVELOPMENT OF THE SOUTH AFRICAN CHEMICAL SECTOR
AS A WHOLE**

Date of submission

26th February 2010

Final Report Submitted by



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THE IMPACT OF UPSTREAM PRICING PRACTICES IN THE CHEMICAL SECTOR ON THE DEVELOPMENT OF THE SOUTH AFRICAN CHEMICAL SECTOR AS A WHOLE

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Note 1: This document contains sensitive commercial information related to the pricing and business practises of the products included. For confidentiality purposes the information is restricted to the FRIDGE CPG members only, and cannot be freely distributed within their respective constituencies without prior permission.

Note 2: The research process was unsuccessful in achieving significant participation of downstream industries in providing pricing and financial data. In addition poor participation by downstream industry resulted in a statistically insignificant number of participants providing at least 5 years of financials, as required to produce sound or scientific EVC results. In cases where the small sample size could compromise the conclusions, the conclusions and policy options relating to price have been qualified accordingly in the report.

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LIST OF ABBREVIATIONS

ANS	Ammonium nitrate solution
ANPP	Ammonium nitrate porous prills
ARMSA	Association of Rotational Moulders of South Africa
ASGISA	Accelerated and Shared Growth Initiative for South Africa
BA	Butyl acrylate
BOPP	Bi-axially oriented film
BPL	Bone Phosphate of Lime or Tri-calcium Phosphate
CFR	Cost and Freight
CHIETA	Chemical Industries Education and Training Authority
CIF	Cost, Insurance, and Freight
DAP	Di-ammonium Phosphate
DCP	Di-calcium Phosphate
EA	Ethyl acrylate
EC	European Community
EPASA	Expanded Polystyrene Association of South Africa
EPDM	Ethylene-propylene-diene rubber
EPZ	Export Processing Zones
EVC	Economic Value Creation Model
FOB	Free on board
FRIDGE	Fund for Research Into Industrial Development Growth and Equity
FSSA	Fertilizer Society of SA
GAA	Glacial acrylic acid
GDP	Gross Domestic Product
GDS	Growth and Development Summit
HDPE	High density polyethylene
H ₃ PO ₄	Phosphoric acid
IMF	International Monetary Fund
IoM	Institute of Materials
IPP	Import parity pricing
IRR	Internal Rate of Return
IVC	Intrinsic value created
JV	Joint venture

K	Weighted average cost of capital
LAN	Lime ammonium nitrate
LC	Letter of Credit
LDPE	Low density polyethylene
LLDPE	Linear-low density polyethylene
MAP	Mono-ammonium Phosphate
MCC	Mitsubishi Chemical Corporation
MCP	Mono-calcium Phosphate
MERSETA	Manufacturing, Engineering and Related Services Sector Education and Training Authority
MGA	Merchant Grade Acid
NEDLAC	National Economic Development and Labour Council
NPK	Nitrogen, Phosphorus, Potassium
PASAF	Polyurethane Association of South Africa
PBIT	Profit before Interest and Tax
PCA	Plastics Converters Association
PDASA	Plastic Distributors Association of South Africa
PET	Polyethylene terephthalate
PFSA	Plastics Federation of South Africa
PISA	Plastics Institute of South Africa
PMMA	Plastic Mould Makers Association
PP	Polypropylene
PPA	Purified Phosphoric Acid
PVC	Polyvinylchloride
SA or RSA	Republic of South Africa
SAMPLAS	South African Machinery Suppliers Association for Plastics, Printing, Paper and Allied Industries
SAPIA	South African Polymer Importers Association
SAPMA	South African Paint Manufacturers Association
SAPPMA	South African Plastic Pipe Manufacturers Association
SDA	Sasol Dia Acrylates
SME	Small and Medium Sized Enterprises
SSP	Single super phosphate
the dti	The Department of Trade and Industry

tpa	Tons per annum
TSP	Triple Super Phosphate
UK	United Kingdom
USA or US	United States of America
USSR	Union of the Soviet Socialist Republics
VAT	Value added tax
VCM	Vinyl chloride monomer
WTO	World Trade Organization

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EXECUTIVE SUMMARY

Background

E1 The South African government has prioritised the chemical industry for spearheading growth and development for the country as a whole as part of a much broader government growth and development agenda. In order to realize such aspirations in the chemical industry in particular, the (chemical) sector development strategy's focus is upon downstream development and beneficiation of abundant feedstock. The government wants the chemical industry as a whole and the downstream chemical industry in particular to meet the economic aspirations such as competitiveness, investment, exports, job creation and equity. One of the ways of achieving competitiveness is to ensure competitive cost inputs and therefore pricing practices are one of the important factors in the development of the chemical industry. It is against this background that during the Nedlac Chemical Sector Summit process it was agreed to conduct a study on the role of pricing practices in the South African chemical sector. One of the pricing practices is import parity pricing (IPP), which is the pricing of a locally manufactured product that it would cost to import. Pricing practices as applied by the upstream chemical industry and the implications on the downstream chemical industry was the subject of this investigation. The investigation was focussed only on the following value chains: Polypropylene (PP), Polyethylene (LDPE, LLDPE, HDPE), Polyvinyl chloride (PVC), titanium dioxide, acrylic acid, and fertilizer feedstock or raw materials; namely, ammonia and phosphoric acid.

Methodology

E2 The information required for this investigation was gathered from local and international databases and other desk sources. Furthermore, personal and telephonic interviews were done with upstream and downstream role-players. Among international sources used were ICIS LOR, Platts Polymerscan, Tecnon Parpinelli and Harriman Chemsult. These sources were used for the pricing data as they publish weekly and monthly quotes on the prices that prevailed for various markets around the world. Data on the conversion and usage of

polymers was sourced from Tecnon Parpinelli and CMAI while data on the country populations and GDP was sourced from the IMF and the World Bank.

- .
- E3 When it comes to international competitiveness of the South African chemicals pricing, time series for price comparisons were compiled for the period January 1994 to January 2005 for China, India, Northwest Europe and the USA. Pricing data collected from international sources/agencies was compared with that collected from the relevant upstream and downstream companies in South Africa as a means of verification. Similarly, local pricing data collected from upstream companies was compared with that received from downstream companies for verification.
- E4 In terms of assessing the impact of the South African upstream chemical industry pricing practices on the development of the downstream chemical industry, a comparison of the relative development of downstream chemical industries for a range of countries with the status in South Africa was done. This comparison of the relative development of the downstream chemical sector is called the “Reality Test”. A comparison of the Per Capita GDP versus Per Capita Polymer Usage for all countries is a well established “Reality Test” worldwide. The “Reality Test” attempts to check if there is any correlation between the stage of economic development as measured by Per Capita GDP with the size of the polymer conversion sector as measured by Per Capita polymer converted within a country. A sample of 97 countries has been selected for this comparison and the comparison was done for polymers only since polymers represented the most value of all the intermediate products which were the subject of this investigation.
- E5 In order to analyse the impact of upstream pricing practices on the downstream industry the Economic Value Creation Model (EVC) was used. EVC is a practical measure of the company's operating performance that correlates with the value of the company. What makes it so relevant is that it takes into account a cost that conventional measures exclude, namely, the cost of equity. EVC is simply the before interest and after tax operating profit minus the total annual cost of capital. In essence, the objective of this study was to determine the impact of IPP in particular across both the upstream and downstream

elements of the chemical industry. Accordingly, financial data from upstream companies in the research sample has been agglomerated, as was the financial data from downstream companies. The effect is that no single company can be identified in the report.

- E6 In order to make valid comparisons of the impact of selling price changes on both the upstream and downstream levels of the chemical industry, it was necessary to determine the relationship that existed between selling price changes and changes in sales to customers. Technically, this relationship is known as the "elasticity of demand". Accordingly a Demand Elasticity analysis was done in order to check the relationship between potential changes in prices to the quantity of products sold.

Challenges encountered during the research

- E7 The major challenge experienced during the research process was the lack of co-operation from downstream companies. To address the situation contacts were made with Executive Directors of the respective associations that the value chains under investigation fall within in order to encourage their members to take part in the investigation. Furthermore, three workshop sessions were held in Cape Town, Durban and Johannesburg with the aim of encouraging downstream companies to give their submissions for this investigation. The respective value chain associations invited their members to these workshops on top of the invitations issued by the researchers. Even with this effort the study failed to get a significant number of downstream companies to participate in the investigation for the value chains polymers and titanium dioxide, with the exception of fertiliser raw materials/feedstock value chain. Accordingly, in cases where the downstream sample size could compromise conclusions drawn, such conclusions have been qualified in the report.

The nature of the South African industry

- E8 The South African chemical industry generally has a mostly well-developed and concentrated (with few manufacturers) upstream industry and a downstream industry that is generally perceived as underdeveloped that comprises of many players.

Polymers

- E9 Polypropylene supply in South Africa is concentrated with only two suppliers; namely, Sasol Polymers in Secunda and Safripol (formerly Dow Plastics) in Sasolburg. Sasol Polymers also produce LDPE, LLDPE and PVC while Safripol also produce HDPE. In terms of feedstock PP is manufactured from propylene monomer which is supplied by only two manufacturers; namely, Sasol Synthetic Fuels in Secunda and Sapref (Shell and BP refinery) in Durban. South Africa has a unique propylene monomer supply from the Fischer Tropsch (coal gasification) synthetic fuel technology employed by Sasol in Secunda. The Fischer Tropsch process streams are relatively rich in recoverable propylene while relatively smaller quantities of propylene monomer are also recoverable from conventional refinery operations like Sapref. LDPE, LLDPE and HDPE are all manufactured from ethylene monomer which is also supplied by Sasol Synthetic Fuels in Secunda. PVC is manufactured from ethylene monomer and chlorine. Sasol Polymers manufacture chlorine captively (for own in-house consumption) from salt.
- E10 [In terms of application PP is used in the manufacturing of appliances \(what is normally referred to as white goods\), automotive batteries, automotives, buckets, domestic ware/furniture, closures and caps, food containers, woven packaging/bags and fibres \(carpets and other\).](#) Of these the dominant market applications are woven packaging/bags (20%), non-woven other (18%), domestic ware/furniture (15%) and fibres (15%). In case of polyethylene, more than 70% is for packaging applications. PVC is used in two main product categories; namely, flexible and rigid products. [The PVC market is different to the polyethylene in that it is not dominated by packaging applications, but rather it is used in a variety of other applications and in particular construction.](#) More than 45% of the PVC market applications is pipes and packaging is only 10% while by way of comparison the PP market applications for pipes is only 1%.
- E11 The cost structure of South African based upstream polymers operations is not directly comparable to international operations largely because of two reasons. Firstly because both Safripol and Sasol Polymers have integrated operations that are manufacturing both Polypropylene and Polyethylene. Secondly, in the case of Sasol Polymers, the production

infrastructure includes an olefin purification operation that purifies ethylene and propylene that is obtained in crude form from the Fischer Tropsch process. It is important to note that the ethylene and propylene supplied by Sasol Synthetic Fuels to Sasol Polymers is not polymer grade but raw condensate, hence there is a purification operation at the Sasol Polymers side. This is a unique operation on a global basis. Generally feedstock costs in South Africa's case is a lower portion of total costs compared to international manufacturers, while other costs, which include variable and fixed manufacturing costs, but no depreciation, are higher in South Africa's case. However, in absolute terms South Africa's cost base is relatively higher than the international norm due to relatively small manufacturing plant sizes.

- E12 Tariff protection in South Africa for polymers supplied from non-European countries is 10% *ad valorem* import duty calculated based on the FOB price while for Europeans countries it is 7.5% *ad valorem*. In other words the upstream manufacturers enjoy tariff protection of 10% (PP), 8.4% (Polyethylene and PVC) *ad valorem* duty at the most. By contrast tariff protection for (downstream) products manufactured from polymers is in the order of 15% – 20% for most products and up to a high of 24% for one particular product. It is only in the case of a few polyethylene downstream products that tariff protection is as low as 5%. Therefore, for most products downstream tariff protection is not only higher than tariff protection upstream, it is also calculated on a figure that is numerically higher in weight terms meaning that on a Rand/ton basis the protection is up to four times higher for downstream products compared to the upstream polymers.

Fertilizer feedstocks/raw materials

Phosphate rock

- E13 There is only one commercial supplier of phosphate rock in South Africa. Phosphate rock is mined by Foskor in Phalaborwa for commercial supply but there is also another mine in Lephalale owned by Fer-Min-Ore Phosphate. Unlike Foskor, Fer-Min-Ore beneficiates the phosphate rock they mine for the production of single super phosphate which they supply to the market. The South African phosphate rock resource base has a poor P_2O_5 content compared to other world sources. In South Africa, phosphate rock has to be beneficiated to

increase P_2O_5 contents from less than 10% to an average 38%. Elsewhere in the world phosphate rock is mostly applied to the soil as is (as fertilizer) due to a higher P_2O_5 content. South Africa is the 9th largest global producer with a 2.1% share.

E14 Phosphate rock in South Africa is igneous which is found through deep mining versus most of the world supply which is sedimentary and is near the surface. South Africa's phosphate rock is produced by means of a mining process, followed by a metallurgical beneficiation and concentration process that involves chemical flotation and drying. This process increases the average P_2O_5 contents from less than 10% to an average 38%. Major exporting countries elsewhere in the world have phosphate resources that have a natural P_2O_5 contents that is high enough not to require expensive chemical processing and drying. In addition, the inland position of Foskor also results in high inland transportation cost to the Richards Bay harbour for export. In South Africa's case the major cost elements are therefore related to typical mining operations, including materials handling and milling, as well as the beneficiation process. The beneficiation process and waste management of the flotation tailings are an added cost for South Africa compared to major global suppliers.

E15 There is no tariff protection on phosphate rock.

Phosphoric acid

E16 Phosphoric acid is produced by Foskor in Richards Bay, Sasol Nitro in Phalaborwa and Omnia in Rustenburg. Phosphoric acid is a unique value chain for the study in that downstream companies have captive production. The three major fertilizer companies use 100% of the commercial (non-captive) phosphoric acid.

E17 Phosphoric acid is commercially available in a range of qualities and concentrations. These range from crude phosphoric acid containing most of the impurities present in phosphate rock to a very pure phosphoric acid containing very low impurity levels. Crude phosphoric acid has low concentrations of 40-54% P_2O_5 and it is used for the manufacture of fertilizers such as di-ammonium phosphate (DAP) and triple super phosphate (TSP). Very pure phosphoric acid has concentrations of 75% and 85% and it is used for food

applications and other high value end-uses. The greatest use of phosphoric acid by far is in the manufacture of phosphate chemicals consumed primarily as carriers of phosphorus in fertilizers and animal feeds. Phosphoric acid is also used in the manufacture of phosphate chemicals for use in water treatment and detergent builders, dentifrices, fire control chemicals and a host of smaller markets. Consumption of phosphoric acid for its acid properties per se is relatively small (e.g. beverage acidulation).

E18 Phosphoric acid is produced by means of the reaction of sulfuric acid with phosphate rock. The cost of production therefore includes the cost of production of sulfuric acid as well. The main cost element in sulfuric acid production is sulfur feedstock. South Africa has little sulfur feedstock, and the majority of requirements are imported from Canada. Due to the low unit cost of sulfur, logistical handling and shipping costs are relatively high, making the cost of sulfuric acid production high. The major cost items in phosphoric acid production are therefore phosphate rock and sulfuric acid, which account for around two-thirds of total production costs.

E19 There is no tariff protection on the major derivatives of phosphoric acid.

Ammonia

E20 Sasol is the only producer of ammonia in South Africa. Sasol operates two ammonia operations, one in Sasolburg and one in Secunda. The other plants in Modderfontein (AECI) and Milnerton (Calref) have been closed down since they were no longer economically viable to operate and maintain. The Sasolburg plant is a conventional unit, previously using Sasol's own synthesis gas produced from coal, and pure nitrogen. This plant has now been converted to use reformed natural gas supplied from Mozambique. Sasol's operation in Secunda is utilising the so-called Phenosolvan process. The plant recovers ammonia that becomes available from Sasol's coal gasification operations. Ammonia production from the Phenolsolvan process is part of an integrated process that produces a range of other products. The cost structure of ammonia production could not be established.

- E21 The major application markets for ammonia are in fertilizer (50%) and explosives manufacturing (45%). The downstream sectors affected by ammonia feedstock are mainly the primary fertilizer and explosives production sector. This includes Sasol Nitro's fertilizer and explosives business units which also purchase ammonia at arm's length from Sasol Nitro's ammonia business unit. Sasol Nitro's ammonia, fertilizer and explosives business units operate as separate business units.
- E22 There is no duty protection on the major ammonia derivatives.

Titanium dioxide

- E23 Titanium feedstock is typically obtained from natural deposits of heavy mineral sands, which contain titanium ores together with other minerals such as Iron and Zircon. Around one-third of global titanium ore is supplied as slag produced from lower grade ores. This slag is then used for pigment manufacturing. South Africa is a major global source of titanium feedstock, accounting for around 17% of the total global supply, and 50% of particularly titanium slag. Titanium slag operations are Richards Bay Minerals and Ticor in Richards Bay and Namaqua Sands in Saldanha Bay.
- E24 Huntsman Tioxide in Umbongwintini is the only titanium dioxide pigment manufacturer in South Africa. The operation is relatively old and small in capacity. Also, it is based upon older sulphate-based technology, compared to newer plants that are based upon chloride technology. South Africa's overall cost per ton of pigment is significantly higher than international low-cost producers. Titanium dioxide is the standard white pigment used principally in paints (79%), plastics conversion (10%), inks (3%) and other formulations such as paper. It is the most important pigment in the world, accounting for about 70% of total volume.
- E25 There is an import duty of 10% applicable to titanium dioxide pigments

Acrylic acid and Acrylate esters

- E26 Acrylic acid and acrylate esters are produced by Sasol Dia Acrylates in Sasolburg, previously a joint venture between Sasol and Mitsubishi Chemical Corporation of Japan but now fully-owned by Sasol with a license and off take agreement with Mitsubishi. Glacial acrylic acid, is used primarily to manufacture water treatment chemicals, as well as emulsion polymers while acrylate esters are mainly used to manufacture emulsion polymers. Sasol Dia Acrylates manufactures acrylic acid from propylene monomer, while acrylate esters are manufactured from n-butanol, which is in turn manufactured from propylene, and ethanol in addition to acrylic acid. Propylene is supplied by Sasol Synthetic Fuels in Secunda and Sapref in Durban, the only two suppliers.
- E27 The cost structure of acrylic acid and acrylate esters manufacturing in South Africa is not directly comparable to international glacial acrylic acid and acrylate esters operations in that the Sasol Dia Acrylates has an integrated operation that is manufacturing n-butanol as well as acrylates. It is important to note that the feedstock used in South Africa's case is propylene, ethanol and butanol, while in the international manufacturer's case the feedstock is acrylic acid and butanol.
- E28 There is no tariff protection for glacial acrylic acid, ethyl acrylate and butyl acrylate.

The nature of the global industry

Polymers

- E29 PP is produced in a range of grades; namely, homopolymer, impact copolymer and random copolymer. It is produced by many countries and it is traded in large volumes (45 times the South African market) around the globe. Injection moulding and fibre and filament are the world's largest end uses for PP, at 33% and 29%, respectively, followed by film uses at 18%. The injection moulding end-use category seems to be inversely related to the maturity and overall growth of consumption in countries and regions. That is, as a country/region matures and growth slows, the PP end-use breakdown shifts toward injection moulding. Transportation constitutes one of the major end-use markets for injection-moulded PP. Numerous other types of products are injection moulded from PP. [Tariff protection is](#)

[comparable to that of South Africa for selected countries except in the case of Malaysia where it is the highest at 30% and it is calculated on CIF basis.](#)

- E30 Polyethylenes are produced in a range of grades. LDPE and LLDPE grades are commodity and special film grades, extrusion coating LDPE grades, injection moulding grades and rotational moulding grades in pellet or ground powder form. HDPE grades are blow and injection moulding, bottle and film grades. Polyethylenes in general are regarded as commodity products that are produced by many countries and is well-traded in large volumes (44 times the South African market) around the globe. Global plant sizes are increasing due to economies of scale issues. [Tariff protection is comparable to that of South Africa for selected countries except in the case of Malaysia where it is the highest at 30% and it is calculated on CIF basis.](#)
- E31 Film applications are by far the largest market for LDPE, split roughly 50/50 between packaging and non-packaging uses. Extrusion coating is the second largest market for LDPE worldwide. Extrusion coating continues to be a growth area for LDPE, largely because of innovations in packaging technology. Injection moulding is the third-most-important consumer of LDPE. The two largest net importing regions for LDPE in 2006 were Asia (excluding Japan) and Central/South America while the United States and Japan are net exporters. The major applications for LLDPE are packaging, particularly film for bags and sheets. Other applications are cable covering, toys, lids, buckets and containers and pipes. The Middle East, Canada and Asia are the largest net exporters of LLDPE. Major net importers are Western Europe, the United States and China. Blow moulding and injection moulding are the dominant end uses in both Western Europe and North America, accounting for 55% – 60% of total consumption. In contrast, consumption of HDPE in these end applications constitutes only about 30% – 40% of total HDPE consumed in Japan and the rest of Asia. As a percentage of total HDPE consumption, film usage in Japan and the rest of Asia is over twice as much as the film share in either the United States or Western Europe.

E32 PVC is produced in a range of grades; namely, rigid, flexible, and injection moulding. Rigid applications account for 65 –75% of total consumption. Flexible PVC is used for film and sheet, wire and cable insulation, floor coverings, synthetic leather products, coatings and many other consumer goods. PVC consumption is mostly influenced by the construction market, as about 60% of world consumption is for pipe, fittings, siding, windows, fencing and other applications. PVC is increasingly used as a replacement for traditional construction materials such as wood and metals, and glass in packaging applications; so its growth has been above that experienced by the overall construction industry. The global market size for PVC is 50 times the size of the South African market. [Tariff protection is comparable to that of South Africa for selected countries and it is the highest in Malaysia at 20% and it is calculated on CIF basis.](#)

Fertilizer feedstocks/raw materials

Phosphate rock

E33 Globally the primary end-use for phosphate rock is phosphoric acid and phosphate fertilizers manufacturing. Since the 1970s the rate of consumption has been increasing although the rate of growth has slowed consistently. The second biggest demand sector is detergents. Consumption in this market application has been affected by the growing acceptance that phosphates lead to pollution of waterways. The pattern of consumption of phosphate rock is affected more by seasonal weather patterns and regulations covering its use, than by alternate periods of growth and recession that characterise the consumption of other industrial minerals.

Phosphoric acid

E34 Globally phosphoric acid is the leading inorganic acid produced and consumed in terms of production value. It is the second largest in terms of volume after sulfuric acid. By far its greatest use is in the manufacture of phosphate chemicals consumed primarily as carriers of phosphorus in fertilizers and animal feeds. Phosphoric acid is also used in the manufacture of phosphate chemicals for use in water treatment and detergent builders, dentifrices, fire control chemicals and a host of smaller markets. Consumption of phosphoric acid for its acid properties per se (beverage acidulation) is relatively small.

E35 The primary market for wet phosphoric acid is the production of phosphate fertilizer products (ammonium phosphates and triple super phosphate). Fertilizer production accounts for approximately 85% of the global market for wet phosphoric acid. The balance is consumed in a variety of industrial applications. The United States is the largest consumer, accounting for about 35% of world consumption in 2002, and Southwest Asia, Africa and Western Europe combined accounted for an additional 28%. Consumption in the former USSR, which accounted for 21% of world consumption in 1986, accounted for only 8% in 2002. Africa dominates the export market for wet phosphoric acid with 68% of world export volume. The United States, Western Europe and the Middle East are also large exporters.

Ammonia

E36 Ammonia is predominantly made from natural gas, and there has been a continuous shift in production capacity towards regions with low-cost natural gas. Global plant sizes are also increasing due to economies of scale issues. In 1974 the developing countries accounted for 27% of ammonia capacity. By 2003 their share was 52%. Some 88% of world ammonia production is processed or used in the countries where it is produced. The remaining 12% of world ammonia production enters international trade directly for all end-users.

Titanium dioxide

E37 There are about sixty plants worldwide manufacturing titanium dioxide with an average capacity of 60 thousand metric tons per year. In recent years, the industry has been restructuring towards consolidation but not new capacity. The top six producers accounted for about 80% of total worldwide capacity. The major consuming industries for titanium dioxide pigments are mature sectors in the developed world, and those are surface coatings, paper and paperboard, inks and plastics. Paints and coating applications account for the largest global share (around 75%), while inks and plastics and paper account for most of the rest.

- E38 In terms of manufacturing technology used, chloride and sulphate based pigment can be substituted in around 80% of applications. Around 10% of the market can only use chloride-based pigment (automotive paints), while 10% prefers to use sulphate process pigment (inks).

Acrylic acid and Acrylate esters

- E39 Glacial acrylic acid and acrylate esters are well traded in large volumes (about 90 times the South African market) around the globe. Unlike in South Africa, about 30% of acrylic acid is converted to super absorbents (super absorbents are not made in South Africa yet) and around 55% is converted to acrylate esters. Major markets for the esters include surface coatings (60%), textiles (15%), adhesives (12%) and plastics. Polyacrylic acid or copolymers find applications in super absorbents, detergents, dispersants, flocculants and thickeners. Super absorbent polymers are used primarily in disposable diapers.
- E40 The largest global producers of acrylic acid are BASF (23% market share) followed by Rohm and Haas/StoHaas (20%), Dow (14%), Nippon Shokubai (11%), ATOFINA, Mitsubishi Chemical Company and Formosa Plastics.

Global pricing practices

Polymers

- E41 Global prices are determined by supply and demand basis on a global scale, but are particularly driven by the Far East, due to the availability of low-cost polymers and ill-considered expansions in the 1990's in countries such as Korea, as well as the ever-growing demand from China. However, it is necessary to distinguish between the large developed countries/regions of USA/Canada, Western Europe and Japan from all other countries. Reason being these countries or regions have very large markets in relation to the quantity of product that is available from countries that export polymers. These countries/regions are largely self-sufficient in supply. There are limited imports into and exports from these countries/regions in relation to the size of the domestic market. While individual polymer users in each of these countries could import product from anywhere,

the quantum of these imports in relation to the size of the market is such that the price of the imports would have no noticeable impact on the market price within the region.

- E42 By contrast, developing countries or regions such as South Asia, South East Asia, North Asia, Africa and South America are much more open to imports than the larger markets. Over the years, the market price in each of these countries (including the price in South Africa) has become set by reference to a “Reference Price” that is reported/published by one of several polymer price reporting agencies. [There are three Reference Prices that have evolved and are used as the basis for setting prices in developing countries and regions. These are CFR Hong Kong, FOB US Gulf Coast and FOB North Western Europe.](#)

The application of Reference Pricing is such that all countries in the Asia Pacific and East Africa (including South Africa) have prices that fall within the influence of the CFR Hong Kong Reference Price. In other words, the CFR Hong Kong price sets/influences the market price in each of the countries in South Asia, South East Asia, North Asia, East & Southern Africa and Oceania (Australia and New Zealand). For polymer supplied to South America even if out of the Middle East, the CFR South American port is set by reference to the FOB US Gulf Coast price. The same applies for polymer supplied to countries in North Africa and the Eastern Mediterranean out of the Middle East, the CFR port price is set by reference to the FOB NW Europe price.

- E43 In times when installed production capacity exceeds demand, which is the norm for most of the price cycle, high cost producers are barely able to cover their costs and cut back supply accordingly, while those with a lower cost base will achieve a low return. During these periods, little re-investment occurs because of the low returns and, as demand increases with time, a stage is eventually reached where demand exceeds installed production capacity. At this time prices rise rapidly and high margins are earned prompting new capacity investment and within 1 - 2 years, another situation of excess capacity and subsequent low margins exists. Historically, this price cycle repeats itself every 6 - 8 years. It is important to note that polymer producers’ returns are realised over entire price cycles. The high returns earned for short periods during the peaks of price cycles, and the inadequate returns experienced during the trough, balance out the average return for the

polymer producers. This need for an adequate long term average return on investment is typical of the international polymer industry and applies to all regions, including South Africa.

Fertilizer Feedstocks/Raw Material

Phosphate rock

E44 Phosphate rock is priced according to the available P_2O_5 contents in the rock, taking into account the logistical cost to move the rock to the site where beneficiation takes place. The higher the relative P_2O_5 contents the higher the price. Global prices for phosphate rock are determined on a supply/demand basis, but are mainly determined by India as they import around 10% of global phosphate rock trade. The major Indian importers publish on an annual basis the phosphate rock price, after negotiations with the major suppliers. Global supply of phosphate rock has to be competitive based on the set prices, as importation of downstream products such as DAP will result in uncompetitive regional phosphate rock suppliers being forced out of the market.

Phosphoric acid

E45 Global prices for phosphoric acid are also set by India, due to their dominance as importer of phosphoric acid.

Ammonia

E46 Ammonia price is calculated for each preceding month on the 15th of the previous month based upon the average published spot price out of the Middle East and Yuzhny. This takes into account the average exchange rates for the previous four weeks and also makes provision for a competitive position for limestone ammonium nitrate fertilizer versus urea. Ammonia price is therefore based on a set formula.

Titanium dioxide

E47 Titanium dioxide is a commodity item and hence pricing is driven by world demand and supply. The price is calculated on the basis of a published price in a specific region or country. Customers monitor prices from all major trading regions and the lowest price

available at any point in time is then used by them as a basis for negotiations with their pigment supplier. Pigment suppliers tend to publish these agreed prices on a regular basis.

Acrylic acid and Acrylate esters

E48 Globally Acrylic acid and Acrylate esters prices are determined on a similar basis to polymer prices. Developing countries or regions such as South Asia, South East Asia, North Asia, Africa and South America are much more open to imports than the larger markets and the market price in each of these countries (including the price in South Africa) has become set by reference to a “Reference Price” that is reported/published by one of several price reporting agencies such as ICIS.

South African pricing practices

Polymers

E49 Polymer prices are determined relative to the competitive forces acting in particular regions. In order for a supplier to be successful in penetrating the market and sustaining a market share position, the customers’ alternative purchasing options are considered and a competitive offering is made. The producers use all relevant information at their disposal to prepare for the price negotiations in order to offer a competitive price. The price is negotiated and takes into account several variables such as competitive offers from other suppliers, quantities purchased by a customer and the logistics costs associated with such quantities, requests for export or development assistance, distribution costs for different packaging types and competing alternatives in the form of substitute materials (glass, wood, paper).

E50 During recent years, the competitive supplies into South Africa have come from the Far East and the Middle East and they therefore normally set the price levels in the South African domestic market. Hence Far East prices are typically monitored and tracked as defined by CFR Hong Kong prices (Reference Price). The final outcome is that the most competitive supplier sets the price, which ultimately results in a direct link between the domestic market price and the international reference price.

E51 Prices agreed to with customers can be adjustable month by month or, quarter by quarter, or fixed for longer periods. Generally, there is a price continuum across the customer base. It should be noted though that over a relatively long period average domestic delivered prices compared to average calculated prices of imports on an import parity basis would be fairly close to each other. Import duties are inherent in the domestic market prices and therefore their removal will result in overall price reduction.

Fertilizer feedstock/raw materials

Phosphate rock

E52 Historically up until May 2004 the price of phosphate rock was determined on the basis of import parity price for Di-ammonium Phosphate (DAP) and phosphoric acid. The rock contents of DAP and phosphoric acid were calculated, and split on a ratio of 60/40 to determine the phosphate rock price. This formula was found to be unsustainable, and after negotiations with customers a new formula was agreed upon. The new pricing formula is indexed upon the CFR price of phosphate rock in India.

Phosphoric acid

E53 Phosphoric acid is priced on an import parity basis, using the Indian CFR price as a basis. An agreement has been reached between suppliers and customers whereby the local price will be equivalent to the Indian CFR price, decreased by 25% of the freight cost from India.

Ammonia

E54 Ammonia is sold on contract to explosives, fertilizer and mainly on a non-contractual basis to smaller industrial customers. A contract price formula is used to determine the monthly selling price of ammonia to explosives and fertilizer industry customers. The contract price is based upon the actual FOB import prices to South Africa from the Middle East (75%) and Yuzhny, Russia (25%) including all logistics costs. The ammonia contract price formula also makes provision for a competitive position for limestone ammonium nitrate fertilizer versus imported urea. The ammonia price for each preceding month is calculated on the 15th of the previous month based upon the average published spot price out of the Middle

East and Yuzhny for the previous four weeks and the average exchange rates for the same period.

Titanium dioxide

E55 The local titanium dioxide pigment producer sells polymer products to customers in markets which include South Africa and other countries or regions. Their policy is to sell at the market price prevailing in each of these regions at any point in time, and this also applies to sales in South Africa. Titanium dioxide is a commodity item and hence pricing is driven by world demand and supply.

Acrylic acid and Acrylate esters

E56 The pricing philosophy practiced in South Africa was introduced by the local producer as part of a market entry strategy to enable market growth aligned with business objectives. It should be borne in mind that the local plant was commissioned in 2004 and the pricing philosophy was introduced then. The following factors are taken into consideration when setting the local market price; global market price, Rand/Dollar exchange rate, packaging types and exports incentives among others. The local producer's domestic prices are comparable with prices in the USA and Asia. Prevailing domestic prices in South Africa are derived from the published ICIS LOR data by taking the average of the lowest values quoted for North West Europe (Free Delivered) and Asia Pacific on a CIF basis of the preceding week's published prices at the time of determination. This pricing philosophy may be revisited in future as market conditions change.

International competitiveness of South African pricing

Polymers

E57 International competitiveness assessment done has revealed that prices paid by South African downstream users are always within range of prices that prevailed in the regions or countries covered for this investigation (China, India, NW Europe and the USA) over a 10 year period, mostly at the lower end of the range. It should be noted that China is the most competitive (lowest priced market) in the world. In the early part of the period under review, the prices in South Africa were much lower than those in China and India. However, as

imports into China have grown over the period the CFR Hong Kong price has fallen to the low end of the range. In addition, import duties in China have fallen. Both factors have contributed to a narrowing of the gap between prices in South Africa and those in China.

Fertiliser feedstock/Raw material

Phosphate rock

E58 South Africa's domestic prices are not directly comparable with international phosphate rock prices because the price of phosphate rock depends upon the relative P_2O_5 content which is expressed as Bone Phosphate of Lime (BPL) or Tricalcium Phosphate. Due to this factor, it would not have been useful to compare South Africa's inland prices against a range of countries, as this would require a detailed knowledge of actual BPL contents in those countries, and that information was not readily available. However, using Morocco's export FOB price as the largest exporter and adjusting it relative to South Africa's BPL, domestic prices in South Africa are historically similar to Morocco's export prices and below Indian CFR prices, which does not take into account logistics costs in India.

Phosphoric acid

E59 Phosphoric acid delivered prices in South Africa were compared to Indian CFR prices, as India is the price setter for phosphoric acid on a global basis due to their exceptionally large import volumes. The comparison showed that domestic delivered prices in South Africa were historically comparable to Indian CFR prices, which does not take into account logistics costs in India.

Ammonia

E60 South African domestic prices are directly linked by means of the formula-applied pricing mechanism to international prices. The price history of international ammonia prices in major producing and consuming countries (India, Middle East, Russia and US Gulf Coast) compared to South African domestic prices showed that India, which is a major ammonia importing country, had an average price of around 3.7% lower than South Africa over the period July 1996 to April 2005. Over the same period domestic prices in South Africa were on average 1.8% lower than the US Gulf Coast prices.

Titanium dioxide

- E61 Prices paid by South African downstream users are always within range of prices that prevailed in the regions covered for this investigation (Asia Pacific, North America and NW Europe) over a period of 5 years.

Acrylic acid and Acrylate esters

- E62 A historically long enough assessment could not be done since the local plant had been trading these products for a period of only one year during the course of this investigation.

Impact of pricing on downstream purchasers

Polymers

- E63 The impact of the current pricing practices of the upstream players on the downstream was assessed firstly by looking at the EVC for both the upstream and downstream sectors separately and also by looking at the elasticity of demand for downstream plastics products. It was not possible to obtain the required information for the EVC analysis at individual product level because the operations are integrated. The analysis was therefore conducted on the combined polymers for the upstream separately and downstream separately for the period 1997 to 2005.
- E64 [For upstream polymers, the EVC analysis indicated that the return on capital was frequently lower than the weighted average cost of capital. This means that the current pricing practices of the upstream sector are not resulting in super profits for the upstream sector, as measured against the total cost of capital.](#)
- E65 Despite all efforts no financial data was submitted by downstream companies for EVC analysis pertaining to the PP and PVC value chains. Only four companies, accounting for around 30% of the polyethylene market, provided financial data for the EVC analysis. The EVC analysis of polyethylene downstream companies that submitted financial data indicates that the return on capital was lower than the weighted average cost of capital in every year except only two of the years. This situation means that a final conclusion on the

financial performance of the downstream sector could not be reached. [However the financial information submitted shows that the downstream companies that responded are not making super profits either.](#)

- E66 In terms of elasticity of demand it was not possible to collect sufficient information to enable the plotting of historical and future demand elasticity for polymers over all the various applications in order to obtain an aggregate view of its price elasticity. As such, the research used the results of an econometric study done in 2005 by Professor Johannes Fedderke in order to come up with a practical verification of the elasticity of demand of polymers by doing a market segments analysis of the respective major applications. The market segments analysis showed that in excess of 80% of end-use applications for PP and Polyethylene there is no significant demand elasticity. However, for PVC there is no significant demand elasticity for most end-use applications, with the notable exception of packaging bottles and sheet. Overall this means that polymer elasticity of demand can only be impacted by product substitution, which in most cases occurs at elevated price differentials due to technical considerations as for example, changing from plastic bottles to glass.

Fertilizer feedstock/raw materials

- E67 The impact of the current pricing practices of the upstream players on the downstream was assessed firstly by looking at the EVC for both the upstream and downstream sectors separately and also by looking at the elasticity of demand for fertilisers. The EVC value analysis illustrated that the downstream fertilizers sector had returns that were higher than the cost of capital by 2005 while in the upstream fertilizers sector the returns were lower at the same time. This seems to illustrate an inversely proportional relationship between upstream and downstream financial performance.
- E68 The elasticity of demand analysis for fertilizers showed that fertilizers demand responds positively to GDP growth to a large extend as well as to rainfall. However the elasticity is relatively less when it comes to price changes.

Titanium dioxide

- E69 The impact of the current pricing practices of the upstream players on the downstream was assessed firstly by looking at the EVC for both the upstream and downstream sectors separately and also by looking at the elasticity of demand for downstream products.
- E70 [EVC analysis was conducted for 1997 to 2005 for the only upstream company. The analysis indicates that the first 6 years starting in 1997, with the exception of 1997, recorded returns were higher than the weighted average cost of capital. However, from 2003 to 2005 the returns have been lower than the weighted average cost of capital. The lower returns between 2003 and 2005 outweighed the returns made in the earlier years to the extent that the IVC became negative by 2005. No historical financial information on downstream titanium dioxide pigments has been provided and therefore no comparison could be made between the upstream and downstream.](#)
- E71 From a practical perspective, most titanium dioxide pigments are used in the paints industry. In this application titanium dioxide pigments accounts for around 20 – 25% of raw material costs, or around 10 – 13% of selling prices. At retail level titanium dioxide pigments accounts for only around 5% of the price. It is therefore unlikely that a decrease in titanium dioxide pigment prices will significantly increase demand for paints.

Acrylic acid and Acrylate esters

- E72 There was no historically long enough data to do an analysis since the operation has only being trading for one year.

Global competitiveness of the South African downstream industry

- E73 A “Reality Test” was done in order to assess the global competitiveness of the downstream industry. A comparison of the Per Capita GDP versus Per Capita Polymer Usage for all countries is a well-established “Reality Test”. A selection of 97 countries was used in this analysis for comparison with South Africa. The “Reality Test” attempts to find out if there is any correlation between the stage and size of economic development (as measured by per

capita GDP) with the size of the polymer conversion sector (as measured by per capita polymer converted within the economy).

- E74 [The “Reality Test” showed that in relation to the 97 other countries used for this investigation, South African downstream polymer conversion industry is not lagging in terms of development, taking into account South Africa’s current state of economic development.](#) Also, it is economic activity within an economy that directly impacts on demand for plastic products and primary polymers. Countries such as South Korea and Taiwan whose polymer conversion eventually gets incorporated into more exports of consumer goods are the ones that lead the polymer conversion sector in terms of being at the highest level of development. Therefore for the South African polymer conversion sector to reach a higher level of development more than this “Reality Test” suggests, South Africa needs to export more finished goods which have plastic components.
- E75 The “Reality Test” was done for polymers only because as a value chain polymers represent the most value of all the intermediate products included in the study.

Growth drivers in the downstream sector

- E76 There are several identified drivers for growth in the downstream chemical sector. These drivers for growth tend to be universally applicable, with the only difference being the relative importance of such drivers as impacted upon by local circumstances. Proximity to large export markets, the availability of polymer from local manufacturing and the availability of polymers at competitive prices are just three of the several identified growth drivers.
- E77 [This assessment showed that the most important growth driver category for the successful development of a downstream polymer industry is market related, and that competitive pricing of polymer plays a role, but in proportion to all the other factors.](#) The success or health of a conversion industry is therefore not determined by a single driver, but a combination of drivers. Development of a successful downstream beneficiation strategy therefore needs to take all the factors into account. By enforcing an improvement of one

factor without addressing the other factors will not result in the desired development of the downstream sector.

- E78 Although this has been done for the polymer value chain only it should be noted that these growth drivers are also applicable to most of the other value chains as far as the development of the downstream sector is concerned.

Potential policy options for the development of the entire industry

- E79 The workshops held to encourage the downstream to participate in the research in terms of providing information were also used as a platform to debate the policies that the downstream sector would want to see implemented for the development of the sector. Although the downstream participation was low, the policy options were debated and noted nonetheless. Where the policy options related to the level of participation of the downstream it is acknowledged that the assessment could have been compromised by the small sample size. Further policy options based on constraints to downstream developments and other conclusions of the study which are also presented and evaluated are not dependent on the sample size as they have been identified in the Accelerated Shared Growth Initiative.
- E80 [The study revealed that local availability of polymer played a stronger role in the development of the downstream industry. Any policy options that could affect the continued existence of the upstream industry therefore need to be considered with great care. As such ensuring sustainable local manufacturing should be one of the government's policies.](#)
- E81 One of the policy options that emanated from the workshops is the removal of import duties for primary polymers. The immediate effect of duty removal is for local feedstock prices to fall based upon competitive pressure from imports. Import duties are inherent in the market price and therefore their removal will lead to price reduction. The demand elasticity evaluation has however indicated that lowered prices will not result in significant market

expansion. In terms of profitability, the upstream sector will be negatively affected and further investment may be compromised.

E82 Other potential policy options identified are:

- [Ensuring availability of polymers at competitive prices](#)
- [Promotion of exports of industrial consumer goods](#)
- [Reducing freight logistics costs](#)
- [Increasing innovation capability](#)
- [Increased duty protection for downstream products](#)
- Fast-track approach to anti-dumping investigations
- Prevention of illegal imports

1. INTRODUCTION

1.1. Background to the Study

The South African chemical industry has a mostly well-developed upstream industry with a few primary producers, and an apparently relatively underdeveloped downstream industry that comprises of many players. As part of a much broader government agenda, the chemical sector has been prioritised within ASGISA (Accelerated and Shared Growth Initiative for South Africa) for spearheading growth and development for the country as a whole. Furthermore, **the dti's** chemical sector development strategy's focus is upon downstream development and beneficiation of abundant feedstock in order to meet economic aspirations such as competitiveness, investment, exports, job creation and equity. Pricing practices are an important factor in the development of the chemical sector and particularly relevant to the competitiveness of the sector. One pricing practice is import parity pricing (IPP) which is the pricing of a product that it would cost to import, including notional costs such as transport and import tariffs.

Pursuant to the Growth and Development Summit (GDS) agreement to address this issue, a set of studies on the impact of IPP on downstream manufacturing sectors and sub-sectors in the South African economy were commissioned in various sectors. During the Nedlac Chemicals Sector Summit process, it was agreed that a tri-partite study under the auspices of FRIDGE would be conducted on the role of pricing practices, including IPP, in the South African Chemical sector. One of the ways of achieving competitiveness along the value chains is to ensure competitive cost inputs. By investigating the impact of pricing practices and other factors that affect the competitiveness of the downstream chemical sector, the extent to which these factors contribute to the value chain's competitiveness or otherwise can be verified.

The aim of this study is to research the impact of pricing practices, in the chemical sector of the South African economy with particular emphasis on the development of the sector as a whole.

1.2. **Objectives**

a) The objective of the study was to investigate and assess the impact of upstream pricing practices on the upstream and downstream industries (including the long term). The assessment was focused on the impact of pricing practices on the following aspects of upstream and downstream economic performance:

- Output
- Value added
- Employment
- Investment
- Exports

b) An evaluation of the relative development of downstream chemical sectors for a range of countries, and comparison with the status in South Africa. This comparison needed to identify any significant underdevelopment of the SA downstream sectors. This comparison of relative development of downstream chemical sector is called the “Reality Test” within the context of this study. For selected Upstream/Downstream combinations, these are simply tests to find out the relative level of development of the respective value chains. The Reality checks if there is any correlation between the state of economic development as measured by per capita GDP with the size of domestic consumption of the respective primary chemicals as measured by per capita consumption.

c) The value chains to be investigated emanate from the following primary chemicals:

- Polypropylene
- Polyethylene (HDPE, LDPE, LLDPE)
- PVC
- Feedstock / raw materials for Fertilizers (phosphate rock and ammonia)
- Titanium dioxide
- Acrylic acid

1.3. **Deliverables**

The major deliverables of the study are as follows:

- Market definition of upstream chemical products
- Market structure and shares of upstream chemical producers
- Costs and pricing of upstream chemicals products
- Major downstream industries that purchase upstream products
- International competitiveness of South African chemicals pricing
- Impact of pricing on downstream purchasers
- Policy options for pricing practice

1.4. **Methodology**

The information required for this investigation was sourced from local and international databases and other desk sources, as well as personal and telephonic interviews with upstream and downstream role-players.

The interviews were conducted with respondents that were selected from upstream and downstream participants on the basis of their relative importance in the value-chain. By focusing on larger role-players, it was ensured that extrapolations of data accurately reflect the true nature of the products/industry. However, some smaller SME players were also included in each product category to identify possible price discrimination against them.

- In terms of international competitiveness of South African chemicals pricing, time series for price comparisons were compiled over at least the last five years. The prices are reflected in US Dollar based upon the average exchange rates of the selected economies for the applicable periods. The sourcing of international price data was done by means of personal contacts with international upstream companies and consulting companies to access published contract prices. Sources of pricing data in this case included ICIS LOR, Tecnon Parpinelli, Harriman Chemsult and Platts Polymerscan.

International price data collected was correlated with that collected from the relevant upstream and downstream companies in South Africa as a means of verification.

The “Reality Test” attempts to check if there is any correlation between the stage of economic development as measured by per capita GDP with the size of the polymer conversion sector as measured by per capita polymer converted within a country. Data on the conversion and usage of polymer was sourced from independent sources Tecnon Parpinelli and CMAI. Data on the country populations and GDP was sourced from the IMF and the World Bank.

In order to analyse the impact of upstream pricing practices on downstream players an objective, proven and validated methodology which is applicable to all types of businesses was used. A formula developed by Modigliani and Miller, for which they won a Nobel price in 1969, called the Economic Value Creation Model (EVC) was used to evaluate the impact of pricing practices in the vertically integrated chemical industry. $EVC = R - K$, where R is the calculated return (Net Operating Profit After Tax) and K is the cost of generating the return (Weighted Average Cost of Capital). Any meaningful model of future performance will be influenced by assumptions regarding asset replacement cost. It is for this reason that historic data was used in the EVC model. EVC will provide the same result as IRR but it is easier to follow on a year by year basis. An expanded explanation of the suitability of using EVC for measuring value in this study compared to other methods is provided in Appendix 2.

A Demand Elasticity analysis was also done in order to check the relationship between potential changes in prices to the quantity of products sold. This category of information reflects estimates of the likely changes in selling prices and sales volumes for each of the product categories that could result from price changes (i.e. increases and decreases) associated with raw material inputs purchased from upstream producers. These estimates were used to calculate the Demand Elasticity (i.e. changes in the quantity of products purchased) resulting from increases and/or decreases in downstream producers' selling prices. The methodology used was based on an analysis done by Professor Johannes Fedderke from SA Econometric Research Unit analysis, which is entitled: “Price Elasticities in Sasol’s LDPE, LLDPE, PVC and PP markets - Assessment

of upstream feedstock impact on final applications and its price elasticity”. Further explanation of this methodology and the relevance of the results thereof are provided in Appendix 1.

1.5. Problems experienced in the Research Process

A major problem experienced during the research process was the lack of co-operation experienced from the selected downstream respondents. In contrast, most of the selected upstream respondent companies with the exception of the fertilizer value chain, have provided completed questionnaires within the requested timeframe.

As illustration, the following table shows the level of participation by downstream companies for the full duration of the study:

Value Chain	Completed Questionnaires		
	General	Financial	
		Completed	History*
LDPE	3	1	5 years
HDPE	4	0	n/a
LLDPE	2	1	1 year
PP	9	0	n/a
PVC	5	1	5 years
HDPE/PP	1	1	10 years
LDPE/LLDPE/HDPE	3	2	10 years
LDPE/LLDPE/HDPE/PP	1	1	9 years
Fertilizers feedstock	3	1	10 years
Titanium dioxide	1	0	n/a
TOTAL	32	8	

* History means the number of historical years that the financial data was provided for.

No downstream financial data was received for the value chains HDPE, PP, Titanium dioxide and Acrylates. This made it impossible to derive downstream EVC results for the polymers value chains separately as proposed in the methodology. In total companies, accounting for around 30%

of the polyethylene market based on consumption volumes, provided financial data. However, in the case of two companies the time period of the data did not correspond historically with the information provided by upstream companies. This means the data was for a shorter time period. For PVC, only one company provided financial data and the data did not correspond historically with the information provided by upstream companies.

The general pattern by downstream companies was that of excitement upon hearing about the study and been given an opportunity to make an input. However, once the potential respondents saw the information requirements in the questionnaires, most of them changed their attitudes and subsequently their response was that they would not be able to take part in the study.

The reasons advanced by the contacted companies for declining to participate in the investigation are as follows:

- *Lack of time and/or human resources to commit to the investigation* [80% of all declines]
- *Upstream companies will always do what they like in terms of pricing regardless of any interventions* [10% of all declines]
- *Other reasons* [10%]

While it is true that some downstream companies are SMEs, and they are sometimes understaffed, it is certainly not true for the majority of them and even more so for the relatively large companies. However, lack of capacity was cited in most instances as the reason for not participating for all the various sizes of downstream companies alike. All respondents (32) filled in the general questionnaire and very few of them (8) filled in the financial questionnaire.

Contacts were made with the Executive Directors of the associations that the value chains under investigation fall within in order to encourage their members to take part in the investigation. Furthermore, three feedback sessions were held around the country to encourage the downstream companies to give their submissions for this investigation. What this effort achieved was more enthusiasm from the association members to participate in the study in the sense that

more came forward and expressed an interest to participate. However, once the companies saw the information requirements the rate of declines escalated.

The number of downstream companies that responded to this investigation represents the following levels of market coverage in the respective value chains. [The level of market coverage was based on the respondents' collective consumption volumes of the feedstocks under investigation, and not on their sales.] :

- Polymers – 17% of total value chain based on consumption volumes. Operations that submitted financial data collectively account for about 6% of total value chain based on consumption volumes.
- Fertilizer raw materials – 90% of total value chain based on estimated non-captive consumption volumes. Operations that submitted financial data collectively account for about 50% of total value chain based on consumption volumes.
- Titanium dioxide – 14% of total value chain based on consumption volumes. No financial data was submitted.

1.6. Data Sources and Accuracy

There are several reputable sources of data on international polymer prices. The ones that are most often used in contracts or as “Reference Prices” are: ICIS LOR and Platts Polymerscan. These sources provide weekly and monthly quotes on the prices they deem to have prevailed for the following markets and used as Reference Prices:

- North West Europe: Delivered Prices for large domestic customers (located close to Rotterdam) and FOB (free on board) prices for product available for exports.
- USA: Delivered Prices for large domestic customers (close to the US Gulf Coast) and FOB prices for product available for exports from US Gulf Coast ports.
- Far East: CFR Hong Kong for product sold in all Far East and SE Asian countries.

As China has become such a large importer of all polymers, the CFR Hong Kong price is accepted as being “at the low end of the range of international market prices”.

There is no accepted source of data for the market prices (or prices paid by customers) in all other countries. In all countries the development of a market price is the outcome of discussion and negotiation between buyer and seller around the customer's alternate sources of supply (usually from imports).

Trade journals are a source of data on the “price range” that is deemed to have prevailed for a time before publication of the trade journal. The prices quoted in trade publications are not usually used in contracts. However, they can be used by customers in negotiation with suppliers in obtaining discounts off the supplier's List Price.

For countries not included in the published data of ICIS LOR or Platts Polymerscan, all industry commentators develop “proxy” market prices based on the quoted Reference Prices (e.g. CFR Hong Kong, Del NW Europe, FOB USGC Export Prices, etc.) by developing an Import Parity Price equivalent in the country. The Derived Import Parity Price includes all the costs a customer will incur in importing a polymer. These include:

- Shipping
- Import duties
- Landing & clearing charges
- Warehouse charges
- Finance charges
- Any other government costs or taxes
- Transport to the user.

Polymers covered are LDPE, LLDPE, HDPE, PP and PVC for the time period: Jan 1994 – July 2005 on a monthly basis. Countries included in the initial price comparison exercise:

- South Africa (inland price paid by converters)
- USA (Gulf Coast)
- North West Europe – delivered users close to Rotterdam
- China

- India

Price Comparison Basis: Price paid by polymer converters on a delivered basis in US\$ per tonne.

For South Africa, the price is the “average price for all polymer sold during the month”.

For USA and NW Europe, it is the delivered price paid by large customers relatively close to Rotterdam. For China and India, it is the derived import parity price for large customers.

Note: The import parity price is the accepted and established way of estimating the market price in these two countries (China and India).

Source of Data:

- South Africa: Upstream - Sasol Polymers, Dow Chemicals and Importers. The published results of Sasol Polymers as a business unit within the Sasol group were consistent with the raw data presented to the consultants for the EVC calculations. In addition, Sasol Polymers offered to have the information submitted to consultants audited for accuracy by an independent audit company.
- Historical pricing data received from the upstream and downstream data was comparable with historical pricing data provided by international consultants and sources. Historical pricing data as used in the study was therefore verifiable and thus reliable.
- EVC conclusions relating to the upstream are based on financial data supplied by them. Similarly, the downstream EVC conclusions are based on the financial data received from the downstream companies that responded.
- USA and NW Europe: ICIS LOR, Platts Polymerscan, Harriman Chemsult and Tecnon Parpinelli.
- China and India: Derived Import Parity Prices using methodology and assumptions approved by independent international consultants.

The Reference Prices from ICIS LOR and Platts Polymerscan are considered 100% reliable/accurate as Reference Prices. However, customers can and will negotiate discounts off the quoted Reference Price.

As the prices reported for South Africa are “average monthly prices for all polymer sold in the month”, the prices will be higher than the Derived Import Parity Prices for China and India as these are developed from a Reference Price that is applicable to large customers.

The Derived Import Parity Prices for China and India estimated by the consultant are considered to be accurate within +/- 5% for any month, but over a longer period (i.e. annual averages) the error range is lower. The reasons are:

- Shipping costs could be different from that used by the consultants.
- Periodically, there are parcels of “distressed cargoes” that are made available at less than the prevailing Reference Price.

2. POLYPROPYLENE

2.1. Market definition of upstream chemical products

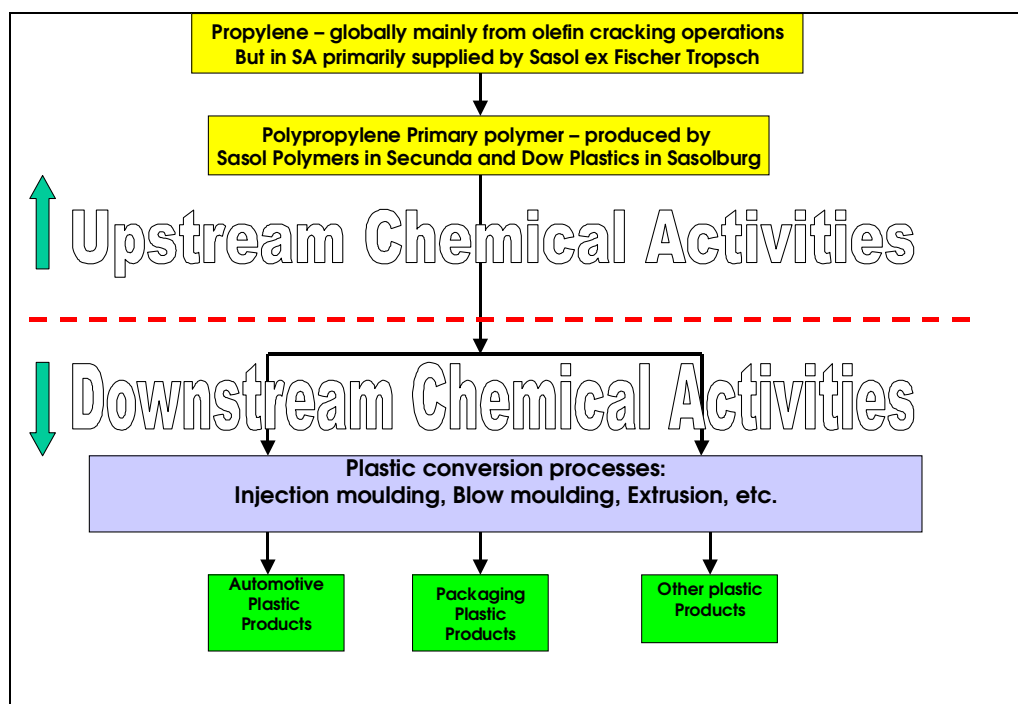
a) Introduction

Polypropylene (PP) in primary, or unconverted, form is part of the Primary Polymer and Rubber sub-sector of the chemical industry. Polypropylene is the fastest growing commodity polymer category globally, and is only surpassed by polyethylene in market size. PP has a very low density and good mechanical properties [especially when filled or compounded], and is therefore very suitable for sectors where large volume, cost & weight are issues.

b) Value chain

PP is made by means of the catalytic polymerisation of pure propylene, usually in large, integrated plants that are operated on a continuous basis. Propylene feedstock is primarily obtained from large olefin crackers, using crude-oil refinery based streams. Smaller quantities are also directly recovered from refinery streams. South Africa has unique propylene supply from the Fischer Tropsch synthetic fuel technology employed by Sasol in Secunda. Fischer Tropsch process streams are relatively rich in recoverable propylene. Smaller quantities of propylene feedstock are also recovered from conventional refinery operations. The value chain for PP is summarised in the diagram below:

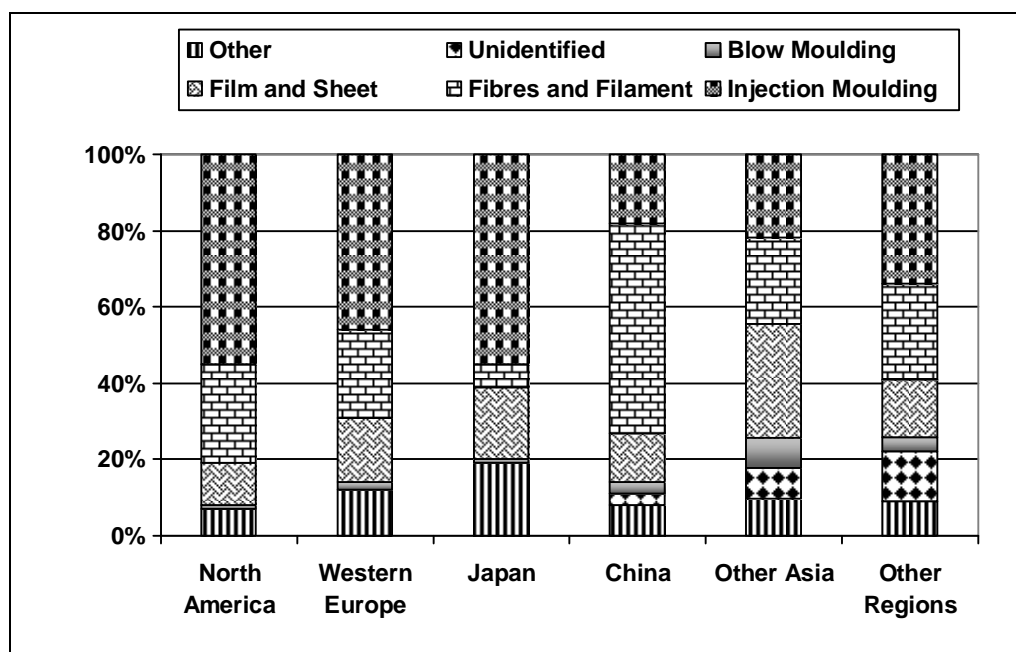
Figure 2.1: Polypropylene Value Chain



c) Applications and Global Market Size

In 2004, global PP production grew to 38 million metric tons operating at 89% of active capacity, with an estimated value of \$33 billion. This level of production represents an average annual growth of 6.8% from the 1998 level. (Source: SRI Consulting)

The estimated breakdown of global application of primary polypropylene is shown in the diagram below:

Figure 2.2: Global Application of Primary Polypropylene

Source: SRI Consulting

Injection moulding and fibre and filament are the world's largest end uses for PP, at 33% and 29%, respectively, followed by film uses at 18%. As demonstrated above by the geographic breakdown of consumption patterns, there are wide differences in the end-use patterns of PP across regions and countries.

The injection moulding end-use category seems to be inversely related to the maturity and overall growth of consumption in countries and regions. That is, as a country/region matures and growth slows, the PP end-use breakdown shifts toward injection moulding, perhaps because moulding growth is a function of inter-material substitution, which takes time to take hold.

Transportation constitutes one of the major end-use markets for injection-moulded PP. Numerous other types of products are injection moulded from PP, including container caps and closures, appliance parts, disposable syringes and a wide variety of household and miscellaneous products.

Polypropylene's very low density (0.89-0.91 gram per cubic centimetre) combined with its good mechanical properties (especially when talc-filled or compounded with EPDM elastomers) and

injection-moulding characteristics make it especially suitable for the large-volume cost- and weight-conscious automotive market.

In the textiles fibres arena, PP is used in carpet backing and has a strong growth market in carpet face yarn, particularly in the United States. Polypropylene fibre also plays an important part in the non-wovens market, an end use that continues to experience rapid growth in virtually all regions of the world.

Polypropylene film provides excellent optical clarity and low moisture vapour transmission, enabling it to be used in snack food packaging, pressure-sensitive tape backing and labels. Smaller markets for PP films include a diverse group of product areas such as shrink-film over wrap, capacitor and other electronic industry films, photo and graphic arts applications, soft-goods over wrap and disposable diaper tabs and closures.

d) Impact of different product grades or performance specifications on market applications

The main grade of PP is homopolymer, or pure unfilled or compounded product. Homopolymers are polymers formed from a large single monomer unit (molecule), with a long chain of the same monomer units. Homopolymer PP is a translucent, crystalline polymer that exhibits high stiffness, good impact strength at room temperatures, and good electrical insulation properties. The commercial grades of polypropylene homopolymer are available in a wide range of melt flows and molecular weight distributions. Homopolymer grades of polypropylene are available for various fabrication processes such as injection moulding, sheet and thermoforming, bi-axially oriented film (BOPP), capacitor film, fibre spinning, and slit tape. Suppliers such as ExxonMobil offer speciality grades of homopolymer PP that claim superior properties in specific applications such as thermoforming.

PP is co-polymerised with ethylene, for a PP with increased toughness at ambient and below zero temperatures. PP is also compounded with elastomers such as EPDM to obtain high-impact properties, and also filled with glass or minerals such as chalk, mica and talc. This typically

reduces cost and cycle times, and also imparts mechanical strength and dimensional stability to end products [e.g. garden furniture].

e) Level of competition in supply for major geographic export markets for upstream products

There are a large number of PP plants in operation globally. The major companies include Dow Chemical, Exxon Mobil, Basell, Sabic, BP, Atofina, Borealis, Sinopec, Equistar and Formosa.

2.2. SA Market structure and shares of upstream chemical producers

2.2.1. Domestic industry structure

a) Feedstock for Polypropylene production

Polypropylene (PP) is manufactured from propylene monomer. Propylene supply in SA is concentrated with only two suppliers, namely Sasol Secunda and Sapref [Shell/BP] in Durban. Sasol's capacity is currently around 530 000 t/a and Sapref around 32 000 t/a. However, Sapref's supply in 2003 was only 20 000 t/a. There is a possibility of further propylene extraction in Durban. The Sasol Project Turbo that was approved in late-2003 will add a further 430 000 t/a propylene capacity.

b) Polypropylene Production

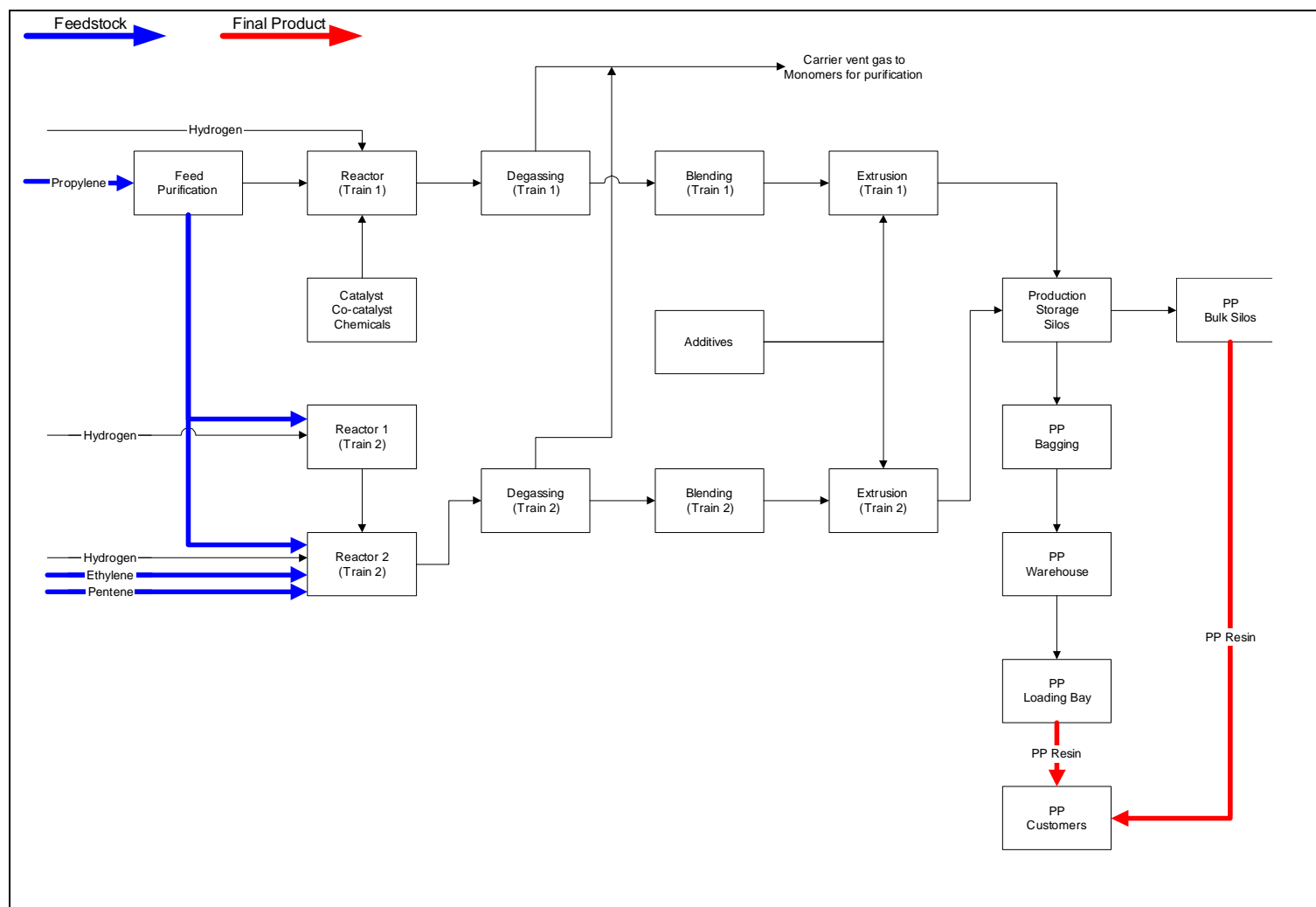
Polypropylene supply in SA is also concentrated with only two suppliers, namely Sasol Polymers in Secunda, and Dow Plastics in Sasolburg.

Sasol Polymers' PP is produced by reacting propylene over a titanium based catalyst (Ziegler Natta catalyst) in a gas phase reactor, utilizing BASF technology (BASF's technology was acquired by Novolen Technology Holdings who now develops and licenses this technology).

Stringent control of temperatures, pressures, additive, catalyst and other hydrocarbon streams ensure that a quality finished product is produced.

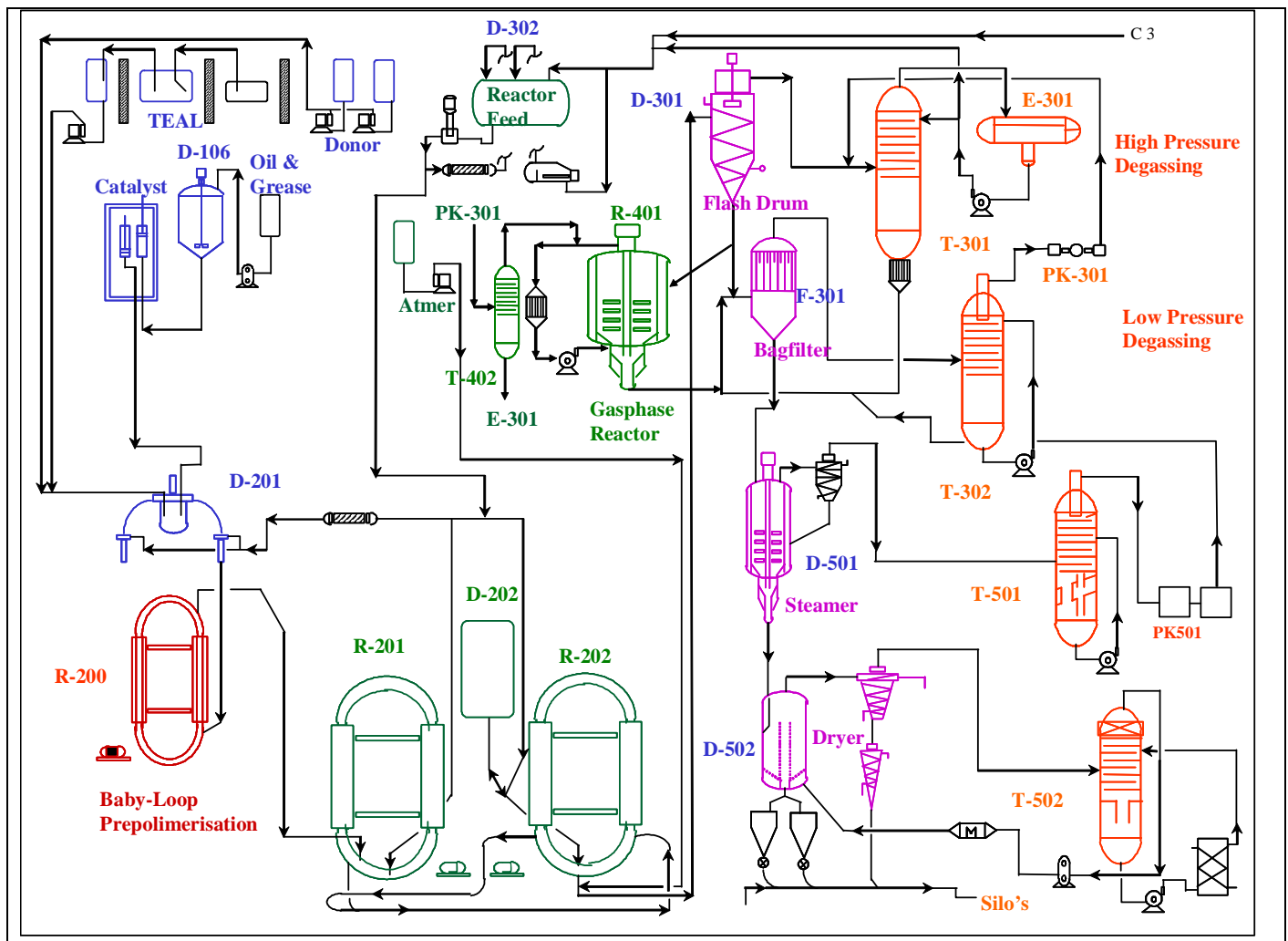
The polymer production capability of the PP plant is 230 000 tpa (original capacity 120 000 tpa). A flow diagram of the manufacturing process is as follows:

Figure 2.3: Polypropylene – Sasol Polymers Flow Diagram



Dow Plastics has an estimated PP production capacity of 120 - 130 000 t/a. A schematic diagram of the Dow Plastics process, demonstrating the complexity, is shown below:

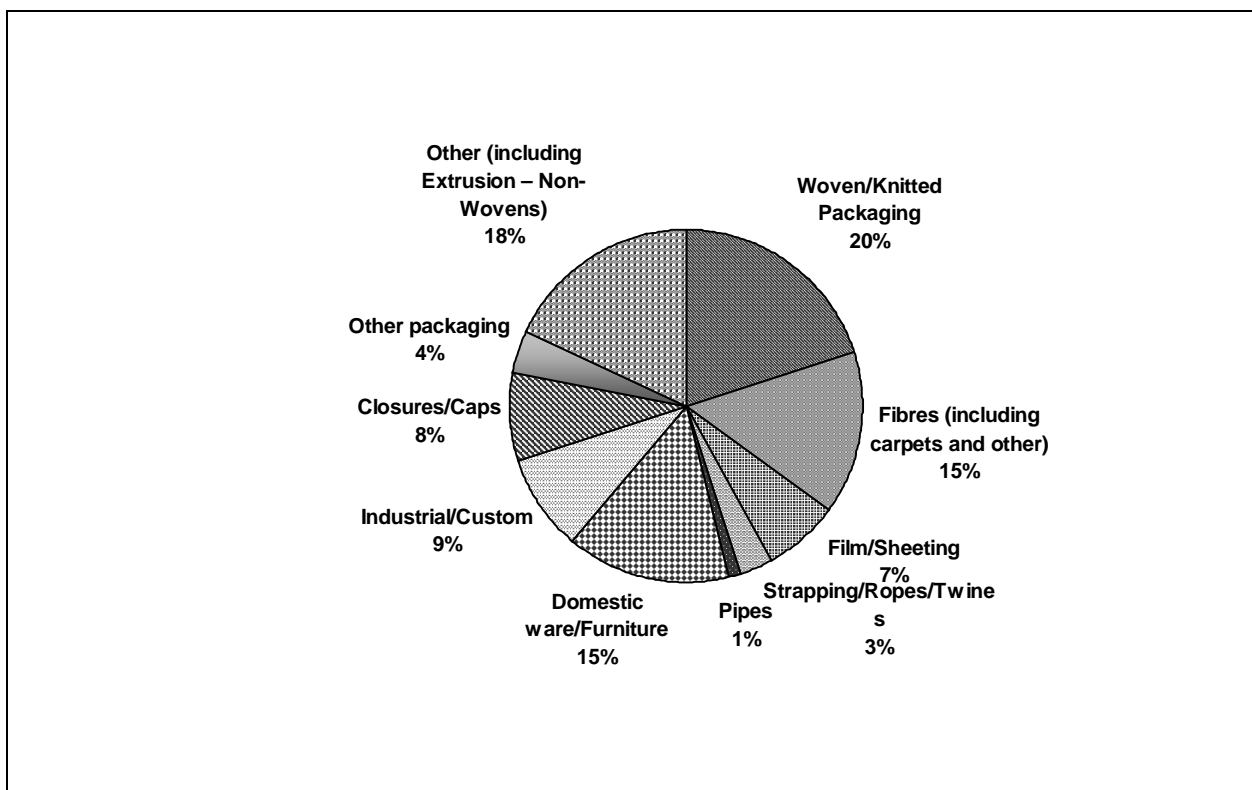
Figure 2.4: Polypropylene – Dow Plastics Schematic Diagram



c) Polypropylene Market

The SA market size in 2004 for polypropylene primary polymer used in local plastic conversion was estimated at 223 000 tons, of which 93.7% was supplied by local producers. Local uses include appliances, batteries, automotive, buckets, chairs & furniture, closures and caps, food containers, woven packaging/bags, fibres. The breakdown of the market is demonstrated in the following diagram.

Figure 2.5: SA Polypropylene Market Breakdown



Some of the companies involved in Polypropylene conversion are shown in [Appendix 4](#).

2.2.2. The effect of import tariffs, anti-dumping duties and any other regulatory factors affecting pricing

Tariff protection for base PP resin products in SA is as follows:

- Tariff protection for polymer product supplied out of **non European** countries is:
 - 10% ad valorem import duty calculated on the FOB price.
- Tariff protection for polymer product supplied out of **European** countries is:
 - 7.5% ad valorem import duty calculated on the FOB price.

Compared to SA, PP polymer tariff protection levels (ad valorem duties only, excluding any other surcharges or taxes) for other countries are:

Table 2.1: Polypropylene – Tariff Protection in Other Countries

Country	Duty basis on:	PP
United States	FOB	6.5%
China	CIF ¹	9.7%
Japan	CIF	6.5%
Canada	n/a	None
Indonesia	CIF	10.0%
Chile	CIF	8.0%
Australia	FOB	5.0%
Malaysia	CIF	30.0%
India	CIF	10.0%

2.2.3. The global nature of the industry

PP is produced in a range of grades [e.g. homopolymer, impact copolymer and random copolymer], but in general is regarded as a commodity product that is produced by many countries and is well-traded in large volumes (10 million tons/annum – 45 times the SA market) around the globe, demonstrating its global nature. Global prices are determined by supply/demand basis on a global scale, but are particularly driven by the Far East, due to the availability of low-cost product and ill-considered expansions in the 1990's in countries such as Korea, as well as the ever-growing demand from China. Global plant sizes are also increasing, due to economies-of-scale issues.

2.3. Costs and pricing of upstream chemicals products

2.3.1. The cost structure of the industry and global comparison

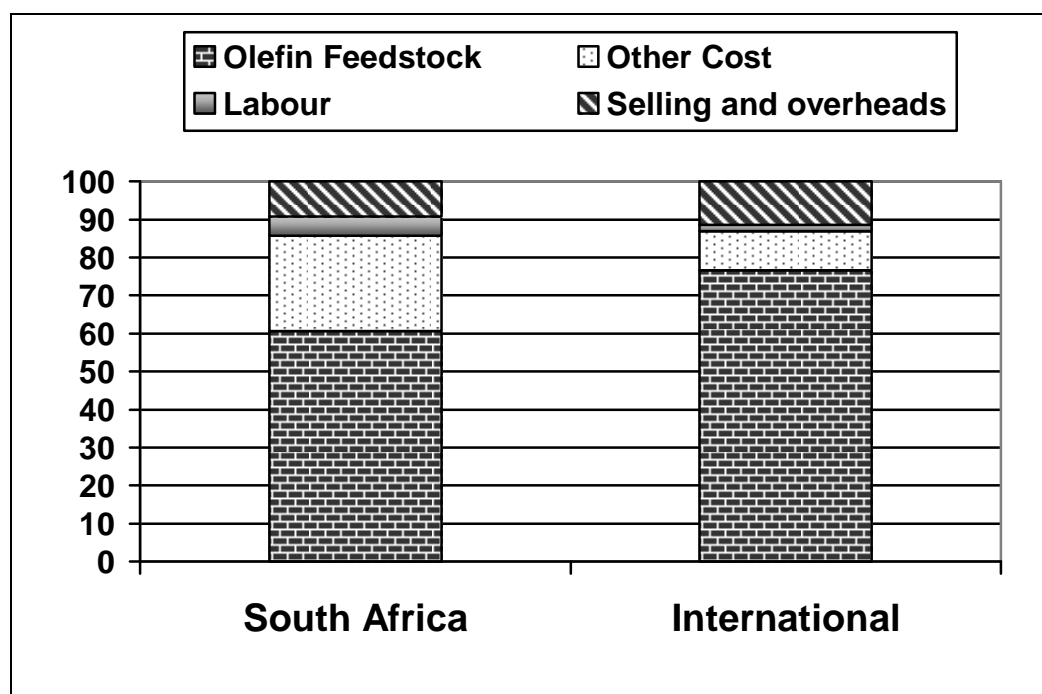
The cost structure of SA based operations is not directly comparable to international PP operations, in that:

¹ It should be noted that CIF prices are higher than FOB, based upon freight and insurance costs. A duty on a CIF price is therefore effectively higher than a similar duty on a FOB price

- a) Both PP producers have integrated operations that are manufacturing both PP and polyethylene.
- b) In the case of Sasol Polymers, the production infrastructure includes an olefin purification operation that purifies ethylene and propylene that is obtained in crude form from the Fischer Tropsch process – this is a unique operation on a global basis.

The relative cost structures for SA based operations, compared with standard global PP operations are shown in the figure below. The international PP information is based on SRI consulting data – US Gulf Coast.

Figure 2.6: Relative PP Cost Structures – SA and International (US Gulf Coast)²



Based upon these cost structures, feedstock in SA's case is a lower portion of total costs, while other costs, which include variable and fixed manufacturing costs, but no depreciation, are higher in SA's case. It should be noted in SA's case the feedstock used is not polymer grade propylene, but the raw propylene condensate supplied to the Sasol Polymers purification unit from the Sasol

² It should be noted that in absolute terms SA's cost base is higher due to relatively small plant sizes

Secunda upstream operations. The transfer cost mechanism of this feedstock stream has not been analysed in this report.

2.3.2. SA Production Advantages & Disadvantages

SA advantages include:

- Sufficient and cost competitive propylene feedstock based upon Fischer Tropsch synthetic fuel upstream operations.
- Globally competitive polymer production technology and facilities.
- Well-developed downstream converter sector with widespread end-product applications.

SA disadvantages include:

- Relatively small local and regional market.
- Long distance from attractive export markets.
- Inland location of production facilities in the case of exports.

2.3.3. Upstream pricing practices with respect to downstream domestic purchasers

Local PP producers sell polymer products to customers in markets which include the RSA and other African countries, Asia, USA, Europe and South America. Their policy is to sell at the market price prevailing in each of these regions, and this also applies to sales in South Africa.

It should be noted that the local F.O.B price is not the price paid by these export customers. The following serves as an example for PP:

- Average local delivered price: R7.23/kg in South Africa.
- In 2004 average F.O.B. price under tariff 39.02.10 to all destinations was R5.93/kg (98 938 tons; R587 million).
- The major country that SA exported to was Hong Kong: average F.O.B. price of R5.71 (18 924 tons)
- The difference between local delivered prices and F.O.B price to Hong Kong was around 21%

- Selling in Hong Kong requires logistical costs, duties/tariffs, inland distribution and agent's commission. Comparative delivered prices between countries/regions as shown by Figure 2.11 in particular reveal that the prices are set by the market.

The producers use all relevant information at their disposal to prepare for the price negotiations in order to offer a competitive price. The price is negotiated and takes into account inter alia:

- competitive offers from other suppliers (prevailing market price),
- the quantities purchased by a customer and the costs associated with such quantities,
- requests for export or development assistance,
- distribution costs for different packaging types (viz. bags, bulk or semi-bulk),
- Sasol Polymers' total offering (commercial, product, technical and service components), and
- Competing alternatives whether these are substitute materials (glass, wood, paper) or imported finished products.

The validity of these prices is part of the negotiations and can be adjustable month by month or, quarter by quarter, or fixed for longer periods (typically less than 6 months). Generally, there is a price continuum across the customer base. It should be noted though that over a relatively long period average delivered prices compared to average calculated prices of imports on an import parity basis would be fairly close to each other.

Included in producers' offering is a technical and engineering service, which is available to all customers. This technical and engineering service covers the following aspects:

- product and application development,
- engineering expertise for converter's equipment modification,
- technical expertise for use of complementary products,
- assistance with operation problems, and
- problem solving on converters equipment.

In order to fully explain the PP producers' domestic pricing policy, a description of global polymer price mechanisms and their impact on South African domestic polymer prices will be further

discussed. In [Appendix 3](#) a detailed description of international pricing practices, based upon reference prices, is shown.

a) Europe and USA Polymer Prices:

The domestic prices of the commodity polymers (LDPE, LLDPE, PVC and PP) in Europe and the USA are targeted at levels that provide adequate long term returns on investment to producers investing in new plants. These targeted price levels are generally achieved because the markets are large, there are several domestic producers and levels of “dumped” imports are relatively low.

In times when installed production capacity exceeds demand, which is the norm for most of the price cycle, high cost producers are barely able to cover their costs and cut back supply accordingly, while those with a lower cost base will achieve a low return. During these periods, little re-investment occurs because of the low returns and, as demand increases with time (normally 5-6 years), a stage is eventually reached where demand exceeds installed production capacity. At this time prices rise rapidly and high margins are earned prompting new capacity investment and within 1-2 years, another situation of excess capacity and subsequent low margins exists. Historically, this price cycle repeats itself every 6-8 years.

It is important to note that polymer producers’ returns are seen over entire price cycles. The high returns earned for short periods during the peaks of price cycles, and the inadequate returns experienced during the trough, balance out the average return for the polymer producers. Hence, earnings during the peak should not be seen in isolation, nor viewed as excessive. This need for an adequate long term average return on investment is typical of the international polymer industry and applies to all regions, including South Africa. This is because the polymer market is effectively a single global market and the same price cycle applies to all producers in all regions of the world that trade with each other.

b) Far East Polymer Prices:

Until the early 1990s, prices of polymers in the Far East were set out of the USA and were generally higher than in either Europe or the USA. When the Korean petrochemical expansions occurred, these resulted in overcapacity in the region and a hunger for market share that eroded

margins. As a result, since the mid-1990s, prices in the Far East have been generally lower than either Europe or the USA, and in many instances, at a level that barely covers the costs of raw materials and failed to adequately reward the investment to a Far East producer.

c) Middle East Polymer Prices:

In recent years the very large polymer plant investments in the Middle East have had an influence on the global supply/demand balance. Most of this production is exported into China and is economically viable at the Far East price levels due to low feedstock costs and very efficient economies-of-scale. The Middle East producers generally adopt a “price follower” strategy as determined by market competition in the Far East and other export destinations.

d) South African Polymer Prices:

As with all regions in the global market, polymer prices are determined relative to the competitive forces acting in the particular region. In order for a supplier to be successful in penetrating the market and sustaining a market share position, the customers’ alternative purchasing options must be considered and a competitive offering made.

South African polymer producers follow the above approach. They do not select a particular price from a particular region and rigorously apply that to determine its price to the South African domestic market. They are driven by market dynamics and react to the lowest price imports being offered by competitive suppliers to its customers. Prices of locally manufactured substitute materials, such as paper, metal and glass, are also monitored and considered for the market sectors where they compete as alternatives to polymers.

During recent years, the competitive supplies have come from the Far East and the Middle East and they therefore normally set the price levels in the South African domestic market. Hence Far East prices are typically monitored and tracked as defined by Hong Kong CFR prices. Because traded volume of polymer through Hong Kong (destined for China) is active, substantial and continuous, this is a reliable, well reported and globally recognized competitive source which is used to monitor international price trends.

SA PP producers regularly monitor the published international polymer price data and in addition, they are either active in both exporting and importing of commodity polymers, or they are part of a major multinational polymer producer and are able to supplement the published information with their own trade experience. Competitive pricing information is also obtained from customers during supply negotiation discussions and is often used in preference to the data obtained from the trade consultants mentioned above.

The above discussed points form the basis for the market price and hence for the customer price negotiations.

In addition, the local cost of feedstock (propylene in the case of PP), also has to be taken into consideration. In the case of Dow Plastics, this price is determined by Sasol Polymers, which is their major source of the feedstock.

e) Rebates and discounts

The major rebate category on PP is for export of customer/finished goods. Export rebates are given to encourage customers to convert the exported product to finished goods and exporters themselves export the value added finished goods.

There are special pricing schemes available to **all** customers (large and small) and include:

- Rebates for the development of new products and markets to compete with alternative materials,
- Rebates to compete with imports of finished goods,
- Rebates for exports of finished goods (export rebate), and
- Rebates for early settlement.

The first two rebate schemes are available for a specific application or development; are applicable for a limited period and limited to the volume for the specific purchases (that is not across the full volume of polymer purchased). These rebates are specifically designed to facilitate or assist:

- Converter development and introduction of products into the market by reducing the cost of the raw material during the early stages of the product life cycle (namely development, market introduction and acceptance),
- Converter competitiveness in the export market to overcome competitors who may have geographic, labour cost, governmental incentives, fiscal or other competitive advantages, or
- Converters to be more competitive in the local market against final product imports from international converters (which is sometimes dumped) who have labour cost, governmental incentives, fiscal or other competitive advantages.

The early settlement rebate scheme is to encourage customers to reduce the credit terms, which is mutually beneficial to both supplier and consumer.

Analysis of the downstream responses showed that the uptake of the rebate schemes mentioned above is on a case by case basis. One upstream respondent mentioned that 10% of volumes sold (not customers) are making use of the export rebate schemes. This is verifiable by the export data.

f) Upstream suppliers' view on Actual Pricing Mechanism Versus Import Parity Pricing

The pricing mechanism prevailing in South Africa is one where the price is negotiated, based on offers in an open market where products are readily traded across national boundaries. The outcome is that the most competitive supplier sets the price and it is better referred to as market pricing. The pricing methodology is commonly seen internationally in most countries that are signatories to the WTO. It prevails in countries with a free, open-access market, rather than the regulated price-setting typically found in centrally planned economies. In South Africa this situation is no different as locally produced products compete with imports. The advantage of this method of pricing is that it directly links the domestic price to the international reference prices ([See Appendix 3](#)). It also brings a country's pricing practices in line with all the countries that are signatories to the WTO and its rules on trade and eliminates the creation of subsidies throughout polymer value chain.

An aspect that should be borne in mind is that the price of the imported product is typically set by the spot price of another region, which is substantially lower than that region's domestic price, as it is set by producers only needing to cover their marginal operational costs. The international domestic prices are normally "delivered prices". In most producing countries the domestic supply typically consume a significant portion of the producers' volume, so enabling the export volumes to be priced using marginal costing. This results in domestic delivered prices in countries that compete through trade, having domestic delivered prices that are broadly in the same range, as is the case in South Africa. This is due to the combination of freight and duty values not being too dissimilar to the difference between domestic price and spot in the exporters' market. However, it should be noted that in producing countries where average costs are fairly constant (as it in the case in the South African polymer manufacturing industry), marginal costs are usually equal to average costs. Also, in South Africa's case, variable costs are higher than the international norm because of poor economies of scale. It should also be noted that where marginal costing is practiced it is used only in the short term.

The actual pricing mechanism in SA can therefore be regarded as a "Market Reference Pricing".

A definition for the SA market reference pricing is as follows:

A market reference price is where the price is negotiated based on offers in an open market where products are readily traded across national boundaries. The outcome is that the most competitive supplier sets the price, which results in a direct link between the domestic price and the international reference prices.

A definition of Import Parity Pricing is as follows:

An import parity price is a mechanistic formula-based calculation which is done by specifically calculating a price based on what it would cost to import the product. The inputs into the formula include the following: a reference price for the product (usually on an FOB basis), all costs associated with transporting the product to a port in South Africa, import duties & taxes, landing

and clearing costs, inland transport costs, storage costs and local delivery costs. For example, the cost of fuel in South Africa is determined via a formula-based IPP.

The difference between market pricing and import parity pricing is that in the case of the former prices change continuously based on the cheapest available source at a particular point in time. In the case of import parity pricing, the price is calculated on the basis of a published price in a specific region or country and the ultimate price is formula-based. Furthermore, in the case of market pricing, customers monitor prices from all major trading regions and the lowest price available at any point in time is then used by them as a basis for negotiations with their polymer supplier.

The breakdown below gives an example of how an import parity price is calculated:

Table 2.2: Polypropylene – Import Parity Price Calculation

Estimated Import Parity Price		
=	FOB (lowest cost source) ³	Based on published information (ICISLOR, Platts or Harriman)
+	Freight from source to Durban (South Africa)	Cost to get polymer to South Africa
+	Freight insurance	Insurance on goods in transit
	Convert to Rands	Above normally quoted in US Dollars
+	Logistic costs includes <ul style="list-style-type: none"> • Landing cost • Transport cost (Inland / coastal) • Duty (ad valorem duty on FOB price in rands) 	Landing Costs comprise of terminal handling costs, wharfage – Cargo dues, Carrier service fee, Agency fee, Handover and document fees and disbursements on landing and wharfage, and duty and customs

³ A FOB (free on board) is a INCO 2000 term, in which the responsibility of the supplier is transferred to the buyer when the goods have been delivered on the rail of named carrier at a named port. As discussed, FOB prices are normally spot sale values and are lower than the corresponding domestic price, as the prices are normally based on the producers marginal cost of production.

		<p>VAT.</p> <p>Transport costs for inland would include container turn in and railage.</p> <p>Transport cost for coastal would include cartage to customer.</p> <p>Duty currently 10% of FOB price.</p>
+	Indirect costs	<p>Adjusts for example stock holding costs, payment terms, LC costs, container destuffing and warehousing costs</p>

Based upon the schedule shown above, the actual calculated IPP price for PP in July 2005 is shown in the following table:

Table 2.3: Polypropylene – Methodology and Assumptions Used in Establishing a Derived Import Parity Price in Selected Countries Based on the Reference Price⁴

Price Linkages and Derived Import Parity Price in Selected Countries										Domestic Reference Prices	
Polymer: PP Period: Jul-05										USA	NW Europe
Country ----->	Unit	RSA	China	India	Australia	S. Korea	Taiwan	Turkey	Brazil		
Source of (Marginal) Polymer Imports (1)		SK/Sing CFR HK	Sing/SK/Aus CFR HK	RSA/Sing/SK CFR HK	SK CFR HK	ME/Sing CFR HK	Sing/SK/Aus CFR HK	NW E/RSA FOB NW E	USA FOB USGC		
Reference Price	\$/tonne	1,028	1,028	1,028	1,028	1,028	1,028	994	961		
Transport Adjustment to Ref Price (2)											
See Note		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		
Quantum of Adjustment											
CFR Port		50	10	35	45	10	15	45	45		
Handling & Clearing	% of CFR	1.5%	1.0%	1.5%	1.5%	1.5%	1.5%	1.5%	3.0%		
Import Duty	% of CFR	10.0%	9.7%	10.0%	5.0%	10.0%	10.0%	10.0%	15.0%		
Transport to Converter	\$/tonne	108	101	106	54	104	104	104	151		
Other Costs	\$/tonne	25	75	55	20	20	20	20	15		
Del Cost to Converter	\$/tonne	1,227	1,224	1,262	1,163	1,177	1,183	1,178	1,202		
	% of Ave	102%	102%	105%	97%	98%	98%	98%	100%		
Additional Notes ----->										<--Ave: 1,202 1,244 1,097	

Notes:

1. SK = S. Korea, ME = Middle East, Sing = Singapore, NW E = NW Europe, USGC = US Gulf Coast, Aus = Australia
2. This is the amount that is added to the Reference price to get the CFR Port Value
3. Marginal imports into South Africa come from S.Korea and these have tended to set the CFR price of imports. This is expected to continue for some time. The quantum assumed is the estimated cost of shipping polymer to South Africa, less the estimated cost of shipping from Korea to Hong Kong.
4. While polymer is imported from a number of sources, the CFR China price is set by the CFR Hong Kong Reference Price plus an amount equivalent to shipping from Hong Kong to a port in China.
5. India's marginal imports seem to come predominantly from Singapore, South Africa and South Korea. There is very little PP produced in the Middle East. The quantum is set by the cost of shipping from South Korea, less the estimate cost of shipping from Korea to HK.
6. While Australia is a net exporter of PP, the prices are set by the marginal imports from South Korea on the same basis as the prices set in China and India.
7. While South Korea is a net exporter of PP, the prices are set by cost of imports (from Singapore, Thailand and Australia) with reference to the CFR Hong Kong Reference Price.
8. The prices in Taiwan are set by the CFR Hong Kong Reference Price plus the cost of shipping from Hong Kong.
9. The price in Turkey is set by the cost of imports from NW Europe.
10. The price in Brazil is set by the cost of cost of polymer imported from the USA.
11. The additional costs in India are: Special Auxiliary Duty (2%) and higher clearing charges.

As at July 2005, marginal imports of Polypropylene into South Africa came from South Korea and therefore these have tended to set the CFR price of imports in South Africa. This situation (source of marginal imports) is expected to continue until one region/country has more surplus production that would be exported at marginal costing at a lower landed price. This means the CFR price of imports into South Africa changes continually over time. Similarly, South Africa is also a player in marginal imports into other countries.

⁴ Please note that the Reference Price is normally a spot price of a particular region or country. It is not arrived at by using a particular formula. There are three Reference Prices that have evolved for the global polymer industry that are used as the basis for setting prices in developing countries and regions. Those are CFR Hong Kong, FOB US Gulf Coast and FOB North Western Europe.

2.4. Major downstream industries that purchase upstream products

2.4.1. End-use structure

The local PP polymer market of 223 000 tons/annum in 2004 is supplied in more or less equal volumes by Sasol Polymers and Dow Plastics, with imports accounting for around 6% of the market. The end-use structure for PP polymer is segmented into the grade of polymer used, as well as the conversion technology employed.

The major PP grade is homopolymer, which accounts for 70% of the market. Homopolymer is mainly used in extrusion processes (80%) for applications such as artificial hair, BOPP, fibres, film, flooring, sanitary ware (non-wovens), ropes and twine, stationary, strapping and woven cloth. Moulding processes (injection and blow moulding) account for 20% of homopolymer consumption, and is used in applications such as appliances, chairs and closures.

The other main PP grade is copolymer, which accounts for 28% of the market. Copolymer is mainly used in extrusion processes (10%) for applications such as pipe and twin walled applications. Moulding processes (injection and blow moulding) account for 90% of copolymer consumption, and is used in applications such as automotive, batteries, buckets (water based paint, industrial packaging), crates, house wares, food containers, pallets, pipe fittings and furniture.

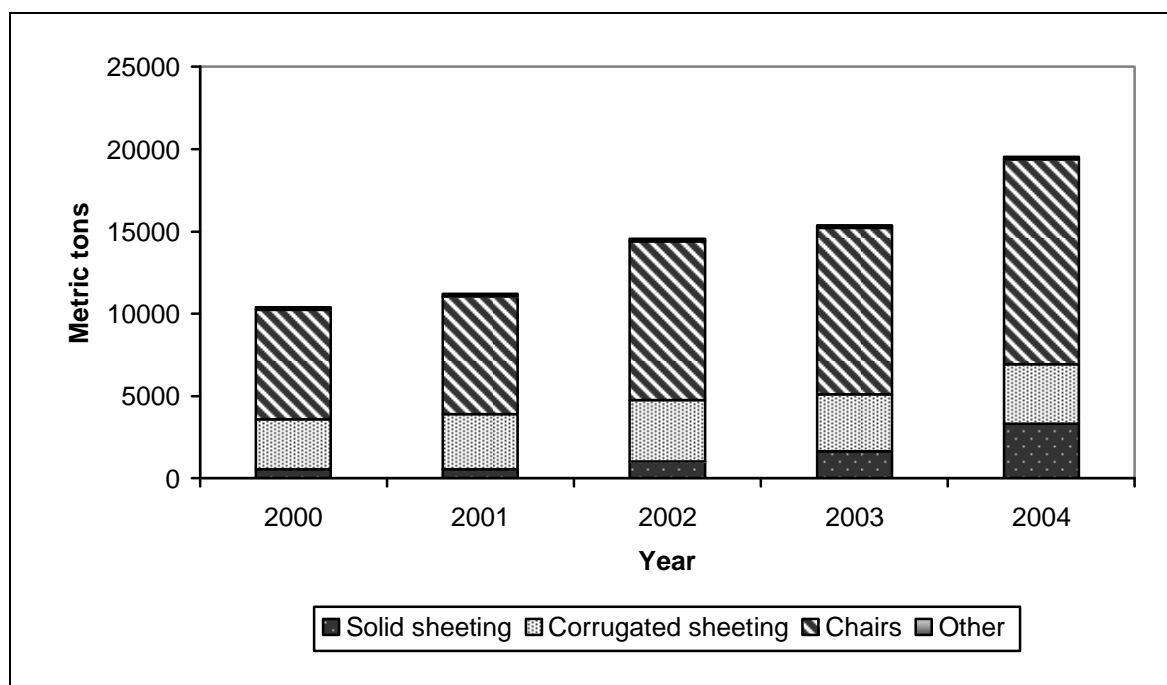
Random copolymer accounts for only 2% of the market and is used for moulded cosmetic containers and food containers (75%), as well as coating for hot fill application (25%).

In most downstream applications there are many converters, although major companies tend to dominate in each application sector. However, the segmentation threshold between large and small customers is the ability of the customers to take full truck loads of polymer per order. For PP a full truckload represents 33 tons, and on average more than 87% of the total supply volume is for more than the threshold minimum order quantity. Both PP polymer producers employ distributors for customers that require less than a full truckload per order.

PP polymer is used to manufacture a large range of end-products, including packaging products such as crates and buckets, textile products such as carpets, non-wovens and netting, construction products such as sheeting, as well as many other types.

The figure below indicates for few product categories the historical growth in output, as supplied by a small number of downstream respondents.

Figure 2.7: Historical SA Sales – PP Derivatives



The above figure is based upon a small sample, but it still indicates a positive growth pattern for the products included (this is supported by sales volumes provided by upstream producers). Growth is attained by both general market growth, as well as new applications. This illustrates the significant growth that PP based products experienced in general around the world, but also specifically in SA.

2.4.2. Impact of feedstock cost on total cost structure

Based on limited respondent input, PP polymer accounts for 50 – 73% of Cost-of-sales, with the balance shared between other manufacturing costs (mainly labour), and sales/administration/distribution costs.

2.4.3. Organisation of downstream players

The Plastics Federation of South Africa (PFSA) is an umbrella body for the plastics value chain under which there are several associations. The Plastics Converters Association (PCA) represents the interests of converters in the plastics industry. The PCA is the biggest association in terms of membership with 316 members. There are also associations such as the South African Polymer Importers Association (SAPIA) that represent the interests of 12 importers in the industry. SAMPLAS is an association that represents 14 suppliers of machinery to the plastics industry while the Plastics Institute of South Africa (PISA) represents individuals in the industry. Other associations or interest groups in the plastics value chain are Association of Rotational Moulders of South Africa (ARMSA) which has a membership of 43 companies 13 of which are outside of South Africa, Expanded Polystyrene Association of South Africa (EPASA), South African Plastic Pipe Manufacturers Association (SAPPMA), and Institute of Materials (IoM). The following associations still exist but are no longer active in the plastics industry, Plastic Mould Makers Association (PMMA), Polyurethane Association of South Africa (PASAF), and Plastic Distributors Association of South Africa (PDASA).

2.4.4. Downstream sector ability to influence input prices received

Downstream respondents indicated that they have very little leverage to influence prices for PP polymer, even though there are two local producers. One the reason offered is that not all grades are being offered by both suppliers.

2.4.5. Duty Structures and anti-dumping measures

Tariff protection for downstream PP plastic products is extensive. The table below indicates specific tariff headings that consist of either PP based products, or could potentially be made of PP. The tariff protection quoted is the general tariff, and excludes the European Community (EC).

Table 2.4: Polypropylene End-products – Tariff Protection in SA

Product Description	Tariff	General
Of polymers of propylene	39.17.22	15%
Of polymers of propylene seamless without fittings	39.17.31.50	15%
Of polymers of propylene , seamless	39.17.32.50	15%
Other, of biaxially oriented polymers of propylene	39.19.10.45	15%
Other, of polymers of propylene	39.19.10.50	15%
Other, of polymers of propylene	39.19.90.45	15%
Of biaxially oriented polymers of propylene, of a width not exceeding 125mm, metallised	39.21.90.56	24%
Of biaxially oriented polymers of propylene, of a thickness not exceeding 0,09 mm and a width exceeding 125 mm.	39.21.90.58	20%
Of other biaxially oriented polymers of propylene	39.21.90.60	20%
Of polymers of propylene	39.21.90.63	15%
Textile fabrics embedded in or coated or covered on both sides with polymerisation or copolymerisation products	39.21.90.64	15%
Of other polymerisation or copolymerisation products	39.21.90.66	15%
Baths, shower-baths and wash-basins	39.22.10	20%
Lavatory seats and covers	39.22.20	20%
Other	39.22.90	20%
Of other plastics	39.23.29	15%
Carboys, bottles, flasks and similar articles	39.23.30	15%
Other	39.23.40.90	15%
Stoppers, lids caps and other closures	39.23.50	15%
Other	39.23.50.90	15%
Capsules and tubular neckbands, for bottles and similar containers	39.23.90.20	5%
Other	39.23.90.90	15%
Tableware and kitchenware	39.24.10	20%
Other	39.24.90	20%
Reservoirs, tanks, vats and similar containers, of a capacity exceeding 300 litre	39.25.10	20%
Doors, windows and their frames and thresholds for doors	39.25.20	20%
Shutters, blinds (including venetian blinds) and similar articles and parts thereof	39.25.30	20%
Other	39.25.90	20%
Office or school supplies	39.26.10	20%
Other	39.26.20.90	20%
Fittings for furniture, coachwork or the like	39.26.30	20%

Product Description	Tariff	General
Statuettes and other ornamental articles	39.26.40	20%
Beads, not coated with pearl essence	39.26.90.03	15%
Transmission belts	39.26.90.20	5%
Power transmission line equipment	39.26.90.25	5%
Other	39.26.90.90	20%

In most cases where tariff protection is applicable the rate is in the order of 15 – 20%, which is higher than the 10% applicable to primary PP polymer. It is also calculated on a figure that is numerically higher per weight, meaning that in Rand/ton the protection is up to 4 times higher for downstream sector than the upstream.

None of the downstream respondents have indicated any anti-dumping investigation, or action, in any of their PP products.

2.5. International competitiveness of South African chemicals pricing

2.5.1. Introduction

It is important in the analysis of pricing that a common understanding of pricing terminology is agreed upon, especially in the context of a comparative analysis. The main issue that is involved is the concept of an inland price for products, which is the price paid by local customers in a particular country [which can be based on a delivered, or ex-factory basis], compared to export prices, which are the export based prices for producers in a particular country.

The competitiveness of South African chemicals pricing is dealt with under the following headings:

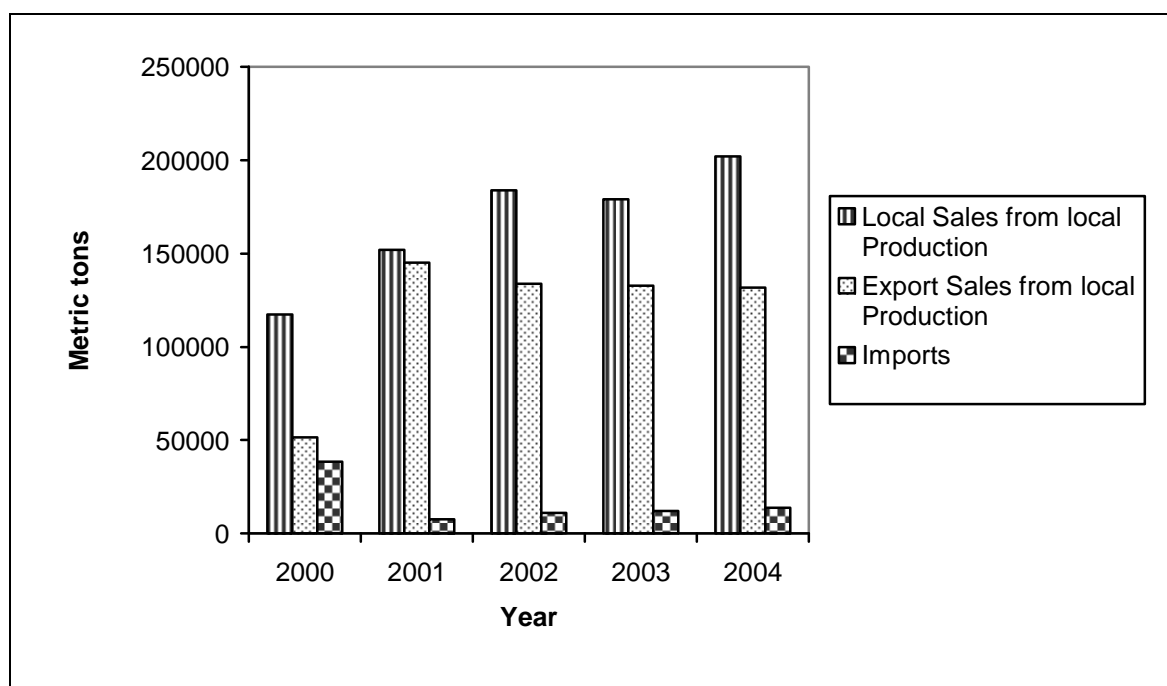
- Historical SA feedstock market volumes and pricing levels
- Comparison of SA inland prices for feedstock with international prices
- Historical sales levels for key downstream products
- Basis for SA pricing calculations
- Key differentiation factors for purchasing feedstock
- Operations: (Upstream/ Downstream: Basis for operation [e.g. 24/7]; Average age and original cost of equipment; Capacity utilisation; Workforce)

- Assessment of global competitiveness of downstream producers
- Ability for downstream to expand product range based on lower feedstock prices
- Impact of current pricing practices (Skills; Wages; Technology; Long-term sustainability; Import replacement)

2.5.2. Historical SA feedstock market volumes and pricing levels

The historical local and export sales volumes of PP, as well as average delivered prices are shown in the figures below.

Figure 2.8: Historical Local & Export Volumes – PP

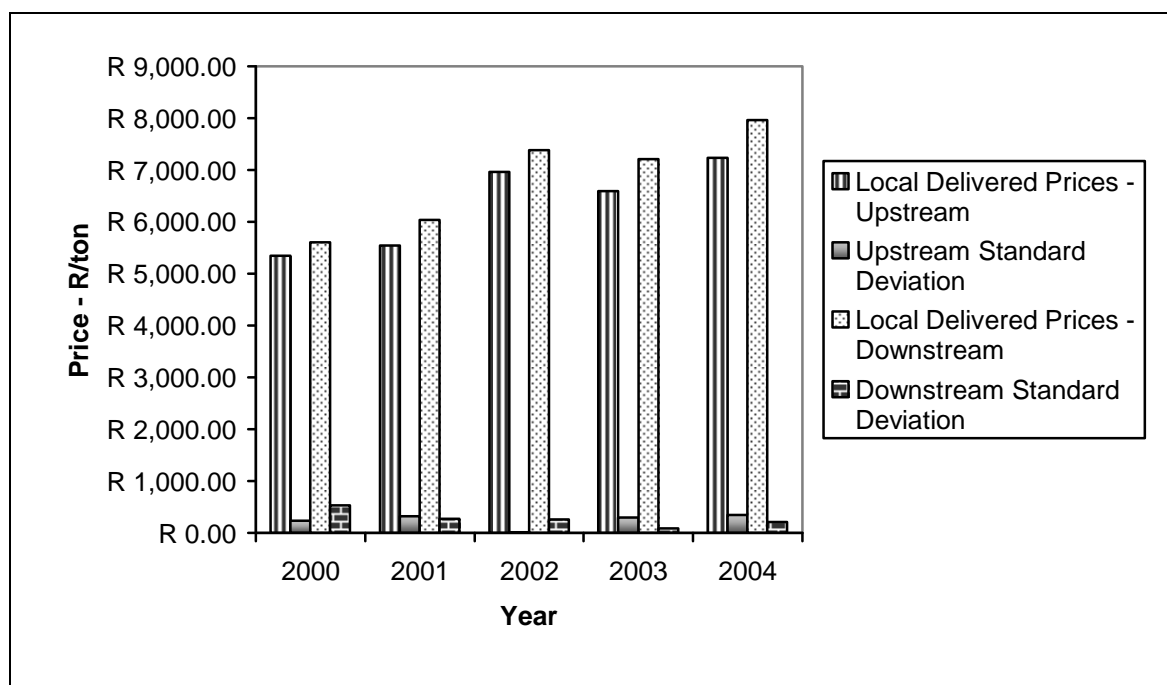


Local sales from local production are showing a general growth pattern, growing by 9.5% annually over the last 3 years. This is the most significant growth for all kinds of polymer. Exports were generally constant for the last few years. A fire at one of the polypropylene plants severely disrupted the production operations for approximately 9 months in 2000, leading to significant imports.

Homopolymer PP is the dominant product, accounting for approximately 70% of total local consumption. The international market prices for impact copolymer and random copolymer are

typically 4% and 8% respectively higher than the homopolymer grade. Similar price differences are seen in the South African market. Local delivered prices based upon total volumes and total values for the respective years are shown in the figure below (ex-factory prices are not available as PP is sold on a delivered basis):

Figure 2.9: Historical Local Delivered Prices (Excluding VAT) – PP All grades



Note: Downstream data was based on a small sample size. The difference between upstream and downstream prices can be attributed to not all downstream companies having participated in the study and that to the fact that downstream companies also buy polymer from other companies, such as traders and other importers, who were not part of the upstream sample participating in the study.

It should be noted that the prices shown to be paid by downstream respondents are numerical averages, and not weighted averages. As polymer product is mostly sold to large customers, a weighted average will result in lower values to bulk rebates provided.

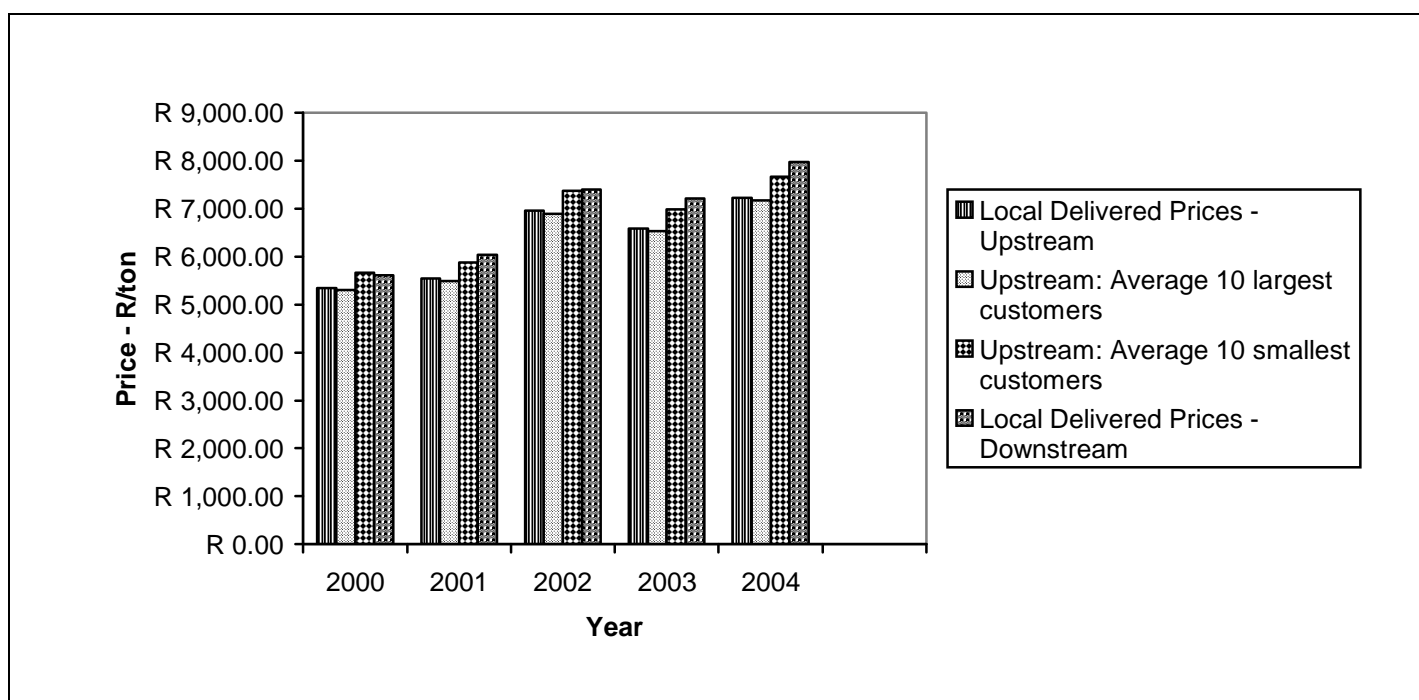
Information provided by upstream suppliers, based upon detailed “per customer” pricing analysis indicated the following:

- The average price difference between the largest 10 customers, and the smallest 10 customers is the order of 7%
- The weighted average price shown before from upstream suppliers is within 1% of the price paid by the largest 10 customers

- Downstream respondents predominantly small

The relative price bands for upstream suppliers are indicated below:

Figure 2.10: Historical Local Delivered Prices, including Average Prices for Large & Small Customers – PP All grades



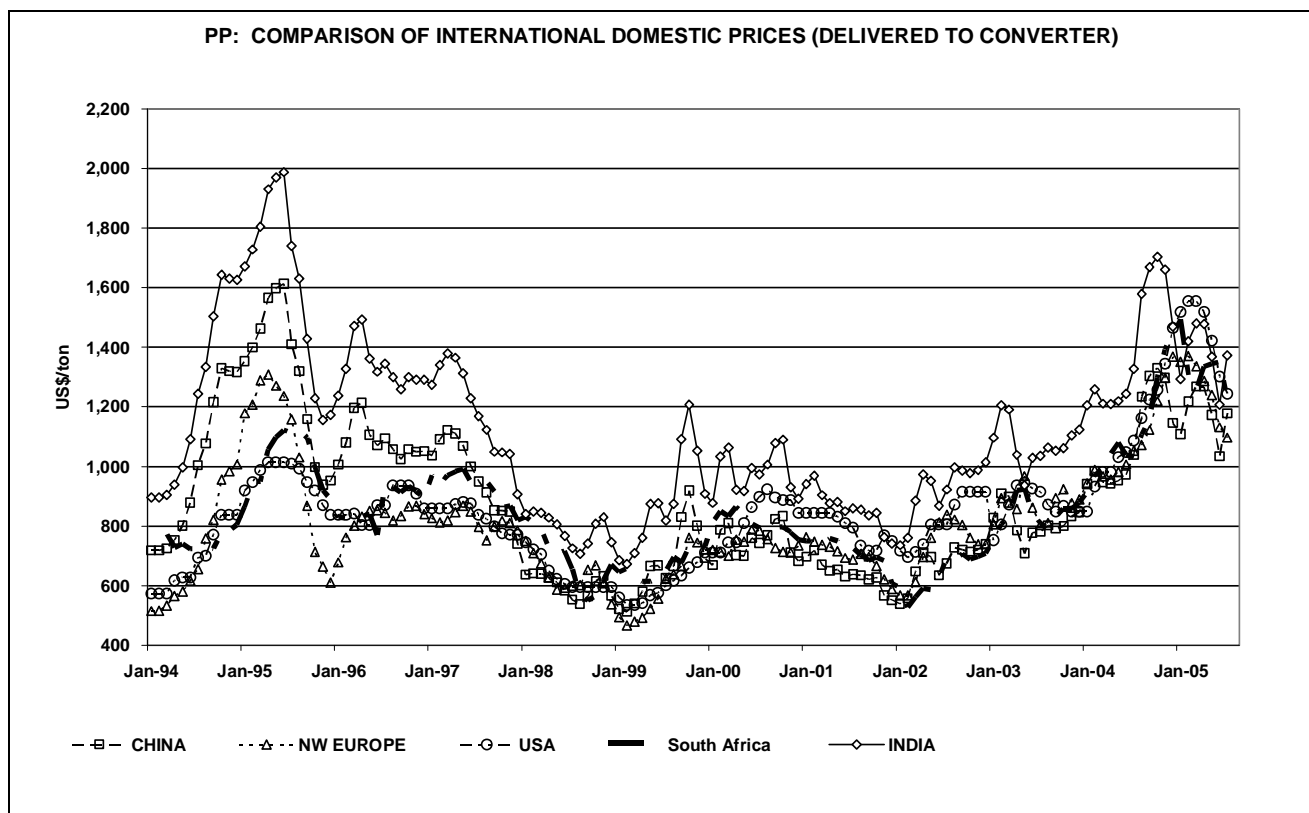
Note: Downstream data was based on a small sample size. The difference between upstream and downstream prices can be attributed to not all downstream companies having participated in the study and that to the fact that downstream companies also buy polymer from other companies, such as traders and other importers, who were not part of the upstream sample participating in the study.

It can be seen from this example that the difference in prices supplied by upstream versus downstream respondents can also be explained by the weighted average price approximating the average price for largest customers, while the numerical average price approximating the average price for smallest customers.

2.5.3. Comparison of SA inland prices for feedstock with international prices

The background to international pricing as well as sources for data is discussed in [Appendix 3](#) and in [Chapter 1](#). The trend and the general relationships are more important to gain insight into the fundamentals than a comparison of prices in a particular month.

Figure 2.11: SA and International Polypropylene Domestic Prices



Some conclusions and commentary on the data shown above are as follows:

- When comparing average prices as obtained from downstream respondents, SA domestic prices are still in the middle-to-lower end of the price band; these average prices (in US\$) are as follows:
 - 2000: \$ 807
 - 2001: \$ 698
 - 2002: \$ 704
 - 2003: \$ 968
 - 2004: \$ 1,230
- Prices around the world are linked.
- In any month, there can be a very wide variation in the prices. The following are some of the reasons:

- The derived import parity prices (for India and China) assume an instantaneous connection with the Reference Price (CFR Hong Kong). In reality there is a time lag of between 6 and 8 weeks.
- Fluctuations in the currencies in relation to the US\$ will have an impact because in all countries (except the USA) the prices paid by local converters is in the local currency.
- During periods of regional shortages or surpluses, international and local supply/demand balances will play a role. For example, during the periods of tight supply, the local domestic prices in the USA were considerably higher than those in Europe and Asia. Due to supply constraints, it was not possible to physically ship product to the (massive) US market and the local producers were able to maintain prices higher than import parity (from Europe or the Middle East).
- In the early part of the period under review, there was a big variation in the prices for all polymers. The major factor contributing to this is that China and India had relatively high import duties (>35%), but these have been reduced and this has brought the prices across all countries covered much closer together.
- Prices paid by South African converters are always in the range of prices that prevailed in the regions or countries covered, mostly at the lower end of the range. It should be noted that China is the most competitive (lowest priced market) in the world. In the early part of the period under review, the prices in South Africa were much lower than those in China and India. However, as imports into China have grown over the period the CFR Hong Kong price has fallen to the low end of the range. In addition, import duties have fallen. Both factors have contributed to a narrowing of the gap between prices in South Africa and those in China.
- For the monthly comparison over the recent past years, there have been periods when the price in China was lower (sometimes considerably so) than the price in South Africa. However, this comparison does not take into account the fact that there is a 6-10 week lag between the prices in South Africa and the prices in China. From the analysis of only the recent data it seems that prices in China have on average been lower than those in South Africa, even if a price lag is taken into account. A contributing factor is that the cost of

shipping has been high in relation to the cost of shipping a few years back. The shipping cost is expected to fall to a more normal/acceptable range.

2.5.4. Basis for SA Downstream Products pricing calculations

According to the small sample of downstream respondents, product pricing is based upon the cost of production, and converters are striving to achieve an acceptable return on capital. However, due to the large number of downstream competitors, they have little leverage on their customers, which are often companies much larger than themselves.

They have some leverage in terms of prices, based upon polymer cost increases. However, the downstream pricing mechanisms typically require a period of around 3 months before polymer price changes can be incorporated, while upstream price changes are affected sooner. But this was disputed by “the downstream of downstream”, that is, the retailers, who mentioned during discussions on demand elasticity that converters implement polymer price changes immediately after they get notice of price increase from polymer suppliers. However, no pricing data was collected from them.

2.5.5. Key differentiation factors for purchasing feedstock

The first differentiation factor is to determine the most suitable PP grade, based upon product requirements and costs. Once the grade has been determined, suppliers are chosen on the basis of quality, continuity of supply and price.

2.5.6. Downstream Operations

Basis for operation [e.g. 24/7]

All respondent operations are operating on a 24hour basis, but only 60% operate 7 days/week, and the balance 5 days/week.

Average age and original cost of equipment

The age of PP converting equipment reported by the respondents varies from 5 – 18 years with an average of around 10 years. The average original cost of equipment is R26 million.

Capacity utilisation

Capacity utilisation varies between 40% and 95%, with an average of 72%, not taking into account idle weekend time.

Workforce

The average number of the workforce for respondent companies is 106, with around 59% in manufacturing. A notable situation is the employment of contractors instead of full-time employees, due to insecurity of demand and low plant utilisation rates.

2.5.7. Assessment of global competitiveness of downstream producers

The relative small sample of downstream respondents (not representative and potentially subjective) indicated that PP conversion in SA is either of average competitiveness, or below. Some reasons given were:

- Small local market necessitates short production runs and low capacity utilisation.
- One respondent indicated that PP in SA is 33% more expensive than in the USA, which makes them uncompetitive, although their equipment, manufacturing procedures, marketing and distribution are world class. This anecdotal price reference is however not borne out by the international price comparison done.
- Some export orders for engineering components are being won against competition from China, USA and the UK, but could be better with more support from local polymer suppliers.
- One respondent claimed that imported modified PP can be sourced at a 30% discount to local homopolymer. Again, this anecdotal price reference is however not borne out by the international price comparison done.

Downstream respondents have commented that integrated international producers such as Formosa Plastics are accused of transferring polymer at marginal cost to conversion operations for exports. This is a major problem for plastic converters all around the world. In China, converters that are based in an "export processing zone" do have access to lower priced polymers because they do not have to pay import duties provided the polymer is converted into a product that is exported. Similarly, plastic converters in South Africa have access to certain polymers (really only PP at present) at export parity prices for PP converted into products that are exported.

The difficulty arises from the fact that converters in South Africa supplying product into the domestic market sometimes have to compete with Chinese (and other Asian converters) that have access to polymers at less-than-the-domestic price because they are located in export processing zones or have access to polymer at special prices.

Chinese exports have rebate of duty, similar to SA's exporters. Landed imported end-product is subject to duty typically in the range of 15 – 20% which should protect the domestic industry against WTO compliant imported end-products. It should be noted that end-products attract up to four times the Rand/ton duty protection compared to that of the upstream polymer. If the domestic converters cannot compete against such product, it indicates that either the Chinese exports are cross-subsidised (dumped), duty is not being administered properly or that SA converters are not competitive.

This is where anti-dumping regulations are supposed to help and aggrieved converters can call upon their governments to evaluate if dumping is taking place. Proving that any product from China is dumped is very difficult.

Regarding fully integrated producers like Formosa Plastics, the problem of transfer pricing of polymer to a conversion operation is real and does exist. Technically, this is illegal and not allowed under WTO rules and anti-dumping measures can be made against such an exporter. However, once again proving that dumping is taking place is not easy and in the time between dumped imports arriving and proving a case can take more than twelve months. Trade policies

are important in enhancing the competitiveness of a country. However the available countervailing measures are not uniformly applied in all countries.

2.5.8. Ability for downstream to expand product range based on lower feedstock prices

Respondents are either unsure, or only have assumed views regarding their ability to expand based on lower feedstock cost. One respondent indicated they export an extruded intermediary product that is very cost sensitive, and lower feedstock price will result in higher volumes. Another respondent indicated that plastic boxes, a relatively new application will show much higher growth replacing paper/board products, but a lower PP feedstock price is required.

2.5.9. Impact of current pricing PP polymer practices

Skills

The relatively small sample of downstream respondents generally do not see a major effect on skills levels caused by current pricing practices, although indirectly they feel it is negative, as skill are mainly developed during period of buoyant growth.

Upstream respondents commented that the growth of the local polymer industry has encouraged and required the development of technical, managerial, business and operational **skills** that are necessary to efficiently conduct business through the whole polymer value chain. The downstream conversion industry in South Africa is well developed and typically follows international polymer industry value chain norms; namely large national conversion companies, large independent companies and multitude of smaller entrepreneurial type operations. These companies can either focus on polymer conversion or can be multifaceted companies specialising in, for example, packaging irrespective of material type - steel, glass, paper or polymer.

Wages

Downstream respondents generally feel that wages are agreed to in bargaining councils, and are not influenced by feedstock pricing. However, there is a trend to part-time contractors, mainly induced by low margins, which are ascribed to high feedstock prices. The downstream focus could

also become more focused on labour intensive operations adding further value to end-products, but this requires lower material costs.

Upstream respondents commented that the established polymer pricing practices have allowed for the sustained development and growth of the downstream industry, the major employers of labour within this industry.

Technology

The relatively small sample of downstream respondents believe that low margins caused by upstream polymer pricing practices are a major driver towards more capital intensive equipment, in order to improve productivity. Some respondents, however, feel that they do not make enough margin to invest in necessary new technology.

Upstream respondents commented that the sophistication of the South African end user market is comparable with that of developed countries and hence the local polymer conversion industry is required to keep pace with global developments in polymer technology. Consumer requirements for specialised applications in turn require that the conversion industry invests in the necessary skills and equipment to facilitate the development and production of these applications and products (import replacement). Hence the upstream polymer production industry assists the conversion industry by developing new grades, enhancing and modifying existing grades to meet these requirements. Thus both the upstream and downstream industry players are required to track and apply changes in polymer technology into their operations and product offering.

Long-term sustainability

Downstream respondents have concerns that the long-term sustainability of the downstream sector is threatened by the economies of scale and high capital re-investment in China in particular. Current pricing practices are incorrectly stated by some respondents that they do not offer anything special to enhance exports, and thereby helping to alleviate the negative impact of the small domestic market.

Upstream respondents feel that to keep pace with growth, long term sustainability of the local polymer industry will be required to expand its operations to meet the increased demand and this can only continue if all parts of the polymer value chain are profitable and the invested capital (equipment and skills) is adequately rewarded.

Import replacement

Downstream respondents (based on small non-representative sample) believe that current polymer pricing practises have created little incentive for end-users to source locally, especially as end-products have similar mass to volume ratios as the primary polymer. The only drivers left for import replacement are convenience and “Quick response” issues.

Upstream respondents view is that if the alternative is considered for a moment (no local polymer production and all polymer goods are imported), the polymer conversion industry would be significantly exposed to the global supply and demand balances which would manifest itself in reliability of supply and would significant expose the domestic market to price fluctuations and polymer merchants wishing to take advantage of the import situation. Secondly, South Africa itself would not be able to handle the importation of these vast quantities of polymer raw materials and the market would likely switch to the importation of semi finished goods and final products which would significant damage the South African polymer conversion industry. The current pricing practices have allowed for the growth and development of the local polymer conversion industry as supplied by local production and as such facilitated the replacement of imports (polymer and semi-finished goods) with locally produced products. In countries where there is no local producer there is a significantly under developed polymer value chain, as semi finished and final products are imported rather than development of a capital intensive downstream industry.

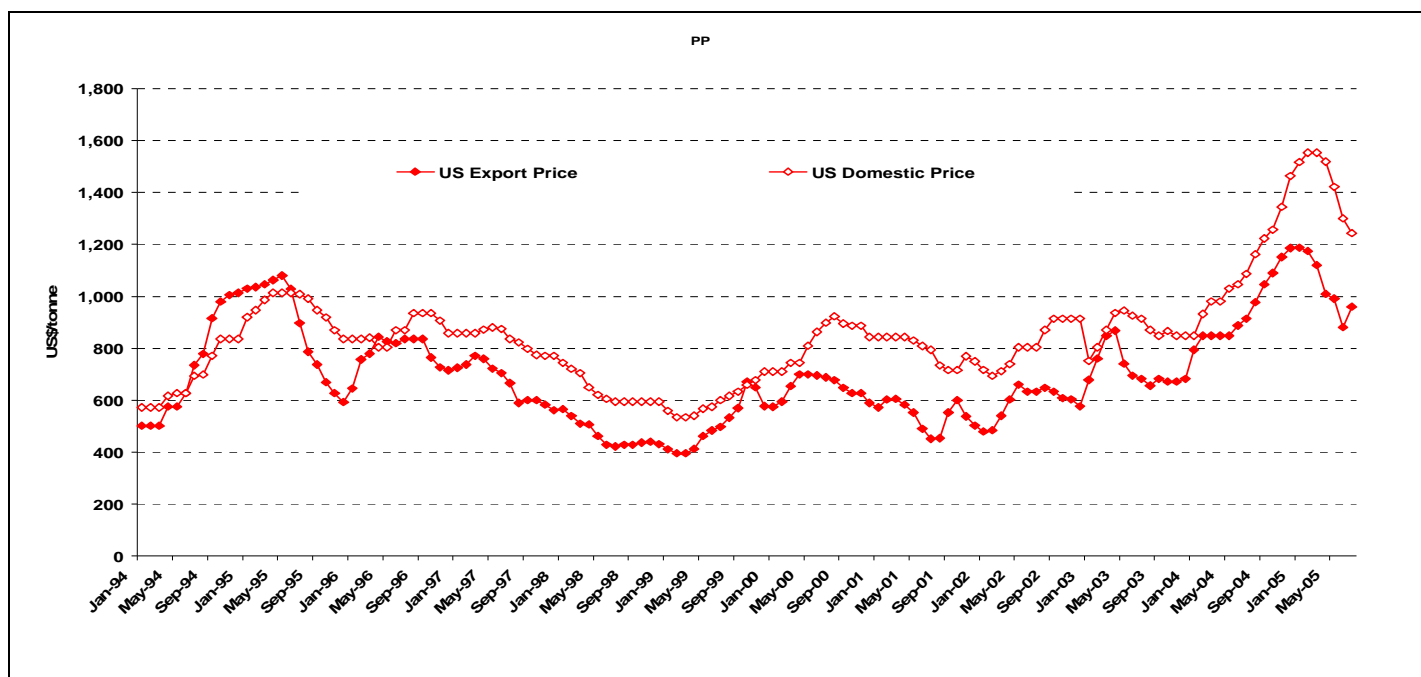
2.6. Comparison of inland prices with export prices

No time series data was available for export prices of product that was exported out of South Africa. The comparison has therefore been done on the average local delivered prices as received from Polypropylene manufacturers and converters and average export prices. In 2004, the average local delivered price for Polypropylene was R 7.23/kg. The average F.O.B. price in the same year was R 5.93/kg. The major destination for South African exports was Hong Kong. The

average F.O.B. price to Hong Kong was R 5.71/kg. The difference between the local delivered prices and F.O.B. price to Hong Kong was around 21%. It should be noted that selling these exports in Hong Kong has to add onto the F.O.B. price logistics costs, tariff duties, inland distribution and agents' commission. This is why the selling price in China is comparable to that prevailing in South Africa as shown in Figure 2.11 in section 2.5.3 above.

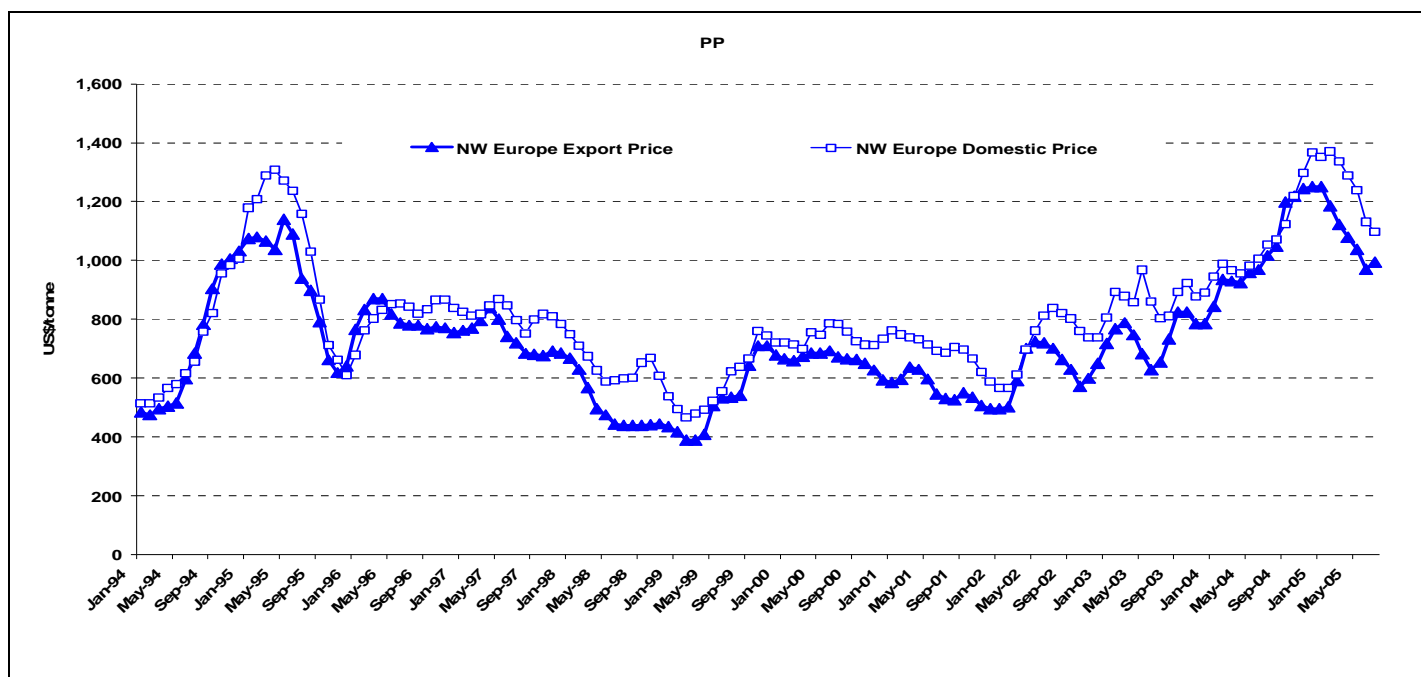
Time series data of export prices has however been obtained for a period of 10 years for other countries or regions; namely the USA and North West Europe. Figures 2.12 and 2.13 below show that the 21% difference between delivered domestic prices and export prices in South Africa is not unusual. For example, in the case of the USA the difference between their delivered domestic prices and FOB prices was as high as 24% by May 2005. It should be noted that the FOB price is not the price paid in the export market, rather it is the price at which the polymer exits the borders of the source country. Upon landing at the export market logistical costs, duties/tariffs (where applicable), inland distribution and agent's commission (in some instances) and other costs are added onto the price at which the polymer exited the borders of the source country. The difference between the delivered domestic price and the FOB price does not mean the domestic customers subsidize export customers. It should be mentioned that the gap between the two is sometimes much closer if not non-existent. Only for a limited period (May 2004 to May 2005) was the domestic price in the USA lower than the export price. The same trend should be expected in the case of South Africa as well.

Figure 2.12 Time series comparison of delivered domestic prices and FOB prices in the USA



The same trend is evident in the case of North West Europe as shown in figure 2.13 below, although the difference between the delivered domestic prices and the FOB price is relatively smaller and in some instances non-existent. The reason for the small difference is because of the close proximity of the export destinations and because of the relatively small volumes available for exports.

Figure 2.13 Time series comparison of delivered domestic prices and FOB prices in NW Europe



An important feature of the polymer industry world-wide is that in any country that has surplus in any polymer, the price at which the polymer is exported is different (and usually lower) than the price at which it is sold to domestic users even after allowing for transport and other logistics costs. This statement is supported by the trend of the historical FOB and domestic prices of the USA and North West Europe. A comparison between the domestic and FOB prices in the USA and NW Europe over the ten year period shows that:

- In both regions the polypropylene export price is usually lower than the domestic price.
- However, there are periods when the export price is very close to or actually higher than the domestic price. This takes place when the export demand increases faster than domestic, leading to higher export prices for a short period of time.

2.7. Impact of pricing on downstream purchasers - Demand Elasticity

2.7.1. Introduction

The approach followed to determine demand elasticity in the PP value chain is described in [Appendix 1](#).

2.7.2. Demand Elasticity Analysis for PP

Measuring the demand elasticity of PP consumption is done by assessing the elasticity (change) of the polymer consumption to price movements of polymer sold by the upstream. The actual change in consumption is determined by how much PP is consumed at lower or higher prices through the whole value chain, and when measured over all PP consumed, will reflect the aggregate of PP elasticity in all its different applications.

It was not possible to collect accurate information from sufficient companies to enable the plotting of historical and future demand elasticity for PP over all its many applications to obtain an aggregate view of its price elasticity. As such, alternative methods have been used to calculate demand elasticity.

During the course of 2005, Professor Johannes Fedderke of the Southern African Econometric Research Unit undertook a study of price elasticity in Sasol's LDPE, LLDPE, PVC and PP markets. This study set out to determine the price elasticity of demand and the price elasticity of supply for these commodities in South Africa. The input data used covered the period from January 1994 to June 2005. The study which uses sophisticated econometric techniques draws on 10 years of quarterly polymer consumption, polymer price and national economic data to determine both the supply and demand side price dynamics to determine the product's elasticity. The results of this study indicated for PP that a 10% decrease in price would result in a 2% increase in market size, and vice versa. The implication is that for PP any price decrease will result in a less than proportional increase in market size.

This elasticity study deals with the elasticity of polymer resin, produced by the upstream, supplied to the downstream and gives the aggregate across all PP's market segments (all value chains).

2.7.3. Practical Verification of Demand Elasticity for PP

To further investigate the demand elasticity of PP a market segment analysis was done. As the demand elasticity for PP resin is determined by the price elasticity of all its value chains (market

segments) to the price of PP, the price aggregate elasticity determined above can be verified from a practical perspective by evaluating the portion of the PP polymer cost in the final product that is being sold. If the end-product which determines the demand of the PP used contains a small portion of PP (e.g. soft drink bottle caps made of PP), the cost of PP will have a small impact on the price of the end-product and that particular segment will be inelastic to the price of PP sold by the upstream, as a reduction in price will not lead to a material drop in the price of the end-product (e.g. soft drinks in this example). Conversely if the product has been made predominantly of PP (e.g. garden furniture made of PP), the cost of PP will have a greater impact on the final price of the product and it will have a greater elasticity to the price of PP provided by the upstream.

By reviewing the market segments for the various grades of PP, assessing the market segment and the amount of PP contained in the final product, an understanding of the complete PP value chain's elasticity to price can be obtained, to verify the outcome of the more rigorous analysis conducted by Prof Fedderke.

This was done for the various segments for PP and is shown below:

a) PP - Homopolymer extrusion grade (50% of PP demand)

Major applications	% Cost of PP polymer in converted product	End-use product	% Cost of PP polymer in end-use product	PP Polymer Demand Elasticity for end-product
1. Woven cloth	40 – 50%	Packaged vegetables, maize meal, etc.	2 – 5%	Small possibility for maize; generally not elastic
2. Flooring	40 – 50%	Installed Carpets (includes cost of installation)	< 10%	A significant decrease in PP price, e.g. >20% required to influence demand elasticity
3. Non-wovens	40 – 50%	Waterproofing, industrial, consumer	Retail: <10% Other: 5-10%	Some LDPE competition, but generally not elastic
4. BOPP-film	40 – 50%	Packaging for snacks (e.g. crisps), etc.	<3%	No demand elasticity

The conclusion is that for 80% plus of the applications, PP polymer constitutes such a small fraction of the end-product price that it cannot impact on the demand elasticity.

b) PP - Homopolymer moulding grade (14% of PP demand)

Major applications	% Cost of PP polymer in converted product	End-use product	% Cost of PP polymer in end-use product	PP Polymer Demand Elasticity for end-product
1. Plastic chairs (80%)	40 – 50%	Retail Furniture	20 – 25%	Demand elasticity likely, but expected to require >10% change in PP price

The conclusion is that price changes in PP polymer have a possibility to impact on the demand elasticity.

c) PP – Impact Co-polymer extrusion grade (3% of PP demand)

Major applications	% Cost of PP polymer in converted product	End-use product	% Cost of PP polymer in end-use product	PP Polymer Demand Elasticity for end-product
1. Pipes	50 – 60%	Retail sales of drain pipes, etc.	40 – 50%	PP price cannot impact demand for construction projects; some competition with PVC

The conclusion is that although PP polymer constitutes a significant fraction of the retail end-product price that it cannot impact on the demand elasticity of construction projects, where pipes account for <1% of total cost.

d) PP – Impact Co-polymer moulding grade (29% of PP demand)

Major applications	% Cost of PP polymer in converted product	End-use product	% Cost of PP polymer in end-use product	PP Polymer Demand Elasticity for end-product
1. Buckets	40 – 50%	Packaging e.g. paints etc.	<5%	Some steel competition, but generally not elastic unless >20% price changes
2. House-ware	40 – 50%	Tupperware, lunchboxes, etc.	< 25%	Could have some elasticity as products are lower-range
3. Food containers	40 – 50%	Ice cream, industrial packaging	<5%	No demand elasticity
4. Crates	40 – 50%	Materials handling support for industrial products	<1%	No demand elasticity

The conclusion is that for 80% plus of the applications, PP polymer constitutes such a small fraction of the end-product price that it cannot impact on the demand elasticity.

The technical analysis done by Professor Fedderke has indicated a relatively small elasticity. The practical examples of final products elasticity provided in the study were merely an effort to explain the results of the technical analysis. The practical examples show that interim product elasticity can only be impacted upon by product substitution, which in most cases occur only at elevated price differentials due to technical considerations (e.g. changing from plastic to glass bottles requires complete packaging system changes).

The general conclusion for PP polymer is therefore that for in excess of 80% of end-use applications there is no significant demand elasticity. This is therefore a verification of the statistical analysis that indicated a low elasticity.

2.7. Impact of pricing on downstream purchasers – EVC

2.7.1. Introduction

Given the relationship that exists between sales volumes and price (as measured in this study by the demand elasticity curves), the challenge is to find an equitable method of comparing the impact on the financial performance of upstream and downstream businesses of the chemical industry brought about by changes in selling prices and sales volumes. The measure used must be unbiased and objective, and based on readily available data.

The measure that meets the above criterion that has been used in this study is Economic Profit, also known as Economic Value Created (EVC). A basic introduction and description of EVC and the methodology employed is shown in [Appendix 2](#).

EVC is a practical measure of the company's operating performance that correlates with the value of the company. What makes it so relevant is that it takes into account a cost that conventional measures exclude, namely, the cost of equity. Economic value created is simply the before interest and after tax operating profit, R, minus the total annual cost of capital, K. It is expressed as follows.

$$EVC = R - K$$

In this model,

R is the stream of cash available to the providers of capital, and

K is the total cost of the capital used, including the cost of equity and debt

The weighted average cost of capital (K) would normally vary across industries and over time. EVC is relatively insensitive to variations in K in the value chains measured.

This study seeks to determine the relative impact of pricing policies between upstream and downstream protagonists. Accordingly the view was taken that a single K could be applied as a consistent-and-equal benchmark for all companies in the study. This approach eliminates the moving benchmark effect of applying a different K to each company in each year.

Table 2.4: Determination of K - Weighted average cost of capital %

Target debt as % of capital	50
Risk free rate of return %	12
Market rate of return %	20
Risk index (beta)	1.5
Cost of equity %	24
Marginal debt rate %	15
Marginal corporate tax rate %	30
Cost of debt %	10.5
K, Weighted average cost of capital %	17.25

Accounting measures do not correlate well with share price. The accounting model is precise but inadequate. Value creation is a long term economic, not an accounting, concept. Value creation takes account of risk and the cost of equity and looks beyond the company into the market. As an economic measure it can also be used to take account of the time value of earnings. Although accounting measures are precise they do not measure value. Therefore when an accounting measure is used as a proxy for value it will be precisely wrong. EVC is the closest proxy for measuring value and therefore the choice is between being precisely wrong or approximately right.

2.7.2. Actual EVC results for upstream companies (All polymers)

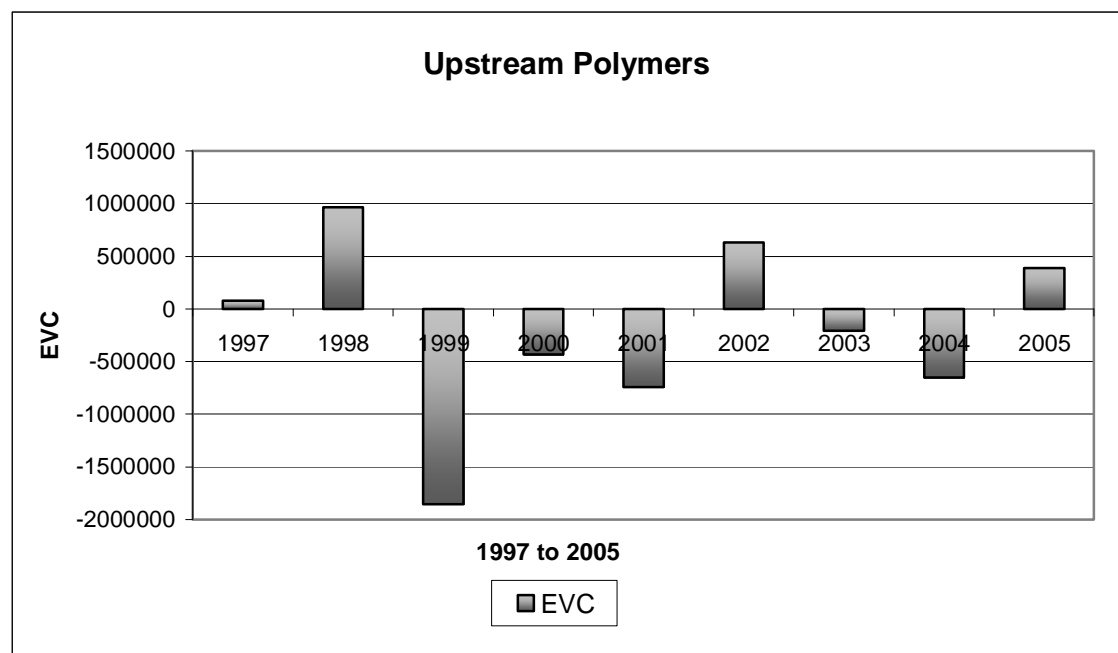
Due to the integration of production facilities, it was not possible to obtain the required information for the EVC analysis at individual product level. The analysis was therefore conducted on the combined polymers upstream and downstream sectors.

The following EVC graph represents the actual EVC values in each year between 1997 and 2005 for upstream polymers. The graph indicates that the return on capital was less than the weighted average cost of capital as measured by K (17.25) more frequently than it was equal or above K. However, this does not mean the upstream has been making losses. What this means is that the providers of equity don't get rewarded for their risk, but the business can still operate profitably. It should be noted furthermore that the EVC values shown on the graph below represent both

upstream polymers manufacturers, namely, Dow Plastics and Sasol Polymers. In the case of Sasol, the focus for this study was on Sasol Polymers, the polymers manufacturing unit within the group and not on the whole group. Therefore profits of Sasol Limited as a group cannot be equated to those of Sasol Polymers.

Sasol Polymers, situated within Sasol's chemical businesses, is a separate company within the Sasol Group, and has a supply agreement for raw material from another Sasol Group company, Sasol Synfuels. The supply of these raw materials is based upon a pricing mechanism that sets the price at the equivalent fuel value, i.e. the gate price of fuel (which is set by using the regulated Basic Fuel Price mechanism, which in turn is directly set by international fuel prices. Therefore, Sasol Synfuels sells the feedstock at a price that they would have realised in the marketplace if it was converted to saleable fuels. This mechanism ensures that there is no cross-subsidization between fuels and polymers businesses and hence the respective profitability of the businesses is a true reflection of the value add of the chemicals and fuel businesses.

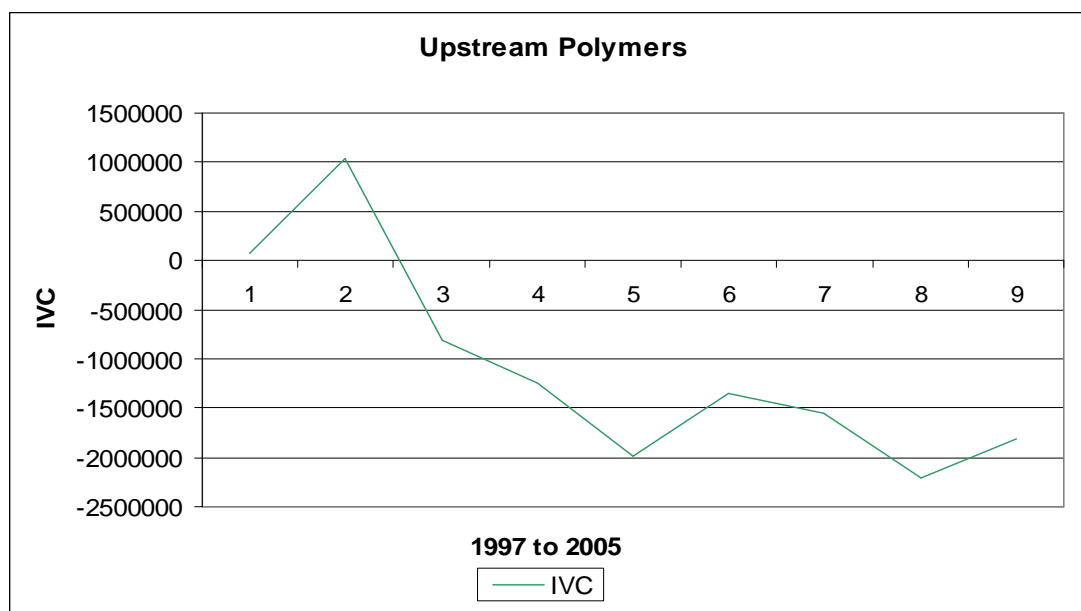
Figure 2.14: EVC Results – Upstream Polymers



The following IVC graph represents the intrinsic value calculated for upstream polymers. IVC is starting capital plus the cumulative value of each year's EVC, discounted to present time. In this instance, "present time" is 1997.

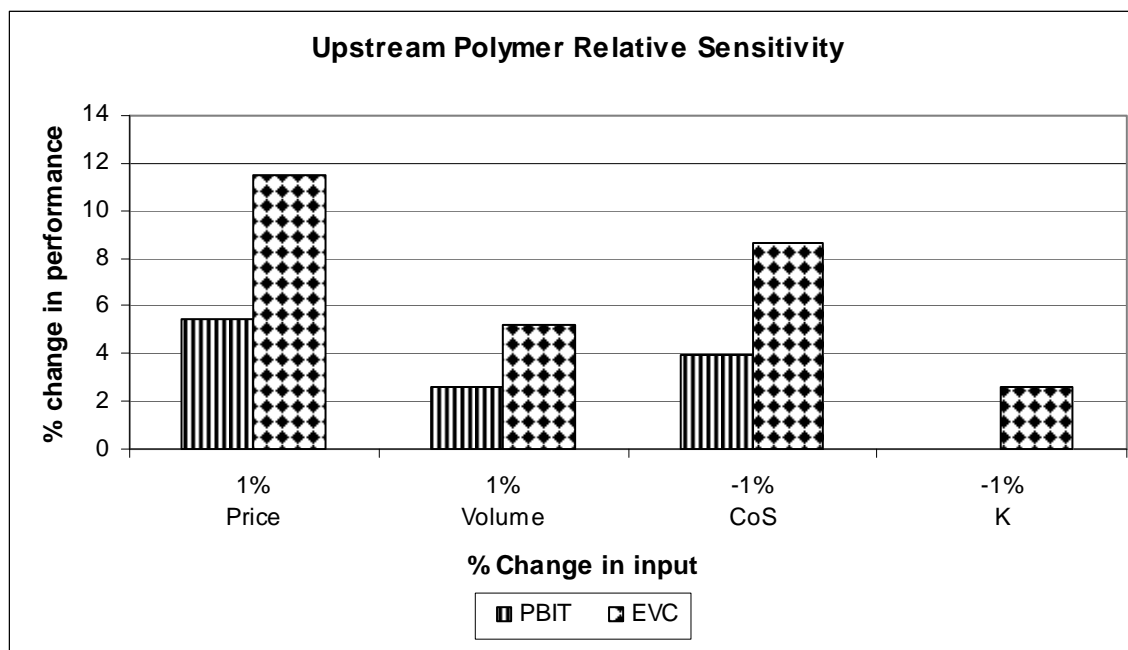
The graph illustrates the cumulative effect of economic value calculated by the end of each year between 1997 and 2005. When EVC calculations shows returns that are lower than K, the weighted average cost of capital over long periods of time as in the polymer business below it becomes increasingly more difficult to reverse the accumulated returns that are lower than K. The intrinsic value shows large accumulated returns that are below K by 2005.

Figure 2.15: IVC Results – Upstream Polymers



The following graph illustrates the relative sensitivity of EVC and Profit before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K in upstream polymers. The bar groups indicate by what percentage PBIT and EVC would change for a one percent improvement in Prices or Sales Volumes or Cost of Sales or K. (Note: The inverse is also true, i.e. a 1% decrease in values).

Figure 2.16: Sensitivity of EVC and Profit Before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K – Upstream Polymers



Note that the inverse of what this graph shows is also true. That is, PBIT and EVC would change by the same percentage points but in the opposite direction for a one percent decline in Prices or Volumes or one percent increase in Cost of Sales or K.

Note the following:

- EVC is relatively insensitive to K
- EVC (and PBIT) are relatively insensitive to Sales Volume
- EVC (and PBIT) are very sensitive to Selling Price and Cost of Sales

2.7.7. Downstream Polymers

No financial data was received for downstream Polypropylene EVC analysis. The EVC was calculated for each year between 1997 and 2005 for combined downstream polymers. Please refer to [Appendix 2](#) for downstream EVC results of combined polymers.

2.8. Conclusions – Polypropylene

Production capacity for PP in SA is around 355 000 tpa, increasing to 685 000 tpa by completion of Sasol's Project Turbo. The SA market size in 2004 for polypropylene primary polymer used in local plastic conversion was estimated at 223 000 tons, of which 93.7% was supplied by local producers. This indicated significant excess capacity which is expected to increase even more beyond the year 2006 as a result of Project Turbo.

Global PP prices are determined by supply/demand basis on a global scale, but are particularly driven by the Far East, due to the availability of low-cost product from ill-considered expansions done in the 1990's in countries such as Korea, as well as the ever-growing demand from China. Global plant sizes are also increasing, in order to benefit from economies-of-scale issues. By comparison South African plants are relatively small and thus local PP manufacturers have relatively high cost base in absolute terms.

Local PP producers sell polymer products to customers in markets which include South Africa and other African countries, Asia, USA, Europe and South America. Their policy is to sell at the market prices prevailing in each of these regions at any time, and this also applies to sales in South Africa. Therefore, PP pricing mechanism prevailing in South Africa is one where the price is negotiated, based on offers in an open market where products are readily traded across national boundaries. The outcome is that the most competitive supplier sets the price and is thus referred to as market pricing as opposed to formula-driven IPP. It should be noted though that the local prices are referenced to the landed costs of competitive imports. Local suppliers do not select a particular price from a particular region and rigorously apply that to determine its price to the South African domestic market. They are driven by market dynamics and react to the lowest price imports being offered by competitive suppliers to South African customers. The prices in export markets are based on marginal cost (variable cost) globally and hence are usually lower than domestic prices as explained in section 2.6 above.

Prices of locally manufactured substitute materials, such as paper, metal and glass, are also monitored and considered for the market sectors where they compete as alternatives to polymers. A combination of all these factors culminates into a domestic price at a particular point in time.

Excess domestic production capacity as in the case of Polypropylene in South Africa is no guarantee that domestic prices will be lower than FOB prices. For example, Australia and South Korea are both net exporters of Polypropylene and yet their domestic prices are set by marginal imports from other countries with reference to the CFR Hong Kong reference price. A comparison between domestic and FOB prices that prevailed in North West Europe and the USA over a 10 year period revealed that in cases where there is surplus Polypropylene, the price at which the polymer is exported is with few exceptions always lower than the price at which it is sold to domestic users. The same situation was found to be the case in South Africa. In general, the further away the export market as in the case of South Africa's exports to Hong Kong, the higher the price differential between the domestic price and the FOB price. The converse is also true, that is, the closer the export market like in the case of North West Europe's exports which go within Europe, the smaller the price differential. There are limited periods when the FOB price is very close to or actually higher than the domestic price. This takes place when the export demand increases faster than domestic, leading to higher FOB prices for a short period of time.

Analysis of South Africa's domestic PP prices compared to a number of major competing countries, including China, US, NW Europe and India, showed that:

- Prices around the world are linked.
- In any month, there can be a very wide variation in the prices.
- Prices paid by South African converters are always in the range of prices that prevailed in the countries or regions (China, India, North West Europe and USA) covered in this analysis, mostly at the lower end of the range.

In the latter period of the analysis China was the most competitive (lowest priced market) in the world. In the early part of the period under review, the prices in South Africa were much lower than those in China and India.

The global reality test revealed that South Africa's PP conversion industry is not lagging in terms of development, taking into account South Africa's current state of economic development. Countries such as South Korea and Taiwan, that have highly developed conversion industries, have developed vigorous manufacturing sectors that export the bulk of production (cars, industrial products, white goods and consumer electronics) that contain plastic components. It is these countries in particular that South Africa can learn from.

The results of the demand elasticity analysis indicated that a 10% decrease in PP price would result in a 2% increase in market size, and vice versa. The implication is that for PP any price change will result in a less than proportional change in market size. From a practical perspective the conclusion is that for 80% plus of the applications, PP polymer constitutes such a small fraction of the end-product price (or installed cost) that price changes cannot impact on the demand elasticity.

Due to the integration of production facilities, it was not possible to obtain the required information for the EVC analysis at individual product level. The analysis was therefore conducted on the combined polymers upstream and downstream sectors for the period 1997 to 2005.

For **upstream** polymers, the EVC analysis indicated that the return on capital was frequently lower than the weighted average cost of capital, K. This is a clear indicator that the current pricing practices of the upstream sector are not resulting in high levels of profitability, as measured against the total cost of capital, K. This situation means that the downstream sector is not making super profits.

For **downstream** PP, despite all efforts no company provided historical financial data for EVC analysis. The analysis was done for combined polymers. Although statistically insignificant, the EVC analysis of combined polymers indicates that the return on capital was lower than the weighted average cost of capital, K in every year except 1997 and 1999. This situation means that the downstream sector is not making super profits either.

3. POLYETHYLENE (HDPE, LDPE, LLDPE)

3.1. Market definition of upstream chemical products

a) Introduction

Polyethylene consists of three distinct product categories, namely:

- High-density polyethylene – HDPE
- Low-density polyethylene – LDPE
- Linear Low-density polyethylene – LLDPE

Polyethylene in primary, or unconverted, form is part of the Primary Polymer and Rubber sub-sector of the chemical industry.

Low density polyethylene (LDPE) has a melting point of 220 - 260 °C and a density of 0.91-0.94 g/cm³. LDPE is more flexible than HDPE due to lower crystallinity. Sasol manufactures LDPE in Sasolburg. LDPE manufacturing is a relatively simple polymerisation process, requiring only ethylene as feedstock. LDPE is a commodity type polymer, used predominantly (83%) in packaging film and sheet applications.

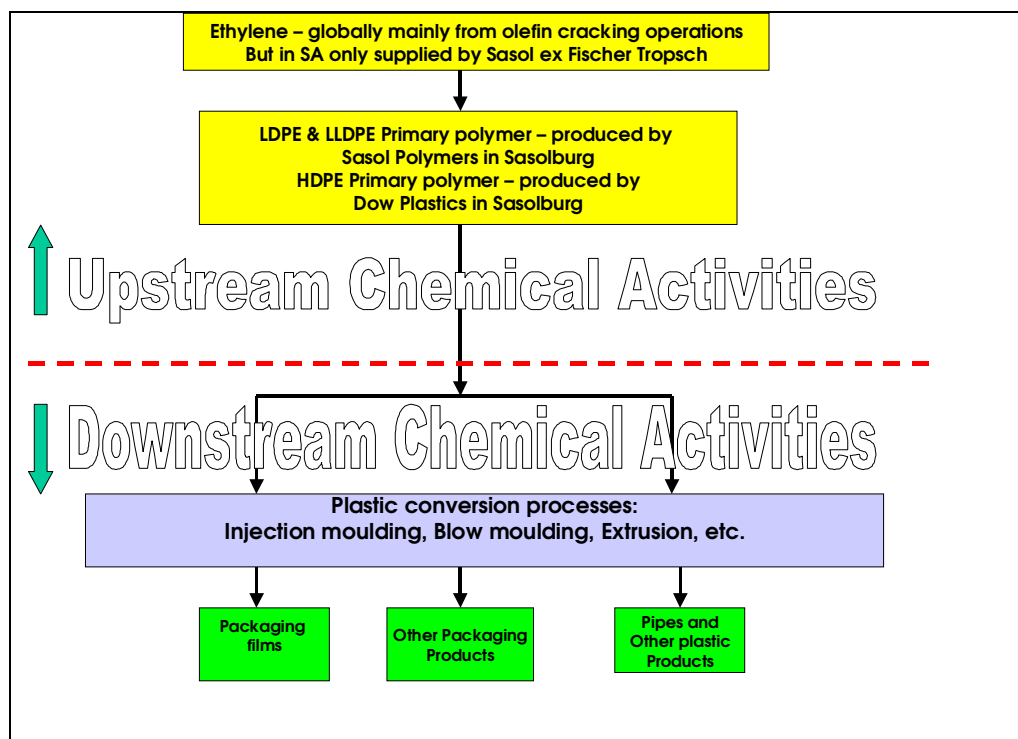
High-density polyethylene (HDPE) has a melting point of 220 - 310 °C and a density of 0.95-0.97 g/cm³. HDPE is more rigid than LDPE due to higher crystallinity. HDPE is manufactured by Dow Plastics at Sasolburg. Ethylene is the major building block for the polymer, although alpha-olefin co-monomers may be incorporated at levels of 1–2 weight percent to modify polymer properties. Blow moulding and injection moulding are the dominant end uses.

Linear Low-density polyethylene (LLDPE) has a melting point of 220 - 260 °C and a density of 0.92 g/cm³. LLDPE has higher tensile strength and exhibits higher impact and puncture resistance than LDPE. Sasol also manufactures LLDPE at Sasolburg. It is a more complex polymerisation process, requiring ethylene as well as an alpha-olefin such as hexene as feedstock.

b) Value chain

The value chain for Polyethylene is summarised in the diagram below:

Figure 3.1: Polyethylene Value Chain



c) Applications and Global Market Size

Low density polyethylene (LDPE):

In 2004, global LDPE production grew to 19 million metric tons operating at 85% of active capacity, with an estimated value of \$22 billion. (Source: SRI Consulting)

LDPE resins are usually converted to plastic products by blown film or cast film extrusion. Other fabricating methods that commonly use LDPE resins are injection moulding and extrusion coating. LDPE resins are sold to fabricators in a pelletised form.

Film applications are by far the largest market for LDPE, split roughly 50/50 between packaging and non-packaging uses. Typical applications for food packaging include baked goods, dairy products, frozen food, produce, meat and poultry, candy, and cookies. Non-food packaging includes industrial liners, heavy-duty sacks, multi-wall sack liners, and shrink-wrap, bundling and

over wrap, grocery sacks, merchandise bags, and garment bags. Typical non-packaging uses include household wrap and bags, garbage bags, industrial sheeting and roll-stock, agricultural film, and disposable diaper backing.

Extrusion coating is the second-largest market for LDPE worldwide. Typical applications include the coating of paper and paperboard products for packaging liquids such as milk and juices, the coating of foil to provide a heat-seal layer in multi-layer film structures, and the coating of paper and woven cloth to provide a moisture barrier. Extrusion coating continues to be a growth area for LDPE, largely because of innovations in packaging technology.

Injection moulding is the third-most-important consumer of LDPE resins worldwide. Typical applications include toys, house wares, lids and caps, and closures for containers.

The two largest net importing regions for LDPE in 2001 were Asia (excluding Japan) with 1.6 million metric tons and Central/South America with 0.2 million metric tons. North America, Western Europe and Japan had combined net exports of 0.7 million metric tons. The rest of the world had net imports of 92 000 metric tons. By 2006, Asia (excluding Japan) will still be the largest net importer; South America and Western Europe will be much smaller net importers. The United States, Japan and the rest of the world will remain net exporters. (Source SRI Consulting)

Linear Low density polyethylene (LLDPE):

In 2004, global LLDPE production grew to 16 million metric tons, with an estimated value of \$17 billion. (Source: SRI Consulting).

The major applications for LLDPE are packaging, particularly film for bags and sheets. Lower thickness (gauge) may be used compared to LDPE. Other applications are cable covering, toys, lids, buckets and containers and pipes.

The Middle East, Canada and Asia are the largest net exporters of LLDPE. Major net importers are Western Europe, the United States and China. (Source SRI Consulting)

High-density polyethylene (HDPE):

In 2004, global HDPE production grew to 25 million metric tons, with an estimated value of \$29 billion. (Source: SRI Consulting)

Blow moulding and injection moulding are the dominant end uses in both Western Europe and North America, accounting for 55–60% of total consumption. In contrast, consumption of HDPE in these end uses constitutes only about 30–40% of total HDPE consumed in Japan and in Other Asia. As a percentage of total HDPE consumption, film usage in Japan and Other Asia is over twice as great as the film share in either the United States or Western Europe. (Source SRI Consulting)

d) Impact of different product grades or performance specifications on market applications

The main grades of polyethylene are the three types discussed above, namely LDPE, LLDPE and HDPE. However, each of these types of polyethylene has various different grades, mainly to obtain improved properties and cost effectiveness in end – applications. These grades include variations in molecular weights and structures.

e) Level of competition in supply for major geographic export markets for upstream products

There are a large number of polyethylene plants in operation globally. The major companies are shown in the table below:

Table 3.1: Major Polyethylene Producers

Polymer/Rubber Type	Major Identified Manufacturers
Low Density Polyethylene (LDPE)	Dow Chemical, Exxon Mobil, Basell, Sabic, BP, Atofina, Borealis, Sinopec, Equistar, Formosa
Linear Low Density Polyethylene (LLDPE)	Dow Chemical, Exxon Mobil, Basell, Sabic, BP, Atofina, Borealis, Sinopec, Equistar, Formosa
High Density Polyethylene (HDPE)	Dow Chemical, Exxon Mobil, Basell, Sabic, BP, Atofina, Borealis, Sinopec, Equistar, Formosa, Chevron, Phillips

3.2. SA Market structure and shares of upstream chemical producers

3.2.1. Domestic industry structure

a) Feedstock for Polyethylene production

Polyethylene is manufactured from ethylene monomer. Ethylene supply in SA is concentrated with only one supplier, namely Sasol Secunda. Sasol's capacity is currently around 454 000 t/a; the capacity will increase to 672 000 t/a as a result of Project Turbo.

b) Polyethylene Production

LDPE & LLDPE

The Polythene Business of Sasol Polymers produces two types of polyethylene:

- Low Density Polyethylene (LDPE) is produced by reacting ethylene with an organic peroxide initiator in high pressure, high temperature autoclaves, utilizing ICI technology (ICI was previously a licensor and operator of LDPE technology, but now have refocused their business on the speciality and pharmaceutical sectors of the global chemicals market).
- Linear Low Density Polyethylene (LLDPE) is produced by reacting ethylene over a titanium based catalyst (Ziegler Natta catalyst) in a gas phase reactor, utilizing Univation technology (originally licensed by Union Carbide).

Stringent control of temperatures, pressures, additive, catalyst and other hydrocarbon streams ensure that a quality finished product is produced.

The current polymer production capability of the LDPE plant is 100 000 t/a (original capacity 60 000 t/a) and that of the LLDPE plant is 150 000 t/a (original capacity 70 000 t/a), however the LLDPE production currently is limited to approximately 100 000 t/a based on ethylene availability.

Figure 3.2: LDPE – Sasol Polymers Flow Diagram

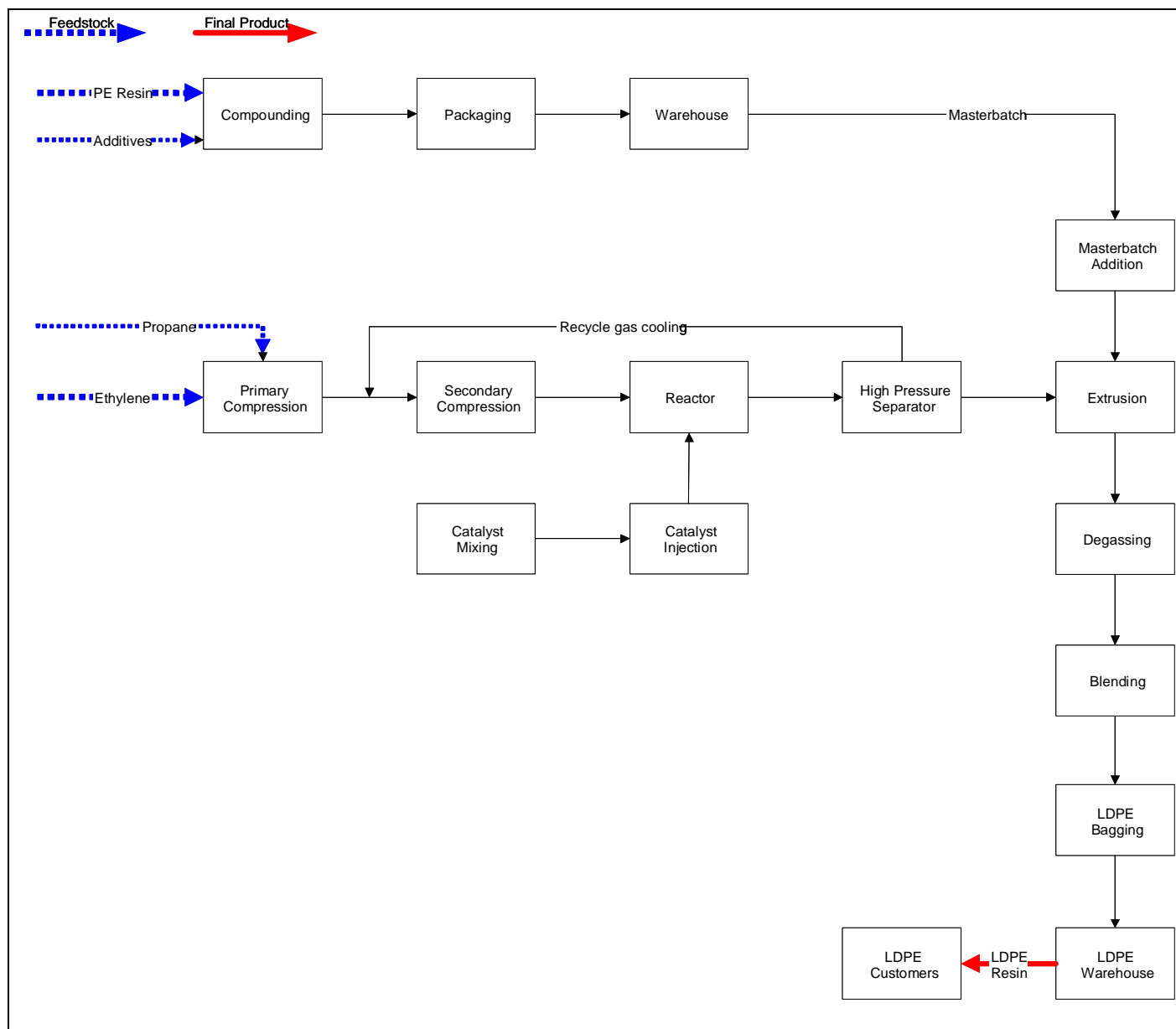
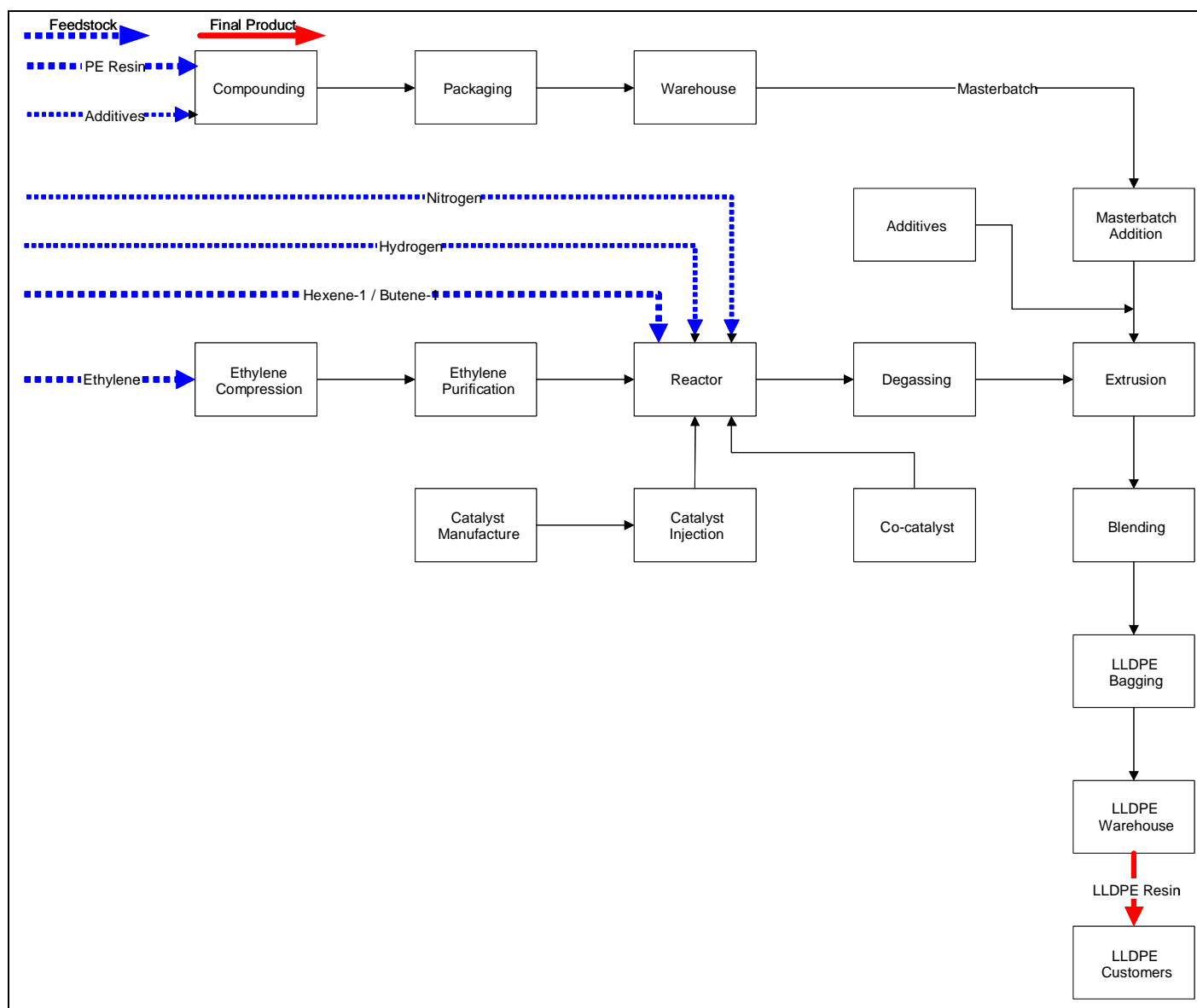


Figure 3.3: LLDPE – Sasol Polymers Flow Diagram

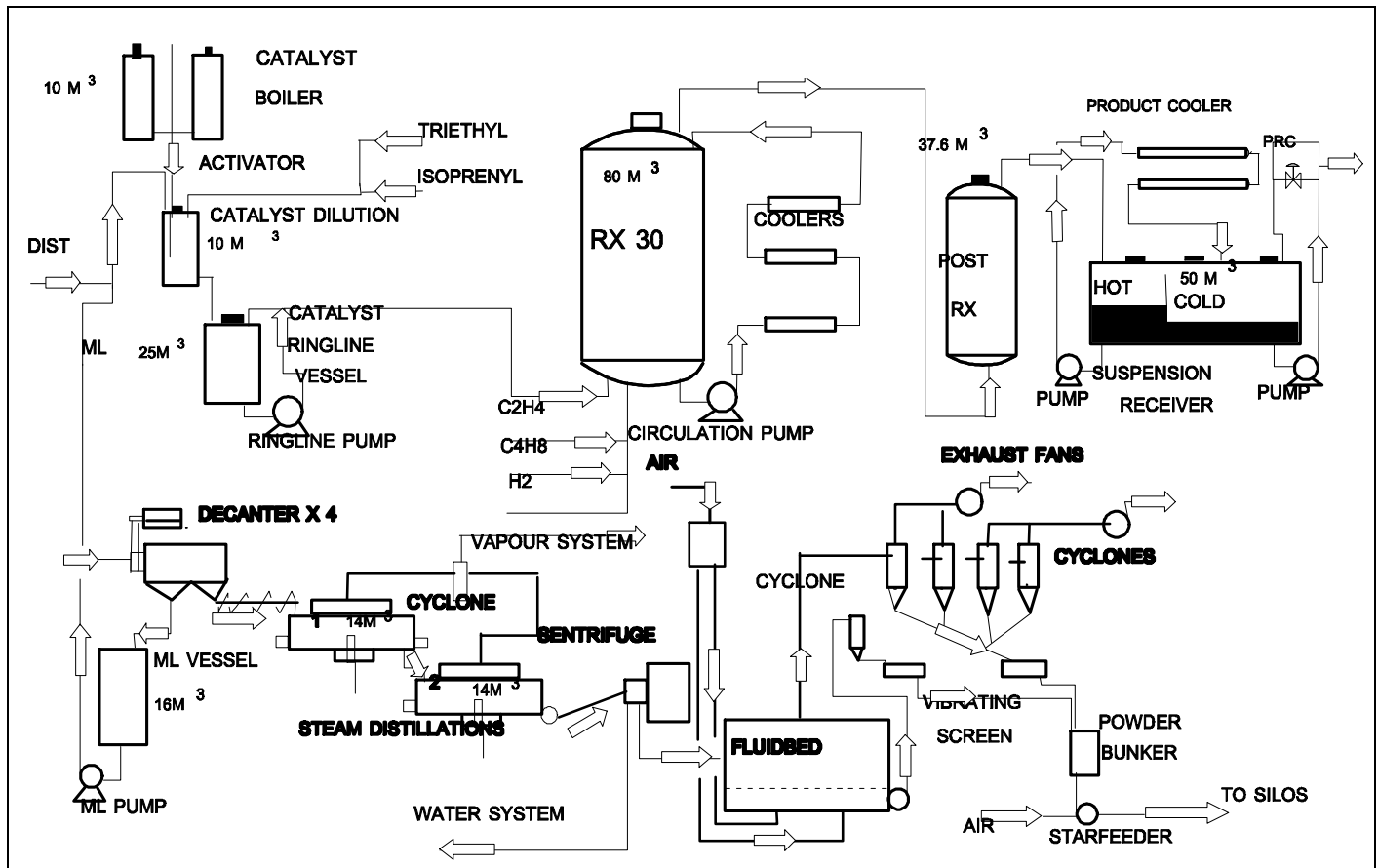


A significant expansion of ethylene capacity will come on line in mid-2006, enabling the LLDPE plant to run at full capacity, and the replacement of the existing LDPE plant with a state-of-the-art, 220 000 tpa operation using ExxonMobil tubular technology at a cost of over R 2 billion.

HDPE

Dow Plastics in Sasolburg with a capacity of 160 000 tons/annum is the only HDPE producer. A schematic diagram of the Dow Plastics process, demonstrating the complexity, is shown below:

Figure 3.4: HDPE – Dow Plastics Schematic Diagram



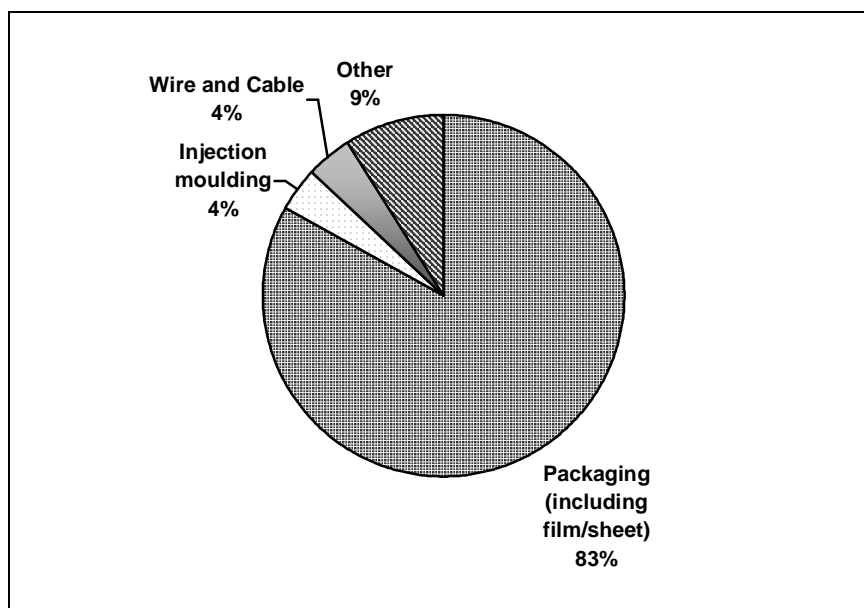
c) Polyethylene Market

The SA market size in 2004 for polyethylene primary polymer used in local plastic conversion was estimated as follows:

- LDPE: 135 000 t/a
- LLDPE: 139 000 t/a
- HDPE: 158 000 t/a
- **Total: 432 000 t/a**

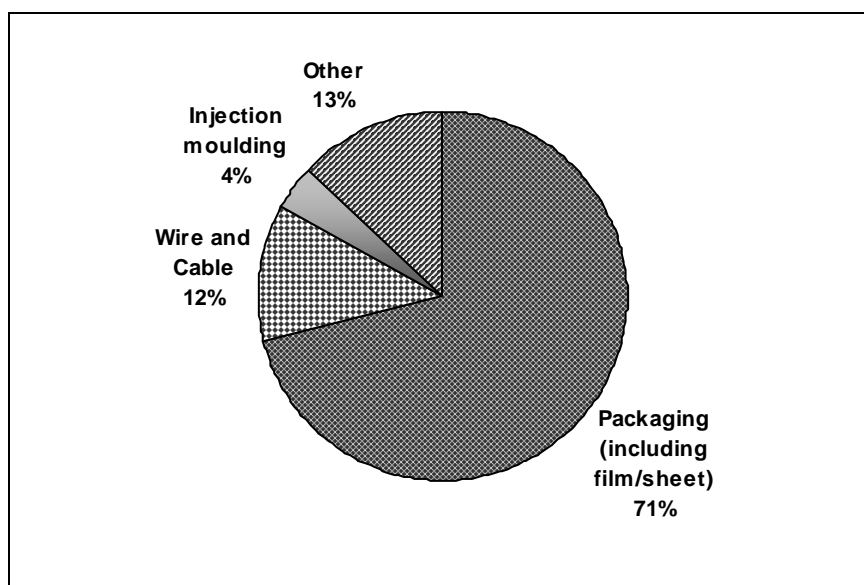
The breakdown of the polyethylene market is demonstrated in the following diagrams.

Figure 3.5: South African LDPE Market Breakdown



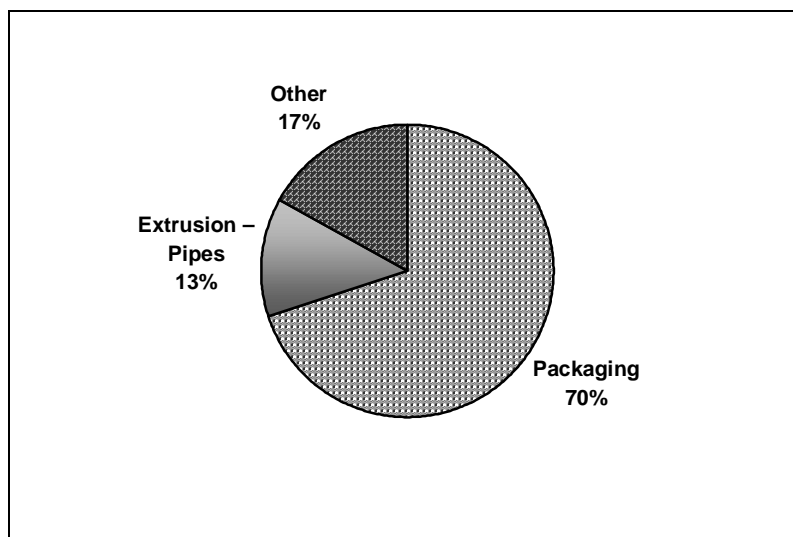
The LDPE market is dominated by packaging applications, particularly extruded film.

Figure 3.6: South African LLDPE Market Breakdown



The LLDPE market is also dominated by packaging applications, especially extruded films and sheeting.

Figure 3.7: South African HDPE Market Breakdown



Packaging applications of various kinds, including extruded sheeting, blow-moulding and injection moulding dominate the use of HDPE primary polymer. Polyethylene converters are shown in [Appendix 5](#).

3.2.2. The effect of import tariffs, anti-dumping duties and any other regulatory factors affecting pricing

Tariff protection for base polyethylene resin products [LDPE, LLDPE, HDPE] in SA is as follows:

- Tariff protection for polymer product supplied out of **non European** countries is:
 - 10% ad valorem import duty calculated on the FOB price
- Tariff protection for polymer product supplied out of **European** countries is:
 - 8.4% ad valorem import duty calculated on the FOB price

Compared to SA, polyethylene polymer tariff protection levels (ad valorem duties only, exclude any other surcharges or taxes) for some other countries are:

Table 3.2: Polyethylene – Tariff Protection in Other Countries

Country	Duty basis on:	Polyethylene
United States	FOB	6.5%
China	CIF	10.3%
Japan	CIF	6.5%
Canada	n/a	None
Indonesia	CIF	10.0%
Chile	CIF	8.0%
Australia	FOB	5.0%
Malaysia	CIF	30.0%
India	CIF	10.0%

3.2.3. The global nature of the industry

Polyethylene [LDPE, LLDPE, HDPE] are produced in a range of grades. These are:

- HDPE grades:
 - Injection moulding
 - Bottle
 - Film
- LDPE and LLDPE grades:
 - Commodity and special film grades,
 - Extrusion coating LDPE grades,
 - Injection moulding grades,
 - Rotational moulding grades in pellet or ground powder form.

Polyethylene in general are regarded as a commodity product that is produced by many countries and is well-traded in large volumes (LDPE & LLDPE: 9.9 million tons/annum; HDPE 9.2 million tons/annum – 44 times the SA market) around the globe, demonstrating its global nature. Global

prices are determined by supply/demand basis on a global scale, but are particularly driven by the Far East, due to the availability of low-cost product and ill-considered expansions in the 1990's in countries such as Korea, as well as the ever-growing demand from China. Global plant sizes are also increasing, due to economies-of-scale issues.

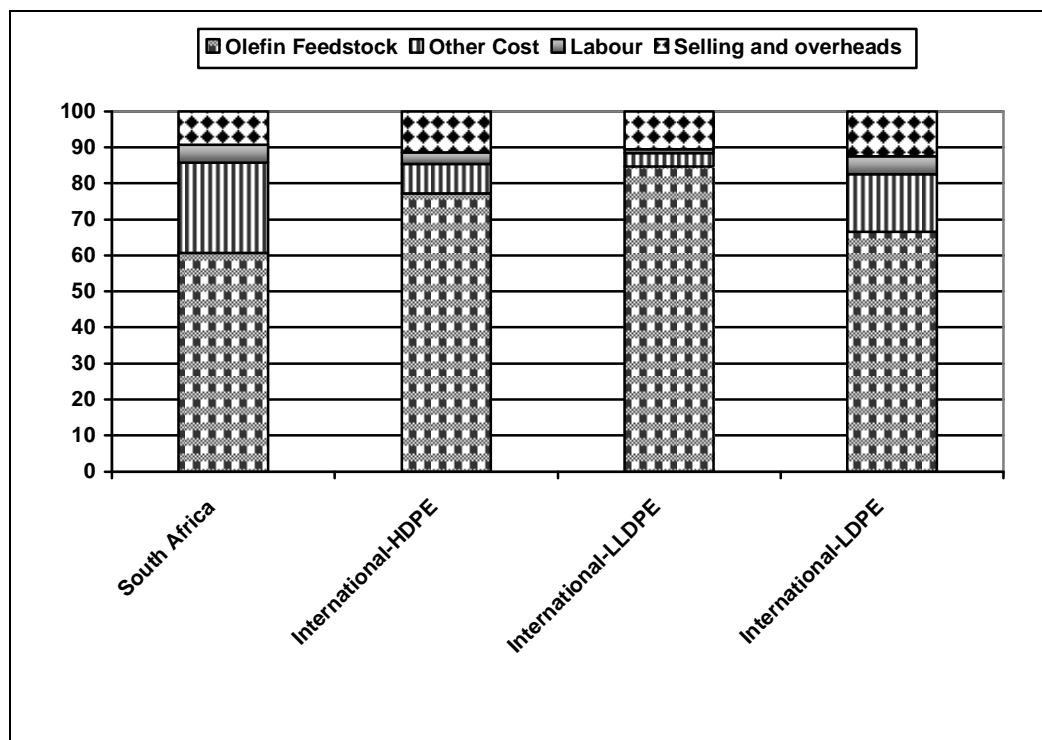
3.3. Costs and pricing of upstream chemicals products

3.3.1. The cost structure of the industry and global comparison

The cost structure of SA based upstream operations is not directly comparable to international polyethylene operations, in that:

- a) Both polyethylene producers have integrated operations that are manufacturing both PP and polyethylene.
- b) In the case of Sasol Polymers, the production infrastructure includes an olefin purification operation that purifies ethylene and propylene that is obtained in crude form from the Fischer Tropsch process – this is a unique operation on a global basis.

The relative cost structures for SA based operations, compared with standard global polyethylene operations are shown in the figure below. The international polyethylene information is based on SRI consulting data – US Gulf Coast. It should be noted that absolute costs are higher in SA due to the relatively small local plants.

Figure 3.8: Relative Polyethylene Cost Structures – SA and International (US Gulf Coast)

Based upon these cost structures, feedstock in SA's case is a lower portion of total costs for all types, while other costs, which include variable and fixed manufacturing costs, but no depreciation, are higher in SA's case. This is partly explained by the relatively small scale of SA plants. It should be noted in SA's case that the feedstock used is not polymer grade ethylene, but the raw ethylene-rich stream supplied to the Sasol Polymers purification unit from the Sasol Secunda upstream operations. The transfer cost mechanism of this feedstock stream has not been analysed in this report.

3.3.2. SA Production Advantages & Disadvantages

SA advantages include:

- Cost competitive ethylene feedstock based upon Fischer Tropsch synthetic fuel upstream operations. Local shortage to be eliminated shortly.
- Globally competitive polymer production technology and facilities, especially upgraded LDPE operations.

- Relatively well-developed downstream converter sector with widespread end-product applications.

SA disadvantages include:

- Relatively small local production facilities compared to new globally competitive facilities.
- Relatively small local and regional market.
- Long distance from attractive export markets.
- Inland location of production facilities in the case of exports.

3.3.3. Upstream pricing practices with respect to downstream domestic purchasers

Local polyethylene producers sell polymer products to customers in markets which include the RSA and other African countries, Asia, USA, Europe and South America. Their policy is to sell at the market price prevailing in each of these regions at any time, and this also applies to sales in South Africa.

The producers use all relevant information at their disposal to prepare for the price negotiations in order to offer a competitive price. The price is negotiated and takes into account inter alia:

- competitive offers from other suppliers (prevailing market price),
- the quantities purchased by a customer and the costs associated with such quantities,
- requests for export or development assistance,
- distribution costs for different packaging types (viz. bags, bulk or semibulk),
- Sasol Polymers' and Dow Plastics' (in case of HDPE) total offering (commercial, product, technical and service components), and
- Competing alternatives whether these are substitute materials (glass, wood, paper) or imported finished products.

The validity of these prices is part of the negotiations and can be adjustable month by month or, quarter by quarter, or fixed for longer periods (typically less than 6 months). Generally, there is a price continuum across the customer base. It should be noted though that over a relatively long

period average delivered prices compared to average calculated prices of imports on an import parity basis would be fairly close to each other.

Included in producers' offering is a technical and engineering service, which is available to all customers. This technical and engineering service covers the following aspects:

- product and application development,
- engineering expertise for converter's equipment modification,
- technical expertise for use of complementary products,
- assistance with operation problems, and
- problem solving on converters equipment.

In order to fully explain the polyethylene producers' domestic pricing policy, a description of global polymer price mechanisms and their impact on South African domestic polymer prices will be further discussed. In Appendix 3 a detailed description of international pricing practices, based upon reference prices, is shown.

a) Europe and USA Polymer Prices:

The domestic prices of the commodity polymers (LDPE, LLDPE, and HDPE) in Europe and the USA are targeted at levels that provide adequate long term returns on investment to producers investing in new plants. These targeted price levels are generally achieved because the markets are large, there are several domestic producers and levels of "dumped" imports are relatively low.

In times when installed production capacity exceeds demand, which is the norm for most of the price cycle, high cost producers are barely able to cover their costs and cut back supply accordingly, while those with a lower cost base will achieve a low return. During these periods, little re-investment occurs because of the low returns and, as demand increases with time (normally 5-6 years) a stage is eventually reached where demand exceeds installed production capacity. At this time prices rise rapidly and high margins are earned prompting new capacity investment and within 1-2 years, another situation of excess capacity and subsequently low margins exist. Historically, this price cycle repeats itself every 6-8 years.

It is important to note that polymer producers in these regions only achieve satisfactory returns over entire price cycles. The high returns earned for short periods during the peaks of price cycles, and the inadequate returns experienced during the trough, balance out the average return for the polymer producers. Hence, earnings during the peak should not be seen in isolation, nor viewed as excessive. This need for an adequate long term average return on investment is typical of the international polymer industry and applies to all regions, including South Africa. This is because the polymer market is effectively a single global market and the same price cycle applies to all producers in all regions of the world that trade with each other.

b) Far East Polymer Prices:

Until the early 1990s, prices of polymers in the Far East were set out of the USA and were generally higher than in either Europe or the USA. When the Korean petrochemical expansions occurred, these resulted in overcapacity in the region and a hunger for market share that eroded margins. As a result, since the mid-1990s, prices in the Far East have been generally lower than either Europe or the USA, and in many instances, at a level that barely covers the costs of raw materials and failed to adequately reward the investment to a Far East producer.

c) Middle East Polymer Prices:

In recent years the very large polymer plant investments in the Middle East have had an influence on the global supply/demand balance. Most of this production is exported into China and is economically viable at the Far East price levels due to low feedstock costs and very efficient economies-of-scale. The Middle East producers generally adopt a “price follower” strategy as determined by market competition in the Far East and other export destinations.

d) South African Polymer Prices:

As with all regions in the global market, polymer prices are determined relative to the competitive forces acting in the particular region. In order for a supplier to be successful in penetrating the market and sustaining a market share position, the customers’ alternative purchasing options must be considered and a competitive offering made.

South African polymer producers follow the above approach. They do not select a particular price from a particular region and rigorously apply that to determine its price to the South African domestic market. They are driven by market dynamics and react to the lowest price imports being offered by competitive suppliers to its customers. Prices of locally manufactured substitute materials, such as paper, metal and glass, are also monitored and considered for the market sectors where they compete as alternatives to polymers.

During recent years, the competitive supplies have come from the Far East and the Middle East and they therefore normally set the price levels in the South African domestic market. Hence Far East prices are typically monitored and tracked as defined by Hong Kong CFR prices. Because traded volume of polymer through Hong Kong (destined for China) is active, substantial and continuous, this is a reliable, well reported and globally recognized competitive source which is used to monitor international price trends.

As discussed above, imports into South Africa from the Middle East are potentially more competitive and sometimes at lower prices than those from the Far East. Although imports from the Far East (e.g. Korea) are normally the lowest priced in South Africa, pricing strategies in the South African domestic market sometimes need to meet low priced polymer from the Middle East and other regions.

SA polyethylene producers regularly monitor the published international polymer price data and in addition, they are either active in both exporting and importing of commodity polymers, or they are part of a major multinational polymer producer and are able to supplement the published information with their own trade experience.

Competitive pricing information is also obtained from customers during supply negotiation discussions and is often used in preference to the data obtained from the trade consultants.

The above discussed points form the basis for the market price and hence for the customer price negotiations.

In addition, the local cost of feedstock (ethylene in the case of polyethylene), also has to be taken into consideration. In the case of Dow Plastics, this price is determined by Sasol Polymers, which is their major source of the feedstock.

e) Rebates and discounts

Individual customers' prices are negotiated taking into account a number of factors which includes the quantities purchased by a customer, which typically results in larger customers receiving a more favourable price.

There are special pricing schemes available to all customers (large and small) and include:

- Rebates for the development of new products and markets to compete with alternative materials,
- Rebates to compete with imports of finished goods, and
- Rebates for exports of finished goods (export rebate).

The first two rebate schemes are available for a specific application or development, are applicable for a limited period and limited to the volume for the specific purchases (that is not across the full volume of polymer purchased). These rebates are specifically designed to facilitate or assist:

- Converter development and introduction of products into the market by reducing the cost of the raw material during the early stages of the product life cycle (namely development, market introduction and acceptance),
- Converter competitiveness in the export market to overcome competitors who may have geographic, labour cost, governmental incentives, fiscal or other competitive advantages,
- Converters to be more competitive in the local market against final product imports from international converters (which is sometimes dumped) who have labour cost, governmental incentives, fiscal or other competitive advantages.

f) Upstream suppliers' view on Actual Pricing Mechanism Versus Import Parity Pricing

Firstly it needs to be understood that prices quoted to South African converters are export prices and not domestic prices of exporting regions. Export prices are always lower (up to 25%) when compared to domestic prices and are generally based on marginal costings. However, it should be noted that in producing countries where average costs are fairly constant (as it is in the case in the South African polymer manufacturing industry), marginal costs are usually equal to average costs. Also, in South Africa's case, variable costs are higher than the international norm because of poor economies of scale. It should also be noted that where marginal costing is practiced it is used only in the short term. In section 2.3.3 a more detailed explanation of the definition and calculation of IPP, based upon PP is provided.

The pricing mechanism prevailing in South Africa is one where the price is negotiated, based on offers in an open market where products are readily traded across national boundaries. The outcome is that the most competitive supplier sets the price and this is better referred to as market pricing. This pricing methodology is commonly seen internationally in most countries that are signatories to the WTO. It prevails in countries with a free, open-access market, rather than the regulated price-setting typically found in centrally planned economies. In South Africa this situation is no different as locally produced products compete with imports. The application of this method of pricing is such that it directly links the domestic price to the international price. It also brings a country's pricing practices in line with all the countries that are signatories to the WTO and its rules on trade and eliminates the creation of subsidies throughout polymer value chain.

An aspect that should be borne in mind is that the price of the imported product is typically set by the spot price of another region, which is substantially lower than that region's domestic price, as it is set by producers incorporating only their marginal operational costs. International domestic prices are normally "delivered prices". In most producing countries the domestic supply typically consumes a significant portion of the producers' volume, so enabling the export volumes to be priced using marginal costing. This results in domestic delivered prices in countries that compete through trade, having domestic delivered prices that are broadly in the same range, as is the case in South Africa. This is due to the combination of freight and duty values not being too dissimilar to the difference between domestic price and spot in the exporters' market.

Import parity pricing is a mechanistic formula driven calculation and is done by specifically calculating a price based on what it would have cost to import the product based on published price data and is thus a proxy or estimate of the local delivered price of a competitive imported product to a downstream converter. This would include all inward transport and other real costs that would be associated with importing the polymer into South Africa. The breakdown below gives an example of these considerations:

Table 3.3: Polyethylene – Import Parity Price Calculation

Estimated Import Parity Price		
=	FOB (lowest cost source) ⁽¹⁾	Based on published information (ICISLOR, Platts or Harriman)
+	Freight from source to Durban (South Africa)	Cost to get polymer to South Africa
+	Freight insurance	Insurance on goods in transit
	Convert to Rands	Above normally quoted in US Dollars
+	Logistic costs includes <ul style="list-style-type: none"> • Landing cost • Transport cost (Inland / coastal) • Duty (ad valorem duty on FOB price in rands) 	Landing Costs comprise of terminal handling costs, wharfage – Cargo dues, Carrier service fee, Agency fee, Handover and document fees and disbursements on landing and wharfage, and duty and customs VAT. Transport costs for inland would include container turn in and railage. Transport cost for coastal would include cartage to customer. Duty currently 10% of FOB price.
+	Indirect costs	Adjusts for example stock holding costs, payment terms, LC costs, container destuffing and warehousing

		costs
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Note 1: A FOB (free on board) is a INCO 2000 term, in which the responsibility of the supplier is transferred to the buyer when the goods have been delivered on the rail of named carrier at a named port. As discussed, FOB prices are normally spot sale values and are lower than the corresponding domestic price, as the prices are normally based on the producers marginal cost of production.

The difference between market pricing and import parity pricing is that in the case of the former prices change continuously based on the cheapest available source at a particular point in time. In the case of import parity pricing, the price is calculated on the basis of a published price in a specific region or country and the ultimate price is formula-based. Furthermore, in the case of market pricing, customers monitor prices from all major trading regions and the lowest price available at any point in time is then used by them as a basis for negotiations with their polymer supplier.

3.4. Major downstream industries that purchase upstream products

3.4.1. End-use structure

The local polyethylene polymer market in 2004 was estimated as follows:

- LDPE: 135 000 tons/annum, Supplied mainly by Sasol Polymers and around 31% imported polymer
- LLDPE: 139 000 tons/annum, Supplied mainly by Sasol Polymers and around 38% imported polymer
- HDPE: 158 000 tons/annum, Supplied mainly by Dow Plastics and around 21% imported polymer

The end-use structure for polyethylene polymer is segmented into the grade of polymer used, as well as the conversion technology employed.

LDPE

The film commodity grades are the dominant grades. Internationally, the extrusion coating and injection moulding grades prices are generally 3 – 4% higher than the commodity film grades, in the South African market similar prices is achieved.

Film grades account for around 82% of LDPE demand. Major uses include consumer food and beverage shrink, collation films and shrink pallet shrouds, Industrial liners, dunnage bags, surface protection and bulk bags, consumer thin printed films such as hygiene film, bread bags, liquid packaging, Fertilizer, polymers, pet food, compost and nursery substrates, building sand and many others.

Moulding grades account for around 12% of demand. Extrusion grades account for around 6% of demand. Major uses include colour and additive masterbatches and igniter cord jacketing.

The upstream polymer supplier has primary volume segregation which divides the customer base into small and large customers. This threshold is the ability of the customers to take full truck loads of polymer per delivery. Customer order requirements for less than the threshold are referred to an in-house distribution company, who provide a break bulk service in which the customers are supplied with their required quantities (ranging from 1 bag of polymer (25kg) to a few ton deliveries). Full truck loads for LDPE equate to 20 ton deliveries. The volume classification for commodity customers is as follows:

Segment	Size (tpa)	Volume (%)
Large Groups and large independents	> 1999	58%
Small groups and medium independents	Between 1000 and 1999	18%
Small independents	Between 20 and 999	24%

The average price spread across all these groups is typically less than 4% (largest to smallest).

LLDPE

The film commodity grades are the dominant grades. Internationally, the injection moulding grades prices are generally 3 – 4% higher than the commodity film grades, in the South African market similar prices is achieved.

Film grades account for around 71% of LLDPE demand. Major uses include Industrial liners, dunnage bags, surface protection and bulk bags, consumer thin printed films such as hygiene film, bread bags, liquid packaging, hand wrap, domestic cling film, pallet machine stretch and power stretch film, fertilizer, polymers, pet food, compost and nursery substrates, building sand and many others.

Moulding grades account for around 24% of demand. Major uses include chemical and water tanks, fuel tanks, crayfish traps, filtration units, caps and closures and general house ware containers.

Extrusion grades account for around 5% of demand. Major uses include pipe extrusion, e.g. drip feed irrigation pipes.

The upstream polymer supplier has primary volume segregation which divides the customer base into small and large customers. This threshold is the ability of the customers to take full truck loads of polymer per delivery. Customer order requirements for less than the threshold are referred to an in-house distribution company, who provide a break bulk service in which the customers are supplied with their required quantities (ranging from 1 bag of polymer (25kg) to a few ton deliveries). Full truck loads for LLDPE equate to 20 ton deliveries. The volume classification for commodity customers is as follows:

Segment	Size (tpa)	Volume (%)
Large Groups and large independents	> 1999	58%
Small groups and medium independents	Between 1000 and 1999	18%
Small independents	Between 20 and 999	24%

The average price spread across all these groups is typically less than 4% (largest to smallest).

HDPE

The vast majority of HDPE grades, be it injection moulding, blow moulding and film extrusion trade within a narrow band of around US\$20/ton, or 1.8% of the current polymer price. An estimated 20% of the business consists of drum and tape, which is fetching a further \$20 premium (3.6% of current polymer price) and pipe which may cost \$80-100/t more than commodity materials (around 8% more).

Injection moulding grades account for around 24% of HDPE demand. Major end-uses are crates, mobile refuse bins and sundry moulding.

Blow moulding grades account for around 40% of demand. Major uses include smaller containers for milk and fruit juice bottles, detergents, cosmetics and toiletries, as well as larger drums for agricultural and general chemicals, fruit concentrates and, lubrication oil.

Extrusion grades account for around 36% of demand. Major uses include film for retail packaging as well as knitted or woven products used for shade and other netting, vegetable and fruit bags.

The upstream polymer supplier has primary volume segregation which divides the customer base into small and large customers. This threshold is the ability of the customers to take full truck loads of polymer per delivery. Customer order requirements for less than the threshold are referred to a distribution company, who provide a break bulk service in which the customers are supplied with their required quantities (ranging from 1 bag of polymer (25kg) to a few ton deliveries). Full truck loads for HDPE equate to 33 ton deliveries. Around 45% of sales are to large companies that consume in excess of 10 000 t/a of HDPE polymer.

3.4.2. Impact of feedstock cost on total cost structure

Based on limited respondent input (14 respondents), polyethylene polymer accounts for 50 – 73% of cost-of-sales, with the balance shared between other manufacturing costs (mainly labour), and sales/administration/distribution costs.

3.4.3. Organisation of downstream players

The Plastics Federation of South Africa (PFSA) is an umbrella body for the plastics value chain under which there are several associations. The Plastics Converters Association (PCA) represents the interests of converters in the plastics industry. The PCA is the biggest association in terms of membership with 316 members. There are also associations such as the South African Polymer Importers Association (SAPIA) that represent the interests of 12 importers in the industry. SAMPLAS is an association that represents 14 suppliers of machinery to the plastics industry while the Plastics Institute of South Africa (PISA) represents individuals in the industry. Other associations or interest groups in the plastics value chain are Association of Rotational Moulders of South Africa (ARMSA) which has a membership of 43 companies 13 of which are outside of South Africa, Expanded Polystyrene Association of South Africa (EPASA), South African Plastic Pipe Manufacturers Association (SAPPMA), and Institute of Materials (IoM). The following associations still exist but are no longer active in the plastics industry, Plastic Mould Makers Association (PMMA), Polyurethane Association of South Africa (PASAF), and Plastic Distributors Association of South Africa (PDASA).

3.4.4. Downstream sector ability to influence input prices received

Downstream respondents indicated that they have very little leverage to influence prices for polyethylene polymer, except for volume, which result in relatively small discounts.

3.4.5. Duty Structures and anti-dumping measures

Tariff protection for downstream polyethylene plastic products is extensive. The table below indicates specific tariff headings that consist of either polyethylene based products, or could

potentially be made of polyethylene. The tariff protection quoted is the general tariff, and excludes the EC.

Table 3.4: Polyethylene End-products – Tariff Protection in SA

Other	39.17.10.90	10%
Other	39.17.21.90	15%
Of polymers of ethylene, seamless	39.17.32.20	15%
Of polymers of ethylene, seamless without fittings	39.17.39.20	15%
Of polymers of ethylene	39.19.10.10	15%
Of polymer of ethylene	39.19.90.10	15%
Of polymers of ethylene	39.20.10	15%
Of polymers of ethylene	39.21.19.40	15%
Other, of polymers of ethylene	39.21.90.26	15%
Textile fabrics embedded in or coated or covered on both sides with polymerisation or copolymerisation products	39.21.90.64	15%
Of other polymerisation or copolymerisation products	39.21.90.66	15%
Baths, shower-baths and wash-basins	39.22.10	20%
Lavatory seats and covers	39.22.20	20%
Other	39.22.90	20%
Of polymers of ethylene	39.23.21	15%
Carboys, bottles, flasks and similar articles	39.23.30	15%
Other	39.23.40.90	15%
Stoppers, lids caps and other closures	39.23.50	15%
Other	39.23.50.90	15%
Capsules and tubular neckbands, for bottles and similar containers	39.23.90.20	5%
Other	39.23.90.90	15%
Tableware and kitchenware	39.24.10	20%
Other	39.24.90	20%
Reservoirs, tanks, vats and similar containers, of a capacity exceeding 300 litre	39.25.10	20%
Doors, windows and their frames and thresholds for doors	39.25.20	20%
Shutters, blinds (including venetian blinds) and similar articles and parts thereof	39.25.30	20%
Other	39.25.90	20%
Office or school supplies	39.26.10	20%
Other	39.26.20.90	20%
Fittings for furniture, coachwork or the like	39.26.30	20%
Statuettes and other ornamental articles	39.26.40	20%
Beads, not coated with pearl essence	39.26.90.03	15%
Transmission belts	39.26.90.20	5%
Power transmission line equipment	39.26.90.25	5%
Other	39.26.90.90	20%

In most cases where tariff protection is applicable the rate is in the order of 15 – 20%, which is higher than the 10% applicable to primary polyethylene polymer.

None of the downstream respondents have indicated any anti-dumping investigation, or action, in any of their polyethylene based products.

3.5. International competitiveness of South African chemicals pricing

3.5.1. Introduction

It is important in the analysis of pricing that a common understanding of pricing terminologies is agreed upon, especially in the context of a comparative analysis. The main issue that is involved is the concept of an inland price for products, which is the price paid by local customers in a particular country [which can be based on a delivered, or ex-factory basis], compared to export prices, which are the export based prices for producers in a particular country.

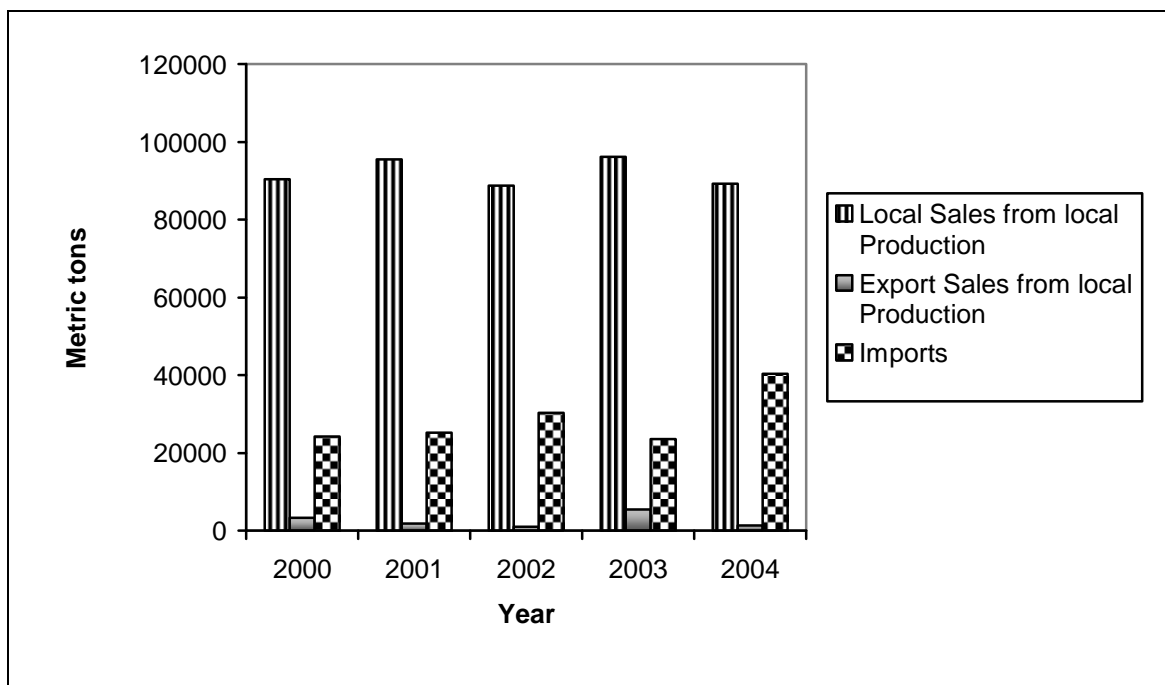
The competitiveness of South African chemicals pricing is dealt with under the following headings:

- Historical SA feedstock market volumes and pricing levels
- Comparison of SA inland prices for feedstock with international prices
- Historical sales levels for key downstream products
- Basis for SA pricing calculations
- Key differentiation factors for purchasing feedstock
- Operations: (Upstream/ Downstream: Basis for operation [e.g. 24/7]; Average age and original cost of equipment; Capacity utilisation; Workforce)
- Assessment of global competitiveness of downstream producers
- Ability for downstream to expand product range based on lower feedstock prices Impact of current pricing practices (Skills; Wages; Technology; Long-term sustainability; Import replacement)

3.5.2. Historical SA feedstock market volumes and pricing levels

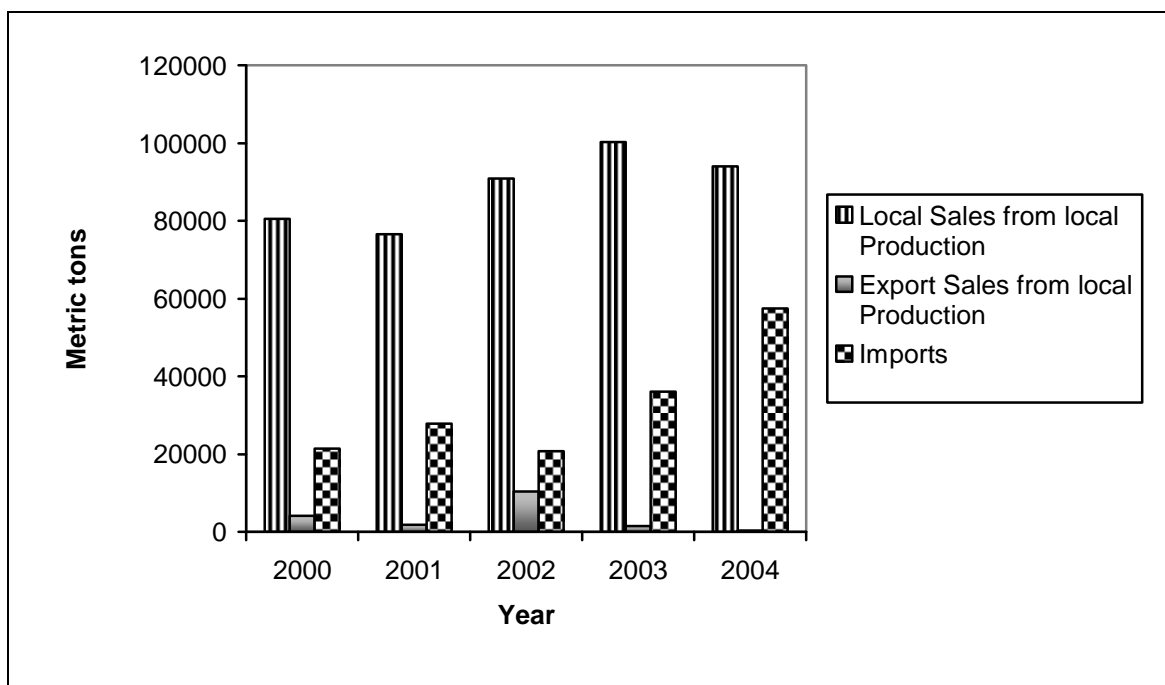
The historical local and export sales volumes of LDPE and delivered prices are shown in the figures below. For commercial sensitivity no actual data values are published on the chart.

Figure 3.9: Historical Local & Export Volumes – LDPE



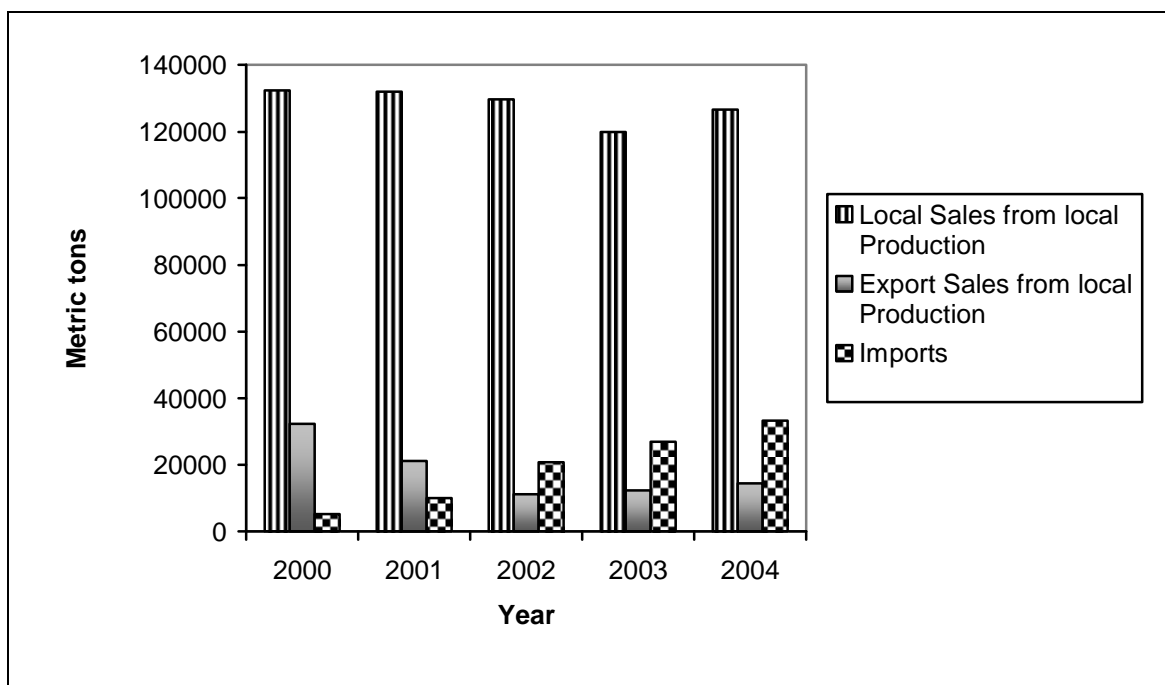
Local sales from local production are showing a general constant pattern, while imports are showing a relative growth pattern. Exports are generally small and have been constant for the last few years.

Figure 3.10: Historical Local & Export Volumes – LLDPE



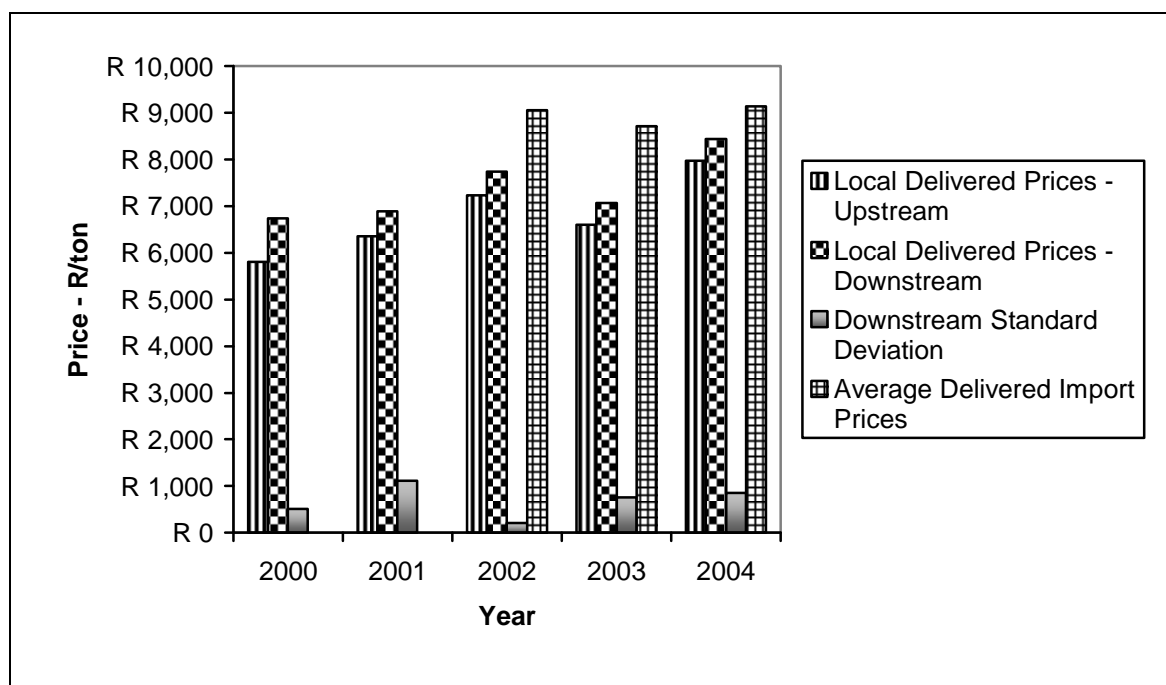
Local sales from local production as well as imports are showing a relative growth pattern. Exports are generally small and have been constant for the last few years.

Figure 3.11: Historical Local & Export Volumes – HDPE



Local sales from local production are showing a general constant pattern, while imports are showing a relative growth pattern. Exports have declined, and generally are small and have been constant for the last few years.

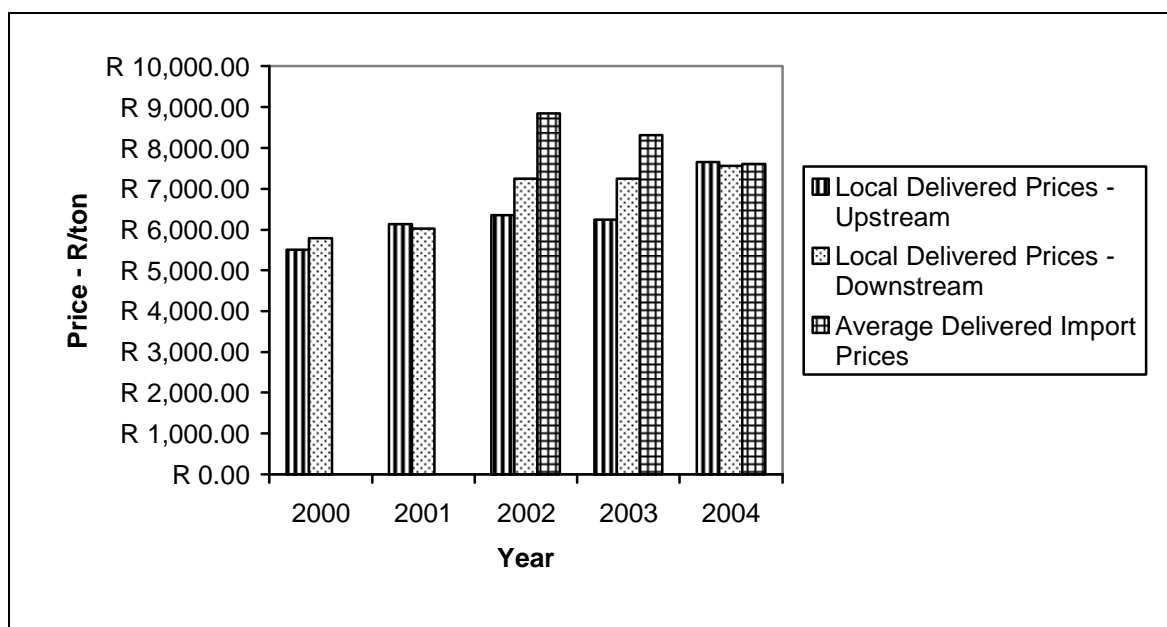
Local delivered prices based upon total volumes and total values for the respective years are shown in the figure below (ex-factory prices are not available as polyethylene is sold on a delivered basis):

Figure 3.12: Historical Local Delivered Prices (Excluding VAT) – LDPE All grades

Note: Downstream data was based on a small sample size. The difference between upstream and downstream prices can be attributed to not all downstream companies having participated in the study and that to the fact that downstream companies also buy polymer from other companies, such as traders and other importers, who were not part of the upstream sample participating in the study.

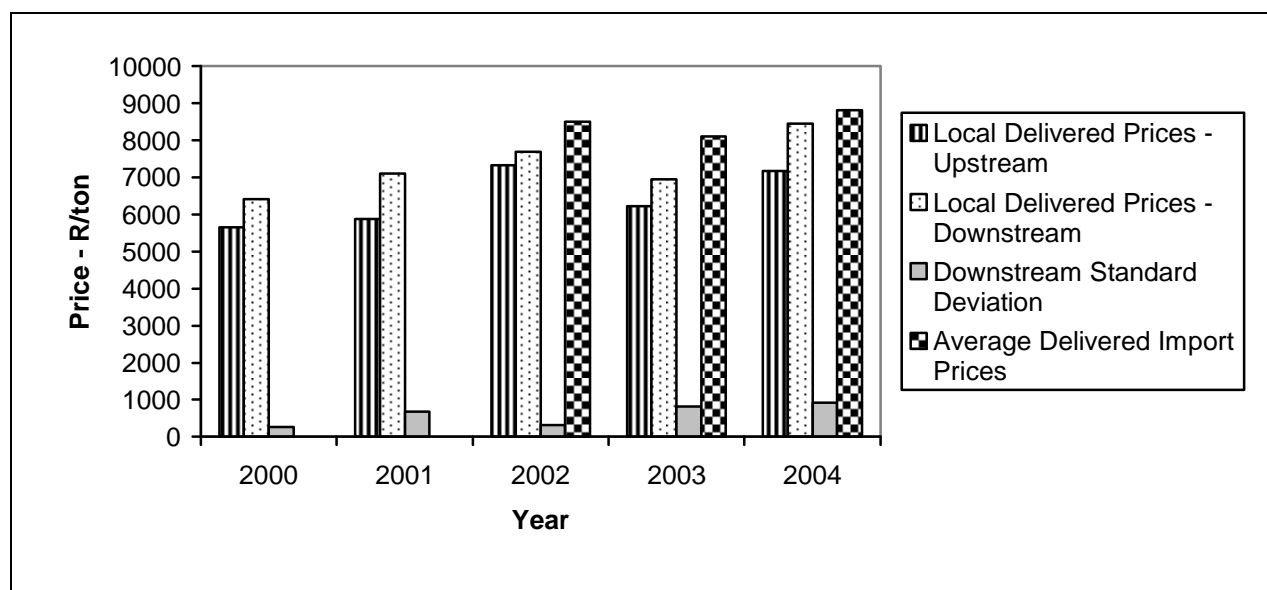
It should also be noted that the prices shown to be paid by downstream respondents are numerical averages, and not weighted averages. As most product is sold to large customers, a weighted average will result in lower values due to bulk rebates provided. [A more detailed explanation, based upon the PP assessment is provided in par. 2.5.2.](#)

The delivered LDPE prices as provided by upstream and downstream respondents are varying between 6 – 16%, with a constantly higher value provided by the downstream respondents. The standard deviation for downstream respondents varies from 3 - 16%. Taking into account the standard deviations, the pricing data indicates a similar trend and relatively good correlation, especially for data provided from 2001 onwards. Average import prices provided by local importers and are notably historically higher than the local delivered prices for the corresponding years 2002 (17%), 2003 (23%) and 2004 (8%). The chart also shows that import prices have been relatively constant historically.

Figure 3.13: Historical Local Delivered Prices (Excluding VAT) – LLDPE All grades

Note: Downstream data was based on a small sample size. The difference between upstream and downstream prices can be attributed to not all downstream companies having participated in the study and that to the fact that downstream companies also buy polymer from other companies, such as traders and other importers, who were not part of the upstream sample participating in the study.

The delivered LLDPE prices as provided by upstream and downstream respondents are varying between -2 to 16%, with the downstream respondent reporting values fairly close to the upstream data. 2002 and 2003 data show relatively higher prices by the downstream, the other years are very close. Import prices were higher in 2002 and 2003 and have been going down for the last three years plotted on the chart. It is interesting to note that in 2004 the price of LLDPE from the three sources was almost the same.

Figure 3.14: Historical Local Delivered Prices (Excluding VAT) – HDPE All grades

Note: Downstream data was based on a small sample size. The difference between upstream and downstream prices can be attributed to not all downstream companies having participated in the study and that to the fact that downstream companies also buy polymer from other companies, such as traders and other importers, who were not part of the upstream sample participating in the study.

It should be noted that the prices shown to be paid by downstream respondents are numerical averages, and not weighted averages. As most product is sold to large customers, a weighted average will result in lower values do bulk rebates provided.

The delivered HDPE prices as provided by upstream and downstream respondents are varying between 5 – 21%, with a constantly higher value provided by the downstream respondents. The standard deviation for downstream respondents varies between 4 – 12%. Taking into account the standard deviations, the pricing data indicates a similar trend and relatively good correlation. Variance between downstream pricing data and data supplied by importers is 11%, 17%, and 4% for 2002, 2003, and 2004, respectively.

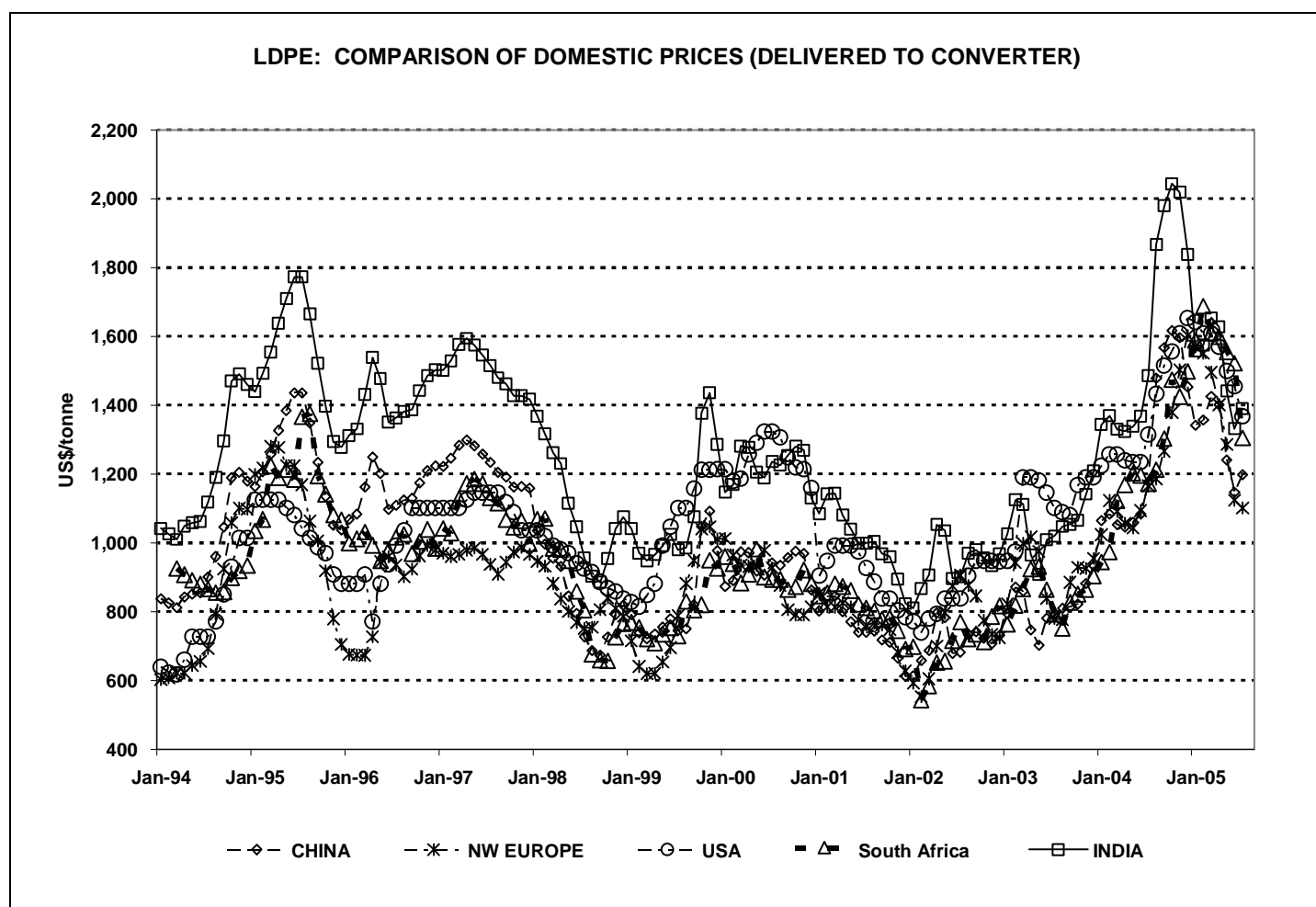
3.5.3. Comparison of SA inland prices for feedstock with international prices

The background to international pricing as well as sources for data is discussed in [Appendix 3](#) and in [Chapter 1](#). The trend and the general relationships are more important to gain insight into the fundamentals than a comparison of prices in a particular month.

The derived prices for China and India are preliminary, as the consultant is seeking confirmation from international consultants of some of the assumptions used in the build-up of the derived import parity price. The choice of India and China as countries for comparison with South Africa is because both countries are large import markets for polymers. The comparison for polyethylene is shown separately for LDPE, LLDPE and HDPE.

a) LDPE

Figure 3.15: SA and International LDPE Domestic Prices

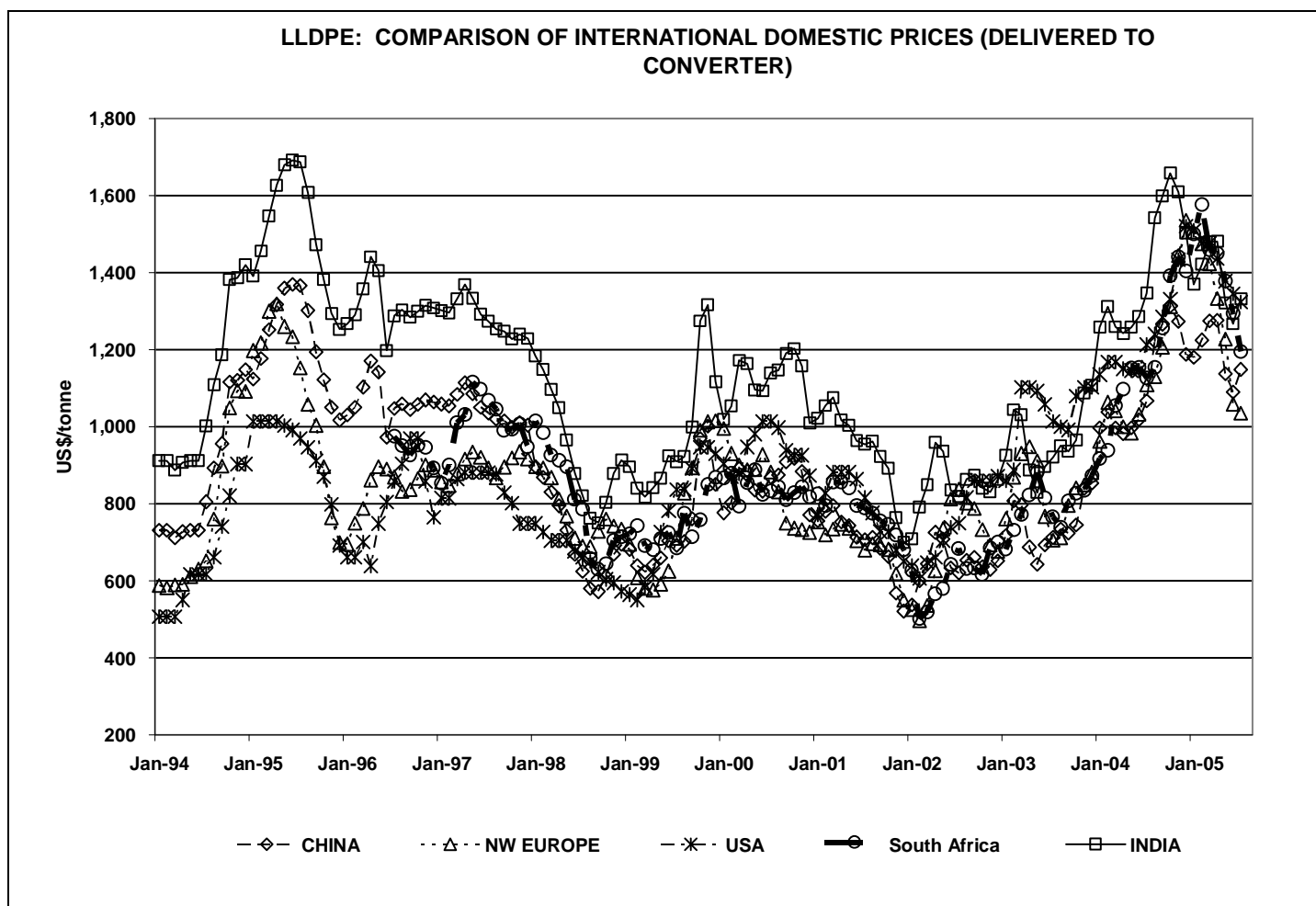


When comparing average LDPE prices as obtained from downstream respondents, SA domestic prices are still in the middle-to-lower end of the price band; these average prices (in US\$) are as follows:

- 2000: \$ 969
- 2001: \$ 797
- 2002: \$ 736
- 2003: \$ 949
- 2004: \$ 1 303

b) LLDPE

Figure 3.16: SA and International LLDPE Domestic Prices



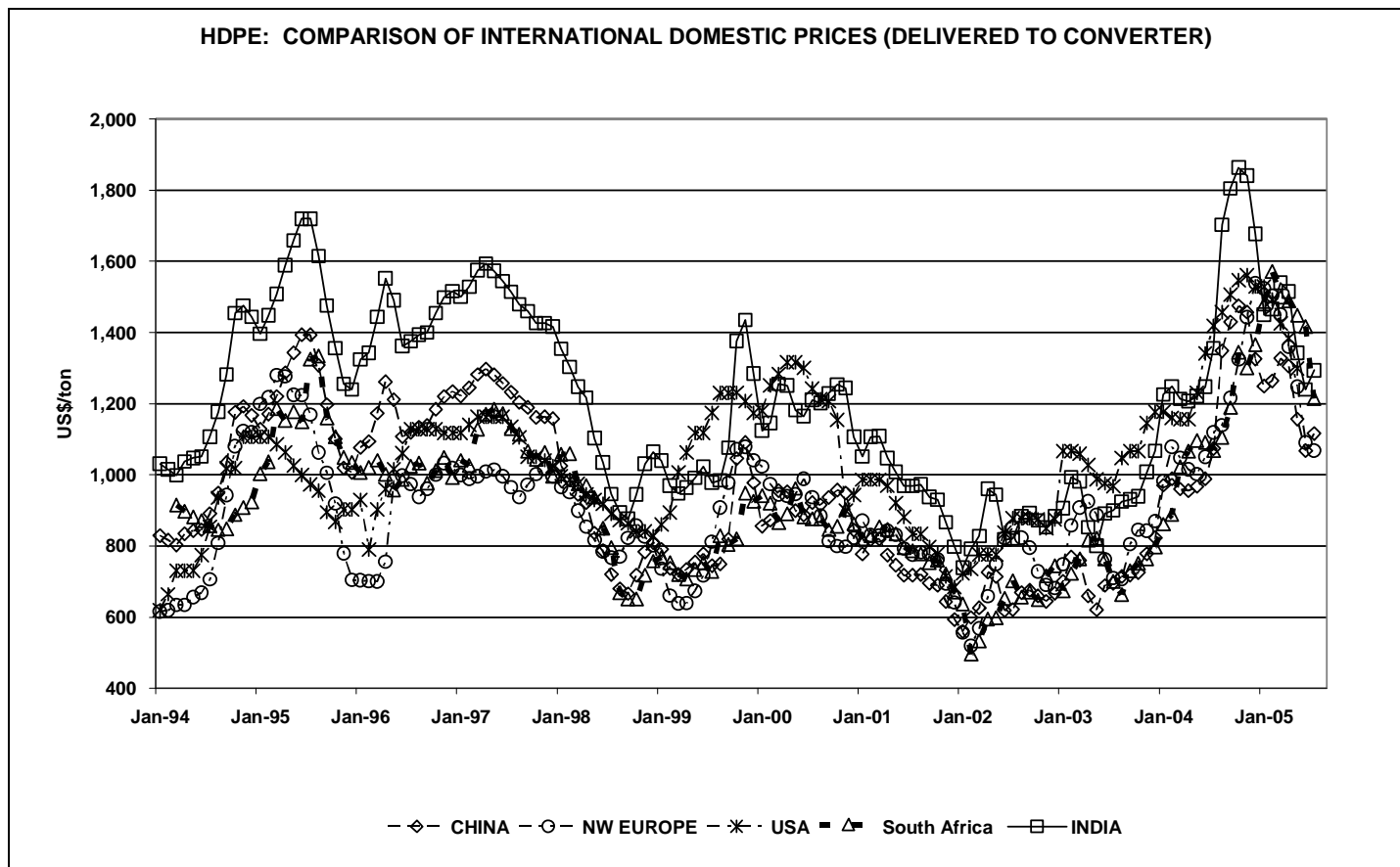
When comparing average LLDPE prices as obtained from downstream respondents, SA domestic prices are still in the middle-to-lower end of the price band; these average prices (in US\$) are as follows:

- 2000: \$ 833

- 2001: \$ 691
- 2002: \$ 689
- 2003: \$ 973
- 2004: \$ 1 165

c) HDPE

Figure 3.17: SA and International HDPE Domestic Prices



When comparing average HDPE prices as obtained from downstream respondents, SA domestic prices are still in the middle-to-lower end of the price band; these average prices (in US\$) are as follows:

- 2000: \$ 923
- 2001: \$ 823
- 2002: \$ 731
- 2003: \$ 933

- 2004: \$ 1 303

Some conclusions and commentary on the data shown above are as follows:

- Prices around the world are linked.
- In any month, there can be a very wide variation in the prices. The following are some of the reasons:
 - The derived import parity prices (for India and China) assume an instantaneous connection with the Reference Price (CFR Hong Kong). In reality there is a time lag of between 6 and 8 weeks.
 - Fluctuations in the currencies in relation to the US\$ will have an impact because in all countries (except the USA) the prices paid by local converters is in the local currency.
 - During periods of regional shortages or surpluses, international and local supply/demand balances will play a role. For example, during the periods of tight supply, the local domestic prices in the USA were considerably higher than those in Europe and Asia. Due to supply constraints, it was not possible to physically ship product to the (massive) US market and the local producers were able to maintain prices higher than import parity (from Europe or the Middle East).
- In the early part of the period under review, there was a big variation in the prices for all polymers. The major factor contributing to this is that China and India had relatively high import duties (>35%), but these have been reduced and this has brought the prices across all countries covered much closer together.
- Prices paid by South African converters are generally not out of line with prices paid in the countries included in the comparison. In the early part of the period under review, the prices in South Africa were much lower than those in China and India. However, as imports into China have grown over the period the CFR Hong Kong price has fallen to the low end of the range. In addition, import duties have fallen. Both factors have contributed to a narrowing of the gap between prices in South Africa and those in China.
- For the monthly comparison over the recent past years, there have been periods when the price in China was lower (sometimes considerably so) than the price in South Africa.

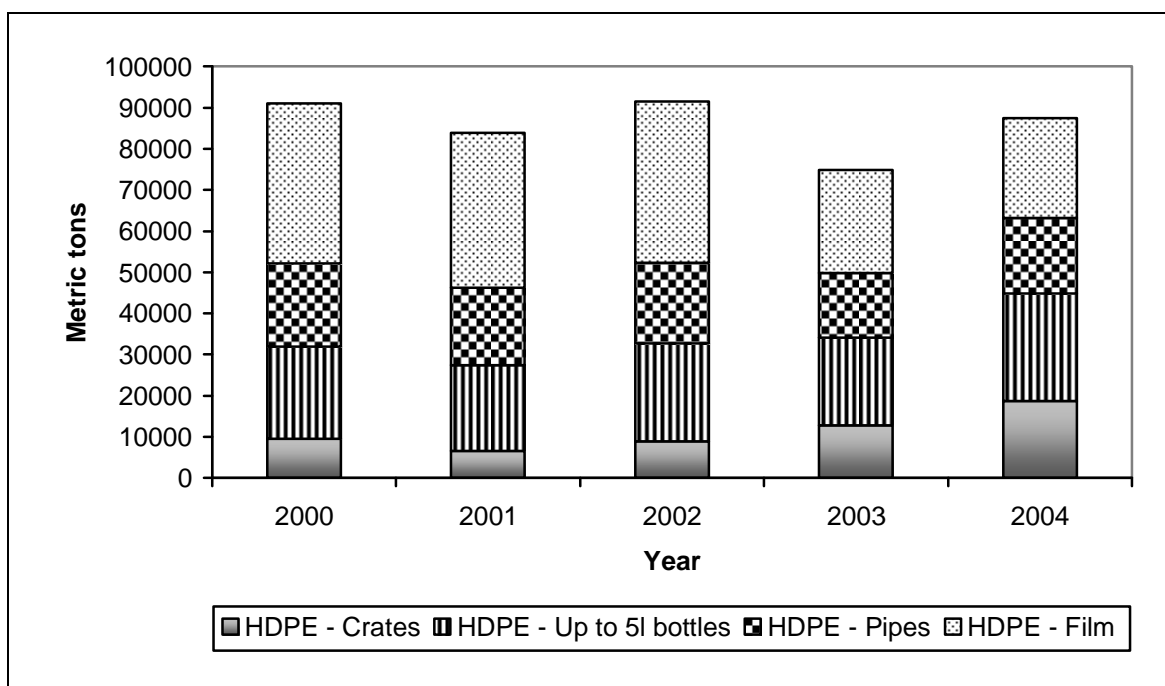
However, this comparison does not take into account the fact that there is a 6-10 week lag between the prices in South Africa and the prices in China. From the analysis of only the recent data it seems that prices in China have on average been lower than those in South Africa, even if a price lag is taken into account. A contributing factor is that the cost of shipping has been high in relation to the cost of shipping a few years back. The shipping cost is expected to fall to a more normal/acceptable range.

3.5.4. Historical sales levels for key downstream products

Polyethylene polymers are used to manufacture a large range of end-products, including packaging products such as consumer food and beverage shrink, collation films and shrink pallet shrouds, Industrial liners, dunnage bags, surface protection and bulk bags, as well as many other types.

The figure below indicates for few product categories the historical growth in output, as supplied by a small number of downstream respondents.

Figure 3.18: Historical SA Sales – Polyethylene Derivatives



Note: No useful information obtained on other product categories

The overall growth in selected HDPE products indicates a cyclical nature. The film category, however, was severely impacted by governments regulations related to the use of thin-walled carrier bags, and a major decline has manifested itself since 2003. The other product categories are showing a general growth pattern.

3.5.5. Basis for SA Downstream Products pricing calculations

According to the small sample of downstream respondents, product pricing is based upon the cost of production, and converters are striving to achieve an acceptable return on capital. They also have to take into consideration perceived value of the end product, alternatives [e.g. other materials such as glass], inflation and exchange rates. With large customers price negotiations take place once a year.

However, due to the large number of downstream competitors, they have little leverage on their customers, which are often companies much larger than themselves. They have some leverage in terms of prices, based upon polymer cost increases, or oil price movements, which generally impact on polymer prices as well as wage negotiations. However, the downstream pricing mechanisms typically require a period of around 3 months before polymer price changes can be incorporated, while upstream price changes are effected sooner. This was disputed by “the downstream of downstream”, that is, the retailers, who mentioned during discussions on demand elasticity that converters implement polymer price changes immediately. However, no pricing data was collected from them.

3.5.6. Key differentiation factors for purchasing feedstock

Suppliers are chosen on the basis of quality, continuity of supply and price.

3.5.7. Downstream Operations

Basis for operation [e.g. 24/7]

All respondent operations are operating on a 24hour basis, but only 56% operate 7 days/week, and the balance 5 days/week.

Average age and original cost of equipment

The age of PP converting equipment reported by the respondents varies from 2 – 12 years with an average of around 7.5 years. The average original cost of equipment is R25 million.

Capacity utilisation

Capacity utilisation varies between 60% and 95%, with an average of 76%, not taking into account idle weekend time.

Workforce

The average number of the workforce for respondent companies is 390, with around 82% in manufacturing.

3.5.8. Assessment of global competitiveness of downstream producers

Downstream respondents indicated that polyethylene conversion in SA is competitive, except for a few issues. The issues mentioned were:

- Small local market necessitates short production runs and low capacity utilisation.
- Some respondents are adamant that they are competitive in all respects, except for polymer prices, where the 10% duty prevents them from penetrating export markets.
- SA's overheads are high [a function of economies-of-scale], while shipping costs to export markets for bulky products are also high.
- Competing countries such as China have much lower wages.

Downstream respondents have commented that integrated international producers such as Formosa Plastics are accused of transferring polymer at marginal cost to conversion operations for exports. This is a major problem for plastic converters all around the world. In China, converters that are based in an "export processing zone" do have access to lower priced polymers because they do not have to pay import duties provided the polymer is converted into a product that is exported.

The difficulty arises from the fact that converters in South Africa supplying product into the domestic market sometimes have to compete with Chinese (and other Asian converters) that have access to polymers at less-than-the-domestic price because they are located in export processing zones or have access to polymer at special prices. This is where anti-dumping regulations are supposed to help and aggrieved converters can call upon the government to evaluate if dumping is taking place. Proving that any product from China is dumped is very difficult.

The problem of transfer pricing of polymer to a conversion operation is real and does exist. Technically, this is illegal and not allowed under WTO rules and anti-dumping measures can be made against such an exporter. However, once again proving that dumping is taking place is not easy and in the time between dumped imports arriving and proving a case can take more than twelve months. Trade policies are important in enhancing the competitiveness of a country. However the available countervailing measures are not uniformly applied in all countries.

3.5.9. Ability for downstream to expand product range based on lower feedstock prices

Respondents are unsure of their ability to expand based on lower feedstock prices. One respondent indicated that they export an extruded intermediary product that is very cost sensitive, and lower feedstock will result in higher volumes. Some respondents are, however confident that they could increase by 25 – 50% on the basis of increased exports, as well as substitution of other materials, should polymer prices decrease by the rate of duty [10%].

3.5.10. Impact of current polyethylene polymer pricing practices

Skills

Downstream respondents generally do not see a major effect on skills levels caused by current pricing practices, although there is a feeling that high polymer prices necessitates multi-skilling, in that minimum workers are employed, and existing workers have to do more tasks. Upstream respondents commented that the growth of the local polymer industry has encouraged and required the development of technical, managerial, business and operational **skills** that are necessary to efficiently conduct business through the whole polymer value chain. The downstream conversion industry in South Africa is relatively well developed and typically follows

international polymer industry value chain norms; namely large national conversion companies, large independent companies and multitude of smaller entrepreneurial type operations. These companies can either focus on polymer conversion or can be multifaceted companies specialising in, for example, packaging irrespective of material type - steel, glass, paper or polymer.

Wages

Downstream respondents generally feel that wages are agreed by in bargaining councils, and are not influenced by feedstock pricing, although increasing polymer costs are placing pressure on wages. The downstream focus could also become more focused on labour intensive operations adding further value to end-products, but this requires lower material costs.

Upstream respondents commented that the polymer pricing practices have allowed for the sustained development and growth of the downstream industry, the major employers of labour within this industry.

Technology

Downstream respondents believe that low margins caused by upstream labour practices are a major driver towards more capital intensive equipment, in order to improve productivity. One respondent indicated that high polymer prices are forcing innovative approaches in existing practises, sometimes leading to improvements. Some respondents, however, feel that they do not make enough margin to invest in necessary new technology.

Upstream respondents commented that the sophistication of the South African end user market is comparable with that of developed countries and hence the local polymer conversion industry is required to keep pace with global developments in polymer technology. Consumer requirements for specialised applications in turn require that the conversion industry invests in the necessary skills and equipment to facilitate the development and production of these applications and products (import replacement). Hence the upstream polymer production industry assists the conversion industry by developing new grades, enhancing and modifying existing grades to meet these requirements. Thus both the upstream and downstream industry players are required to track and apply changes in polymer technology into their operations and product offering.

Long-term sustainability

Downstream respondents have concerns that the long-term sustainability of the downstream sector is threatened by the economies of scale and high capital re-investment in China in particular. Current pricing practices do not offer anything special to enhance exports, and thereby helping to alleviate the negative impact of the small domestic market. Another constraint against long-term sustainability is that polymer is effectively priced at spot prices, causing large fluctuations that are hampering long-term planning.

Upstream respondents feel that to keep pace with growth, long term sustainability of the local polymer industry will be required to expand its operations to meet the increased demand and this can only continue if all parts of the polymer value chain are profitable and the invested capital (equipment and skills) is adequately rewarded.

Import replacement

Downstream respondents believe that current polymer pricing practises have created little incentive for end-users to source locally, especially as end-products have similar mass to volume ratios as the primary polymer. The only drivers left for import replacement are convenience and “Quick response” issues. In some polyethylene products imports are low due to duties as well as bulkiness of products.

Upstream respondents view is that if the alternative is considered for a moment (no local polymer production and all polymer goods are imported), the polymer conversion industry would be significantly exposed to the global supply and demand balances which would manifest itself in reliability of supply and would significant expose the domestic market to price fluctuations and polymer merchants wishing to take advantage of the import situation. Secondly, South Africa itself would not be able to handle the importation of these vast quantities of polymer raw materials and the market would likely switch to the importation of semi finished goods and final products which would significant damage the South African polymer conversion industry. The current pricing practices have allowed for the growth and development of the local polymer conversion industry as supplied by local production and as such facilitated the replacement of imports (polymer and semi-finished goods) with locally produced products. In countries where there is no local producer

there is a significantly under developed polymer value chain, as semi finished and final products are imported rather than development of a capital intensive downstream industry.

3.6. Comparison of domestic prices with export prices

No time series data was available for export prices of products that were exported out of South Africa. The comparison has therefore been done on the average local delivered prices as received from Polyethylene manufacturers and converters and average export prices.

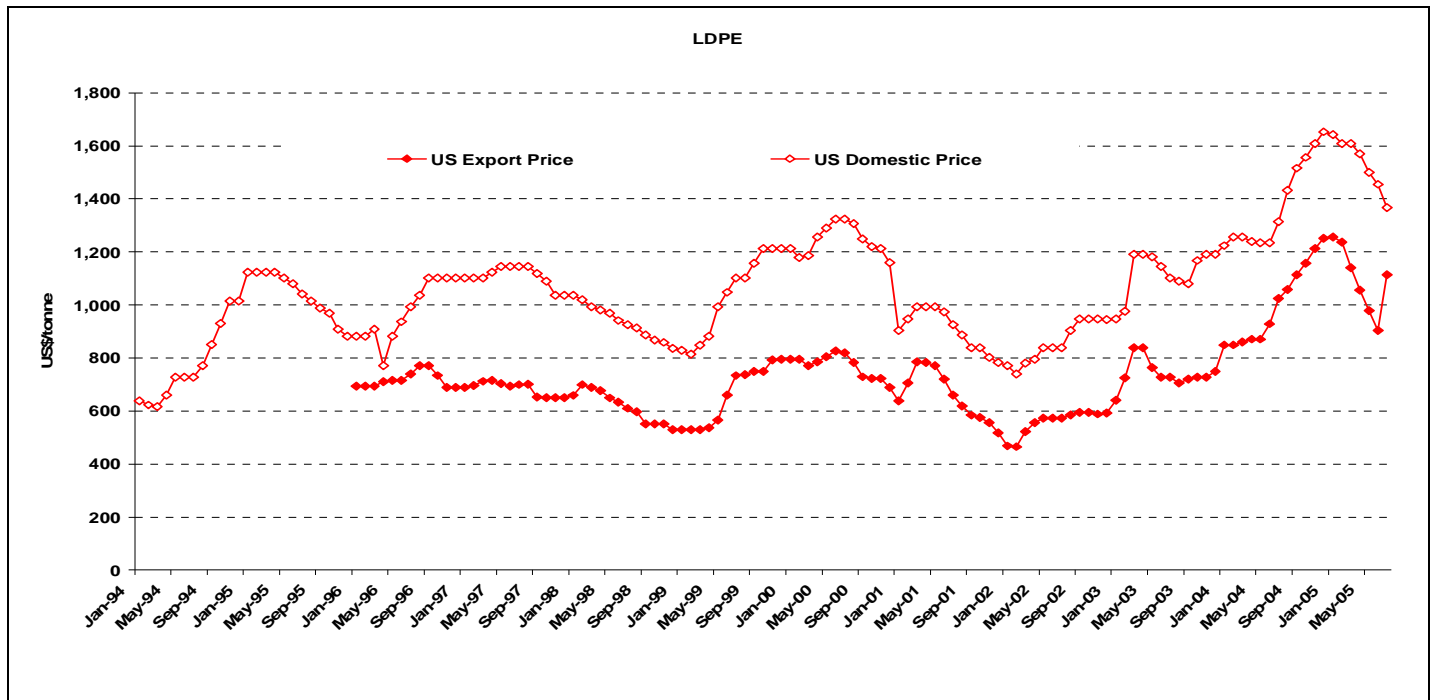
a) LDPE

In 2004, the average local delivered price for LDPE was R 8.44/kg. The average F.O.B. export price in the same year was R 7.53/kg. The major destination for South African exports was Zimbabwe. The average export price to Zimbabwe was R 7.90/kg. The difference between the local delivered prices and export prices to Zimbabwe was around 6%. It should be noted that selling these exports in Zimbabwe has to add onto the export price logistics costs, tariff duties, inland distribution and agents' commission. The relatively lower percentage differential between the domestic price in South Africa and the export price to Zimbabwe is a function of logistics costs based on geographical proximity.

Time series data of export prices has however been obtained for a limited period for other countries or regions; namely the USA and North West Europe. Figures 3.19 and 3.20 below show that the difference between delivered domestic prices in South Africa and FOB prices is not unusual. For example, in the case of the USA the difference between their delivered domestic prices and export prices was as high as about 41% between May and September 2000 but down to about 24% by the last quarter of 2004. It should be mentioned that the gap between the two is sometimes much closer. However for the whole 10 year period as shown in the chart the domestic price was always above the export price. The same trend should be expected in the case of South Africa as well. It should be noted that the FOB price is not the price paid in the export market, rather it is the price at which the polymer exits the borders of the source country. Upon landing at the export market logistical costs, duties/tariffs (where applicable), inland distribution and agent's commission (in some instances) and other costs are added onto the price at which the polymer

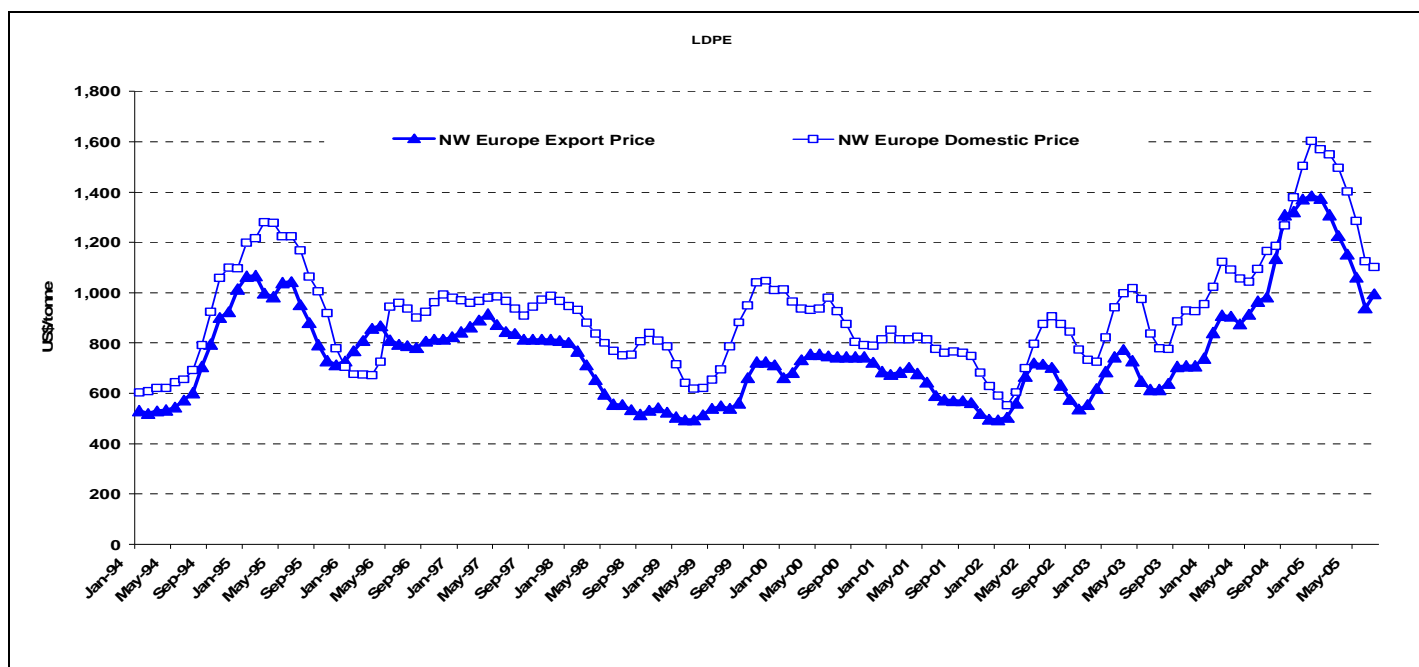
exited the borders of the source country. The difference between the delivered domestic price and the FOB price does not mean that domestic customers subsidize export customers.

Figure 3.19. Time series comparison of domestic prices and FOB prices in the USA



The same trend is evident in the case of North West Europe as shown in figure 3.20 below, although the difference between the delivered domestic prices and the FOB prices is relatively smaller and in some instances non-existent. This is as a result of the geographical proximity of the export markets which are within Europe. For a limited period only (between January and May 1995) the domestic price was lower than the FOB price by about 25%.

Figure 3.20. Time series comparison of domestic prices and FOB prices in North West Europe

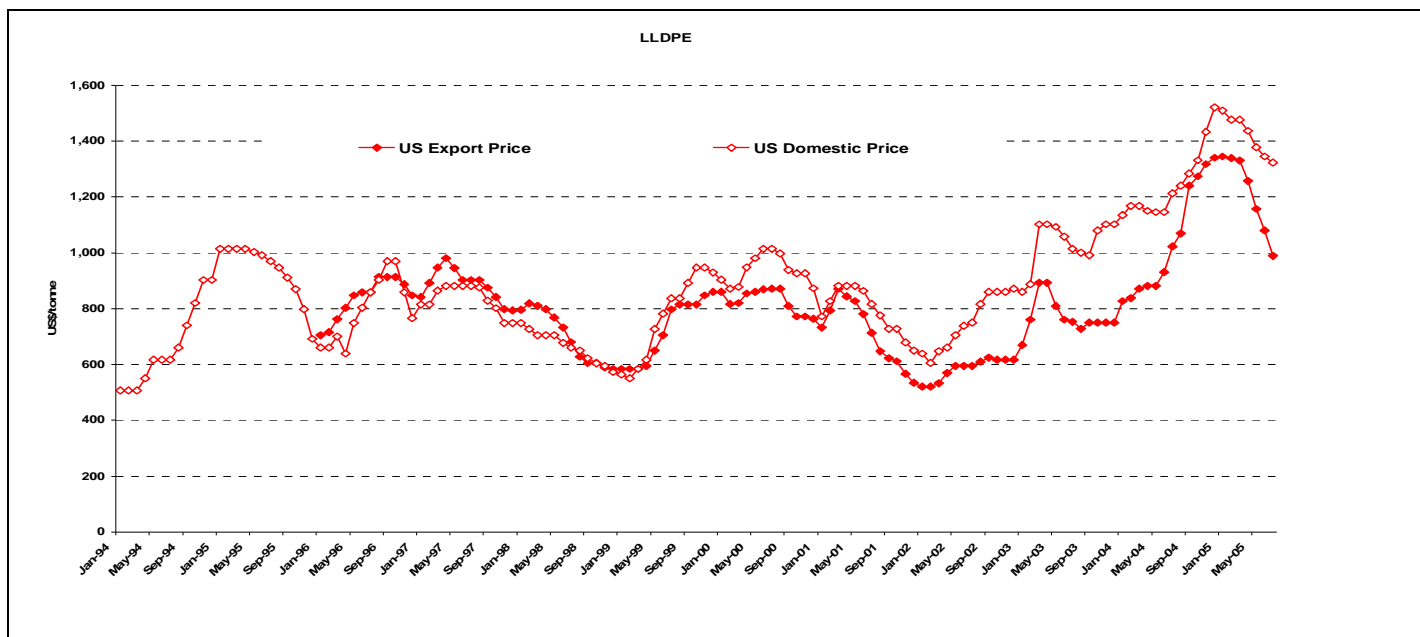


b) LLDPE

In 2004, the average local delivered price for LLDPE was R 7.65/kg. The average F.O.B. price in the same year was R 7.53/kg. The major destination for South African exports was Zimbabwe. The average export price to Zimbabwe was R 7.90/kg. The export price was higher than the local delivered prices by around 3%. It should be noted that selling these exports in Zimbabwe has to add onto the export price logistics costs, tariff duties, inland distribution and agents' commission. The relatively lower percentage differential between the domestic price in South Africa and the export price to Zimbabwe is a function of logistics costs based on geographical proximity.

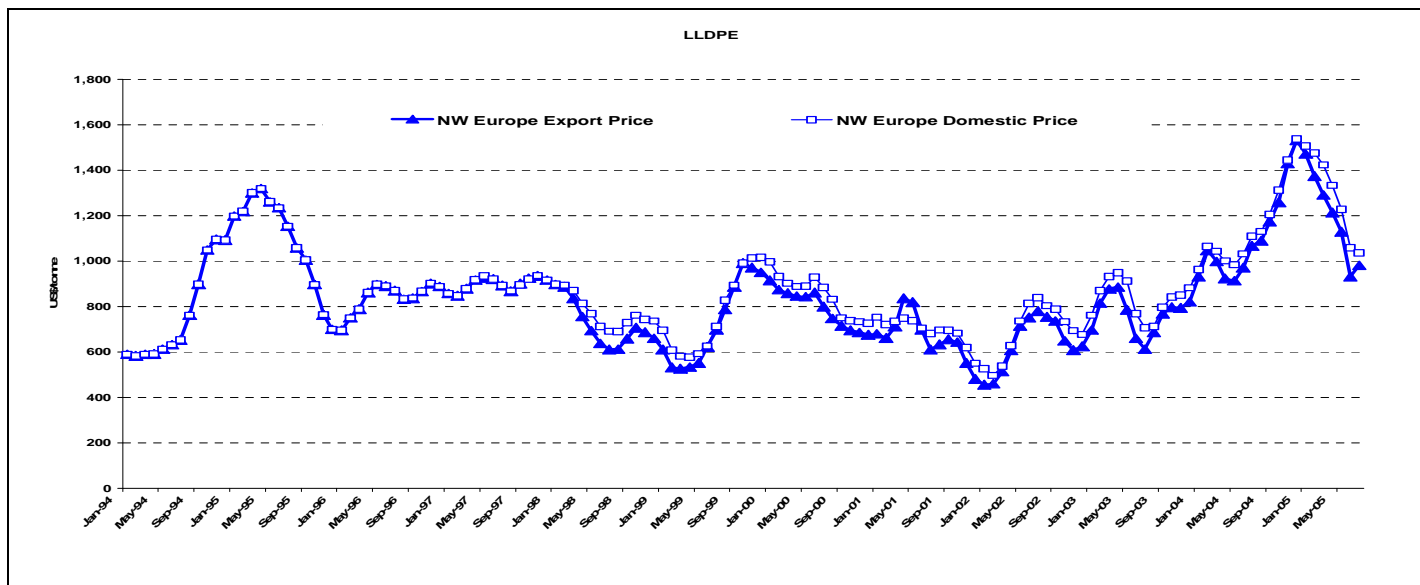
Time series data of export prices has however been obtained for a period of 10 years for the USA and North West Europe. Figures 3.21 and 3.22 below generally show that domestic prices are higher than F.O.B prices; it is unusual for them to be the other way around. For example, for a limited period (May 2004 to May 2005) the domestic price in the USA was lower than the FOB price. The delivered domestic price was as high as 24% above the FOB price by May 2005. It should be mentioned that the gap between the two was sometimes much closer if not non-existent. The same trend should be expected in the case of South Africa as well.

Figure 3.21. Time series comparison of domestic prices and FOB prices in the USA



In the case of North West Europe as shown in figure 3.22 below, the difference between the delivered domestic prices and the F.O.B price was virtually non-existent and when there was a difference, it was negligible. This is as a result of the geographical proximity of the export markets which are within Europe as well as the unavailability of polymer for export.

Figure 3.22. Time series comparison of domestic prices and FOB prices in North West Europe



An important feature of the polymer industry world-wide is that in any country that has a surplus in any polymer, the price at which the polymer is exported is different (and usually lower) than the price at which it is sold to domestic users even after allowing for transport and other logistics costs. This statement is supported by the trend of the historical export and domestic prices of the USA and North West Europe for LDPE and LLDPE over a ten year period. The comparison shows that:

- In both regions the LDPE FOB price in particular and periodically the LLDPE export price are usually lower than the domestic price.
- However, there are also periods when the FOB price is very close to or actually higher than the domestic price. This takes place when the domestic market is tight and there is limited amount of product available for export.

c) HDPE

In 2004, the average local delivered price for HDPE was R 7.17/kg. The average F.O.B. export price in the same year was R 6.03/kg. The major destination for South African exports was Congo (Brazzaville). The average F.O.B. export price to Congo was R 5.25/kg. The difference between the local delivered prices and F.O.B. price to Congo was around 27%. It should be noted that selling these exports in Congo has to add onto the F.O.B. price logistics costs, tariff duties, inland distribution and agents' commission. It is therefore expected that the domestic delivered price in Congo will be comparable to that prevailing in South Africa.

No time series data was available from other regions or countries for comparative purpose. Although there is no time series data for other regions, the same trend seen already in the other polymers is expected to be the case with HDPE.

3.7. Impact of pricing on downstream purchasers - Demand Elasticity

3.7.1. Introduction

The approach followed to determine demand elasticity is described in [Appendix 1](#).

3.7.2. Demand Elasticity Analysis for Polyethylene

It was not possible to collect accurate information from sufficient companies to enable the plotting of historical and future demand elasticity for polyethylene. As such, alternative methods have been used to calculate demand elasticity.

Professor Johannes Fedderke of the Southern African Econometric Research Unit undertook a study of price elasticity in Sasol's LDPE, LLDPE, PVC and PP markets during the course of 2005. The study which uses sophisticated econometric techniques draws on 10 years of quarterly polymer consumption (excluding HDPE), polymer price and national economic data to determine both the supply and demand side price dynamics to determine the product's elasticity. The input data used covered the period from January 1994 to June 2005.

The results of this study indicated for LDPE that a 10% decrease in price would result in a 3% increase in market size, and vice versa. For LLDPE a 10% decrease in price would result in a 7% increase in market size, and vice versa. The implication is that for polyethylene any price decrease will result in a less than proportional increase in market size.

3.7.3. Practical Verification of Demand Elasticity for Polyethylene

A market segment analysis was done to further investigate the demand elasticity of Polyethylene. Demand elasticity for polyethylene can be verified from a practical perspective, by evaluating the relative portion the polyethylene polymer cost in the final product that is being sold. This provides a measure of elasticity as it can determine the extent to which the final product is price sensitive. An analysis for the major polymer grades, as well as end-use applications, is shown below:

a) LDPE - all grades

Major applications	% Cost of LDPE polymer in converted product	End-use product	% Cost of LDPE polymer in end-use product	LDPE Polymer Demand Elasticity for end-product
1. Packaging Film	70%	Packaged manufactured goods, etc.	<1%	No demand elasticity
2. Industrial film	50%	Construction sheeting, dam sheeting	< 15%	No demand elasticity
3. Shrink film	70%	Beverage packaging, pallet stabilisation	<1%	No demand elasticity
4. Check-out bags	70%	Retail –fashion stores, etc.	<1%	No demand elasticity

The conclusion is that for 90% plus of the applications, LDPE polymer constitutes such a small fraction of the end-product price that it cannot impact on the demand elasticity.

b) LLDPE – all grades

Major applications	% Cost of LLDPE polymer in converted product	End-use product	% Cost of LLDPE polymer in end-use product	LLDPE Polymer Demand Elasticity for end-product
1. Packaging Film	60%	Packaged manufactured goods, etc.	<1%	No demand elasticity
2. Roto-moulding	60%	Water & fuel tanks	40%	Demand elasticity likely, but expected to require >10% change in LLDPE price – material substitution

The conclusion is that LLDPE polymer has a possibility to impact on the demand elasticity in less than 20% of the end-use applications.

The general conclusion for polyethylene polymers is therefore that for in excess of 80 - 90% of end-use applications there is no significant demand elasticity. This is therefore a verification of the statistical analysis that indicated a low elasticity.

3.8. Impact of pricing on downstream purchasers – EVC

Due to the integration of production facilities, it was not possible to obtain the required information for the EVC analysis at individual polymer level. The analysis was therefore conducted on the combined polymers for both the upstream and downstream sectors.

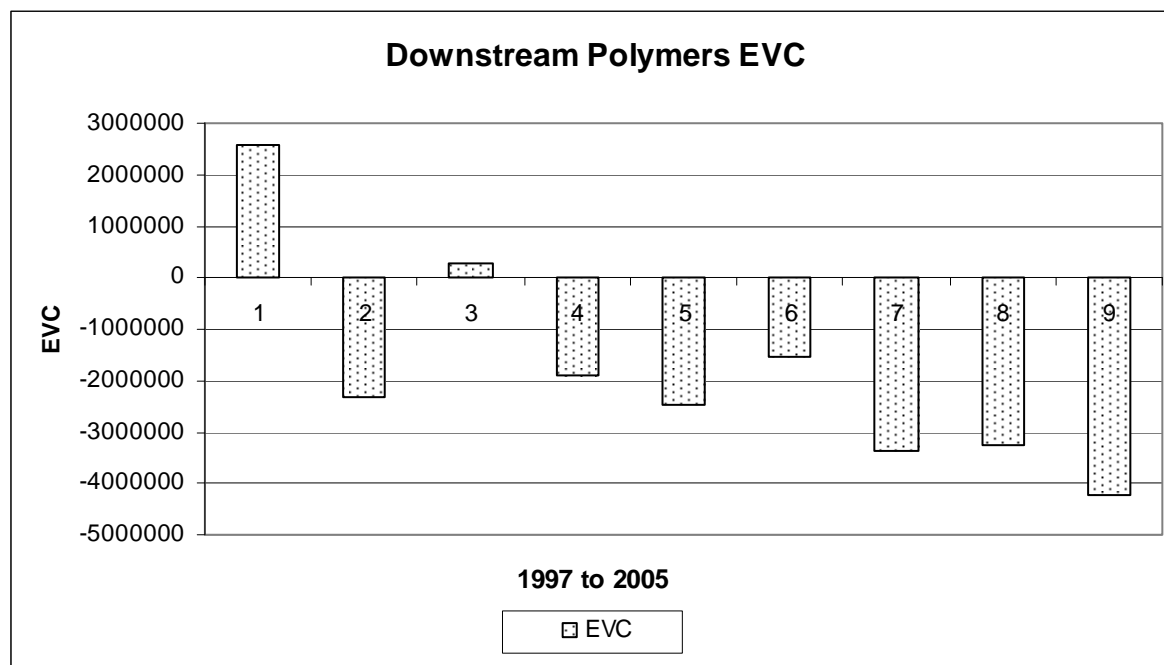
Please refer to [Appendix 2](#) for upstream EVC results for combined polymers.

3.8.1. Downstream Polymers

In total four companies, accounting for around 30% of the polyethylene market, based on consumption volumes, provided financial data. However, some of the financial data (two companies) did not correspond historically with the financial information provided by upstream companies.

The following EVC graph represents the actual values calculated in each year between 1997 and 2005 for combined downstream polymers. The graph indicates that the return on capital as measured against the cost of capital, K , was below K in every year except 1997 and 1999. However, this does not mean the downstream has been making losses all these years.

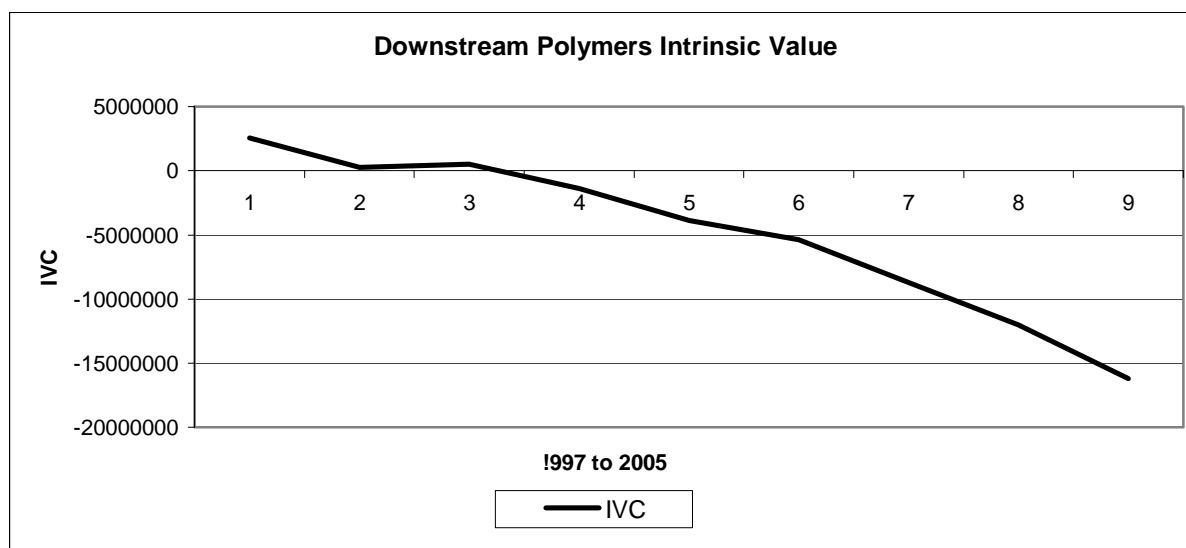
Figure 3.23 EVC Results – Downstream Polymers



Note: This graph represents all polymers' historical 9 years data as given by 3 respondents, which is equivalent of 6% of the market based on their consumption of polymers and not sales. Four other respondents provided financial data for shorter (5 years or less) time periods. Only the 9 years historical data was used to draw the graph and thus any shorter historical period was excluded.

The following IVC graph represents the intrinsic value calculated for downstream polymers. The graph illustrates the cumulative effect of calculated returns by the end of each year. The IVC graph shows returns consistently lower than K by 2005.

Figure 3.24 IVC Results – Downstream Polymers

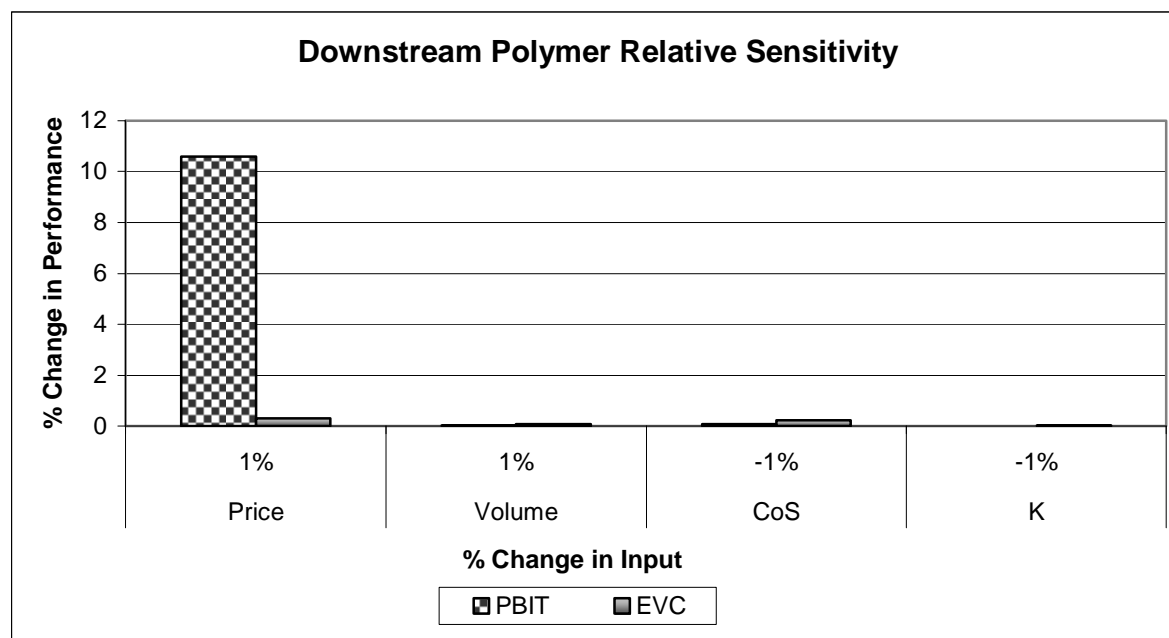


Note: This graph represents all polymers' historical 9 years data as given by 3 respondents, which is equivalent of 6% of the market based on their consumption of polymers and not sales. Four other respondents provided financial data for shorter (5 years or less) time periods. Only the 9 years historical data was used to draw the graph and thus any shorter historical period was excluded.

The following graph illustrates the relative sensitivity of EVC and Profit before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K in downstream polymers.

The bar groups indicate by what percentage PBIT and EVC would change for a one percent improvement in Prices or Volumes or Cost of Sales or K.

Figure 3.25 Sensitivity of EVC and Profit before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K – Downstream Polymers



Note: This graph represents all polymers' historical 9 years data as given by 3 respondents, which is equivalent of 6% of the market based on their consumption of polymers and not sales. Four other respondents provided financial data for shorter (5 years or less) time periods. Note that the inverse of what this graph shows is also true. That is, PBIT and EVC would change by the same percentage points but in the opposite direction for a one percent decline in prices or volumes or one percent increase in Cost of Sales or K.

Note the following;

- EVC is insensitive to K
- EVC (and PBIT) are insensitive to Sales Volume
- EVC (and PBIT) are insensitive to Cost of sales
- EVC is relatively sensitive to Selling Price
- PBIT is very sensitive to Selling Price

It can be expected that a symmetrical result will be obtained for a one percent decline or increase in Prices or Volumes or Cost of Sales or K.

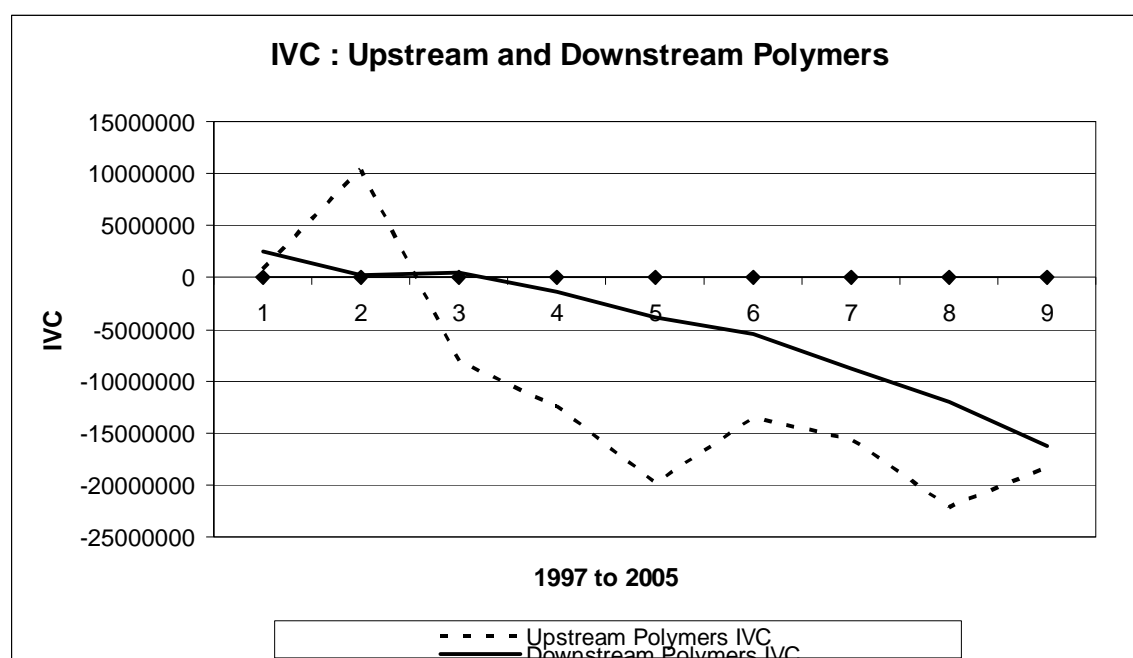
Although statistically insignificant, the EVC analysis of combined polymers indicates that the return on capital was lower than the weighted average cost of capital, K in every year except 1997

and 1999. Based on the data supplied by the few downstream respondents, this situation means that the downstream sector is not making super profits either.

3.8.2 IVC Compared in Upstream and Downstream Polymers

The following graph illustrates the intrinsic value calculated for combined upstream and combined downstream polymers.

Figure 3.26 IVC Comparison – Upstream & Downstream Polymers



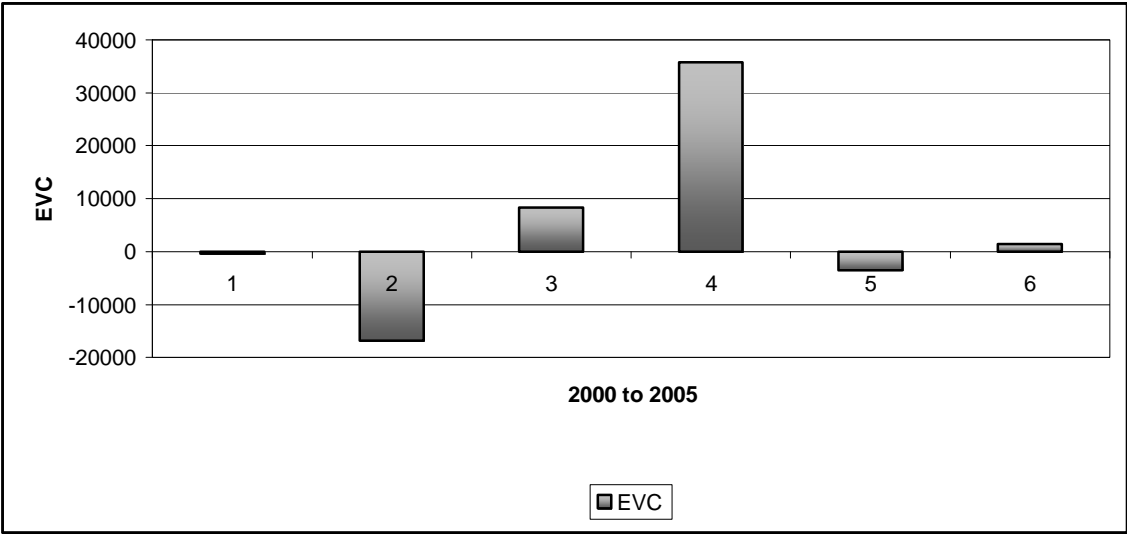
The graph clearly illustrates that both upstream and downstream companies that responded have been getting returns that are below K (the weighted average cost of capital) consistently.

3.8.3 EVC of Publicly Traded Downstream Company

As a result of lack of data from the downstream companies, a set of results from one of the listed companies on the Johannesburg Stock Exchange was used for an additional EVC analysis, the results of which the results are shown in the following graph. The EVC graph represents the actual

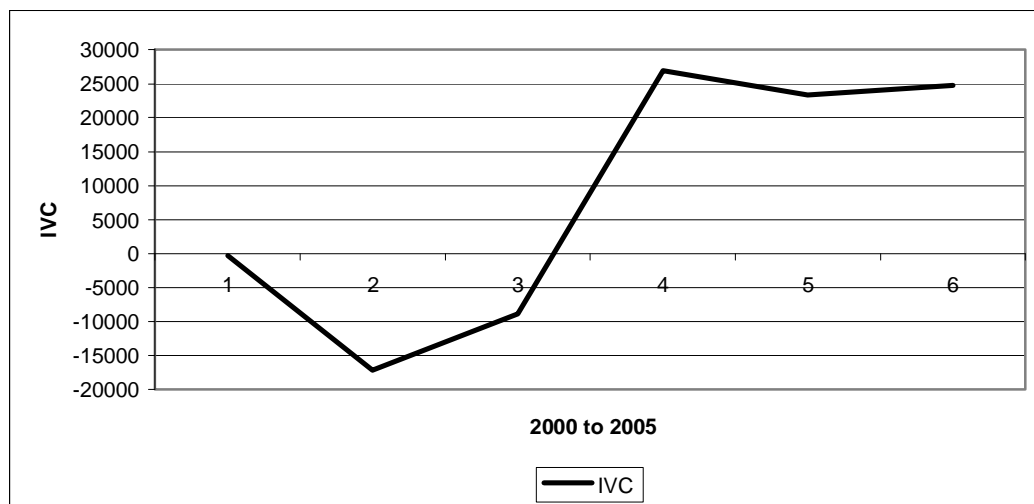
values calculated for combined polymers in each year between 2000 and 2005 for this listed company. The graph indicates that the business is volatile, indicating large swings in the EVC value year by year. This is confirmation that the results should not be seen in isolation but rather throughout the full commodity cycle.

Figure 3.27 EVC Results – Publicly Traded Downstream Company



For the listed company, the IVC graph that follows show that the higher than K (cost of capital) return recorded in 2003 outweighed the years when returns were lower than K, and IVC has remained positive through 2005. Again, this is a case of little data (5 years) that does not cover the full commodity cycle. Also, this particular company was active in acquisitions and this can affect the EVC.

Figure 3.28 IVC Results – Publicly Traded Downstream Company



3.9. Conclusions – Polyethylene

The current polymer production capability of the LDPE plant is 100 000 t/a and that of the LLDPE plant is 150 000 t/a, however the LLDPE production currently is limited to approximately 100 000 t/a based on ethylene availability. With Sasol's Project Turbo fully implemented, LDPE capacity will increase to 220 000 t/a, LLDPE will operate at full capacity. HDPE capacity is 160 000 t/a.

The SA market size in 2004 for polyethylene primary polymer used in local plastic conversion was estimated as follows:

- LDPE: 135 000 t/a
- LLDPE: 139 000 t/a
- HDPE: 158 000 t/a
- **Total: 432 000 t/a**

After implementation of Project Turbo, there will be an excess of LDPE available.

Polyethylene is regarded as commodity products and is produced by many countries and is well-traded in large volumes. Global polyethylene prices are determined by supply/demand basis on a

global scale, but are particularly driven by the Far East, due to the availability of low-cost product from ill-considered expansions in the 1990's in countries such as Korea, as well as the ever-growing demand from China. Global plant sizes are also increasing and so is capacity more especially in China, in order to benefit from economies-of-scale issues. South African polyethylene manufacturers have a relatively high cost base in absolute terms due to the relatively small local plants.

Local polyethylene producers sell polymer products to customers in markets which include South Africa and other African countries, Asia, USA, Europe and South America. Their policy is to sell at the market price prevailing in each of these regions at any time. Polyethylene polymer prices are determined relative to the competitive forces acting in a particular region. In order for a supplier to be successful in penetrating the market and sustaining a market share position, the customers' alternative purchasing options must be considered and a competitive offering made. This also applies to polyethylene sales in South Africa. Therefore, the polyethylene pricing mechanism prevailing in South Africa is one where the price is negotiated based on offers in an open market where products are readily traded across national boundaries. The outcome is that the most competitive supplier sets the price and is thus referred to as market pricing as opposed to formula-driven IPP.

Local polyethylene manufacturers do not select a particular price from a particular region and rigorously apply that to determine the price for the South African domestic market. They are driven by market dynamics and react to the lowest price imports being offered by competitive suppliers to South African customers. In most producing countries the domestic demand typically consumes a significant portion of the producers' volume, so enabling the export volumes to be priced using marginal costing. This means that FOB prices are usually lower than domestic prices. During recent years, the competitive supplies have come from the Far East and the Middle East and they therefore normally set the price levels in the South African domestic market. Prices of locally manufactured substitute materials, such as paper, metal and glass, are also monitored and considered for the market sectors where they compete as alternatives to polymers. All these issues form the basis for the market price and thus for the customer price negotiations.

After implementation of Project Turbo, an excess of LDPE will be available. From 2007 South Africa will be a net exporter of LDPE. However, excess domestic production capacity is no guarantee that domestic prices will always be lower than FOB prices because of marginal costings of exports by other countries or regions. A comparison between domestic and export prices that had prevailed in North West Europe and the USA over a 10 year period revealed that in cases where there is surplus LDPE and LLDPE, the price at which the polymer is exported is almost always lower than the price at which it is sold to domestic users. The same situation was found to be the case in South Africa. In general, the further away the export market like in the case of South Africa's HDPE exports to Congo, the higher the price differential between the domestic price and the export price. The converse is also true, that is, the closer the export market like in the case of South Africa's LDPE and LLDPE exports to Zimbabwe and North West Europe's LLDPE exports which go within Europe, the smaller the price differential. There are limited periods when the export price is very close to or actually higher than the domestic price. This takes place when the export demand increases faster than domestic, leading to higher FOB prices for a short period of time.

Analysis of South Africa's domestic polyethylene prices compared to a number of major competing countries, including China, US, NW Europe and India, showed that:

- Prices around the world are linked.
- In any month, there can be a very wide variation in the prices.
- Prices paid by South African converters are always in the range of prices that prevailed in the countries or regions covered in this analysis, mostly at the lower end of the range.
- In the latter period of the analysis China is the most competitive (lowest priced market) in the world.

The global reality test for polyethylene showed that SA's level of conversion for LLDPE and HDPE in particular is around halfway above the level that can be expected from a country with SA's level of economic development, indicating the existence of relatively well-developed markets for these particular polymers. South Africa's comparison with Taiwan, Malaysia, Saudi Arabia, South Korea and Poland shows that the latter countries have higher per capita polymer usage than the "trend

line” would dictate. There is therefore scope for the South African polymer production and conversion industries to learn from countries such as mentioned that have higher per capital polymer usage to develop and implement strategies to increase per capita usage in South Africa.

The results of the demand elasticity indicated that a 10% decrease in LDPE price would result in a 3% increase in market size, and vice versa. For LLDPE the respective data shows that a 10% decrease in price would result in a 7% increase, and vice versa. The implication is that any price changes will result in a less than proportional change in market size. From a practical perspective the general conclusion for polyethylene polymers is therefore that for in excess of 80 - 90% of end-use applications there is no significant demand elasticity.

Due to the integration of production facilities, it was not possible to obtain the required information for the EVC analysis at individual product level. The analysis was therefore conducted on the combined polymers upstream and downstream sectors for the period 1997 to 2005.

For **upstream** polymers, the EVC analysis indicated that the return on capital was frequently lower than the weighted average cost of capital, K. This is a clear indicator that the current pricing practices of the upstream sector are not resulting in high levels of profitability, as measured against the total cost of capital, namely K. This situation means that the upstream sector is not making super profits.

In the case of Sasol, the focus for this study was on Sasol Polymers, the LDPE and LLDPE manufacturing unit within the group and not on the whole group. Therefore profits of Sasol Limited as a group cannot be equated to those of Sasol Polymers. Sasol Polymers, situated within the Sasol's chemical businesses, is a separate company within the Sasol Group, and has a supply agreement for raw material from another Sasol Group company, Sasol Synfuels. The supply of these raw materials is based upon a pricing mechanism that sets the price at the equivalent fuel value, i.e. the gate price of fuel which is set by Basic Fuel Price mechanism which in turn is directly set by international fuel prices. Therefore, Sasol Synfuels sells the feedstock at a price that they would have realised in the marketplace if it was converted to saleable fuels. This mechanism ensures that there is no cross-subsidization between fuels and polymers businesses

and hence the respective profitability of the businesses is a true reflection of the value add of the chemicals and fuel businesses.

For **downstream** polyethylene a reasonable survey response was obtained. In total four companies, accounting for around 30% of the polyethylene market, provided financial data. However, some of the data (two companies) did not correspond historically with the information provided by upstream companies. Although statistically insignificant, the EVC analysis of combined polymers indicates that the return on capital was lower than the weighted average cost of capital, K in every year except 1997 and 1999. This situation means that the downstream sector companies that responded are not making super profits either.

The listed company analysed showed a return larger than the cost of capital (K) in 2003 that outweighed the years of returns that were lower than the cost of capital, and IVC has remained positive through 2005. This particular company was active in acquisitions, which caused the large increase in EVC.

4. PVC

4.1. Market definition of upstream chemical products

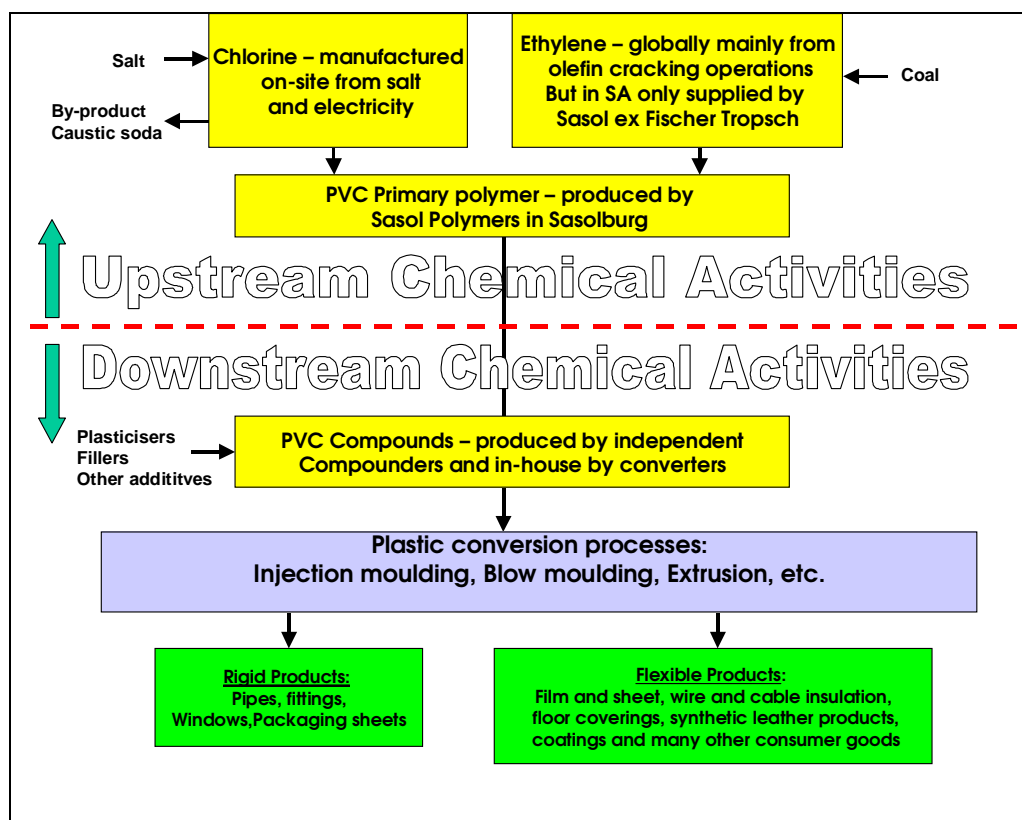
a) Introduction

Polyvinylchloride (PVC) in primary, or unconverted form is part of the Primary Polymer and Rubber sub-sector of the chemical industry. PVC is the second-largest commodity thermoplastic produced in the world, after the polyethylene. PVC is the most versatile of all thermoplastics. It can be converted either into rigid products of considerable strength and hardness or into flexible articles, when compounded with plasticisers.

b) Value chain

PVC is made by means of the catalytic polymerisation of ethylene and chlorine, usually in large, integrated plants that are operated on a continuous basis. Ethylene feedstock is primarily obtained from large olefin crackers, using ethane and other crude-oil refinery based streams. South Africa has unique ethylene supply from the Fischer Tropsch synthetic fuel technology employed by Sasol in Secunda. The value chain for PVC is summarised in the diagram below:

Figure 4.1: Polyvinylchloride Value Chain



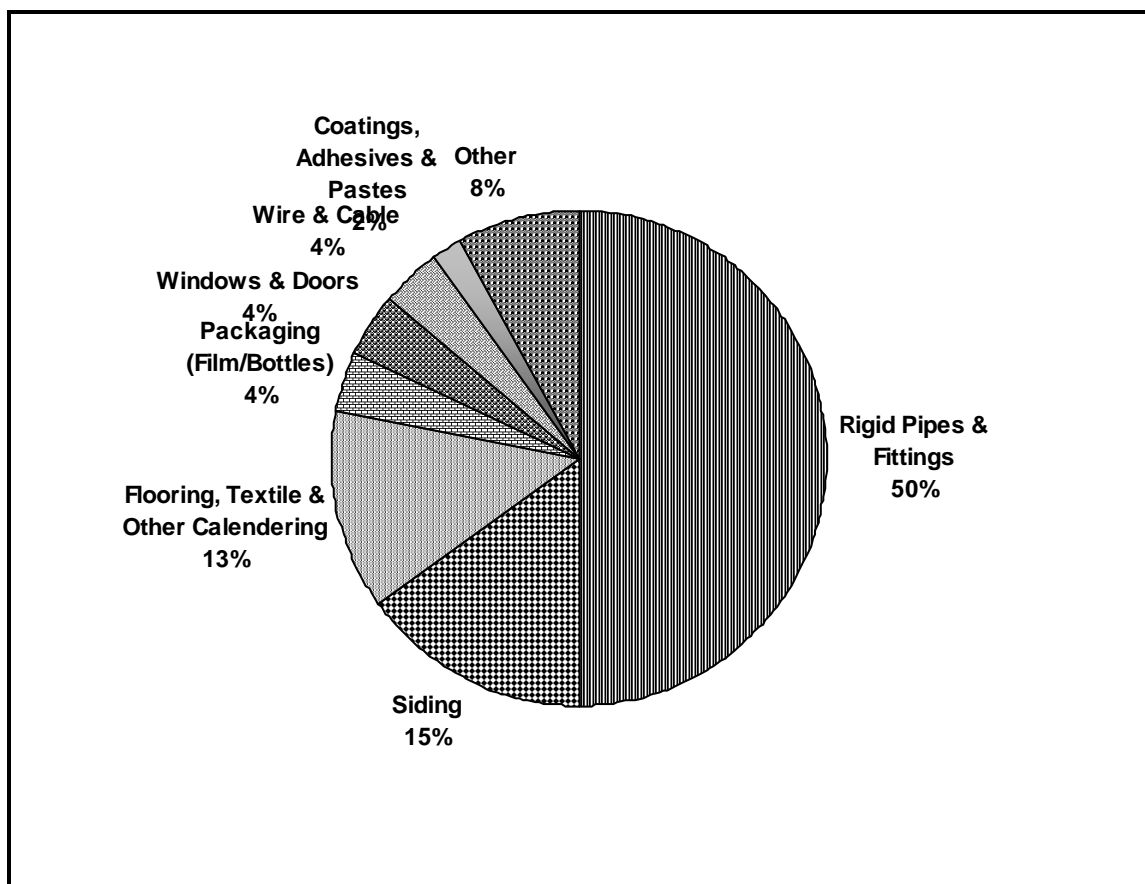
c) Applications and Global Market Size

In 2004, global PVC production grew to 29 million metric tons with an estimated value of \$27 billion. (Source: SRI Consulting)

Rigid applications account for 65–75% of total consumption. The major end use is pipe and fittings; other leading rigid applications are siding, windows, fencing and packaging sheet. Flexible PVC is used for film and sheet, wire and cable insulation, floor coverings, synthetic leather products, coatings and many other consumer goods.

PVC consumption is mostly influenced by the construction market, as about 60% of world consumption is for pipe, fittings, siding, windows, fencing and other applications. PVC is increasingly used as a replacement for traditional construction materials such as wood and metals, and glass in packaging applications; so its growth has been above that experienced by the overall construction industry.

Figure 4.2: Global Market Breakdown of Polyvinyl Chloride (PVC)



d) Impact of different product grades or performance specifications on market applications

A number of different commodity and speciality PVC resins are available. PVC resins are manufactured specifically for a processing method and/or application area. PVC paste polymers are processed by means of spreading coating or dip-coating technology for applications such as leather cloth and tarpaulins. Suspension homo and co-polymers are widely used for applications such as pipe, cable insulation, hose, film, medical equipment and many other end uses. The processing technologies for these applications are well established. Equipment such as extruders, blow moulding machines and injection moulding machines are required to produce the PVC end products. The performance of PVC resin grades are determined primarily by the combination of

molecular weight and the particle morphology. PVC resin has a glass transition temperature of 80°C and a processing temperature of 160 - 180°C is required.

e) Level of competition in supply for major geographic export markets for upstream products

PVC is a global product, manufactured by roughly 150 companies in approximately fifty countries. Major producers include Ineos Vinyls, Arkema, Vinnolit, BF Goodrich and many more.

4.2. SA Market structure and shares of upstream chemical producers

4.2.1. Domestic industry structure

a) Feedstock for PVC production

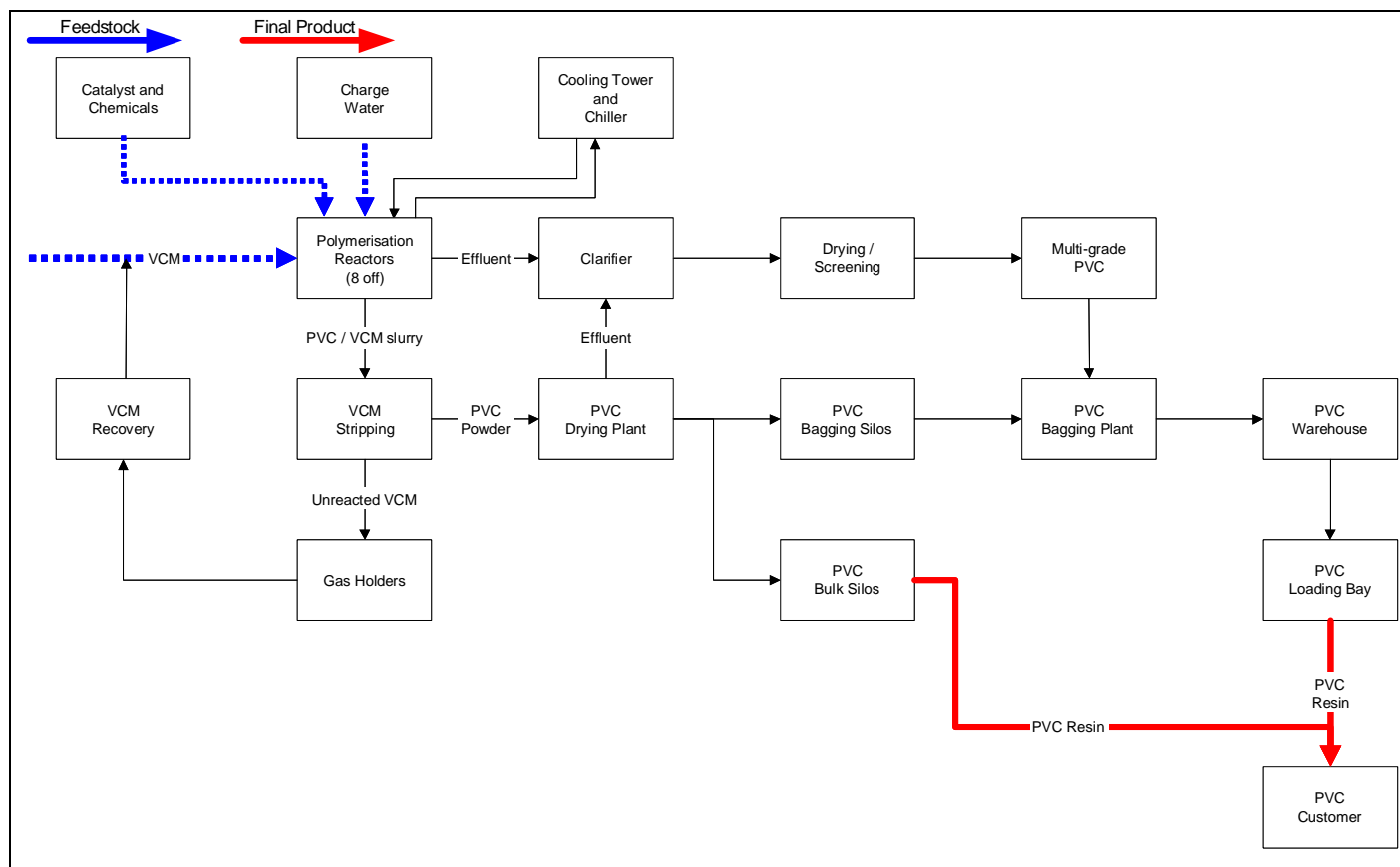
PVC is manufactured from ethylene monomer and chlorine. Ethylene supply in SA is concentrated with only one supplier, namely Sasol Secunda. Sasol's capacity is currently around 454 000 t/a; to increase to 672 000 as a result of Project Turbo. Sasol manufactures chlorine captively from salt (Sodium chloride).

b) PVC Production

PVC is produced by reacting vinyl chloride monomer (VCM) with an organic peroxide initiator in an autoclave, utilizing INEOS technology (a major global PVC producer and technology supplier). Stringent control of temperatures, pressures, additives and batch processing time ensure that a quality finished product is produced. VCM is produced by the chlorination of ethylene to form ethylene dichloride, using the oxychlorination and the direct chlorination production route, followed by the cracking of this intermediate to vinyl chloride monomer. Sasol Polymers produces chlorine from salt utilising diaphragm and membrane separation technology.

Originally the PVC plant was built with a capacity of 100 000 t/a. The most recent expansion increased the capacity of the VCM and PVC plants to 200 000 t/a, at a cost of R 250 million. These production increases have allowed Sasol Polymers to serve the growing South Africa PVC market with quality PVC products.

Figure 4.3: PVC – Sasol Polymers Flow Diagram

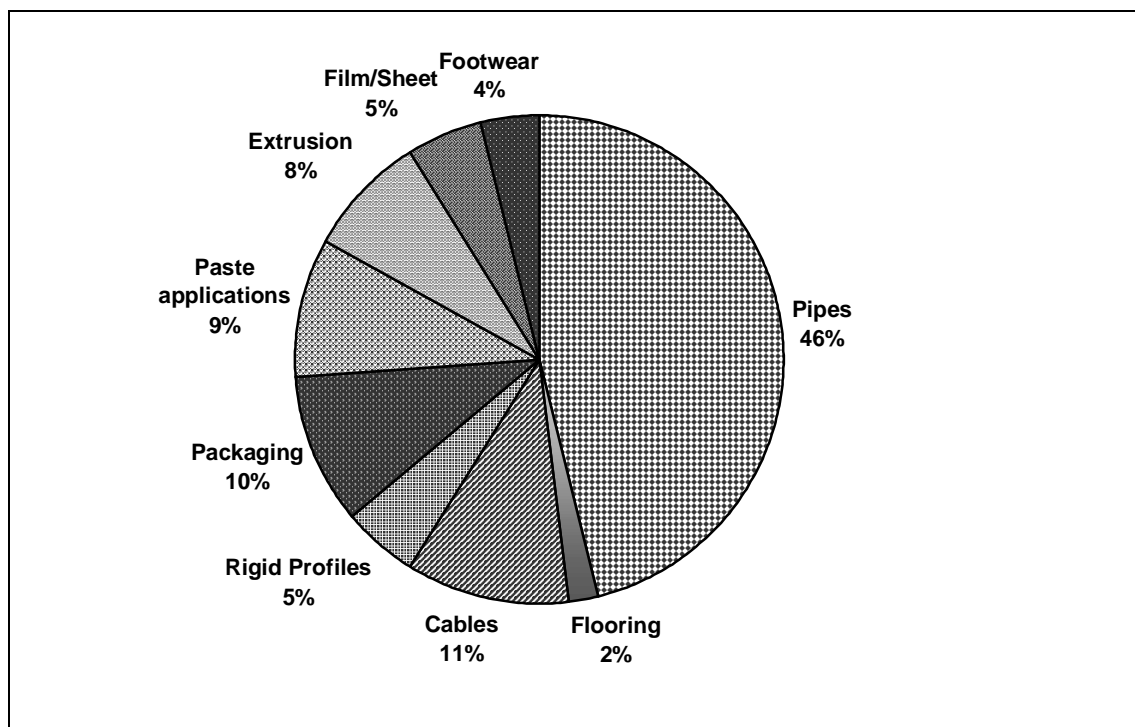


c) PVC Market

The SA market size in 2004 for PVC primary polymer used in local plastic conversion was estimated at 156 000 tons. PVC polymer is used in two main categories of products, namely flexible or rigid products. Flexible products include large quantities of plasticisers (usually phthalate based). PVC products, especially rigid products, also include fillers such as limestone (calcium carbonate), which are used to lower the cost of end-products, but also to enhance mechanical properties. The addition of these and other additives contribute to the actual size of locally converted PVC products to be in the order of 250 000 tons per annum.

The PVC market is different to the other polymers in that it is not dominated by packaging applications, but is used in many other applications, in particular construction. PVC converters are shown in [Appendix 6](#).

Figure 4.4: South African PVC Market Breakdown



4.2.2. The effect of import tariffs, anti-dumping duties and any other regulatory factors affecting pricing

Tariff protection for base PVC resin products in SA is as follows:

- Tariff protection for polymer product supplied out of **non European** countries is:
 - 10% ad valorem import duty calculated on the FOB (Export port) price
- Tariff protection for polymer product supplied out of **European** countries is:
 - 8.4% ad valorem import duty calculated on the FOB (Export port) price

Compared to SA, PVC tariff protection levels (an ad valorem duty only, excludes any other surcharges or taxes) for some other countries are:

Table 4.1: PVC – Tariff Protection in Other Countries

Country	Duty basis on:	PVC
United States	FOB	6.5%
China	CIF	9.7%
Japan	CIF	4.6%
Canada	n/a	None
Indonesia	CIF	10.0%
Chile	CIF	8.0%
Australia	FOB	5.0%
Malaysia	CIF	20.0%
India	CIF	10.0%

4.2.3. The global nature of the industry

PVC is produced in a range of grades [e.g. rigid PVC, Flexible PVC, Injection moulding PVC], but in general is regarded as a commodity product that is produced by many countries and is well-traded in large volumes (8 million tons/annum – 50 times the SA market) around the globe, demonstrating the exposure of the relatively small SA market in relation to the global trading market size.

Commodity PVC suspension grades are distinguishable by the molecular weight (denoted as K-value), which determines the resin's suitability for end-use application. The grade denoted K66 or K67 is the dominant grade and is used for rigid extrusions such as pipe and conduit. Internationally, this grade has the highest consumption by volume and is thus the most traded PVC grade. Due to it being the most predominant grade, K66/K67 represents the marginal ton in deep sea markets and therefore drives the international PVC prices. Global prices are determined by supply/demand basis on a global scale, but are particularly driven by the Far East, due to the availability of low-cost product and ill-considered major expansions in the 1990's in countries such as Korea, as well as the ever-growing demand from China. Global plant sizes are also increasing, in order to benefit from economies-of-scale issues.

4.3. Costs and pricing of upstream chemicals products

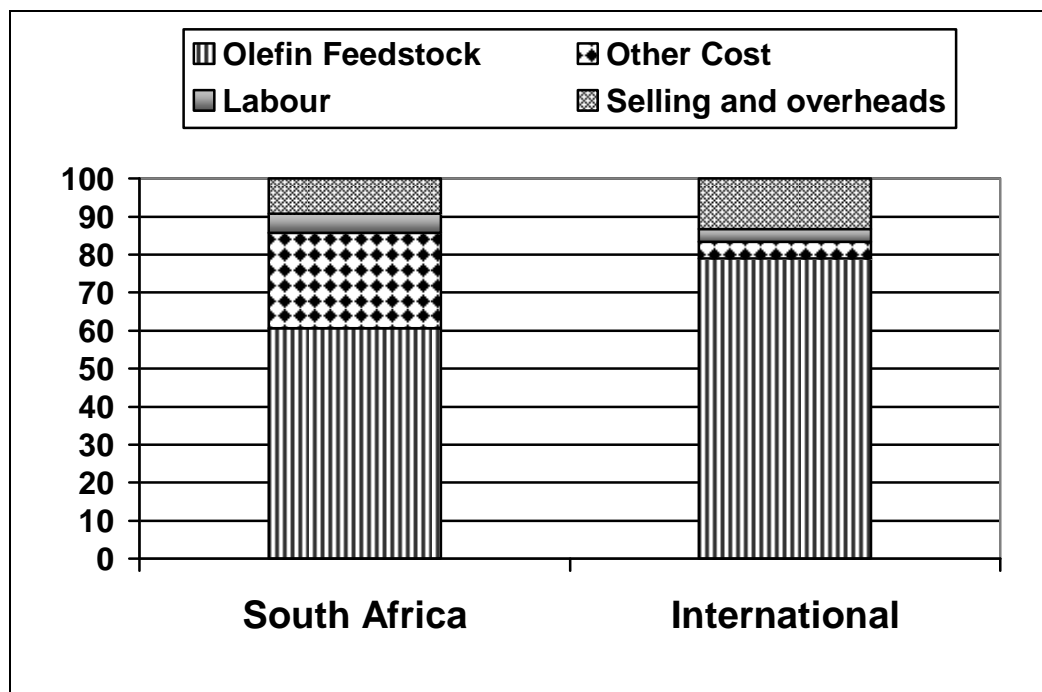
4.3.1. The cost structure of the industry and global comparison

The cost structure of SA based operations is not directly comparable to international PVC operations, in that:

- The SA PVC producer has an integrated operation that is manufacturing PVC, PP and polyethylene.
- The production infrastructure includes an olefin purification operation that purifies ethylene that is obtained in crude form from their Fischer Tropsch process – this is a unique operation on a global basis.

The relative cost structures for the SA based operations, compared with standard global PVC operations are shown in the figure below. The international PVC information is based on SRI Consulting data – US Gulf Coast.

Figure 4.5: Relative PVC Cost Structures – SA and International (US Gulf Coast)



Based upon these cost structures, feedstock in SA's case is a lower portion of total costs, while other costs, which include variable and fixed manufacturing costs, but no depreciation, are higher

in SA's case. It should be noted in SA's case the feedstock used is not polymer grade ethylene, but the raw ethylene-rich stream supplied to the Sasol Polymers purification unit from the Sasol Secunda upstream operations. The transfer cost mechanism of this feedstock stream has not been analysed in this report. The other costs include the purification cost of the raw feedstock stream.

4.3.2. SA Production Advantages & Disadvantages

SA advantages include:

- Cost competitive ethylene feedstock based upon Fischer Tropsch synthetic fuel upstream operations. Local shortage to be eliminated shortly.
- Globally competitive polymer production technology and facilities
- Relatively well-developed downstream converter sector with widespread end-product applications.

SA disadvantages include:

- Relatively small local production facilities compared to new globally competitive facilities.
- Relatively small local and regional market.
- Long distance from attractive export markets.
- Inland location of production facilities in the case of exports.

4.3.3. Upstream pricing practices with respect to downstream domestic purchasers

The local PVC producer sells polymer products to customers in markets which include the RSA and other African countries, Asia, Europe and South America. Their policy is to sell at the market price prevailing in each of these regions at any time, and this also applies to sales in South Africa.

The producer uses all relevant information at their disposal to prepare for the price negotiations in order to offer a competitive price. The price is negotiated and takes into account inter alia:

- competitive offers from other suppliers (prevailing market price),
- the quantities purchased by a customer and the costs associated with such quantities,

- requests for export or development assistance,
- distribution costs for different packaging types (viz. bags, bulk or semibulk),
- Sasol Polymers' total offering (commercial, product, technical and service components), and
- competing alternatives whether these are substitute materials (glass, wood, paper) or imported finished products.

The validity of these prices is part of the negotiations and can be adjusted month by month or, quarter by quarter, or fixed for longer periods (typically less than 6 months). Generally, there is a price continuum across the customer base. It should be noted though that over a relatively long period average delivered prices compared to average calculated prices of imports on an import parity basis would be fairly close to each other.

Included in the producer's offering is a technical and engineering service, which is available to all customers. This technical and engineering service covers the following aspects:

- product and application development,
- engineering expertise for converter's equipment modification,
- technical expertise for use of complementary products,
- assistance with operation problems, and
- problem solving on converters equipment.

In order to fully explain the PVC producers' domestic pricing policy, a description of global polymer price mechanisms and their impact on South African domestic polymer prices will be further discussed. In [Appendix 3](#) a detailed description of international pricing practices, based upon reference prices, is shown.

a) Europe and USA Polymer Prices:

The domestic prices of PVC in Europe and the USA are targeted at levels that provide adequate long term returns on investment to producers investing in new plants. These targeted price levels are generally achieved because the markets are large, there are several domestic producers and levels of "dumped" imports are relatively low.

In times when installed production capacity exceeds demand, which is the norm for most of the price cycle, high cost producers are barely able to cover their costs and cut back supply accordingly, while those with a lower cost base will achieve a low return. During these periods, little re-investment occurs because of the low returns and, as demand increases with time (normally 5-6 years), a stage is eventually reached where demand exceeds installed production capacity. At this time prices rise rapidly and high margins are earned prompting new capacity investment and within 1-2 years, another situation of excess capacity and subsequent low margins exists. Historically, this price cycle repeats itself approximately every 6-8 years.

It is important to note that polymer producers in these regions only achieve satisfactory returns over entire price cycles. The high returns earned for short periods during the peaks of price cycles, and the inadequate returns experienced during the trough, balance out the average return for the polymer producers. Hence, earnings during the peak should not be seen in isolation, nor viewed as excessive. This need for an adequate long term average return on investment is typical of the international polymer industry and applies to all regions, including South Africa. This is because the polymer market is effectively a single global market and the same price cycle applies to all producers in all regions of the world that trade with each other.

b) Far East Polymer Prices:

Until the early 1990s, prices of polymers in the Far East were set out of the USA and were generally higher than in either Europe or the USA. When the Korean petrochemical expansions occurred, these resulted in overcapacity in the region and a hunger for market share that eroded margins. As a result, since the mid-1990s, prices in the Far East have been generally lower than either Europe or the USA, and in many instances, at a level that barely covers the costs of raw materials and failed to adequately reward the investment to a Far East producer.

c) Middle East Polymer Prices:

In recent years the very large polymer plant investments in the Middle East have had an influence on the global supply/demand balance. Most of this production is exported into China and is economically viable at the Far East price levels due to low feedstock costs and very efficient

economies-of-scale. The Middle East producers generally adopt a “price follower” strategy as determined by market competition in the Far East and other export destinations.

d) South African Polymer Prices:

As with all regions in the global market, polymer prices are determined relative to the competitive forces acting in the particular region. In order for a supplier to be successful in penetrating the market and sustaining a market share position, the customers’ alternative purchasing options must be considered and a competitive offering made.

The South African PVC producer follows the above approach. They do not select a particular price from a particular region and rigorously apply that to determine its price to the South African domestic market, they are driven by market dynamics. South African customers monitor prices from all major trading regions and the lowest price available at any point in time is then used by them as a basis for the negotiation with their polymer supplier. Prices of locally manufactured substitute materials, such as paper, metal and glass, are also monitored and considered for the market sectors where they compete as alternatives to PVC.

During recent years, the most competitive supplies have come from the Far East and the Middle East and they therefore normally set the price levels in the South African domestic market. Hence Far East prices are typically monitored and tracked as defined by Hong Kong CFR prices. Because traded volume of polymer through Hong Kong (destined for China) is active, substantial and continuous, this is a reliable, well reported and globally recognized competitive reference point which is used to monitor international price trends.

The SA PVC producer regularly monitors the published international polymer price data and in addition, they are often active in both exporting and importing of commodity polymers, in addition they are in ongoing contact with other major multinational polymer producers and technology suppliers and are able to supplement the published information with their own trade experience.

Competitive pricing information is also obtained from customers during supply negotiation discussions and is often used in combination with the data obtained from the trade consultants and sources mentioned above.

The above discussed points form the basis for the market price and hence for the customer price negotiations.

e) Rebates and discounts

The major rebate category on PVC is for export of customer's finished goods. Due to the very high capital needed to build a polymer plant, its output need to be maximised. Therefore, export rebate mechanisms are employed to encourage customers to grow volumes by exporting finished goods. This adds value to local exports and assist customers to grow sales volumes and run at full capacity.

There are special pricing schemes available to **all** customers (large and small) and include:

- Rebates for the development of new products and markets to compete with alternative materials,
- Rebates to compete with imports of finished goods,
- Rebates for exports of finished goods (export rebate).

The first two rebate schemes are available for a specific application or development; are applicable for a limited period and limited to the volume for the specific purchases (that is not across the full volume of polymer purchased). These rebates are specifically designed to facilitate or assist:

- Converter development and introduction of products into the market by reducing the cost of the raw material during the early stages of the product life cycle (namely development, market introduction and acceptance),
- Converter competitiveness in the export market to overcome competitors who may have geographic, labour cost, governmental incentives, fiscal or other competitive advantages, or

- Converters to be more competitive in the local market against final product imports from international converters (which is sometimes dumped) who have labour cost, governmental incentives, fiscal or other competitive advantages.

The early rebate settlement scheme is to encourage customers to reduce the credit terms, which is mutually beneficial to both supplier and consumer.

f) Upstream supplier's view on Actual Pricing Mechanism Versus Import Parity Pricing

The pricing mechanism prevailing in South Africa is one where the price is negotiated, based on offers in an open market where products are readily traded across national boundaries. The outcome is that the most competitive supplier sets the price and this practice is better referred to as market pricing. The pricing methodology is commonly practised internationally in most countries that are signatories to the WTO. It prevails in countries with a free, open-access market, rather than the regulated price-setting typically found in centrally planned economies. In South Africa this situation is no different as locally produced products compete with imports. The application of this method of pricing is such that it directly links the domestic price to the international price. It also brings a country's pricing practices in line with all the countries that are signatories to the WTO and its rules on trade and eliminates the creation of subsidies throughout polymer value chain.

An aspect that should be borne in mind is that the price of the imported product is typically set by the spot price of another region, which is substantially lower than that region's domestic price, as it is set by producers incorporating only their marginal operational costs. International domestic prices are normally "delivered prices". In most producing countries the domestic supply typically consume a significant portion of the producers' volume, so enabling the export volumes to be priced using marginal costing. This results in domestic delivered prices in countries that compete through trade, having domestic delivered prices that are broadly in the same range, as is the case in South Africa. This is due to the combination of freight and duty values not being too dissimilar to the difference between domestic price and spot in the exporters' market. However, it should be noted that in producing countries where average costs are fairly constant (as it in the case in the South African polymer manufacturing industry), marginal cost is usually equal to average cost.

Also, in South Africa's case, variable costs are higher than the international norm because of poor economies of scale. It should also be noted that where marginal costing is practiced it is used only in the short term.

Import parity pricing is a mechanistic formula driven calculation and is done by specifically calculating a price based on what it would have cost to import the product based on spot prices quoted by a supplier from another trading region and is thus a proxy or estimate of the local delivered price of a competitive imported product to a downstream converter. [\[See section 2.3.3 for a more detailed explanation of import parity pricing\]](#). This would include all inward transport and other real costs that would be associated with importing the polymer into South Africa. The breakdown below gives an example of these considerations:

Table 4.2: PVC – Import Parity Price Calculation

Estimated Import Parity Price		
=	FOB (lowest cost source) ⁽¹⁾	Based on published information (ICIS LOR, Platts or Harriman)
+	Freight from source to Durban (South Africa)	Cost to get polymer to South Africa
+	Freight insurance	Insurance on goods in transit
	Convert to Rands	Above normally quoted in US Dollars
+	Logistic costs includes <ul style="list-style-type: none"> • Landing cost • Transport cost (Inland / coastal) • Duty (ad valorem duty on FOB price in rands) 	<p>Landing Costs comprise of terminal handling costs, wharfage – Cargo dues, Carrier service fee, Agency fee, Handover and document fees and disbursements on landing and wharfage, and duty and customs VAT.</p> <p>Transport costs for inland would include container turn in and railage.</p> <p>Transport cost for coastal would</p>

		include cartage to customer. Duty currently 10% of FOB price.
+	Indirect costs	Adjusts for example stock holding costs, payment terms, LC costs, container destuffing and warehousing costs

Note 1: A FOB (free on board) is a INCO 2000 term, in which the responsibility of the supplier is transferred to the buyer when the goods have been delivered on the rail of named carrier at a named port. As discussed, FOB prices are normally spot sale values and are lower than the corresponding domestic price, as the prices are normally based on the producers marginal cost of production.

The difference between market pricing and import parity pricing is that in the case of the former prices change continuously based on the cheapest available source at a particular point in time. In the case of import parity pricing, the price is calculated on the basis of a published price in a specific region or country and the ultimate price is formula-based. Furthermore, in the case of market pricing, customers monitor prices from all major trading regions and the lowest price available at any point in time is then used by them as a basis for negotiations with their polymer supplier.

4.4. Major downstream industries that purchase upstream products

4.4.1. End-use structure

The local PVC polymer market of 156 000 tons/annum in 2004 is supplied mainly by Sasol Polymers, with imports accounting for around 5% of the market. The end-use structure for PVC polymer is segmented into the grade of polymer used, as well as the conversion technology employed.

The major PVC grade is a grade for rigid applications (Code: S6721), which accounts for 60% of the market. This rigid PVC grade is mainly used in pressure pipe, sewer and drain pipe, gutters and down pipes, conduit and profiles.

The other main PVC grade is a grade for flexible applications (Code: S7106), which accounts for 22% of the market. This flexible PVC grade is mainly used in medical products, cable, cling film and footwear.

Two smaller volume grades are produced for rigid packaging and injection moulding applications (Code: S5718 and S6110), which accounts for 10% of the market. These grades are mainly used in bottles, rigid sheet and rigid fittings.

In most downstream applications there are many converters, although major companies tend to dominate in each application sector. Around 70% of the market is represented by large converters that use in excess of 15 000 tons/annum of polymer.

The PVC business is different to other polymers, as there are only a few small customers and hence the business is able to provide a cost effective bulk tanker service and full truck loads to its customers from its warehouses infrastructure and facilities. For the other polymers customers that order small quantities consolidated loads are used to service their requirements. The average segment price spread over the customer base is typically 3%.

4.4.2. Impact of feedstock cost on total cost structure

Based on limited respondent input (5 respondents), PVC polymer and additives accounts for 50 – 73% of cost-of-sales, with the balance shared between other manufacturing costs (mainly labour), and sales/administration/distribution costs.

4.4.3. Organisation of downstream players

The Plastics Federation of South Africa (PFSA) is an umbrella body for the plastics value chain under which there are several associations. The Plastics Converters Association (PCA) represents the interests of converters in the plastics industry. The PCA is the biggest association in terms of membership with 316 members. There are also associations such as the South African Polymer Importers Association (SAPIA) that represent the interests of 12 importers in the industry.

SAMPLAS is an association that represents 14 suppliers of machinery to the plastics industry while the Plastics Institute of South Africa (PISA) represents individuals in the industry. Other associations or interest groups in the plastics value chain are Association of Rotational Moulders of South Africa (ARMSA) which has a membership of 43 companies 13 of which are outside of South Africa, Expanded Polystyrene Association of South Africa (EPASA), South African Plastic Pipe Manufacturers Association (SAPPMA), and Institute of Materials (IoM). The following associations still exist but are no longer active in the plastics industry, Plastic Mould Makers Association (PMMA), Polyurethane Association of South Africa (PASAF), and Plastic Distributors Association of South Africa (PDASA).

4.4.4. Downstream sector ability to influence input prices received

Downstream respondents indicated that they have very little leverage to influence prices for PVC. Global dynamics drive polymer and end- product prices up and down and the market adjusts prices accordingly to remain competitive.

4.4.5. Duty Structures and anti-dumping measures

Tariff protection for downstream PVC products is extensive. The table below indicates specific tariff headings that consist of either PVC based products, or could potentially be made of PVC. The tariff protection quoted is the general tariff, and excludes the EC.

Table 4.3: PVC End-products – Tariff Protection in SA

Product Description	Tariff	General
Of polymers of vinyl chloride	39.17.23	15%
Of polymers of vinyl chloride, seamless	39.17.32.40	15%
Of polymers of vinyl chloride, seamless without fittings(excluding plaiting material with a rattan core	39.17.39.30	15%
of polymers of vinyl chloride	39.18.10	15%
Of polymers of vinyl chloride	39.19.10.30	15%
Of other polymers of vinyl chloride	39.19.90.30	16%
Of polymers of vinyl chloride	39.21.12	16%

Product Description	Tariff	General
Of polymers of vinyl chloride	39.21.90.47	15%
Baths, shower-baths and wash-basins	39.22.10	20%
Lavatory seats and covers	39.22.20	20%
Other	39.22.90	20%
Boxes, cases, crates and similar articles	39.23.10	15%
Carboys, bottles, flasks and similar articles	39.23.30	15%
Other	39.23.40.90	15%
Stoppers, lids caps and other closures	39.23.50	15%
Other	39.23.50.90	15%
Capsules and tubular neckbands, for bottles and similar containers	39.23.90.20	5%
Other	39.23.90.90	15%
Tableware and kitchenware	39.24.10	20%
Other	39.24.90	20%
Reservoirs, tanks, vats and similar containers, of a capacity exceeding 300 liter	39.25.10	20%
Doors, windows and their frames and thresholds for doors	39.25.20	20%
Shutters, blinds (including venetian blinds) and similar articles and parts thereof	39.25.30	20%
Other	39.25.90	20%
Office or school supplies	39.26.10	20%
Other	39.26.20.90	20%
Fittings for furniture, coachwork or the like	39.26.30	20%
Statuettes and other ornamental articles	39.26.40	20%
Beads, not coated with pearl essence	39.26.90.03	15%
Transmission belts	39.26.90.20	5%
Power transmission line equipment	39.26.90.25	5%
Other	39.26.90.90	20%

In most cases where tariff protection is applicable the rate is in the order of 15 – 20%, which is higher than the 10% applicable to primary PVC polymer.

Although none of the downstream respondents have indicated any anti-dumping investigation or action in any of their PVC products, the cable manufacturers have applied for anti-dumping measures and the industry now enjoy dumping protection against a number of countries.

4.5. International competitiveness of South African chemicals pricing

4.5.1. Introduction

It is important in the analysis of pricing that a common understanding of pricing terminologies is agreed upon, especially in the context of a comparative analysis. The main issues that are involved include the concept of an inland price for products, which is the price paid by local customers in a particular country [which can be based on a delivered, or ex-factory basis], compared to export prices, which are the export based prices for producers in a particular country. This concept is explained in Appendix 3, using polypropylene as example.

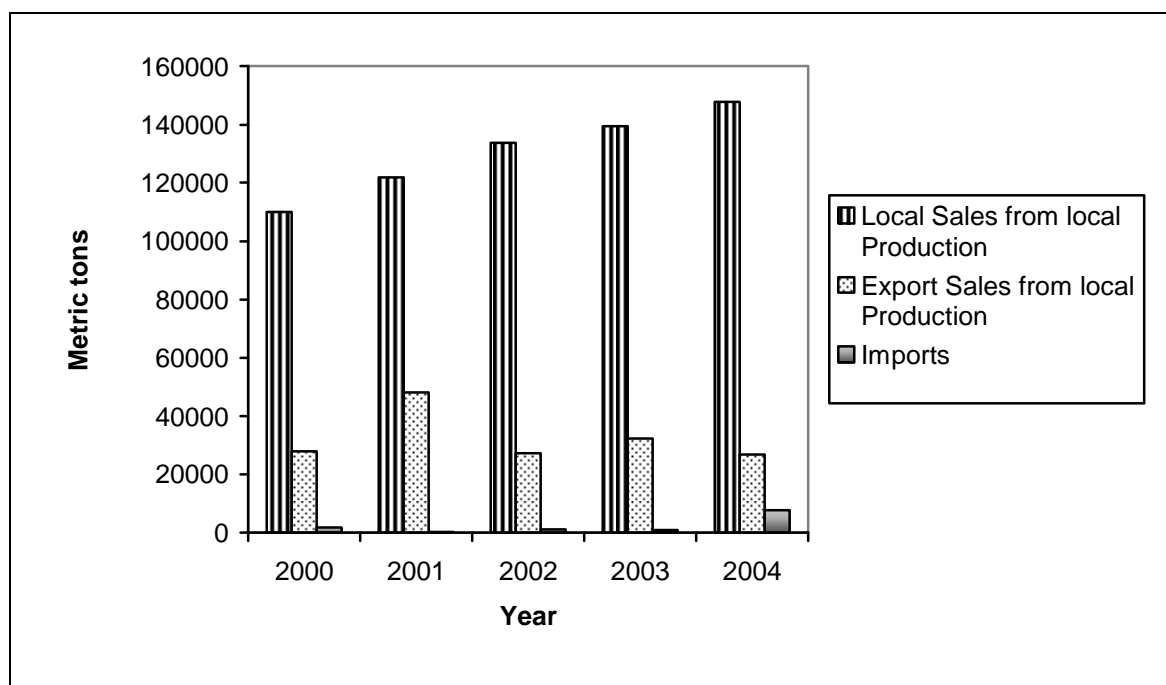
The competitiveness of South African chemicals pricing is dealt with under the following headings:

- Historical SA feedstock market volumes and pricing levels
- Comparison of SA inland prices for feedstock with international prices
- Historical sales levels for key downstream products
- Basis for SA pricing calculations
- Key differentiation factors for purchasing feedstock
- Operations: (Upstream/ Downstream: Basis for operation [e.g. 24/7]; Average age and original cost of equipment; Capacity utilisation; Workforce)
- Assessment of global competitiveness of downstream producers
- Ability for downstream to expand product range based on lower feedstock prices
- Impact of current pricing practices (Skills; Wages; Technology; Long-term sustainability; Import replacement)

4.5.2. Historical SA feedstock market volumes and pricing levels

The historical local and export sales volumes of PVC, as well as average delivered prices are shown in the figures below.

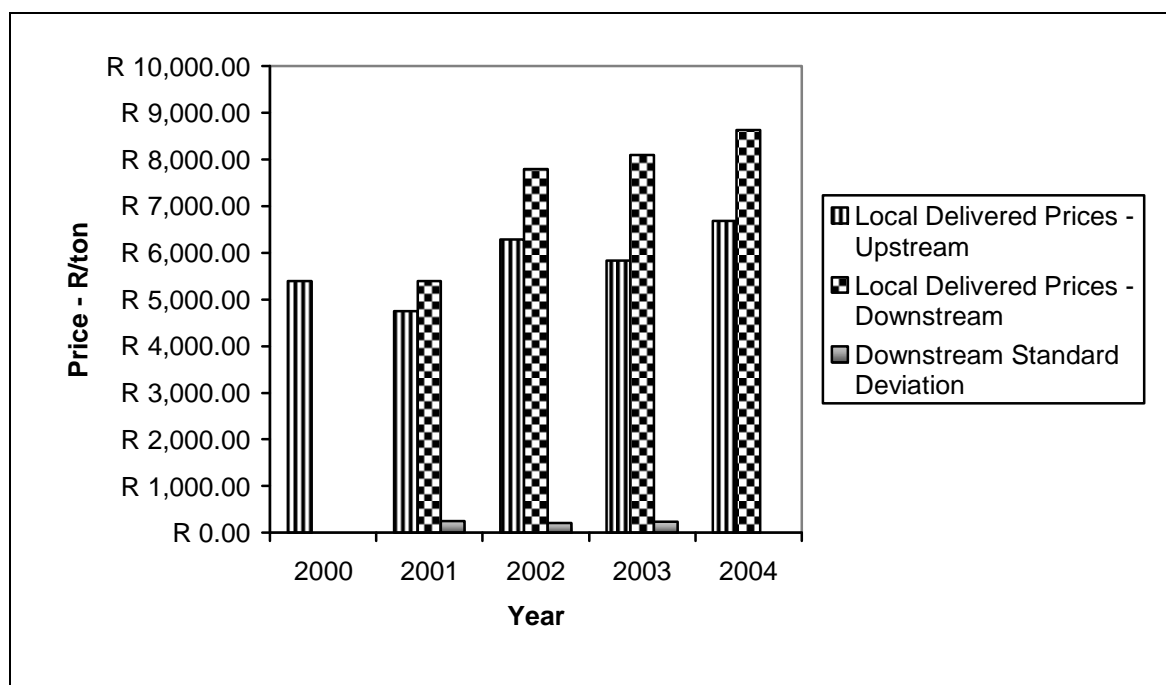
Figure 4.6: Historical Local & Export Volumes – PVC



Local sales from local production are showing a general growth pattern, growing by 7.7% annually over the last 4 years. Exports are generally constant for the last few years.

Commodity PVC suspension grades are distinguishable by the molecular weight (denoted as K-value), which determines the resin's suitability for end-use application. The grade denoted K66 or K67 is the dominant grade and is used for rigid extrusions such as pipe and conduit, which account for approximately 60% of the volume sold in the domestic market. Internationally, this grade has the highest consumption by volume and is thus the most traded PVC grade. Due to it being the most predominant grade, K66/K67 represents the marginal ton in deep sea markets and therefore drives the international PVC prices. All other commodity PVC grades are set by this price, as do PVC prices in the domestic market. The price differential across all grades is not more than 5%.

Local delivered prices based upon total volumes and total values for the respective years are shown in the figure below (ex-factory prices are not available as PVC is sold on a delivered basis):

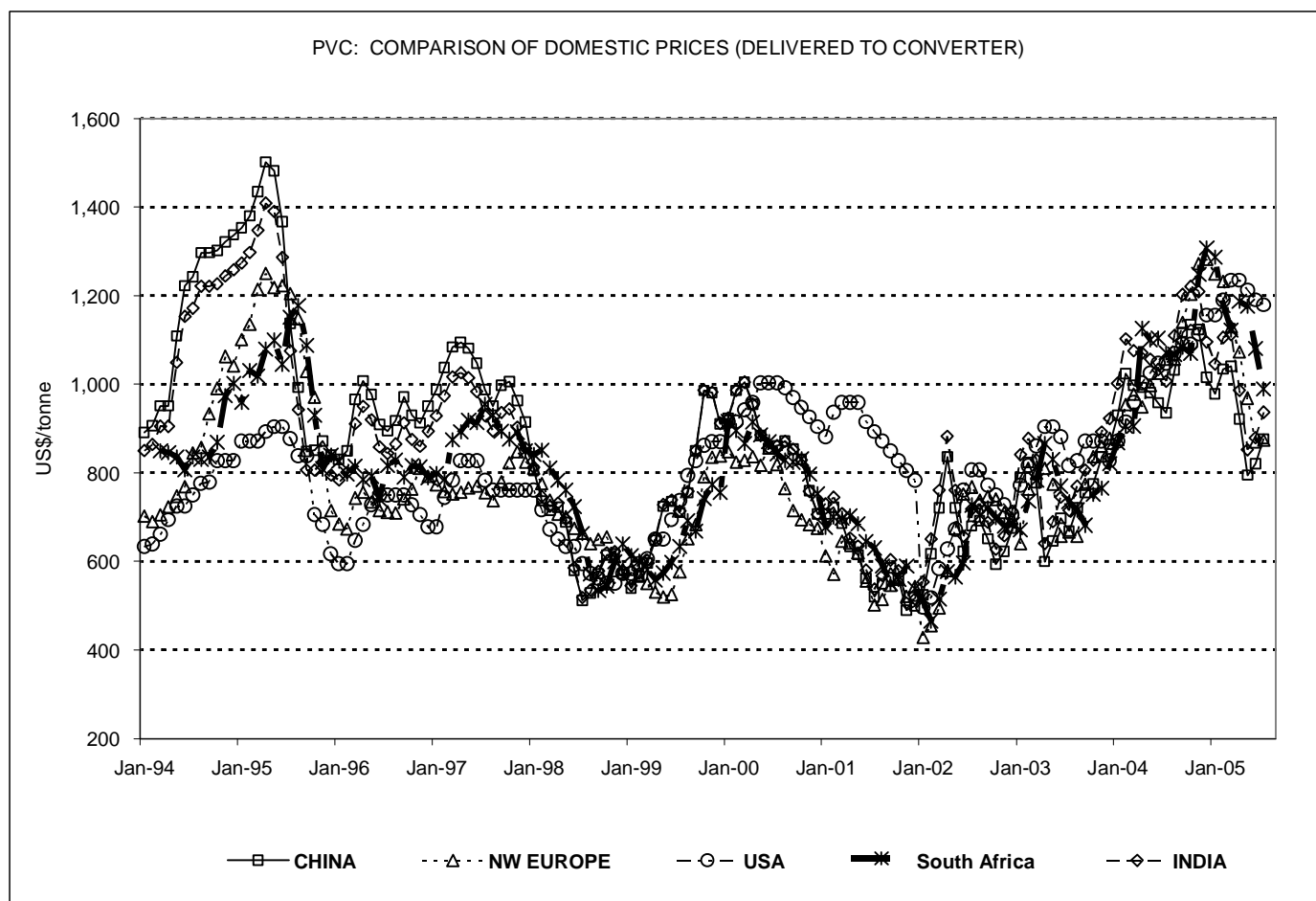
Figure 4.7: Historical Local Delivered Prices (Excluding VAT) – PVC All grades

Note: Downstream data was based on a small sample size. The difference between upstream and downstream prices can be attributed to not all downstream companies having participated in the study and that to the fact that downstream companies also buy polymer from other companies, such as traders and other importers, who were not part of the upstream sample participating in the study.

4.5.3. Comparison of SA inland prices for feedstock with international prices

The background to international pricing as well as sources for data is discussed in [Appendix 3](#) and in [Chapter 1](#). The trend and the general relationships are more important to gain insight into the fundamentals than a comparison of prices in a particular month. The choice of India and China as countries for comparison with South Africa is because both countries are large import markets for polymers.

Figure 4.8: SA and International PVC Domestic Prices



Some conclusions and commentary on the data shown above are as follows:

- Prices around the world are linked.
- In any month, there can be a very wide variation in the prices. The following are some of the reasons:
 - The derived import parity prices (for India and China) assume an instantaneous connection with the Reference Price (CFR Hong Kong). In reality there is a time lag of between 6 and 8 weeks.
 - Fluctuations in the currencies in relation to the US\$ will have an impact because in all countries (except the USA) the prices paid by local converters is in the local currency.

- During periods of regional shortages or surpluses, international and local supply/demand balances will play a role. For example, during the periods of tight supply, the local domestic prices in the USA were considerably higher than those in Europe and Asia. Due to supply constraints, it was not possible to physically ship product to the (massive) US market and the local producers were able to maintain prices higher than import parity (from Europe or the Middle East).
- In the early part of the period under review, there was a big variation in the prices for all polymers. The major factor contributing to this is that China and India had relatively high import duties (>35%), but these have been reduced and this has brought the prices across all countries covered much closer together.

Prices paid by South African converters are generally not out of line with prices paid in the countries included in the comparison. In the early part of the period under review, the prices in South Africa were much lower than those in China and India. However, as imports into China have grown over the period the CFR Hong Kong price has fallen to the low end of the range. In addition, import duties have fallen. Both factors have contributed to a narrowing of the gap between prices in South Africa and those in China.

4.5.4. Historical sales levels for key downstream products

PVC polymer is used to manufacture a large range of end-products, including pressure pipe, sewer and drain pipe, gutters and down pipes, conduit, profiles, medical products, cable, cling film and footwear, bottles, rigid sheet, rigid fittings as well as many other types.

No information regarding historical growth in output was provided by the small number of downstream respondents.

4.5.5. Basis for SA Downstream Products pricing calculations

In PVC products such as fittings, the direct competition is from imports, and local pricing is directly based upon competing with these imports, which have a duty of 15%.

4.5.6. Key differentiation factors for purchasing feedstock

The first differentiation factor is to determine the most suitable PVC grade, based upon product requirements and costs. Once the grade has been determined, suppliers are chosen on the basis of quality, continuity of supply and price.

4.5.7. Downstream Operations

Basis for operation [e.g. 24/7]

There is only one respondent operation that is operating on a 24 hour basis, but only operates 6 days/week.

Average age and original cost of equipment

There is only one respondent operation that reported equipment of 15 years old. The original cost of equipment was R6 million.

Capacity utilisation

Capacity utilisation for the one respondent is 90%, not taking into account idle weekend time.

Workforce

The number of the manufacturing workforce for the respondent company is 14.

4.5.8. Assessment of global competitiveness of downstream producers

One downstream respondent indicated that PVC conversion in SA is only of average competitiveness, mainly because PVC in SA is 20% more expensive than in low-cost countries such as Saudi Arabia.

4.5.9. Ability for downstream to expand product range based on lower feedstock prices

One respondent indicated that their imports of fittings for local resale are R50 million/annum, and these could be made locally, but a lower PVC feedstock price is required, as well as a weaker rand.

4.5.10. Impact of current pricing PVC polymer practices

Skills

One downstream respondent feels that skills are reduced as polymer prices are discouraging value-adding.

The upstream respondent commented that the growth of the local polymer industry has encouraged and required the development of technical, managerial, business and operational **skills** that are necessary to efficiently conduct business through the whole polymer value chain. The downstream conversion industry in South Africa is well developed and typically follows international polymer industry value chain norms; namely large national conversion companies, large independent companies and multitude of smaller entrepreneurial type operations. These companies can either focus on polymer conversion or can be multifaceted companies specialising in, for example, packaging irrespective of material type - steel, glass, paper or polymer.

Wages

One downstream respondent feels that wages are inhibited by low margins caused by high polymer prices.

The upstream respondent commented that the polymer pricing practices have allowed for the sustained development and growth of the downstream industry, the major employers of labour within this industry.

Technology

One downstream respondent believes that low margins caused by upstream polymer pricing practices are preventing them to invest in necessary new technology.

The upstream respondent commented that the sophistication of the South African end user market is comparable with that of developed countries and hence the local polymer conversion industry is required to keep pace with global developments in polymer technology. Consumer requirements

for specialised applications in turn require that the conversion industry invests in the necessary skills and equipment to facilitate the development and production of these applications and products (import replacement). Hence the upstream polymer production industry assists the conversion industry by developing new grades, enhancing and modifying existing grades to meet these requirements. Thus both the upstream and downstream industry players are required to track and apply changes in polymer technology into their operations and product offering.

Long-term sustainability

One downstream respondent had concerns that the long-term sustainability of the downstream sector is threatened, mainly due to low margins caused by high feedstock costs, which favours imports of finished products even at high rates of duty.

The upstream respondent feels that to keep pace with growth, long term sustainability of the local polymer industry will be required to expand its operations to meet the increased demand and this can only continue if all parts of the polymer value chain are profitable and the invested capital (equipment and skills) is adequately rewarded.

Import replacement

One downstream respondent believes that current polymer pricing practises have created little incentive for end-users to source locally.

The upstream respondent's view is that if the alternative is considered for a moment (no local polymer production and all polymer goods are imported), the polymer conversion industry would be significantly exposed to the global supply and demand balances which would manifest itself in unreliability of supply and would significantly expose the domestic market to price fluctuations and polymer merchants wishing to take advantage of the import situation. Secondly, South Africa itself would not be able to handle the importation of these vast quantities of polymer raw materials and the market would likely switch to the importation of semi finished goods and final products which would significant damage the South African polymer conversion industry. The current pricing practices have allowed for the growth and development of the local polymer conversion industry as supplied by local production and as such facilitated the replacement of imports (polymer and

semi-finished goods) with locally produced products. In countries where there is no local producer there is a significantly under developed polymer value chain, as semi finished and final products are imported rather than development of a capital intensive downstream industry.

4.6. Comparison of domestic prices with export prices

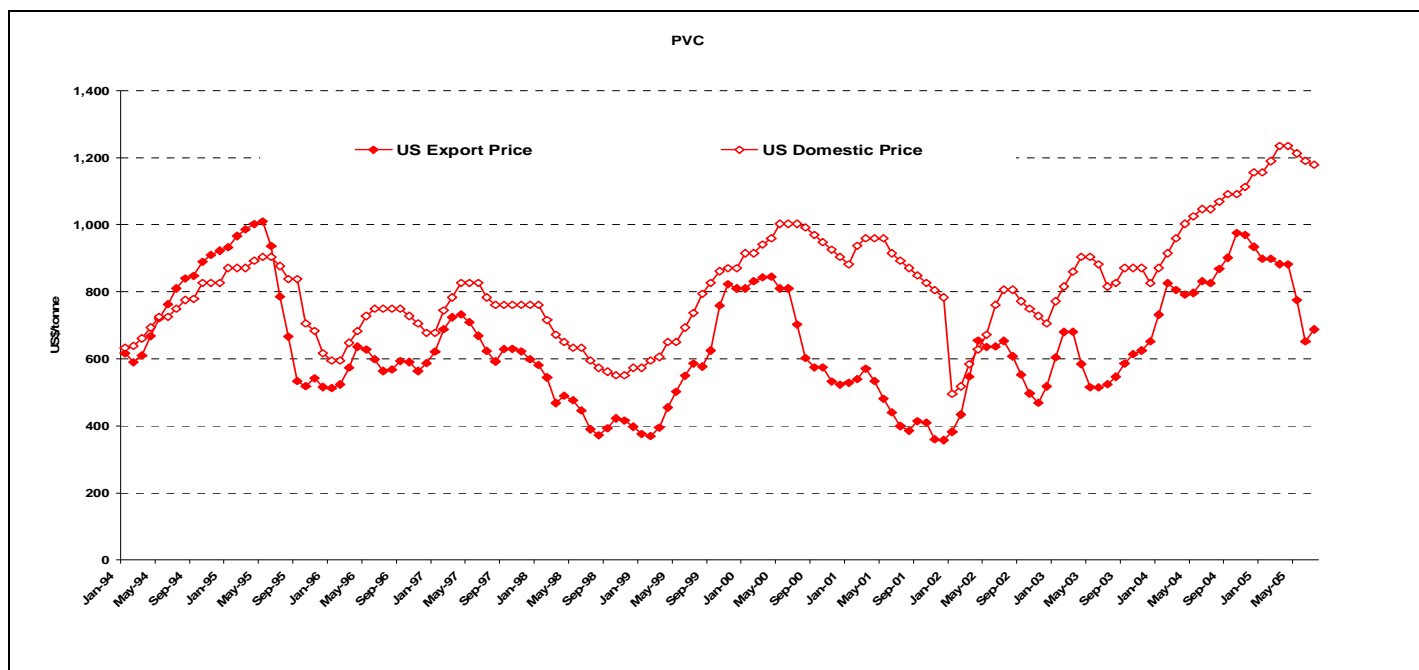
No time series data was available for export prices of products that were exported out of South Africa. The comparison has therefore been done on the average local delivered prices as received from PVC manufacturers and converters and average export prices.

In 2004, the average local delivered price for PVC was R 6.69/kg. The average F.O.B. price in the same year was R 5.64/kg. The major destination for South African exports was Zimbabwe. The average export price to Zimbabwe was R 6.20/kg. The difference between the local delivered prices and export price to Zimbabwe was around 7%. It should be noted that selling these exports in Zimbabwe has to add onto the export price logistics costs, tariff duties, inland distribution and agents' commission. The relatively lower percentage differential between the domestic price in South Africa and the export price to Zimbabwe is a function of logistics costs based on geographical proximity.

Time series data of export prices has however been obtained for a limited period for other countries or regions; namely the USA and North West Europe. Figures 4.9 and 4.10 below show that the difference between delivered domestic prices in South Africa and export prices is not unusual. For example, in the case of the USA the difference between their delivered domestic prices and FOB prices was as high as about 40% between January and May 2001 and as high as 46% by May 2005. It should be mentioned that the gap between the two is sometimes much closer. In fact for a period of almost one year between January 1994 and January 1995 the domestic price was lower than the FOB price. However for most of the 10 year period as shown in the chart the domestic price was always above the export price. The same trend should be expected in the case of South Africa as well. It should be noted that the FOB price is not the price paid in the export market, rather it is the price at which the polymer exits the borders of the source country. Upon landing at the export market logistical costs, duties/tariffs (where applicable), inland distribution and agent's commission (in some instances) and other costs are added onto the price

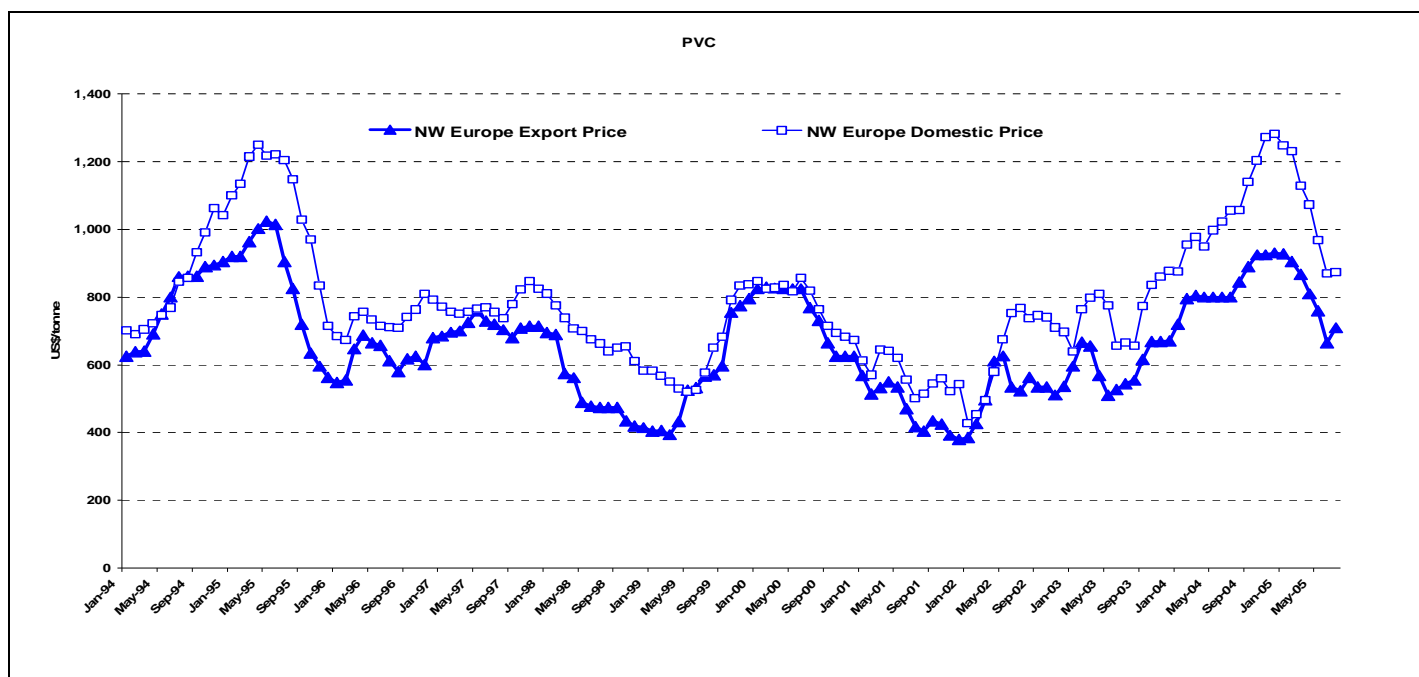
at which the polymer exited the borders of the source country. The difference between the delivered domestic price and the FOB price does not mean the domestic customers subsidize export customers.

Figure 4.9 Comparison of domestic and FOB prices of PVC in the USA



In the case of North West Europe as shown in figure 4.10 below, the difference between the delivered domestic prices and the FOB price was relatively smaller and negligible in some instances. Again this is a function of geographic proximity of export destinations and the unavailability of product for export.

Figure 4.10 Comparison of domestic and FOB prices of PVC in North West Europe



An important feature of the polymer industry world-wide is that in any country that has a surplus in any polymer, the price at which the polymer is exported is different (and usually lower) than the price at which it is sold to domestic users even after allowing for transport and other logistics costs. The comparison of the historical export and domestic prices of the USA and North West Europe over a ten year period shows that:

- In both regions the PVC export price is usually lower than the domestic price.
- However, there are also periods when the export price is very close to or actually higher than the domestic price. This takes place when the export demand increases faster than domestic, leading to higher export prices for a short period of time.
- In general the domestic prices are higher than export prices; it is unusual for these prices to be the other way around.

4.7. Impact of pricing on downstream purchasers - Demand Elasticity

4.7.1. Introduction

The approach followed to determine demand elasticity in the PVC value chain is described in [Appendix 1](#).

4.7.2. Demand Elasticity Analysis for PVC

It was not possible to collect accurate information from sufficient companies to enable the plotting of historical and future demand elasticity for PVC. As such, alternative methods have been used to calculate demand elasticity.

Professor Johannes Fedderke of the Southern African Econometric Research Unit undertook a study of price elasticity in Sasol's LDPE, LLDPE, PVC and PP markets during the course of 2005. This study set out to determine the price elasticity of demand and the price elasticity of supply for these commodities in South Africa. The input data used covered the period from January 1994 to June 2005. The study which uses sophisticated econometric techniques draws on 10 years of quarterly polymer consumption, polymer price and national economic data to determine both the supply and demand side price dynamics to determine the product's elasticity. The results of this study indicated for PVC that a 10% decrease in price would in small segments of the PVC market result in a 10% increase in market size, and vice versa. Only in the PVC market is there any suggestion that price decreases will result in any significant increases in market size. Even in the case of the PVC market, the implication is that the increase in market size will be no more than proportional.

4.7.3. Practical Verification of Demand Elasticity for PVC

A market segment analysis was done in order to investigate the demand elasticity of PVC further. Demand elasticity for PVC can be verified from a practical perspective by evaluating the relative portion the PVC polymer cost in the final product that is being sold. This provides a measure of

elasticity as it can determine the extent to which the final product is price sensitive. An analysis for the major polymer grades, as well as end-use applications, is shown below:

a) PVC – rigid extrusion applications (60% of PVC demand)

Major applications	% Cost of PVC polymer in converted product	End-use product	% Cost of PVC polymer in end-use product	PVC Polymer Demand Elasticity for end-product
1. Pressure pipe	30 – 40%	Installed water reticulation systems, etc.	1 – 2%	PVC price cannot impact demand for water reticulation projects
2. Electrical conduit	30 – 40%	Installed electrical projects	< 1%	PVC price cannot impact demand for electrical projects
3. Sewer & drain pipes	30 – 40%	Building projects	< 1%	PVC price cannot impact demand for sewer and drain projects

The conclusion is that for 90% plus of the applications, PVC polymer constitutes such a small fraction of the installed end-product price that it cannot impact on the demand elasticity.

b) PVC – flexible applications (28% of PVC demand)

Major applications	% Cost of PVC polymer in converted product	End-use product	% Cost of PVC polymer in end-use product	PVC Polymer Demand Elasticity for end-product
1. Cable	8 - 10%	Electrical projects	<2%	PVC price cannot impact demand for electrical projects
2. Hose	25%	Mining hose, garden hose	10 – 25%	PVC price cannot impact demand for mining use. Retail could have some

				elasticity
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The conclusion is that PVC polymer has a possibility to impact on the demand elasticity on the retail rather industrial side.

c) PVC – Moulding applications (10% of PVC demand)

Major applications	% Cost of PVC polymer in converted product	End-use product	% Cost of PVC polymer in end-use product	PVC Polymer Demand Elasticity for end-product
1. PVC fittings	30 – 40%	Pipe fittings, etc.	30 – 40%	PVC price cannot impact demand for water reticulation projects, which include labour and other material costs
2. Bottles	30 – 40%	Packaging of beverages, cosmetics, etc.	<5%	Significant product substitution between PVC and PET in bottles – led to historical demand elasticity

Due to the large impact of product substitution caused by aggressive market share growth of PET (Saturated polyester) in packaging applications, this PVC category is subject to demand elasticity.

The conclusion for PVC polymer is therefore that for most end-use applications there is no significant demand elasticity, with the notable exception of packaging bottles and sheet. This is therefore a verification of the statistical analysis that indicated a low elasticity.

4.8. Impact of pricing on downstream purchasers – EVC

Due to the integration of production facilities, it was not possible to obtain the required information for the EVC analysis at individual polymer level. The analysis was therefore conducted on the combined polymers for both the upstream and downstream sectors.

It is also worth noting that only one company supplied historical financial data for downstream PVC analysis. The data did not correspond historically with that supplied by the upstream. Please refer to [Appendix 2](#) for EVC results of combined upstream and combined downstream polymers.

4.9. Conclusions – PVC

Production capacity for PVC in SA is around 200 000 t/a. The SA market size in 2004 for PVC primary polymer used in local plastic conversion was estimated at 156 000 tons. This indicated some excess capacity.

As with all regions in the global market, PVC prices are determined relative to the competitive forces acting in the particular region. In order for a supplier to be successful in penetrating the market and sustaining a market share position, the customers' alternative purchasing options must be considered and a competitive offering made. South African PVC producers follow the same approach. They do not select a particular price from a particular region and rigorously apply that to determine its price to the South African domestic market. They are driven by market dynamics and react to the lowest price imports being offered by competitive suppliers to its customers. Therefore PVC pricing mechanism prevailing in South Africa is one where the price is negotiated based on offers in an open market where products are readily traded across national boundaries. The outcome is that the most competitive supplier sets the price and is thus better referred to as market pricing as opposed to formula-driven IPP. The prices in export markets are based on marginal cost (variable cost) globally and hence are usually lower than domestic prices.

Prices of locally manufactured substitute materials, such as paper, metal and glass, are also monitored and considered for the market sectors where they compete as alternatives to polymers. A combination of all these factors culminates into a domestic price at a particular point in time.

A comparison between domestic and export prices that had prevailed in North West Europe and the USA over a 10 year period revealed that in cases where there is surplus PVC, the price at which the polymer is exported is usually lower than the price at which it is sold to domestic users.

The same situation was found to be the case in South Africa. In general, the further away the export market like in the case of the USA's exports to Brazil, the higher the price differential between the domestic price and the export price. The converse is also true, that is, the closer the export market as in the case of South Africa's exports to Zimbabwe and North West Europe's exports which go within Europe, the smaller the price differential. There are limited periods when the export price is very close to or actually higher than the domestic price. This takes place when the export demand increases faster than domestic, leading to higher FOB prices for a short period of time.

Analysis of South Africa's domestic PVC prices compared to a number of major competing countries, including China, US, NW Europe and India, showed that:

- Prices around the world are linked.
- In any month, there can be a very wide variation in the prices because the source of marginally costed exports changes on a continuous basis from one country/region to another.
- Prices paid by South African converters are always in the range of prices that prevailed in the countries or regions (China, India, North West Europe and USA) covered in this analysis, mostly at the lower end of the range.
- In general the domestic prices are higher than FOB prices; it is unusual for them to be the other way around.

The global reality test for PVC showed that South Africa's PVC conversion industry is not lagging behind in terms of development, taking into account South Africa's current state of economic development. Countries such as South Korea and Taiwan, that have highly developed conversion industries, have developed leading edge conversion technology and products (e.g. flooring) to serve the international market. It is these countries in particular that South Africa can learn from.

The results of the demand elasticity analysis indicated that a 10% decrease in PVC price would result in a 10% increase in market size, and vice versa. The implication is that the increase in market size will be no more than proportional. From a practical perspective the large impact of

product substitution caused by aggressive market share growth of PET (Saturated polyester) in packaging applications, the PVC bottle packaging category and sheet are subject to demand elasticity. The general conclusion for PVC polymer is therefore that for most end-use applications there is no significant demand elasticity.

Due to the integration of production facilities, it was not possible to obtain the required information for the EVC analysis at individual product level. The analysis was therefore conducted on the combined polymers upstream and downstream sectors for the period 1997 to 2005.

For **upstream** polymers, the EVC analysis indicated that the return on capital was frequently lower than the weighted average cost of capital, K. This is a clear indicator that the current pricing practices of the upstream sector are not resulting in high levels of profitability, as measured against the total cost of capital, namely K. This situation means that the upstream sector is not making super profits.

In the case of Sasol, the focus for this study was on Sasol Polymers, the PVC manufacturing unit within the group and not on the whole group. Therefore profits of Sasol Limited as a group cannot be equated to those of Sasol Polymers. Sasol Polymers, situated within the Sasol's chemical businesses, is a separate company within the Sasol Group, and has a supply agreement for raw material from another Sasol Group company, Sasol Synfuels. The supply of these raw materials is based upon a pricing mechanism that sets the price at the equivalent fuel value, which is set by Basic Fuel Price mechanism which in turn is directly set by international fuel prices. Therefore, Sasol Synfuels sells the feedstock at a price that they would have realised in the marketplace if it was converted to saleable fuels. This mechanism ensures that there is no cross-subsidization between fuels and polymers businesses and hence the profitability of the businesses is a true reflection of the value add of the chemicals and fuel businesses.

For **downstream** PVC, despite all efforts, only one company provided financial data and the data did not corresponded historically with the information provided by upstream companies. Although statistically insignificant, the EVC analysis of combined polymers indicates that the return on capital was lower than the weighted average cost of capital, K in every year except 1997 and

1999. This situation means that the downstream sector companies that responded are not making super profits either.

The listed company analysed showed a return larger than the cost of capital (K) in 2003 that outweighed the years of returns that were lower than the cost of capital, and IVC has remained positive through 2005. This particular company was active in acquisitions, which caused the large increase in EVC.

5. FEEDSTOCK / RAW MATERIALS FOR FERTILIZERS (PHOSPHATE ROCK, PHOSPHORIC ACID & AMMONIA)

5.1. Market definition of upstream chemical products

a) Introduction

Feedstock or raw materials for fertilizers included in the study are phosphate rock, merchant grade phosphoric acid and ammonia.

Phosphate rock is the term applied to marketable concentrates containing phosphate minerals, e.g. apatite. Internationally some rock of high solubility is applied directly to soil as a fertilizer, (not a common practice in South Africa) but most commonly phosphate rock is chemically converted to a soluble form for use in fertilizers. Phosphate rock in SA is beneficiated to increase P_2O_5 contents from less than 10% to an average 38%, but elsewhere in the world it is mostly used as is due to a higher P_2O_5 content. For example, the USA, which is the largest producer and user of phosphate rock, has average P_2O_5 contents of 29% compared to less than 10% for SA. In the USA conversion of phosphate rock to downstream products such as phosphoric acid and super phosphates is mostly on-site at the mines.

Phosphoric acid (H_3PO_4) is commercially available in a range of qualities and concentrations. These range from crude acid containing most of the impurities present in phosphate rock, of low concentration (40-54% P_2O_5), used for the manufacture of fertilizers such as di-ammonium phosphate (DAP) and triple super phosphate (TSP), to a very pure acid containing very low impurity levels, of concentrations of 75% and 85% H_3PO_4 , as used for food applications and other demanding end-uses.

Ammonia (NH_3) is made synthetically by means of a reaction between nitrogen and hydrogen. The hydrogen is prepared from synthesis gas, which typically is produced from natural gas, but also other sources such as refinery gas, coal, crude oil and even wood. Nitrogen is supplied from air, or in pure form from air separation plants.

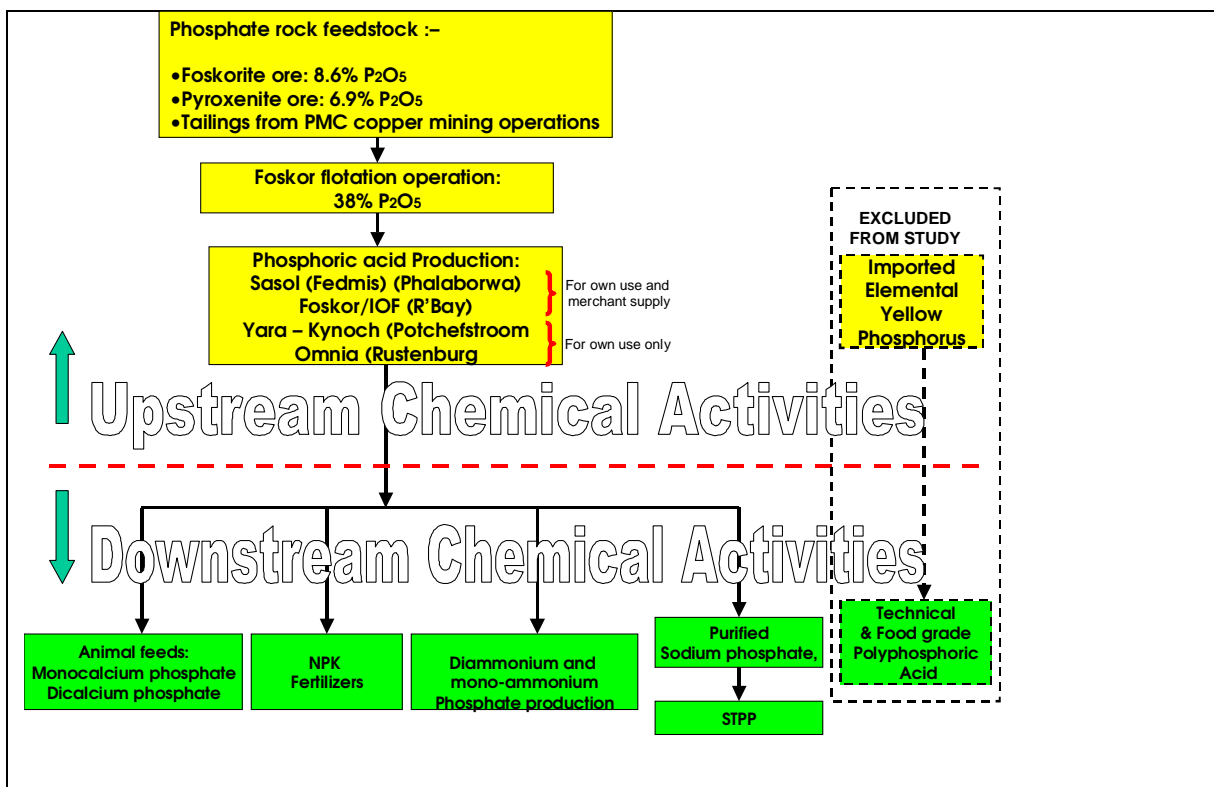
Generally the production of conventional synthetic ammonia is an energy intensive, complex process, operating at elevated temperatures and pressures. Ammonia gas itself is highly dangerous. The gas is mostly compressed and liquefied, and transported in special high-pressure vessels.

In the case of Sasol, the only SA ammonia producer, they operate two ammonia operations, one in Sasolburg and one in Secunda. The Sasolburg plant is a conventional unit, previously using Sasol's own synthesis gas produced from coal. This plant has now been converted to use natural gas supplied from Mozambique. Sasol's operation in Secunda is unique in terms of its process. The plant recovers "occluded ammonia" in coal that becomes available from Sasol's coal gasification operations. The ammonia is recovered from the gas liquor stream which also contains phenols and other tar products.

b) Value chain

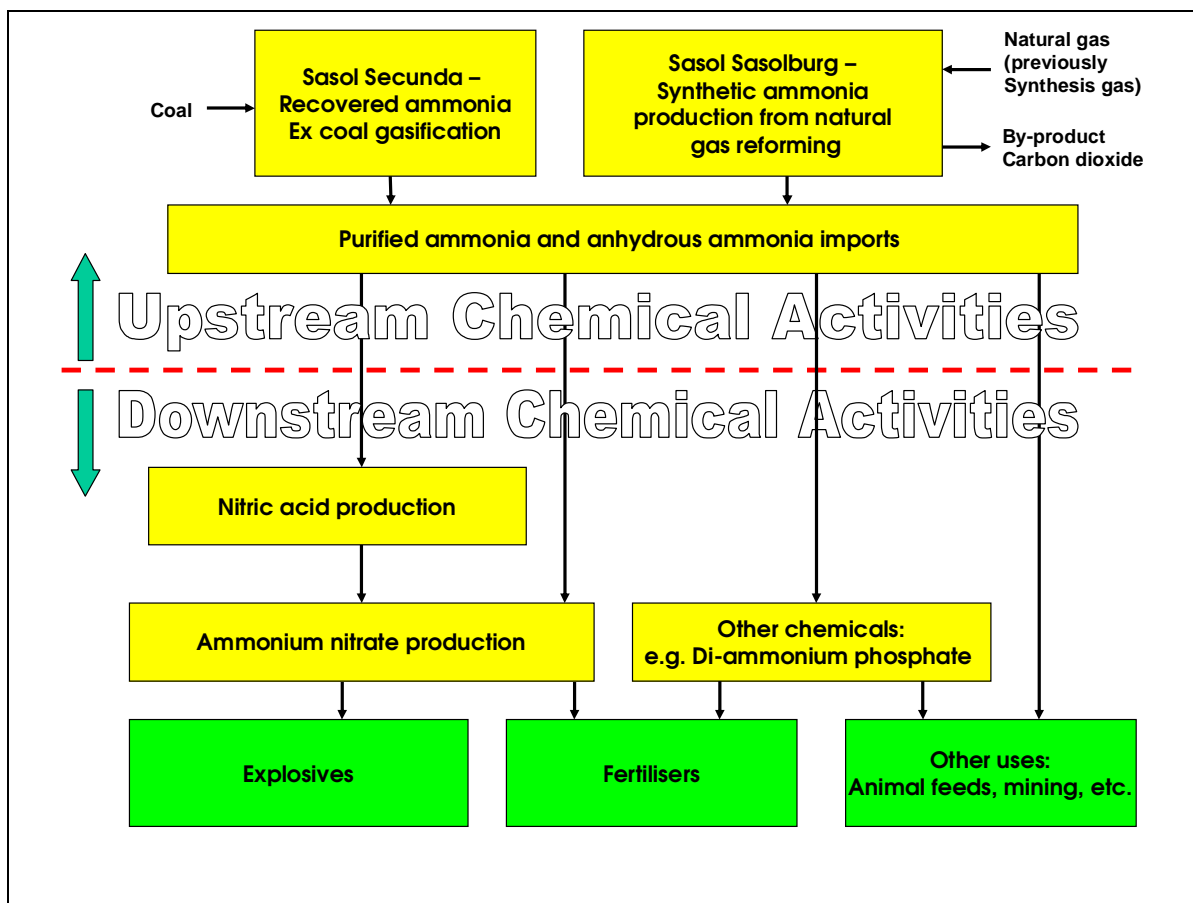
The value chain for Phosphate rock is summarised in the diagram below:

Figure 5.1: Phosphate rock Value Chain



The ammonia value chain is as follows:

Figure 5.2: Ammonia Value Chain



c) Applications and Global Market Size

Phosphate rock:

In 2002, global phosphate rock production grew to 132.6 million metric tons with an estimated value of \$4.8 billion. (Source: DME)

Worldwide consumption of phosphoric acid and phosphate fertilizers - the primary end-use for phosphate rock - has been increasing since the 1970s, but the rate of growth has slowed consistently. The second biggest demand sector - detergents - has been affected by the growing acceptance that phosphates lead to pollution of waterways. The pattern of consumption of phosphate rock is affected more by seasonal weather patterns and regulations covering its use,

than by alternate periods of growth and recession that characterise the consumption of other industrial minerals. (Source Roskill)

Phosphoric acid:

Phosphoric acid (H_3PO_4) is the leading inorganic acid produced and consumed in terms of production value and it is the second largest in terms of volume—after sulfuric acid. By far its greatest use is in the manufacture of phosphate chemicals consumed primarily as carriers of phosphorus in fertilizers and animal feeds. Phosphoric acid is also used in the manufacture of phosphate chemicals for use in water treatment and detergent builders, dentifrices, fire control chemicals and a host of smaller markets. Consumption of phosphoric acid for its acid properties per se is relatively small (e.g., treatment of metal surfaces, beverage acidulation). Phosphoric acid is the leading intermediate product or processing step between phosphate rock and the end markets for phosphorus in phosphate form.

World production (and apparent consumption) reached higher levels of about 30 million metric tons of P_2O_5 in 2004. The primary market for wet phosphoric acid is the production of phosphate fertilizer products — ammonium phosphates and triple super phosphate. Fertilizer production accounts for approximately 85% of the global market for wet phosphoric acid. The balance is consumed in a variety of industrial applications. The United States is the largest consumer, accounting for about 35% of apparent world consumption in 2002, and Southwest Asia, Africa and Western Europe combined accounted for an additional 28%. Consumption in the former USSR, which accounted for 21% of world consumption in 1986, accounted for only 8% in 2002.

Africa, with 68% of world export volume, dominates the export market for wet phosphoric acid. The United States, Western Europe and the Middle East are also large exporters.

Ammonia:

In 2003, global ammonia production grew to 110 million metric tons, with an estimated value of \$26 billion. (Source: SRI Consulting)

Ammonia is the basic building block of the world nitrogen industry and is the intermediate product from which a wide variety of nitrogen fertilizer materials and industrial products are produced. Fertilizer use accounts for an estimated 85-90% of the end-use market for ammonia. Although the direct application of ammonia accounts for approximately 25% of the nitrogen fertilizer market in the United States, on a worldwide basis ammonia is generally processed into a variety of downstream products prior to being applied to the soil.

The major downstream fertilizer products include urea, ammonium nitrate, ammonium sulfate and ammonium phosphates. A wide variety of industrial uses for ammonia and its derivative products account for the remaining 10-15% of the world market, including explosives.

d) Impact of different product grades or performance specifications on market applications

Phosphate rock:

Phosphate rock is priced according to the available P_2O_5 contents in the rock, taking into account the logistical cost to move the rock to the site where beneficiation takes place. The higher the relative P_2O_5 contents the higher the price.

Phosphoric acid:

Crude acid of low concentration (40-54% P_2O_5) (MGA – merchant grade acid) is used for the manufacture of fertilizers such as di-ammonium phosphate (DAP) and triple super phosphate (TSP), while a very pure acid containing very low impurity levels, of concentrations of 75% and 85% (PPA – purified phosphoric acid), is used for food applications and other demanding end-uses. Crude phosphoric acid is also de-fluorinated to produce an animal feed-grade acid.

Ammonia:

Anhydrous ammonia is a commodity chemical with a typical specification of 99.7% purity, and the balance mainly water. Higher purity ammonia is a speciality product, and not included in this study.

e) Level of competition in supply for major geographic export markets for upstream products

Phosphate rock:

Phosphate rock is produced in many countries, of which the majors are:

- USA: 27%
- Morocco: 18.1%
- China: 15.8%
- Russia: 7.9%

SA is the 9th largest global producer with a 2.1% share. In major producing countries such as the USA there are large numbers of independent producers.

Phosphoric acid:

The United States is the major producer of wet phosphoric acid, accounting for 36% of world production in 2002, followed by Africa at 19% and Socialist Asia at 10%. The United States and Africa both significantly increased their share of world production during 1986–2004, while the shares of the former USSR, Western Europe, Eastern Europe and Japan declined.

Ammonia:

Many producers produce anhydrous ammonia in about 80 countries. In 1974 the developing countries accounted for 27% of ammonia capacity. By 2003 their share was 52%. Some 88% of world ammonia production is processed or used in the countries where it is produced. The remaining 12% of world ammonia production enters international trade directly for all end-users. (Source: International Fertilizer Industry Association).

5.2. SA Market structure and shares of upstream chemical producers

5.2.1. Domestic industry structure

a) Feedstock for Fertilizer production

Phosphate rock:

Typical natural phosphate rock in SA contains less than 10% phosphorus pentoxide (P_2O_5). The major natural resource base is in Phalaborwa. There is no other commercial supply of phosphate rock in SA. There is however one other phosphate rock mine (Fer-Min-Ore Phosphate) in South Africa near Steenbokpan in the Limpopo province which beneficiates the phosphate rock for captive production of SSP (single super phosphate) which they supply to the market.

Ammonia:

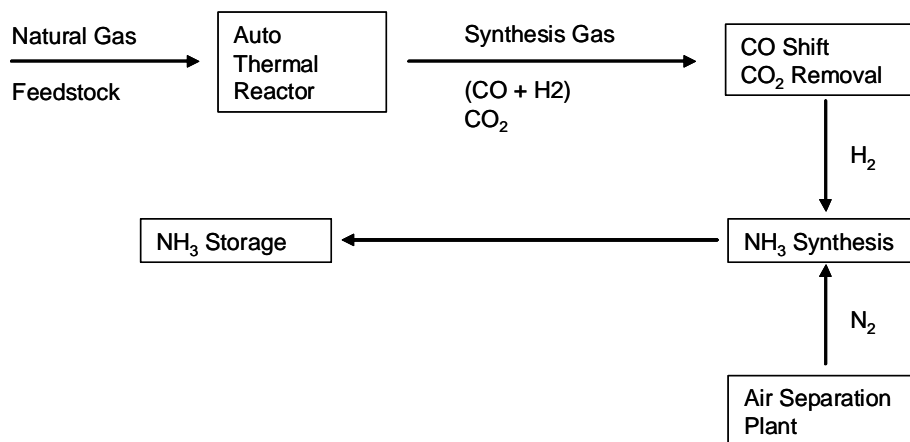
Ammonia is produced by Sasol from two distinct Sasol processes – from the Coal-to-Liquid Fuel process in Secunda and from a dedicated ammonia synthesis process using reformed natural gas in Sasolburg. South Africa is a net importer of ammonia and typically between 60 000 and 100 000 tons are imported annually.

Sasolburg Ammonia Synthesis Process

The key feedstock into the Sasolburg ammonia synthesis process is natural gas from Mozambique, which is synthesized in Sasolburg prior to feeding into the ammonia and other Sasol processes.

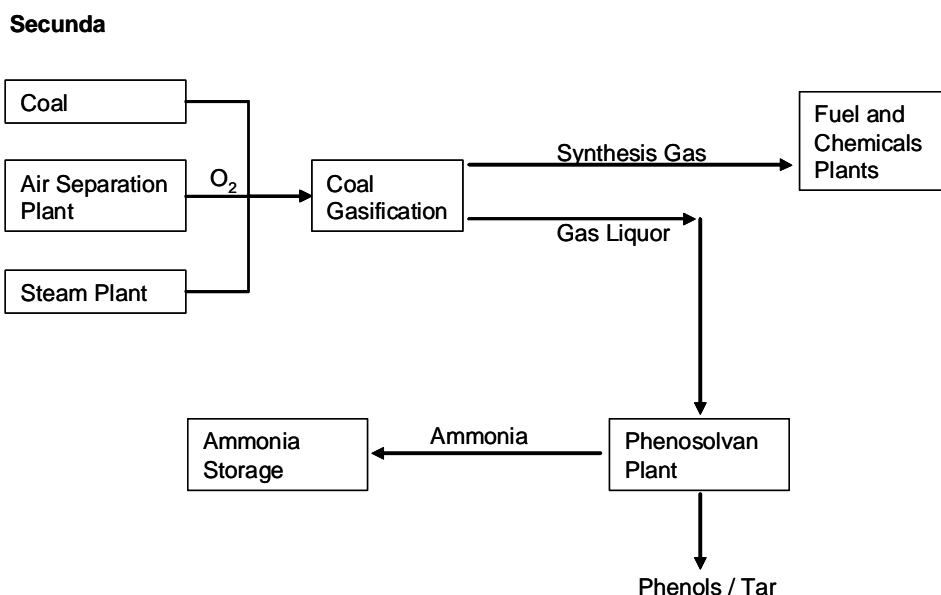
The Sasolburg process has undergone a number of de-bottlenecks, with the current budgeted capacity at approximately 315 000t/a. The process forms an integral part of the Sasolburg Gas Loop and availability of synthesized gas is dependant on the efficiency of the Gas Loop at any given time and the economics of the various Sasol processes comprising the Gas Loop.

Sasolburg



Secunda Ammonia from Coal-to-Liquid Fuels Process

In Secunda ammonia is produced from the extraction of phenols and tars out of the phenolsolvan plant. A key feedstock into the phenolsolvan plant is gas liquor, produced from the coal gasification process. Current ammonia production capacity from the phenolsolvan plant is 345 000t/a.



b) Fertilizer feedstock Production

Ammonia:

Sasol is the only producer of ammonia in SA. In the recent past AECI also manufactured ammonia from coal at Modderfontein, as well as from oil refinery gas in Milnerton, Cape Town. These plants closed down, as they were no longer economically viable to operate and maintain.

Sasol operates two ammonia operations, one in Sasolburg and one in Secunda. The Sasolburg plant is a conventional unit, previously using Sasol's own synthesis gas produced from coal, and pure nitrogen. This plant has now been converted to use reformed natural gas supplied from Mozambique. The installed capacity of this plant is 315 000 t/a. Sasol's operation in Secunda is utilising the so-called Phenosolvan process. The plant recovers ammonia that becomes available from Sasol's coal gasification operations. The plant has a capacity of 345 000 t/a.

Phosphate rock:

Foskor in Phalaborwa employs a relatively expensive flotation process to produce a phosphate rock concentrate containing around 38% P_2O_5 . This relatively high P_2O_5 concentration is required in order to transport the phosphate rock economically to downstream users. Foskor has a stated capacity of 3.3 million t/a, while production in 2003 was only 2.7 million tons.

Phosphoric acid:

Phosphoric acid is produced in SA at three locations, namely:

- Foskor/IOF in Richards Bay with capacity of 430 000 t/a as P_2O_5 , being increased to 780 000 t/a
- Sasol Nitro [Fedmis] in Phalaborwa with an installed capacity of 325 000 t/a (with the smaller plant with a capacity of 100 000 t/a being mothballed) as P_2O_5 . The sale of this operation by Sasol to Foskor did not go ahead because the Competition Commission recommended that it should not be approved.
- Omnia in Rustenburg with a capacity of 55 000 t/a as P_2O_5 , mostly for captive consumption.
- Yara [Kynoch Fertilizers] in Potchefstroom with a capacity of 85 000 t/a as P_2O_5 [Plant has been closed permanently]

c) Fertilizer feedstock Market

The SA market size in 2004 for ammonia was around 710 000 t/a of which around 80 500 tons were supplied via imports. In 2003 the local market for phosphate rock was 2.6 million tons, declining to 1.7 million tons in 2004.

5.2.2. The effect of import tariffs, anti-dumping duties and any other regulatory factors affecting pricing

Ammonia:

There is no tariff protection on ammonia, and no anti-dumping duties have been enacted in the recent past. Prices are also not affected by other regulatory factors.

Phosphate rock:

There is no tariff protection on phosphate rock, and no anti-dumping duties have been enacted in the recent past. Prices are also not affected by other regulatory factors.

Phosphoric acid:

There is no tariff protection on phosphoric acid, and no anti-dumping duties have been enacted in the recent past. Prices are also not affected by other regulatory factors.

5.2.3. The global nature of the industry

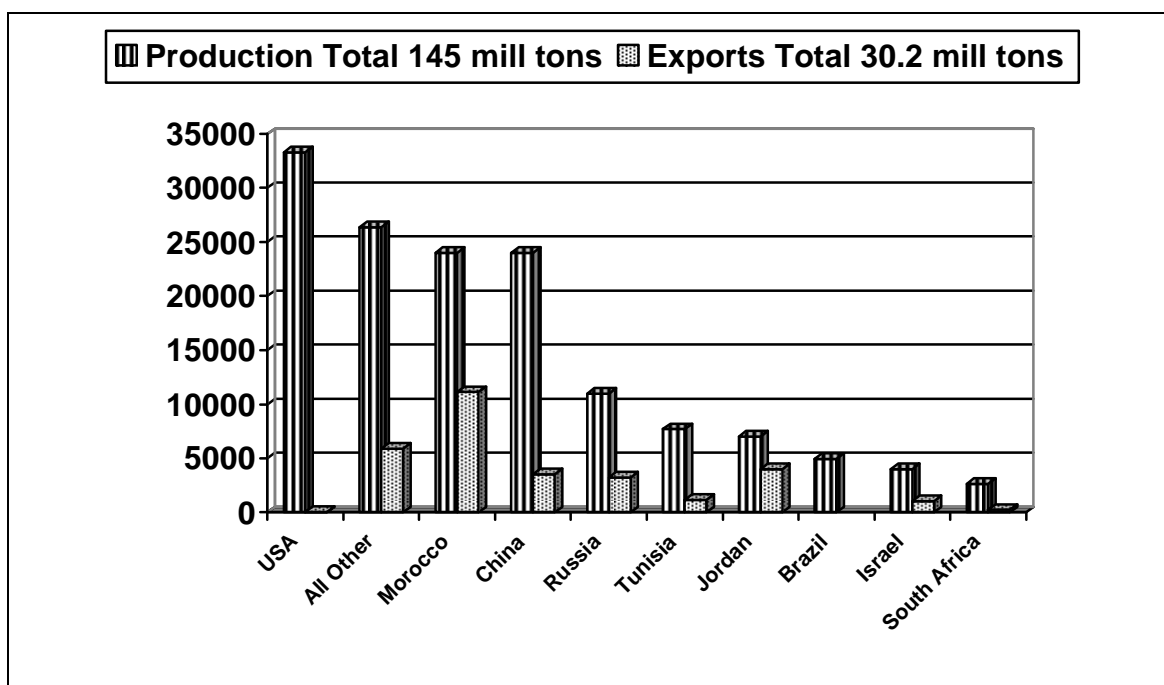
Ammonia:

Ammonia is a commodity product that is produced by many countries and is well-traded in large volumes (13 -18 million tons/annum) around the globe, demonstrating its global nature. Ammonia is predominantly made from natural gas, and there has been a continuous shift in production capacity towards regions with low-cost natural gas. Global plant sizes are also increasing, due to economies-of-scale issues.

Phosphate rock:

Phosphate rock is a commodity product that is produced by many countries and well-traded in large volumes around the globe, demonstrating its global nature. In 2003 SA produced only 1.8% of global phosphate rock, and accounted for only 0.8% of global exports. The global supply and export scenario for phosphate rock is shown in the following diagram:

Figure 5.3: Global Phosphate Rock Production and Exports - 2003



Source: DME

Global prices for phosphate rock are determined on a supply/demand basis, but are mainly determined by India as they import around 10% of global phosphate rock trade. The major Indian importers publish on an annual basis the phosphate rock price, after negotiations with the major suppliers. Global supply of phosphate rock has to be competitive based on the set prices, as importation of downstream products such as DAP will result in uncompetitive regional phosphate rock supply being forced out of the market.

Phosphoric acid:

Phosphoric acid, similarly to phosphate rock is a commodity product that is produced by many countries and is well-traded in large volumes around the globe, demonstrating its global nature. Global prices for phosphoric acid are also set by India, due to their dominance as importer of phosphoric acid. In 2003 India accounted for 30.1% of global imports, or 3.1 million tons. SA accounted for 18% of these Indian imports.

5.3. Costs and pricing of upstream chemicals products

5.3.1. The cost structure of the industry and global comparison

Ammonia

The ammonia production from the phenolsolvan plant in Secunda is part of an integrated process that produces a range of other products, and the cost structure was not assessed as part of the study. The cost structure for the more conventional ammonia production in Sasolburg has not been supplied.

Phosphate Rock

SA is not a global low cost producer for both phosphate rock and phosphoric acid, as local phosphate rock is igneous which is found through deep mining versus most of the world supply of rock which is sedimentary and is near the surface. SA's phosphate rock is produced by means of a mining process, followed by a metallurgical beneficiation and concentration process that involves chemical flotation and drying. This process increases the average P_2O_5 contents from less than 10% to an average 38%. Major exporting countries elsewhere in the world have phosphate resources that have a natural P_2O_5 contents that is high enough not to require expensive chemicals, processing and drying. In addition, the inland position of the phosphate rock source also results in high inland transportation cost to the export harbour. The major cost elements are therefore related to typical mining operations, including materials handling and milling, as well as the beneficiation process. The beneficiation process is an added cost for SA compared to major global suppliers, as is the waste management of the flotation tailings. No detailed breakdown of the actual cost of production for phosphate rock was provided.

Phosphoric Acid

Phosphoric acid is produced by means of the reaction of sulfuric acid with phosphate rock. The cost analysis therefore has to take into consideration the production of sulfuric acid as well. The main cost element in sulfuric acid production is sulfur feedstock. SA has little sulfur feedstock, and the majority of requirements are imported from Canada. Due to the low unit cost of sulfur, logistical handling and shipping costs are relatively high, making the cost of sulfuric acid production high.

The major cost items in phosphoric acid production are phosphate rock and sulfuric acid, which account for around two-thirds of total production costs. According to the upstream respondent, phosphate rock historically was sold at less than import parity, and future inland prices were to be set at around 26% below calculated import parity prices, as set in India. This advantage is however negated by the high cost of imported sulfur, which is more or less double the cost of producers that have inland access to sulphur, as well as the high inland transportation costs in SA.

5.3.2. SA Production Advantages & Disadvantages

Ammonia

SA advantages include:

- Relatively well-developed downstream consumption into fertilizers and explosives applications.

SA disadvantages include:

- Relatively small local production facilities compared to new globally competitive facilities.
- Relatively small local and regional market.
- Inland location of production facilities.

Phosphate Rock

The major disadvantage is high cost of production as mentioned previously and the phosphate rock operation in SA is primarily a mining operation, using chemical flotation technology to concentrate the ore. The advantages SA has include a large and consistent ore body, access to mining technology know-how, maintenance and skills, competitive production factors such as utilities and energy, as well as a good reputation regarding consistently high quality final product which contains low levels of organic material and heavy metals such as cadmium.

The disadvantages of phosphate rock production in SA are related to the relative low P_2O_5 contents in the natural ore body, requiring an expensive concentration process, compared to

lowest cost producers elsewhere that can use their natural ore directly for phosphoric acid production. In addition, the major production is located inland and high transportation cost and lack of rail capacity are impediments to exports, while local demand is dependant upon the agricultural industry, which shows large variations in demand on a seasonal and annual basis. Export freight costs, especially to Europe, is also a disadvantage compared to major suppliers such as Morocco.

Phosphoric Acid

Phosphoric acid production in SA has relatively few advantages. These include manufacturing technology know-how, maintenance and skills, competitive production factors such as utilities and energy, as well as a good reputation regarding consistently good quality final product.

The disadvantages of phosphoric acid production in SA are varying for different operations. Some operations are small and relatively old compared to global best practice, resulting in poor efficiencies and particularly high maintenance costs [one operation has recently been closed due to these factors]. Local demand is dependant upon the agricultural industry, which shows large variations in demand on a seasonal and annual basis. A major disadvantage is the lack of sulphur mineral resources in SA, causing expensive importation of nearly 1 million tons/annum. Sulfur is required to manufacture sulfuric acid, a main raw material for phosphoric acid production.

5.3.3. Upstream pricing practices with respect to downstream domestic purchasers

Ammonia

Ammonia is sold on contract to explosives, fertilizer and mainly on a non-contractual basis to smaller industrial customers. A contract price formula is used to determine the monthly selling price of ammonia to explosives and fertilizer industry customers. The contract price is based upon the actual FOB import prices to South Africa from the Middle East (75%) and Yuzhny, Russia (25%) and including all logistics costs. The ammonia contract price formula also makes provision for a competitive position for limestone ammonium nitrate fertilizer versus imported urea. The ammonia price for each month is calculated on the 15th of the previous month based upon the

average published spot price (FERTECON and FMB) out of the Middle East and Yuzhny for the previous four weeks and the average exchange rates for the same period.

Phosphate Rock

In the past [up to May, 2004] the price of phosphate rock was determined on the basis of import parity price for DAP [Di-ammonium Phosphate] and phosphoric acid. The rock contents of DAP and phosphoric acid were calculated, and split on a ratio of 60/40 to determine the phosphate rock price. This formula was found to be unsustainable for the producer, and after negotiations with all buyers a new formula was agreed upon. This is indexed upon the CFR [freight delivered price] price of phosphate rock in India [currently around \$85/ton], starting at a level of \$59/ton. Effectively local phosphate prices are therefore at a discount of 30.6% compared to India, and this ratio will be maintained in future. However, Sasol Nitro was not party to this agreement and opted to pursue selling their plant to Foskor as the new price made the plant not economically viable. This sale transaction was not approved by the Competition Commission and Sasol Nitro as a result currently produces phosphoric acid from phosphate rock for Foskor by tolling agreement.

Phosphoric Acid

Phosphoric acid is priced on an import parity basis, using the Indian CFR price as basis. A recent agreement has been struck whereby the local price will be equivalent to the Indian CFR price, decreased by 25% of the freight cost from India. This would lead to local prices being around 4% below actual IPP prices.

5.4. Major downstream industries that purchase upstream products

5.4.1. End-use structure

Ammonia

The estimated end-use market structure for ammonia is shown in the table below:

% of total sales	Application	Major end-users
40- 45	Explosives	AEL, BME, Sasol Nitro
45 - 50	Fertilizers	Omnia, Yara, Sasol Nitro
5 - 10	Metal Processing	Impala Platinum
	Cyanide	Sasol Polymers
	Chemical/Biochemical	Bioproducts, African Amines, Anchor Yeast

Phosphate Rock

Phosphate rock is only used to manufacture phosphoric acid. This structure is described in par. 5.2.1.

Phosphoric Acid

Phosphoric acid is used primarily to manufacture phosphate based fertilizer and animal feed products such as NPK mixes, MAP and DAP as well as MCP and DCP that are produced primarily by the three major fertilizer producers, all of whom have their own captive phosphoric acid production, supplemented by third party purchases.

5.4.2. Impact of feedstock cost on total cost structure

Ammonia

Ammonia is mainly used to manufacture ammonium nitrate. The cost of ammonia accounts on average for more than 80% of the variable production cost of ammonium nitrate.

Phosphate Rock

Phosphate rock is only used to manufacture phosphoric acid. In terms of the total cost structure for the manufacturing of phosphoric acid, phosphate rock accounts for around 50 – 55% of total variable costs, and around 40 – 45% of total costs, including fixed costs and depreciation.

Phosphoric Acid

Phosphoric acid is used primarily to manufacture phosphate based fertilizer and animal feed products. The major purchasers of phosphoric acid also have captive production, leading to commercial purchases of phosphoric acid accounting for only around 5% of variable costs, and around 4% of total costs.

5.4.3. Organisation of downstream players

Ammonia

The downstream sectors affected by ammonia feedstock are mainly the primary fertilizer and explosives production sector. This includes Sasol Nitro's fertilizer and explosives business units which also purchase ammonia at arm's length from Sasol Nitro's ammonia business unit, Sasol Nitro's ammonia, fertilizer and explosives business units operate as separate profit centres and this ensures equal pricing of ammonia to all consumers including external customers. The fertilizer companies are corporate members of the fertilizer industry association [Fertilizer Society of SA - www.fssa.org.za]

Phosphate Rock

The downstream sector affected by phosphate rock feedstock is mainly the primary fertilizer production sector, which consists of only four major companies, including Foskor who is a captive producer (producing for own use) of phosphate rock. These companies are corporate members of the fertilizer industry association [Fertilizer Society of SA - www.fssa.org.za]

Phosphoric Acid

Similarly to phosphate rock, the downstream sector affected by phosphoric acid feedstock is mainly the primary fertilizer production sector.

5.4.4. Downstream sector ability to influence input prices received

Ammonia

The downstream sector, consists of the three principal producers of ammonium nitrate [including Sasol Nitro). Sasol Nitro applies formula price for ammonia that also makes provision for a discount to ensure a competitive position for limestone ammonium nitrate versus imported urea. Non-captive downstream users have the freedom to import ammonia.

Phosphate Rock

The downstream sector consists of two large fertilizer companies that manufacture phosphoric acid (the third recently closed their plant), who on a regular basis negotiate the phosphate rock price for a predetermined period. This excludes Sasol Nitro since Sasol Nitro currently manufactures phosphoric acid from phosphate rock for Foskor under a toll agreement. However, once an agreement is reached they do not have the ability to alter it. The ability of the downstream sector to influence the price comes from the lack of global competitiveness for the exports of phosphate rock, which means that the upstream producer must preferably find a local market.

Phosphoric Acid

Phosphoric acid is a unique product for the study in that downstream companies have captive production. The three major fertilizer companies use 100% of the commercial (non-captive) phosphoric acid. Similarly to phosphate rock, the major fertilizer companies negotiate independently on a regular basis the price mechanism for a predetermined period. However, once an agreement is reached they do not have the ability to alter it.

5.4.5. Duty Structures and anti-dumping measures

Ammonia

There are no duty structures on the major derivatives of ammonia, including ammonium nitrate, NPK fertilizers, MAP & DAP. No anti-dumping measures are currently in place.

Phosphate Rock

There is no duty structure on the importation of phosphoric acid. No anti-dumping measures are currently in place.

Phosphoric Acid

There are no duty structures on the major derivatives of phosphoric acid, including NPK fertilizers, MAP & DAP as well as MCP and DCP. No anti-dumping measures are currently in place.

5.5. International competitiveness of South African chemicals pricing

5.5.1. Introduction

It is important in the analysis of pricing that a common understanding of pricing principles is agreed upon, especially in the context of a comparative analysis. The main issue that is involved is the concept of an inland price for products, which is the price paid by local customers in a particular country.

The competitiveness of South African chemicals pricing is dealt with under the following headings:

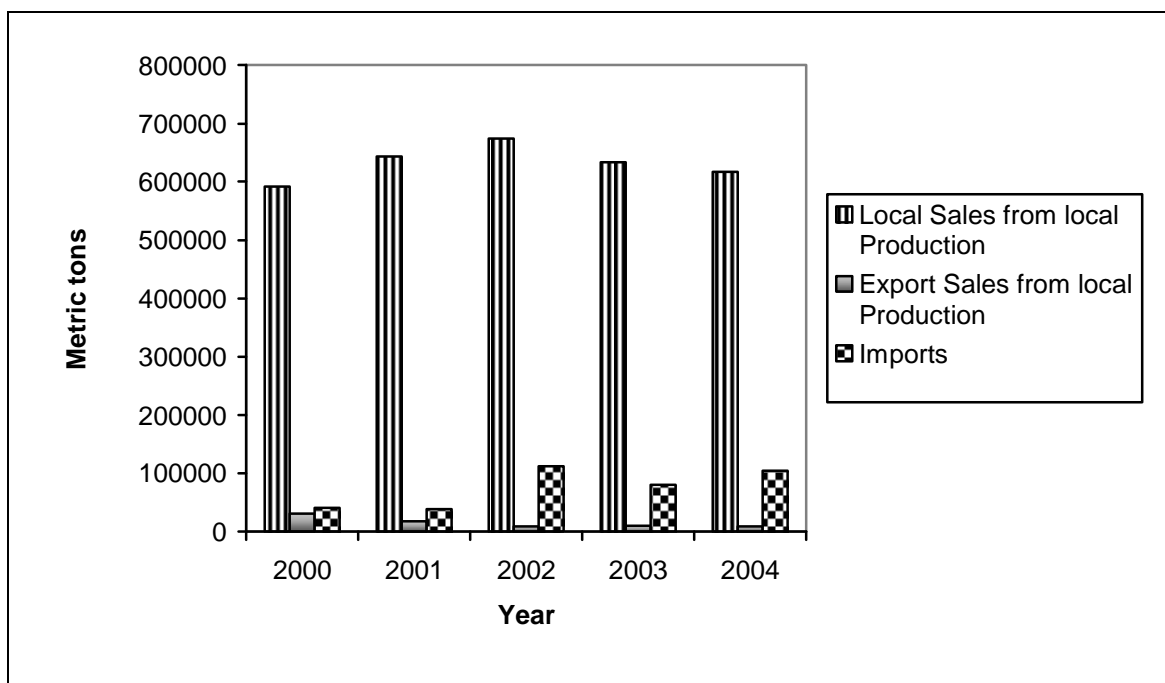
- Historical SA feedstock market volumes and pricing levels
- Comparison of SA inland prices for feedstock with international prices
- Historical sales levels for key downstream products
- Basis for SA pricing calculations
- Key differentiation factors for purchasing feedstock
- Operations: (Upstream/ Downstream: Basis for operation [e.g. 24/7]; Average age and original cost of equipment; Capacity utilisation; Workforce)
- Assessment of global competitiveness of downstream producers
- Ability for downstream to expand product range based on lower feedstock prices
- Impact of current pricing practices (Skills; Wages; Technology; Long-term sustainability; Import replacement)

5.5.2. Historical SA feedstock market volumes and pricing levels

Ammonia

Ammonia sales into the local South African market include both captive sales by Sasol's ammonia business unit to Sasol's fertilizer and explosives business units as well as third party sales. The historical local and export sales volumes of ammonia, as well as average ex-factory and delivered prices are shown in the figures below. For commercial sensitivity no actual data values are published on the chart.

Figure 5.4: Historical Local & Export Volumes – Ammonia

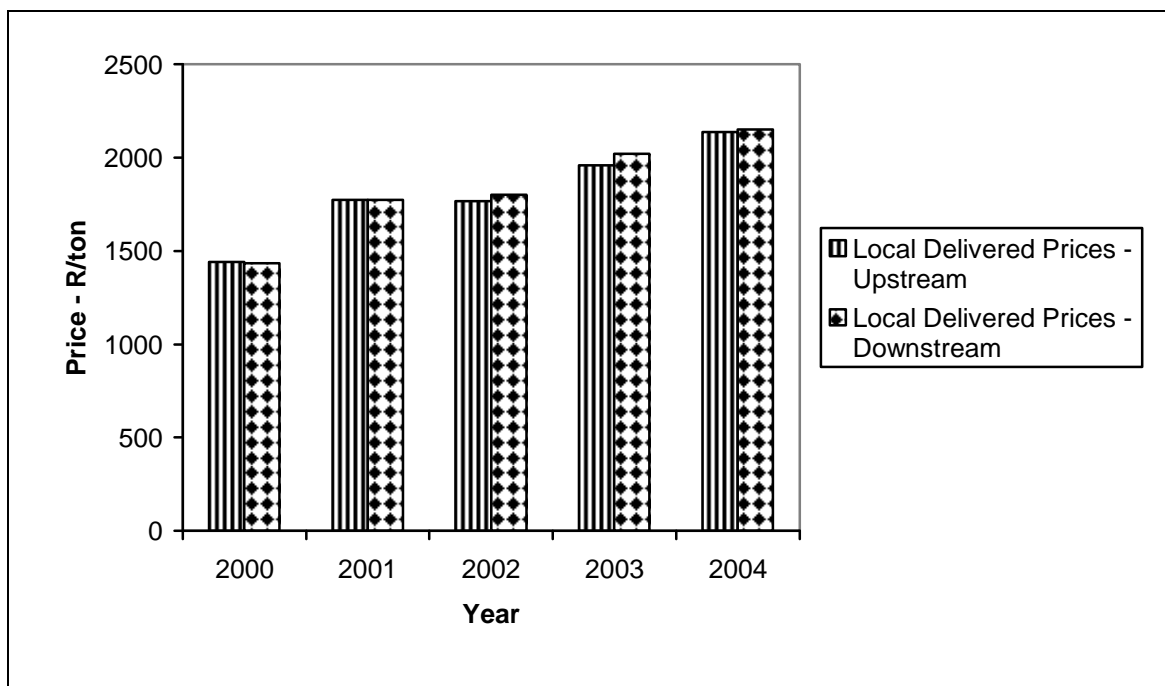


Local supply, imports and export volumes show an erratic growth pattern. Exports (which are to neighbouring Southern African countries) are generally small and declining especially since 2001 when AECI closed down its plants. Therefore South Africa continues to be a net importer of ammonia.

The contract price formula for ammonia does not determine an ex-factory price, but a delivered price, with delivery deemed to have taken place from the coast (Richards Bay port). The average

delivered price for ammonia, as provided by upstream and downstream respondents are shown in the diagram below:

Figure 5.5: Historical Local Delivered Prices - Ammonia

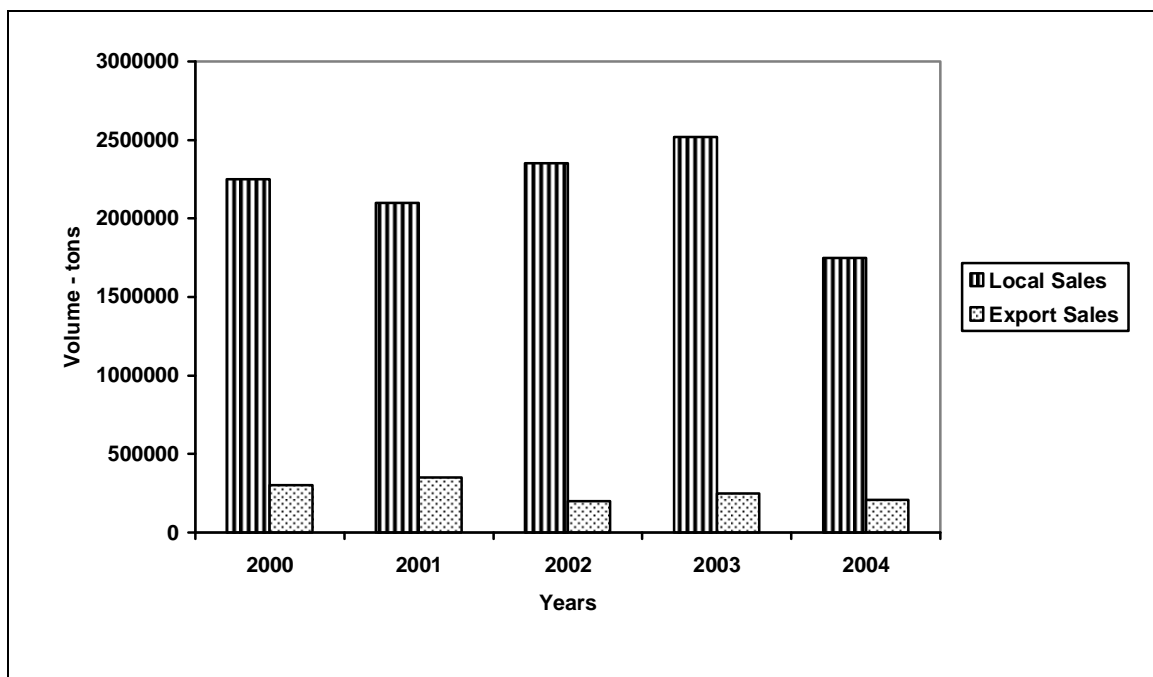


The delivered prices as provided by upstream and downstream respondents are within 5% of each other, which indicates relatively good correlation. It should be noted that the captive downstream user was excluded from the calculation, which could account for the differences. It is also interesting to note that although there was a substantial increase in the value of the Rand since 2002, the SA delivered prices continued to increase, mainly due to the significant increase in international \$-based prices and freight charges for ammonia.

Phosphate Rock

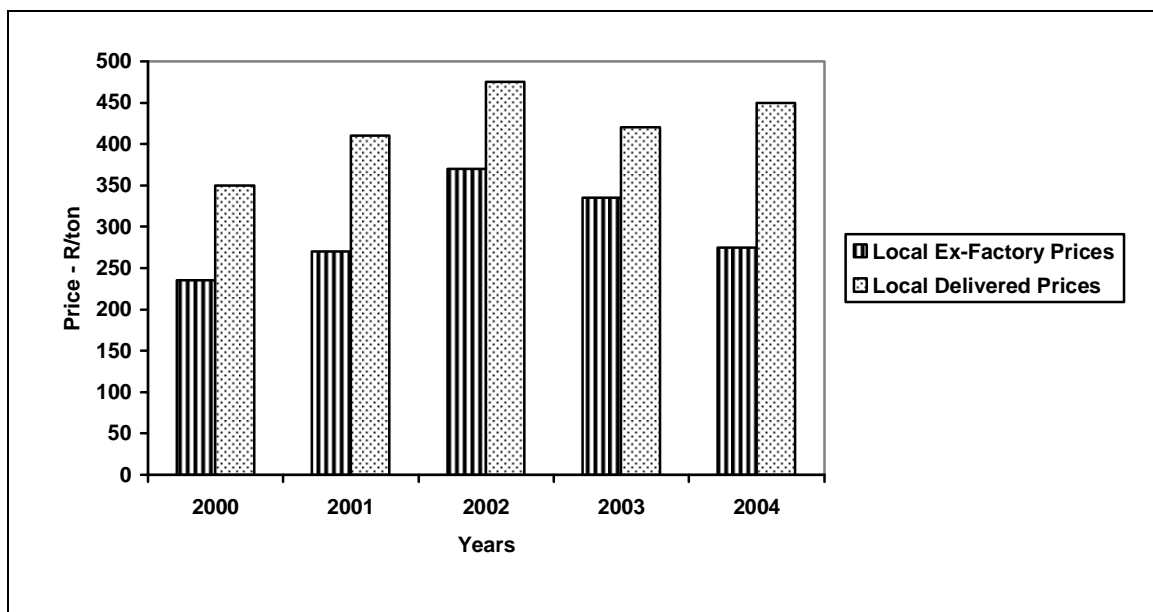
The historical local and export sales volumes of phosphate rock, as well as average ex-factory and delivered prices are shown in the figures below. For commercial sensitivity no actual data values are published on the chart.

Figure 5.6: Historical Local & Export Volumes - Phosphate Rock



Both local and export volumes show an erratic growth pattern. Exports also vary in a range of 6 – 12% of total production.

Figure 5.7: Historical Local Ex-factory and Delivered Prices - Phosphate Rock

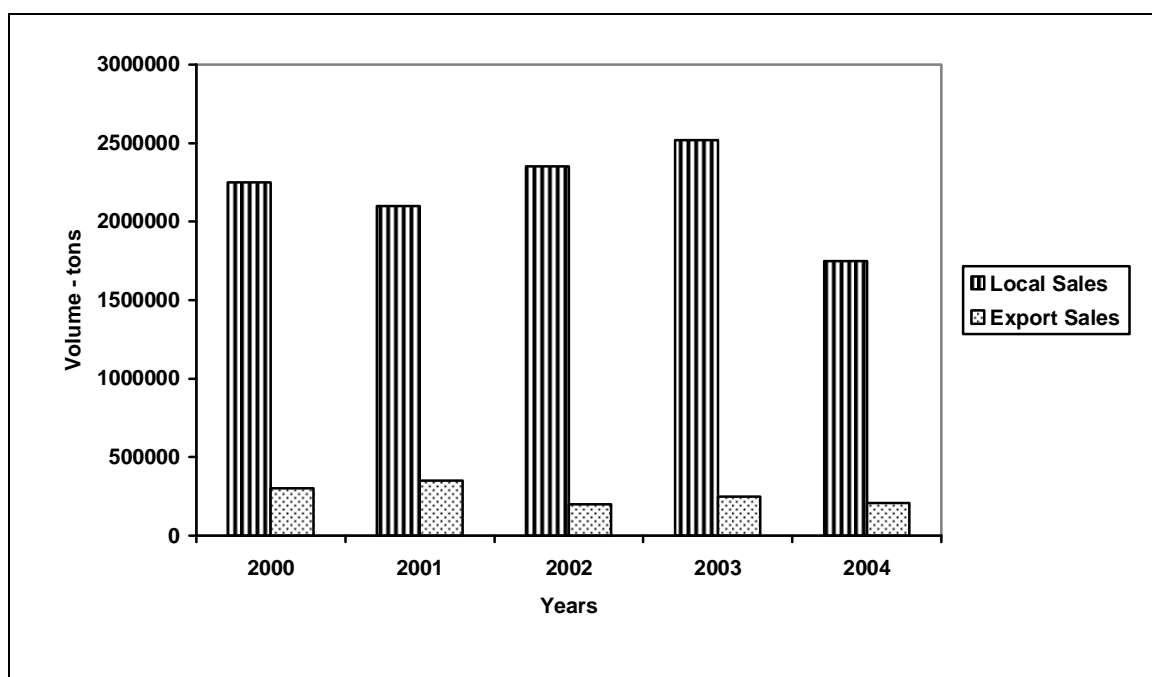


Local delivered prices carry a significant transport cost component, which is as high as 38% of the total cost.

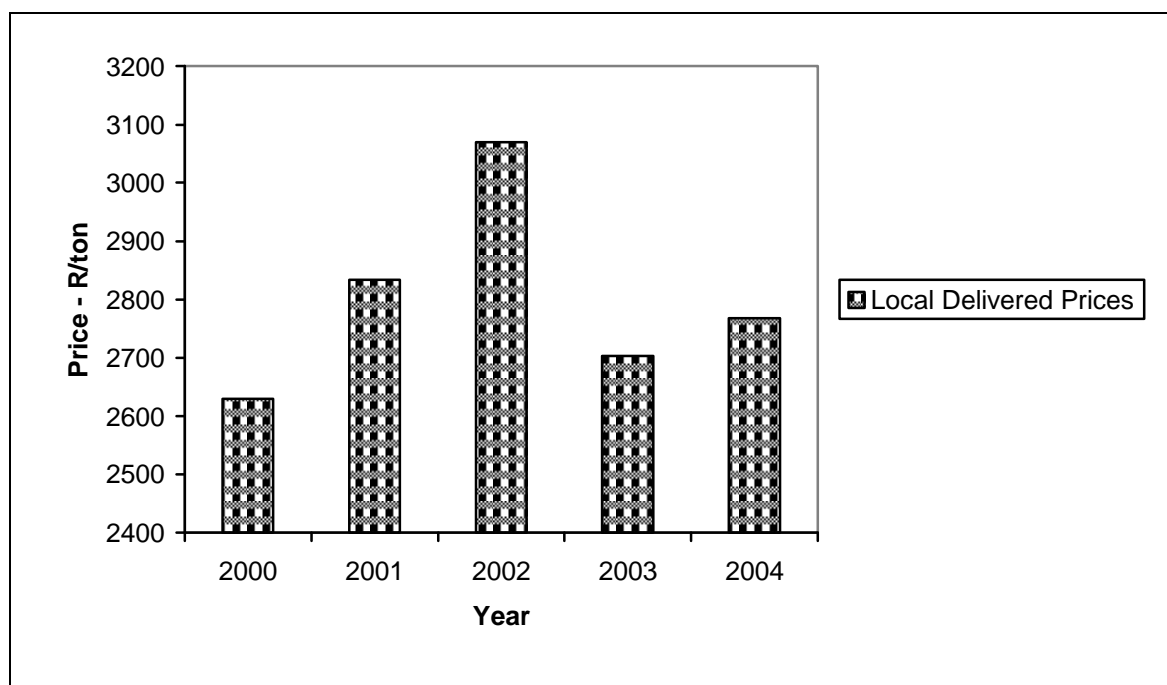
Phosphoric Acid

Phosphoric acid supply into the local market comprises of captive production as well as commercial third party supply. The Competition Commission blocked the sale of Fedmis to Foskor with Sasol now manufacturing phosphoric acid for Foskor under a toll agreement, while Yara [previously called Kynoch] has closed their Potchefstroom plant. No detailed breakdown of the commercial sales of phosphoric acid to domestic customers is made, but as an example, in 2004 only around 5% of the roughly 1 million tons produced was sold as commercial sales, while around 67% was exported, predominantly to India. The historical local and export sales volumes of phosphoric acid, as well as average ex-factory and delivered prices are shown in the figures below.

Figure 5.8: Historical Local & Export Volumes – Phosphoric Acid (Local sales include captive)



Both local and export volumes show an erratic growth pattern. Exports also vary in a range of 6 – 12% of total production.

Figure 5.9: Historical Local Delivered Prices - Phosphoric Acid

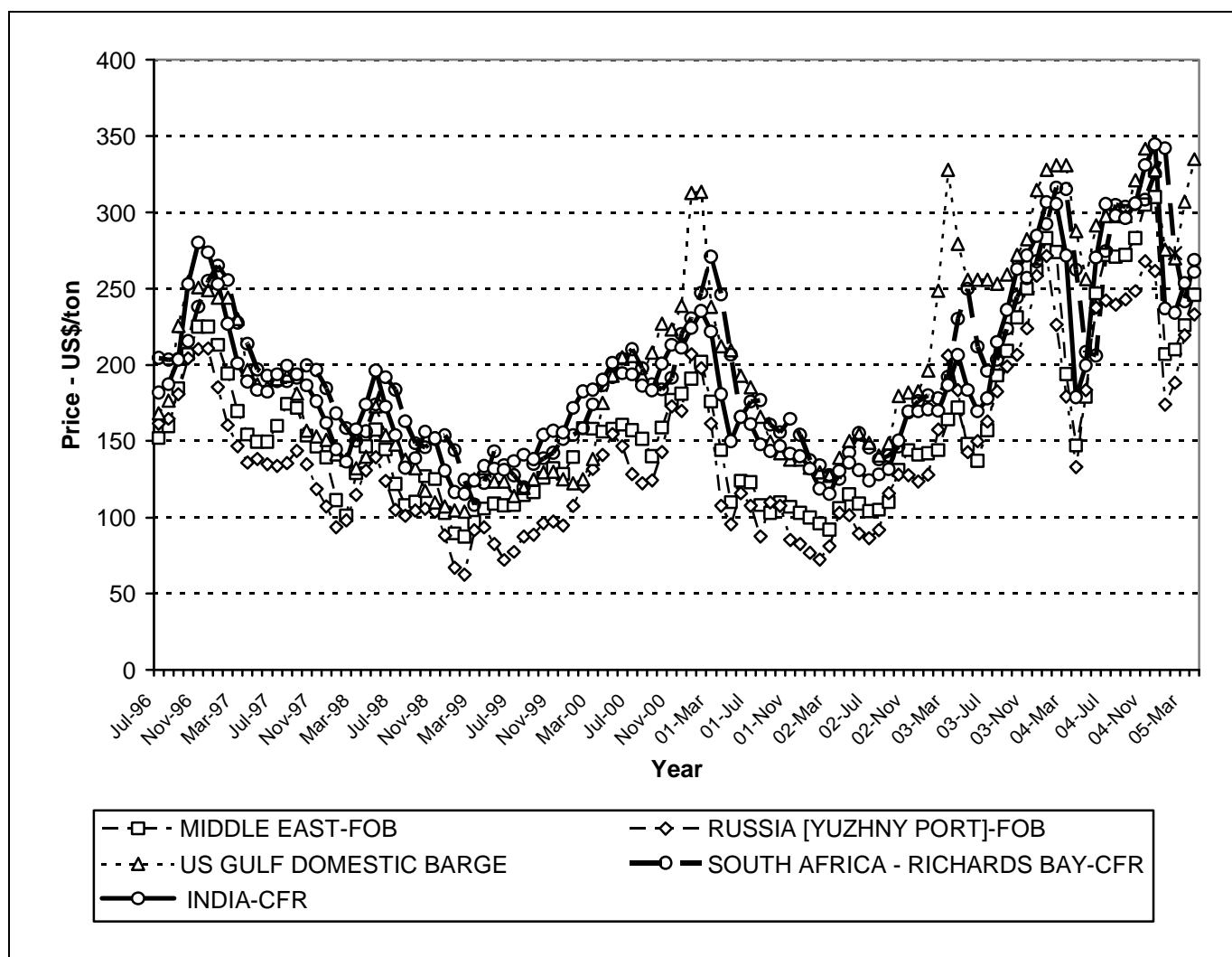
Local delivered prices carry a significant transport cost component, which is as high as 38% of the total cost.

5.5.3. Comparison of SA inland prices for feedstock with international prices

Ammonia

SA inland or domestic prices are directly linked by means of the formula-applied pricing mechanism to international prices. The price history of international ammonia prices in major producing and consuming countries, compared to SA domestic price [Richards Bay] is shown in the diagram below: [Sources: FERTECON, FMB]

Figure 5.10: Historical International and SA Domestic Prices - Ammonia



The Russian (Yuzhny) and Middle Eastern prices are FOB-based prices that are used in determining the SA prices, as these regions have historically represented the lowest cost of manufacturing globally. India, which is a major ammonia importing country, had an average price of around 3.7% lower than SA over the period July 1996 to April 2005. Over the same period SA's prices [Richards Bay] were on average 1.8% lower than the US Gulf Coast prices.

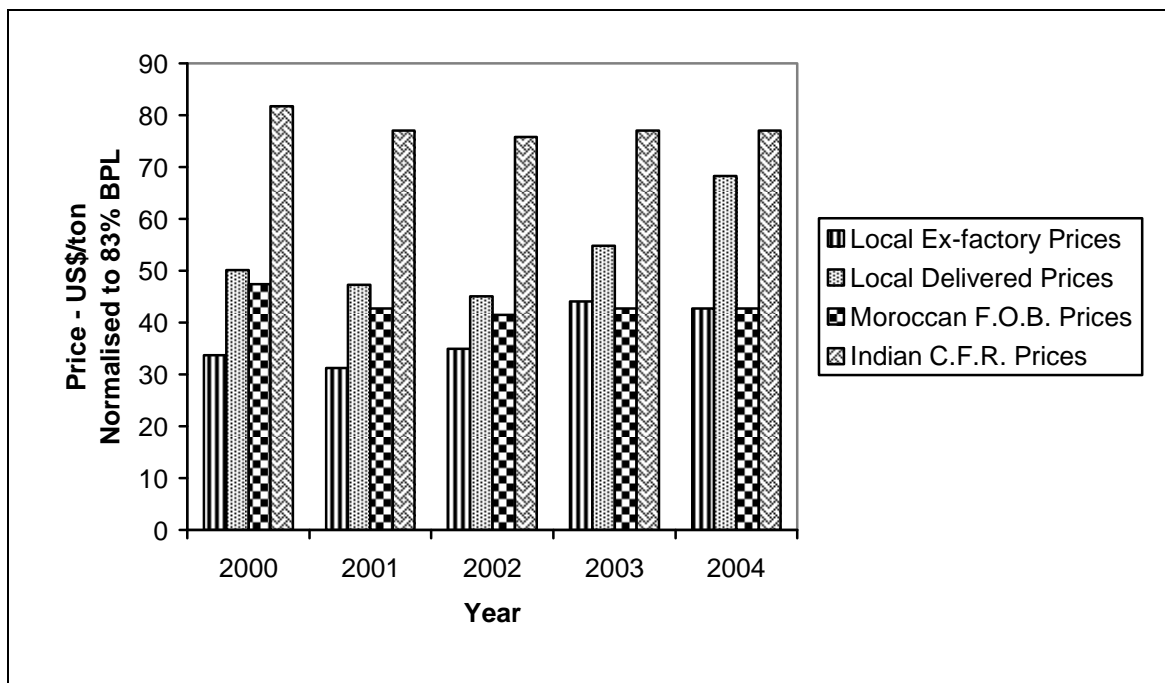
Phosphate Rock

International phosphate rock prices are not directly comparable with SA domestic prices, in that the price of phosphate rock depends upon the relative P_2O_5 contents. SA has relative high phosphate contents of around 38%, also expressed as 83% BPL [Bone Phosphate of Lime, or Tri-

calcium Phosphate]. The major exporter of phosphate rock, Morocco, exports on average a grade that is 70% BPL, or 32% P_2O_5 .

Due to this factor, it would not be useful to compare SA inland prices against a range of countries, as it would require a detailed knowledge of actual BPL contents in those countries, and that is not readily available. It was therefore decided to base the historical price comparison on the basis of the Moroccan export, or F.O.B. price, adjusted to the SA BPL contents. This is shown in the chart below. Indian CFR prices, which are an indication of Indian import parity prices, are also shown and compared to SA delivered prices.

Figure 5.11: Historical Local and International Prices - Phosphate Rock

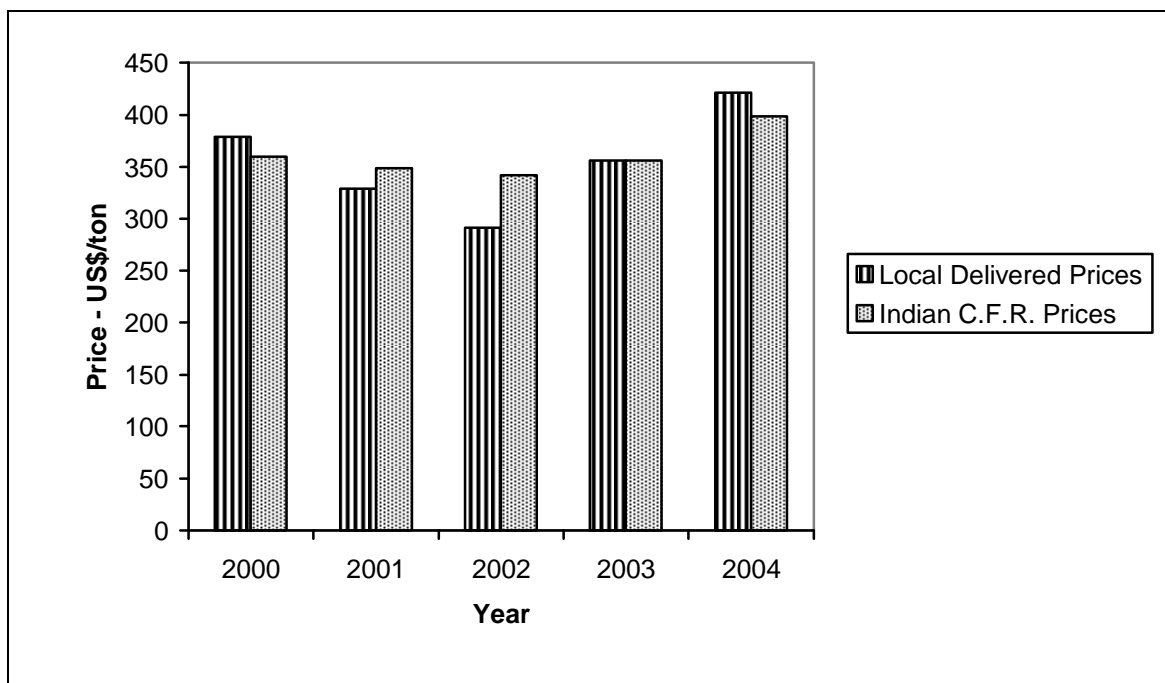


It is clear that in the case of phosphate rock [taking into account variances in BPL levels], SA delivered prices are historically well below Indian CFR prices, which exclude Indian inland delivery costs. Ex-factory SA prices are either below or similar to Moroccan export prices.

Phosphoric Acid

Phosphoric acid delivered prices in SA are compared to Indian CFR prices, as India is the price setter for phosphoric acid on a global basis due to their exceptionally large import volumes [e.g. 2.9 million tons in 2004].

Figure 5.12: Historical Local and International Prices – Phosphoric Acid



Local delivered prices for phosphoric acid [commercial sales between inland based suppliers and consumers] are relatively closely following the Indian CFR price, which does not take into account the inland delivery cost in India.

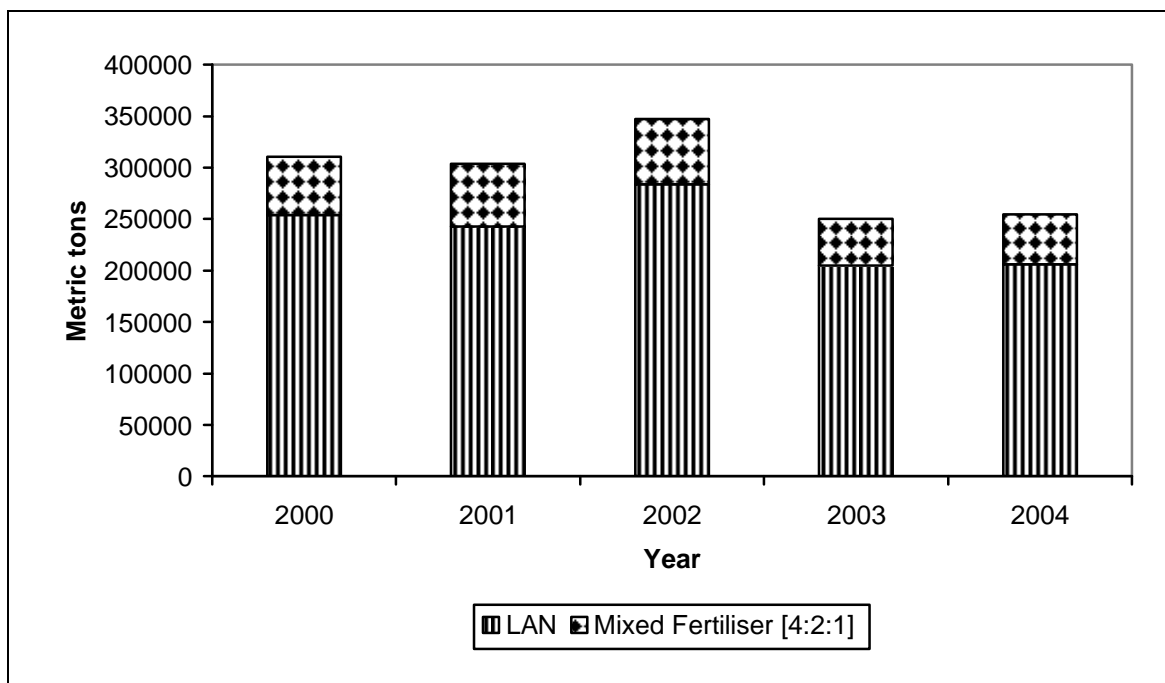
5.5.4. Historical sales levels for key downstream products

Ammonia

Ammonia is mainly used to manufacture ammonium nitrate, which in turn is the major component of commercial explosives [used as porous prills], as well as a key Nitrogen source in mixed fertilizers.

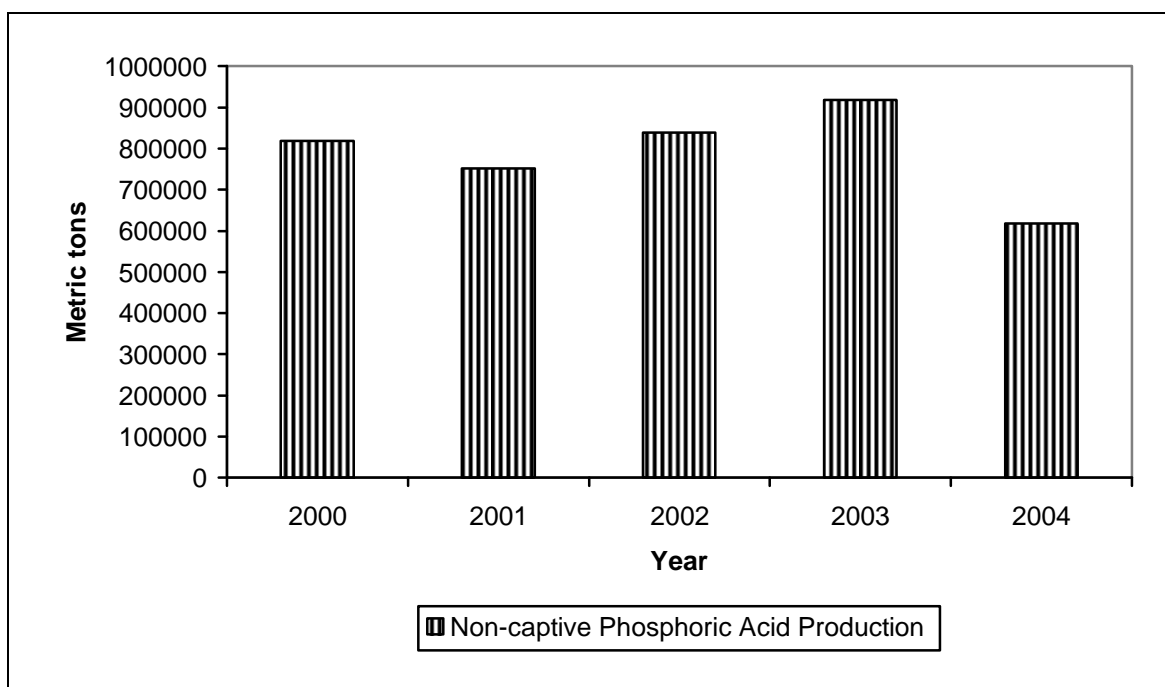
Ammonium nitrate is manufactured as ammonium nitrate solution [ANS], which in turn is used to manufacture explosives grade porous prills [ANPP], or to manufacture fertilizer products such as limestone ammonium nitrate [LAN] or mixed NPK fertilizers. Most ANS is captively used to manufacture end-products such as explosives and fertilizers. The total production of ammonium nitrate in 2004 was estimated at 1.3 million tons. As an example of the commercial sales levels of downstream products, LAN and 4:2:1 mixed fertilizer are used.

Figure 5.13: Historical SA Sales – Major Ammonia Derivatives



Phosphate Rock

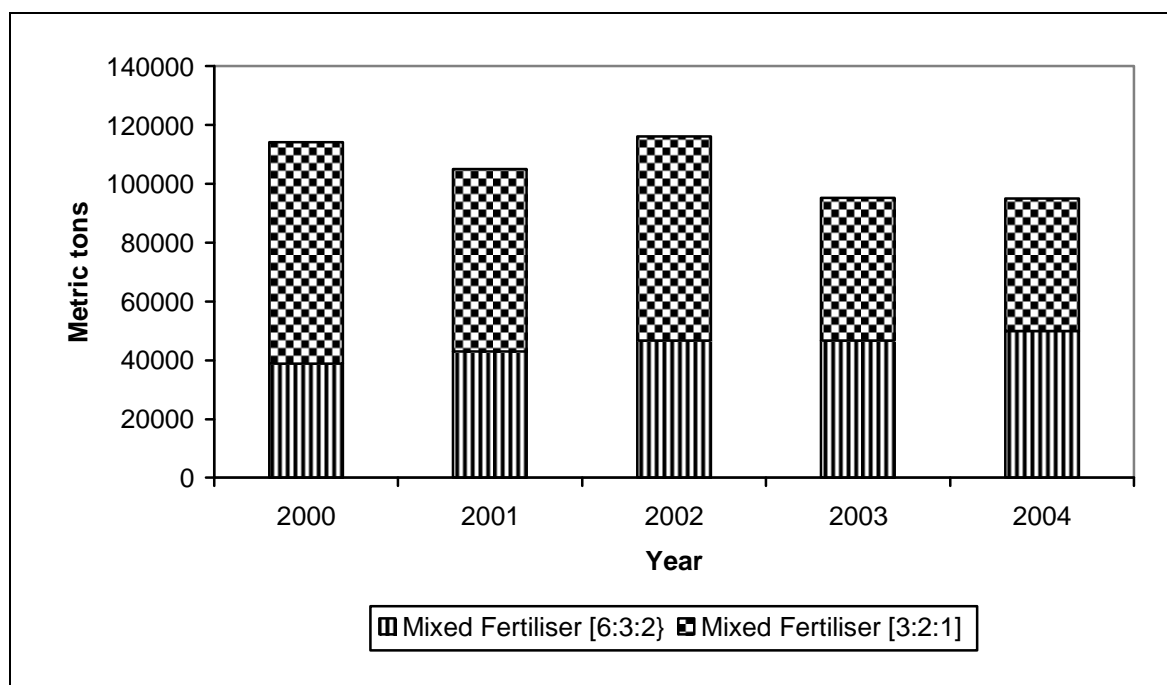
Phosphate rock is predominantly converted to fertilizer grade phosphoric acid, both captively by Foskor, as well as by the major fertilizer companies. Total non-captive production of phosphoric acid in SA is as follows:

Figure 5.14: Historical Non-captive SA Production – Phosphoric Acid

Phosphoric Acid

Phosphoric acid is used to manufacture a range of mixed fertilizers, as well as fertilizer elements such as MAP [Mono-ammonium phosphate] and DAP [Di-ammonium phosphate]. It is also used to manufacture animal feed elements such as MCP [Mono-calcium phosphate] and DCP [Di-calcium phosphate]. In total around 91% of phosphoric acid is used in fertilizer products, and 9% in animal feeds.

There is a large range of fertilizers being sold in the market [2 million tons/annum], many of which contain phosphoric acid derivatives. According to one respondent, sales of two major phosphoric acid derivatives, both mixed fertilizer types, in SA are as follows:

Figure 5.15: Historical SA Sales – Major Phosphoric Acid Derivatives

5.5.5. Basis for SA Downstream Products pricing calculations

Ammonia

For ammonium nitrate, prices are based on a factor of approximately 0.4 times the ammonia cost, plus conversion costs, which differ according to the end-product type. Any price change in ammonia is immediately transferred to industrial purchasers, but contracted explosives users have a time lag that is financed by the downstream supplier. This is a major cost factor for explosives producers, as the price of ammonia over the last few years have continued to rise, with no period where suppliers could recover this cost. The contractual end-users also have a provision where they can forward purchase ammonia from Sasol Nitro in order to improve on cost related to ammonia.

End-users have significant leverage for ammonium nitrate based fertilizer prices in that these fertilizers can be replaced with imported urea based alternatives. The prices of urea based fertilizers fluctuate drastically and are largely impacted by global supply demand balances. Prices for downstream products such as mixed fertilizers are based largely upon the relative costs of imported alternatives and to a lesser extent conversion costs and costs of feedstock.

Phosphate Rock/Phosphoric Acid

The downstream pricing practises for mixed fertilizers produced locally from phosphoric acid are largely based upon the imports of competing end-product fertilizers, which has a relationship with import parity, plus a premium for the added services.

5.5.6. Key differentiation factors for purchasing feedstock

Key differentiation factors for purchasing feedstock include product specifications, price and service levels. It is difficult to separate factors that lead to price differences with, for example 100% imported fertilizer. It is a mixture of reliability of delivery, price security, consistency in quality, services such as soil analysis and advice, etc.

For ammonia, downstream companies do have three “forward buying” options per year where they can opt to use an option depending upon whether ammonia prices are rising or falling.

5.5.7. Operations:

a) Upstream:

Ammonia

The Sasolburg and Secunda plants are operating at 100% of production capacity on a 24 hours/7 days per week basis. The Sasolburg plant requires an 18-day shutdown every four years, and employs in the order of 55 people [80% in production]. At Secunda the integrated nature of the phenolsolvan plant makes it difficult to separate personnel employed solely on the ammonia stream.

Phosphate Rock

The only operation is a mining based plant, operating at around 80% of production capacity on a 24 hours/7 days per week basis. The Foskor operation in Phalaborwa was commissioned in 1951, and is continuously upgraded and expanded.

Phosphoric Acid

The Foskor Richards Bay plant is operating at around 95% of production capacity on a 24 hours/7 days per week basis. The plant was recently expanded at a capital cost of R1.1 billion from 430 to 780 kilotons/annum capacity, and employs in the order of 600 people [90% in production].

b) Downstream:

Fertilizer plants are operating at around 60 – 100% of production capacity on a 24 hours/7 days per week basis. Typical operations have equipment that is aged from more 30 years to less than 6 years. Direct investment in equipment involved in downstream fertilizer is in the range of R300 to R400 million per operation, and employs around 1000 people, of which 70% is in production.

Nitric acid and ammonium nitrate plants are operating at around 87 – 93% of production capacity on a 24 hours/7 days per week basis. One respondent operation has equipment that is 40 years of age. Original direct investment in equipment involved was in the range of R130 to R140 million, and the company employs around 2749 people, of which 68% is in production.

5.5.8. Assessment of global competitiveness of downstream producers

The one respondent company in ammonium nitrate/explosives production indicated that local operations are reasonably competitive with international operations, based upon studies conducted by them. In export markets (being neighbouring Southern African countries) permitted by logistics considerations, the operations are competitive against other exporters.

As far as SA based fertilizer operations are concerned, the general assessment is that they are not globally competitive, mainly due to the following reasons:

- Logistical costs for SA are high, preventing low-cost access for competing feedstock, but also increasing cost for exports of end-product, which lower volumes and increase cost of production.
- Upstream feedstock prices do not allow downstream producers sufficient margin compared to international integrated operations with a low feedstock base. Low-cost based feedstock

countries such as Morocco also competes with downstream fertilizer in the world market, based upon integrated plants.

- Small scale and relative age of SA operations have significantly higher fixed and variable costs compared to large international plants.
- SA interest rates for funding plant expansions and renewals are higher than elsewhere.
- SA tax rates are relatively high, with little or no tax concessions for investment.
- There are skills shortages in areas such as professional technical people and artisans.

It should be noticed that a proper evaluation of global competitiveness can only be done on the basis of a benchmarking analysis, which is not part of this study, and requires significant resources. The comments above came from respondents.

5.5.9. Ability for downstream to expand product range based on lower feedstock prices

SA imports in the order of 500 000 t/a of urea, which can be substituted by limestone ammonium nitrate (which is manufactured from ammonia as the primary feedstock), but it requires a price reduction of around 15% of the ammonia cost, to be competitive against current urea prices. This is, however, not a realistic scenario in that local ammonia capacity is already fully utilised. It must be noted that limestone ammonium nitrate fertilizer generally earns a price premium over urea due to some properties which are preferred by customers for some fertilizer applications. This allows South African fertilizer manufacturers to compete with imported urea at current ammonia prices. Cost, access to feedstock [oil or gas] and scale of manufacturing/market size currently prevents local investment for production of urea and more ammonia. Because of the constraints on local production of ammonia and LAN, a reduction in ammonia prices within SA would be unlikely to have any significant effect on the use by SA farmers of domestically produced LAN or ANS.

By lowering phosphate rock prices in SA, downstream producers could consider further production of phosphoric acid, in particular to use for further exports of fertilizer NPK mixes. Only 9% of African farmers use fertilizers, which indicate a huge untapped market for fertilizer exports into African countries.

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5.5.10. Impact of current pricing practices on:

a) Skills

There is no significant impact in direct operations. Downstream operations believe that they have an opportunity through social upliftment projects to develop skills in the emerging farming sector. Their current low margins in fertilizers do not allow them to initiate such programmes. It is a possibility that SETA funds could be used for this purpose.

b) Wages

Most downstream players are large companies that pay wages that are on the same level as the rest of the sector. They do, however, believe that by decreasing the level of feedstock enough, it will be possible to invest further in downstream capacity with a view on exports, and thereby increase employment and the total wage bill. Downstream commented in this anecdotal manner and no detailed explanation was provided by them.

c) Technology

Downstream technology is relatively old, and increased margins would allow for increased investment in technology advancement, in particular related to environmental improvements. Again, downstream respondents comment in a general way, and no direct conclusion can be drawn that a decrease in feedstock prices will result in new investment.

d) Long-term sustainability

The viability of downstream fertilizer operations is assessed on a day-to-day basis, leading in to the recent announcement of the closure of the Yara phosphoric acid plant in Potchefstroom. New investment in fertilizer operations has been minimal in the recent past. Also, age of equipment and small plant sizes are resulting in relatively high costs.

e) Import replacement

The most significant import replacement opportunity in the fertilizer arena is urea, which competes with LAN made from ammonia. Local capacity constraints in ammonia and LAN cause large volumes of urea imports (483 833 tons in 2005).

5.6. Impact of pricing on downstream purchasers - Demand Elasticity

5.6.1. Introduction

Market prices are the result of interactions between demand and supply. As such, the impact of price (P) on demand (Q) cannot be isolated without taking into account the potential impact that the supply of output to the market would have on both price and quantity. Therefore, it is advisable to use an estimation technique that allows a simultaneous estimation of both the demand and supply side in order to determine the price elasticity of demand that is really characteristic of the market of “fertilizers” in South Africa.

In this study the demand and supply curves of “fertilizers” are separately identified using a Multivariate Vector Error Correction methodology. This report deals with the estimation of price elasticity of demand in “Fertilizers market” in South Africa during the period 1995-2004. The data set to be used in the model consists of quarterly observations of the following time series used in natural log transform:

- Consumption of fertilizers in South Africa (tons) denoted FERT, from the Fertilizer Association of South Africa web-site. The original data is annual, quarterly data is generated by quadratic-match sum interpolation;
- Real price of fertilizers (R), denoted RPRICE, also from the Fertilizer Association of South Africa;
- Real Gross domestic product of the agriculture, forestry and fishing sector (R), denoted GDP, from the Reserve Bank of South Africa quarterly bulletin. This variable serves as a scale variable;
- Production price index for fertilizers , denoted PPI, from StatsSA ; and
- Rainfall in the major crop producing areas denoted RAIN.

5.6.2. Estimation Results

All of the variables used to model the market for fertilizers are integrated of order one. Table 5.1 indicates that ADF test statistics without drift and trend reject the null hypothesis of unit root at 5% level when the variables are considered in first difference. This is to say that the variables are non-stationary in levels, but their first-differences are stationary.

Table 5.1: ADF test statistics but without drift and trend. An asterisk (*) denotes rejection of the null of unit root at the 5% level.

Variable	Level	Critical value	First difference	Critical value
L_FERT	0.965	-1.949	-2.049*	-1.949
L_RPRICE	0.914	-1.947	-8.471*	-1.947
L_GDP	3.037	-1.949	-3.262*	-1.949
L_PPI	2.659	-1.950	-4.926*	-1.950
L_RAIN	-0.276	-1.948	-14.291*	-1.948

After checking the order of integration of all the variables in the model, a Trace Test statistic is used in the next step to test for number of co integrating vectors. The results of the test in Table 5.2 indicate the presence of two co integrating vectors, with two lags in levels.

Table 5.2: Trace Test Statistics. Trend assumption: No deterministic trend. Series: L_FERT, L_RPRICE, L_GDP, L_PPI, L_RAIN.

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Crit. value	Prob.**
None *	0.672513	91.83253	60.06141	0.0000
At most 1 *	0.545083	51.64552	40.17493	0.0024
At most 2	0.400017	23.29046	24.27596	0.0662
At most 3	0.121390	4.899745	12.32090	0.5816
At most 4	0.006667	0.240832	4.129906	0.6822

Notes:

Trace test indicates **2 cointegrating eqn(s)** at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

The results for the different tests then lead to the following structural specification for the VECM:

$$\Pi_{z_{t-k+1}} = \begin{bmatrix} 11 & 21 \\ 12 & 22 \\ 13 & 23 \\ 14 & 24 \\ 15 & 25 \end{bmatrix} \begin{bmatrix} 1 & 11 & 12 & 0 & 14 \\ 1 & 21 & 22 & 23 & 0 \end{bmatrix} \begin{bmatrix} L_FERT \\ L_RPRICE \\ L_GDP \\ L_PPI \\ L_RAIN \end{bmatrix}$$

Proceeding with restrictions on the short and long run matrix yields the results presented in Table 5.2. Note that restrictions on the short-run matrix depicts the assumption that the price does not impact on the consumption of fertilizers in the short run due to the fact that the decision on the quantity of fertilizers to purchase is often taken at the beginning of the season. And the restrictions on the long-run matrix coefficients reflect the fact that the production costs of fertilizers do not impact directly on the demand side. The same is applicable in the treatment of rainfalls on the supply side.

Table 5.3: Vector Error Correction Estimates for Fertilizers markets.

Standard errors in () & t-statistics in []		
Cointegrating Eq:	Demand	Supply
L_FERT	1.000000	1.000000
L_RPRICE	0.375289	0.024323
	(0.18058)	(0.16639)
	[2.07822]	[0.14618]
L_GDP	-1.485515	-1.419594
	(0.10451)	(0.09452)
	[-14.2139]	[-15.0190]
L_PPI	0.000000	0.250077
		(0.02922)
		[8.55752]

L_RAIN	-0.036357	0.000000
	(0.00341)	
	[-10.6665]	

The main results presented in Table 5.3 from the estimation of the Vector Error Correction model are as follows:

- Demand for Fertilizers responds *negatively* to “price” with an elasticity of -0.38 . The coefficient is statistically significant and of the right sign.
- Demand responds *positively* to GDP with an elasticity of 1.49 . The coefficient is also statistically significant and with the right sign.
- Demand of fertilizers also responds *positively* to rainfalls with an elasticity of 0.04 . The coefficient is statistically significant.
- Supply of fertilizers responds *negatively* to price with elasticity: -0.02 . The coefficient is of the wrong sign. However it is close to zero and statistically non-significant, suggesting that supply of fertilizers is not affected by changes in prices.
- Supply responds *positively* to GDP with an elasticity of 1.42 . The coefficient is statistically significant.
- Supply responds *negatively* to “input cost” with elasticity of -0.25 . The coefficient is statistically significant.

5.7. Impact of pricing on downstream purchasers – EVC

5.7.1. Introduction

Given the relationship that exists between sales volumes and price (as measured in this study by the demand elasticity curves described in section 5.6), the challenge is to find an equitable method of comparing the impact on the financial performance of upstream and downstream businesses of the fertilizer sector of the chemical industry brought about by changes in selling prices and sales volumes. The measure used must be unbiased and objective, and based on readily available data.

The measure that meets the above criterion that has been used in this study is Economic Profit, also known as Economic Value Created (EVC). A basic introduction and description of EVC and the methodology employed is shown in [Appendix 2](#).

EVC is an economic, not an accounting concept. In order to measure it, one must look not only within the company, but also into the industry and the economy. Economic value created is a practical measure of the company's operating performance that correlates with the value of the company. What makes it so relevant is that it takes into account a cost that conventional measures exclude, namely, the cost of equity. Economic value created is simply the before interest and after tax operating profit, R, minus the total annual cost of capital, K. It is expressed as follows.

$$EVC = R - K$$

In this model,

R is the stream of cash available to the providers of capital, and

K is the total cost of the capital used, including the cost of equity and debt

The **weighted average cost of capital (K)** would normally vary across industries and over time. EVC is *relatively* insensitive to variations in K in the industries measured.

This study seeks to determine the relative impact of pricing policies between upstream and downstream protagonists. Accordingly the view was taken that a single K could be applied as a consistent-and-equal benchmark for all companies in the study. This approach eliminates the moving benchmark effect of applying a different K to each company in each year.

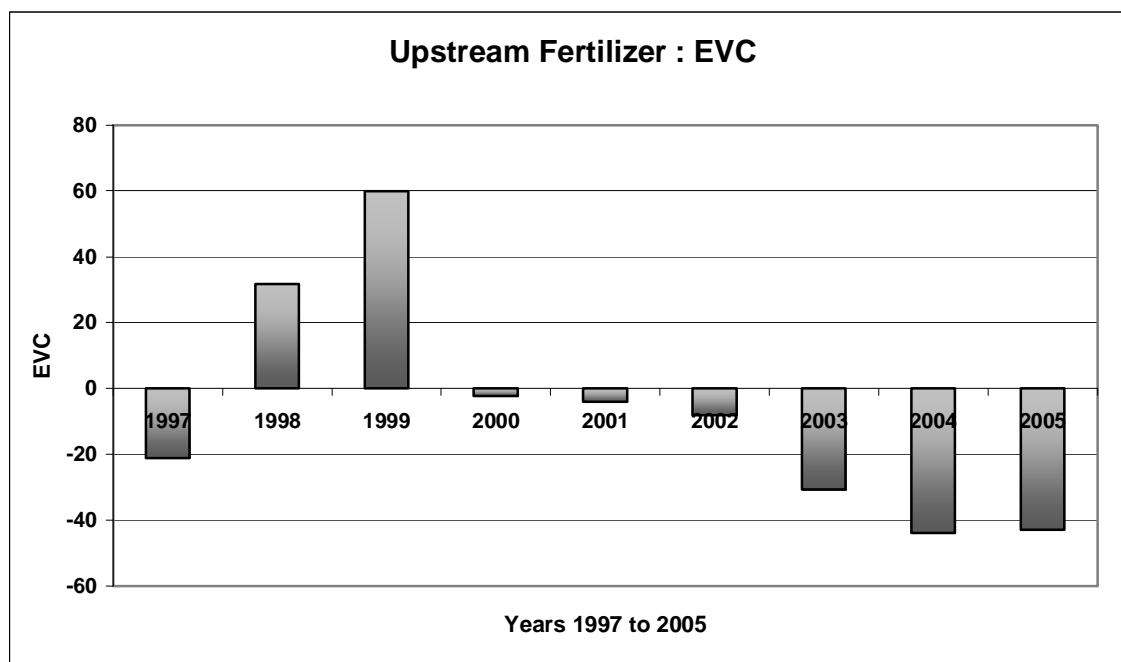
Determination of K - Weighted average cost of capital %	
Target debt as % of capital	50
Risk free rate of return %	12
Market rate of return %	20
Risk index (beta)	1.5
Cost of equity %	24

Marginal debt rate %	15
Marginal corporate tax rate %	30
Cost of debt %	10.5
K, Weighted average cost of capital %	17.25

5.7.2. Actual EVC results for upstream companies.

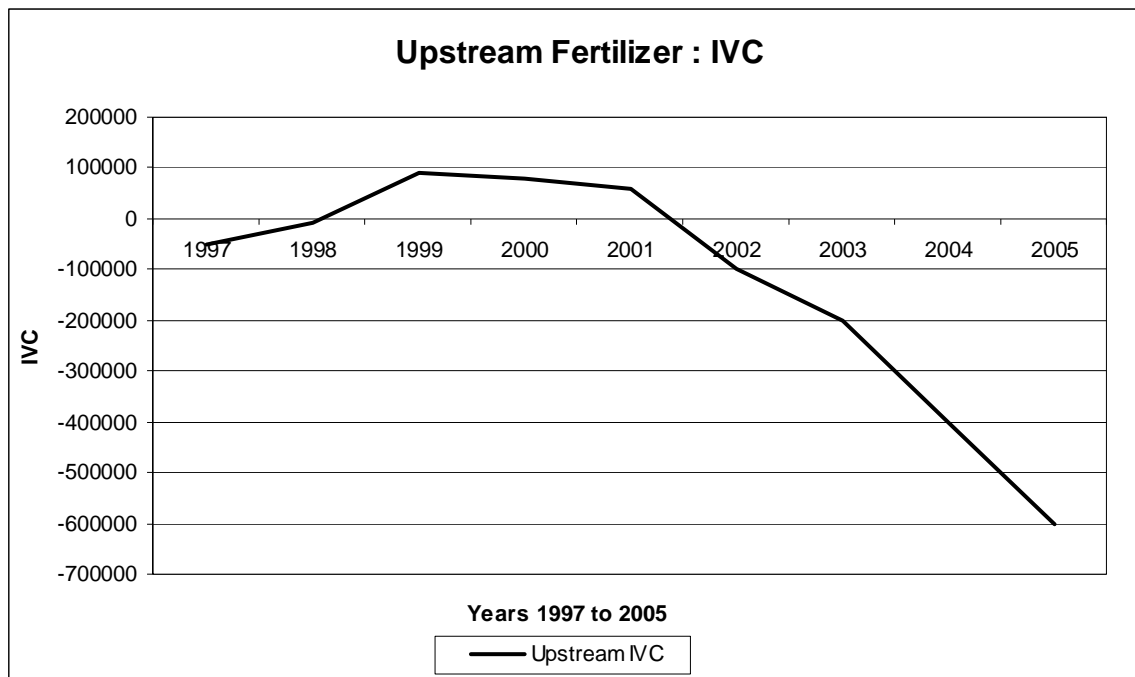
The following EVC graph represents the actual values calculated in each year between 1997 and 2005 for upstream fertilizers. The graph indicates that with the exception of 1998 and 1999 the returns have been significantly and consistently below the weighted average cost of capital as measured by K.

Figure 5.16: EVC Results – Upstream Fertilizers



The following IVC graph represents the intrinsic value calculated for upstream fertilizers. The graph illustrates the cumulative effect of economic value calculated by the end of each year. The IVC graph shows large accumulated returns that are lower than the weighted average cost of capital as measured by K by the year 2005.

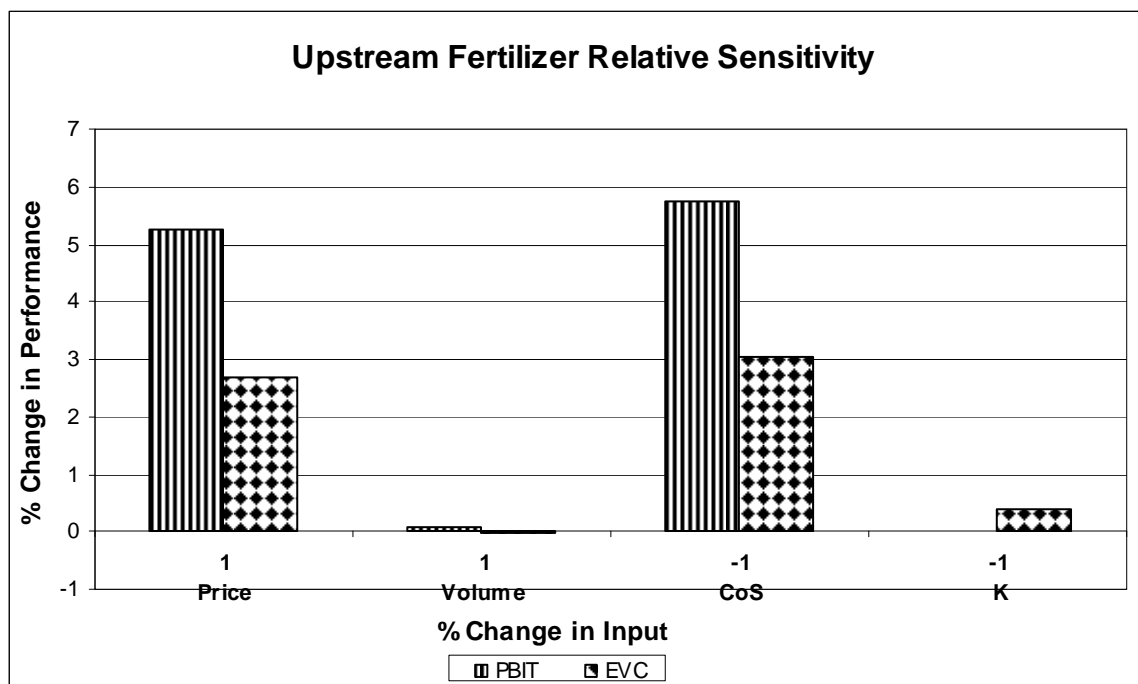
Figure 5.17: IVC Results – Upstream Fertilizers



The following graph illustrates the relative sensitivity of EVC and Profit before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K in upstream fertilizers

The bar groups indicate by what percentage PBIT and EVC would change for a one percent improvement in Prices or Volumes or Cost of Sales or K.

Figure 5.18: Sensitivity of EVC and Profit before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K – Upstream Fertilizers



Note that the inverse of what this graph shows is also true. That is, PBIT and EVC would change by the same percentage points but in the opposite direction for a one percent decline in Prices or Volumes or one percent increase in Cost of Sales or K.

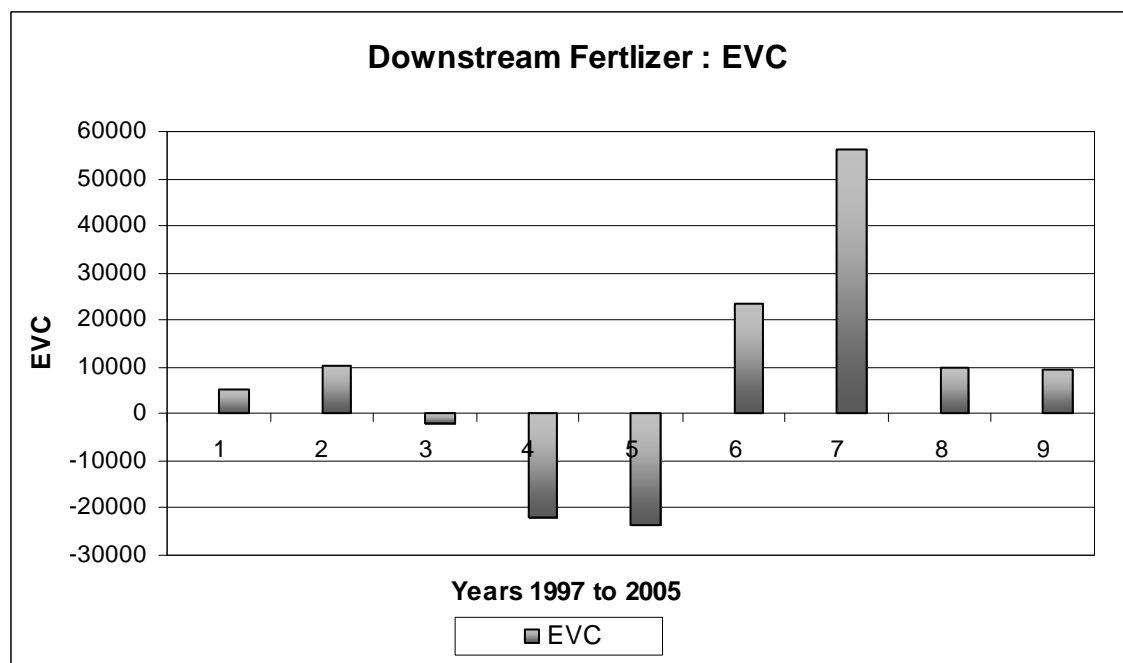
Note the following:

- EVC is insensitive to K
- EVC (and PBIT) are insensitive to Sales Volume
- EVC (and PBIT) are very sensitive to Cost of Sales
- EVC (and PBIT) are very sensitive to Selling Price

5.7.3. Downstream Fertilizers

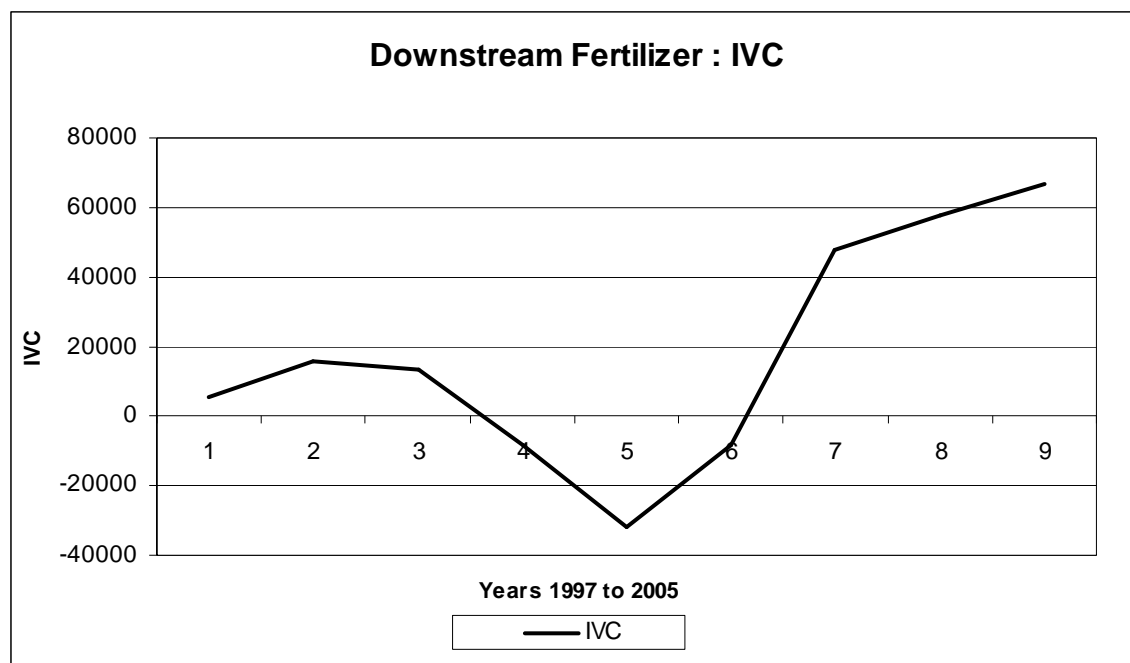
The following EVC graph represents the actual values calculated in each year between 1997 and 2005 for downstream fertilizers. The graph indicates that the returns were frequently (six out of nine years) more than the weighted average cost of capital as measured by K.

Figure 5.19: EVC Results – Downstream Fertilizers



The following IVC graph represents the intrinsic value calculated for downstream fertilizers. The graph illustrates the cumulative effect of economic value calculated by the end of each year between 1997 and 2005. The graph shows that in spite of returns being lower than the weighted average cost of capital as measured by K in 2000 and 2001 there were large accumulated returns which were higher than the weighted average cost of capital by 2005.

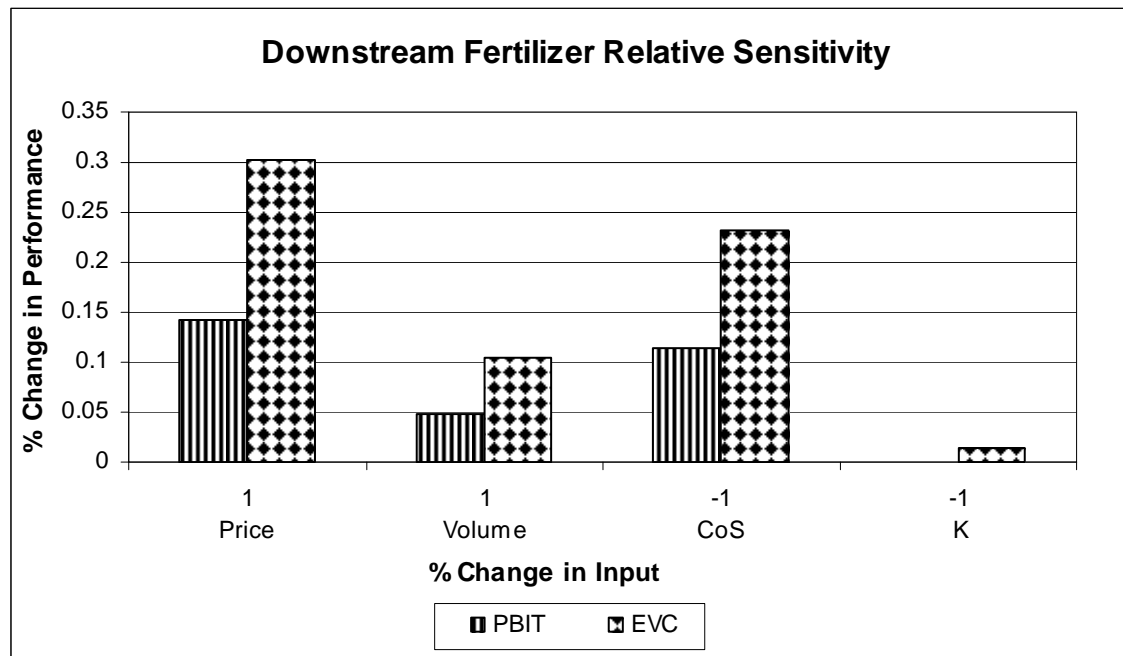
Figure 5.20: IVC Results – Downstream Fertilizers



The following graph illustrates the relative sensitivity of EVC and Profit before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K in downstream fertilizers.

The bar groups indicate by what percentage PBIT and EVC would change for a one percent improvement in Prices or Volumes or Cost of Sales or K.

Figure 5.21: Sensitivity of EVC and Profit before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K – Downstream Fertilizers



Note that the inverse of what this graph shows is also true. That is, PBIT and EVC would change by the same percentage points but in the opposite direction for a one percent decline in Prices or Volumes or one percent increase in Cost of Sales or K.

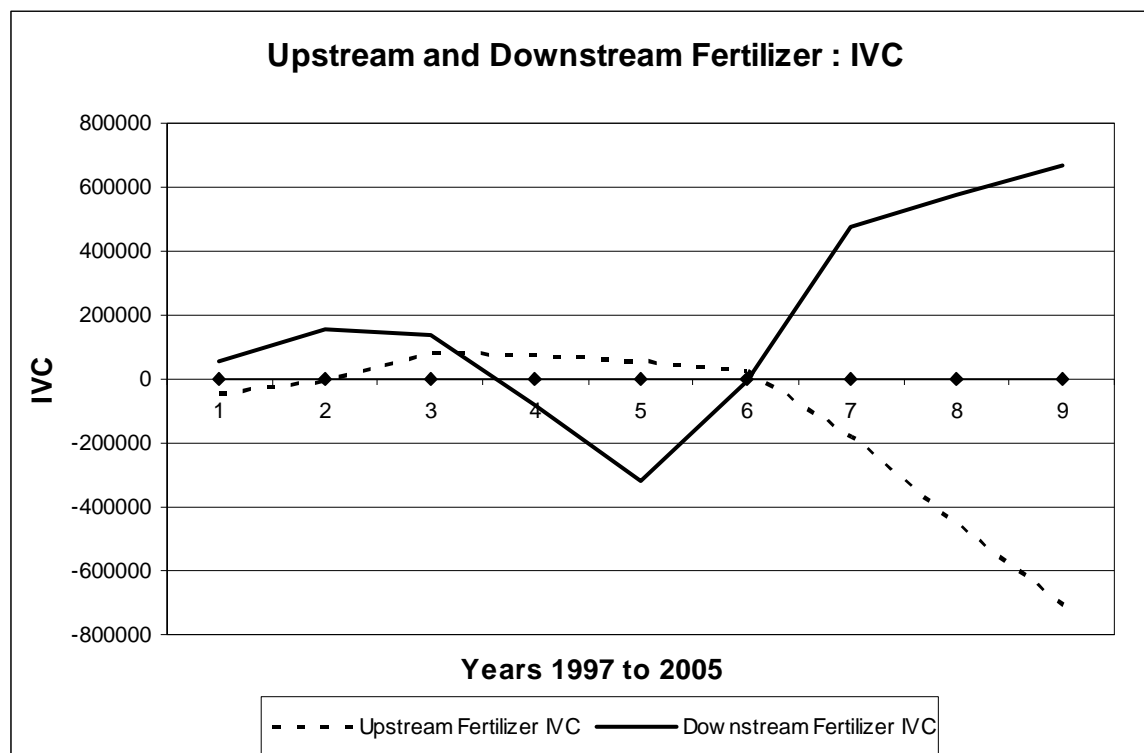
Note the following;

- EVC is insensitive to K
- EVC (and PBIT) are relatively insensitive to Sales Volume
- EVC (and PBIT) are very sensitive to Cost of Sales
- EVC (and PBIT) are very sensitive to Selling Price

5.7.4. IVC Compared in Upstream and Downstream Polymers

The following graph illustrates the intrinsic value calculated for upstream and downstream fertilizers.

Figure 5.22: IVC Comparison – Upstream & Downstream Fertilizers



The graph clearly illustrates that by 2005 the downstream fertilizers sector had returns that were higher than the weighted average cost of capital and the upstream fertilizers sector's returns were lower than the cost of capital. It also seems to illustrate an inversely proportional relationship between low returns upstream and high returns downstream relative to the cost of capital, K.

5.8. Conclusions – Fertilizers feedstocks

Production capacity for ammonia in SA is around 660 000 t/a, and for phosphate rock 3.3 million t/a. The SA market size in 2004 for ammonia used in local applications such as ammonium nitrate was estimated at 710 000 tons. This indicates a shortage in ammonia capacity, which is made up from imports. The SA non-captive market for phosphate rock was 1.7 million t/a in 2004. The balance of the phosphate rock production is either captively converted to phosphate rock or exported.

SA inland or domestic ammonia prices are directly linked by means of the formula-applied pricing mechanism to international prices. There is no import duty on ammonia. The phosphate rock price is indexed upon the CFR [freight delivered price] price of phosphate rock in India. Effectively local phosphate prices in 2005 were at a discount of 30.6% compared to India.

Actual delivered ammonia prices in SA during the period 2000 – 2004 were around 5.1% higher than the US Gulf Coast prices, and 17.6% higher than Indian CFR prices. It should be noted that both the US and Indian prices have to be adjusted with the respective inland delivery costs to obtain a true comparison with the South African delivered prices. In the case of phosphate rock [taking into account variances in BPL levels], SA delivered prices are historically well below Indian CFR prices, which exclude Indian inland delivery costs. Ex-factory SA prices are either below or similar to Moroccan export prices.

Taking the reality test into consideration, SA is consuming around 0.65% of global ammonia, which is in line with SA's share of global GDP. In the case of phosphate rock SA's share of consumption is around 1.2%, which is relatively higher than the contribution to global GDP.

Demand elasticity analysis showed that demand for fertilizers responds negatively to price changes with a small elasticity of -0.38 . Demand responds positively to GDP with an elasticity of 1.49. Demand of fertilizers also responds positively to rainfalls with a small elasticity of 0.04.

The intrinsic value analysis illustrated that the downstream fertilizers sector had returns that were higher than the cost of capital by 2005 while in the upstream fertilizers sector the returns were lower at the same time. This seems to illustrate an inversely proportional relationship between upstream and downstream financial performance.

6. TITANIUM DIOXIDE

6.1. Market definition of upstream chemical products

a) Introduction

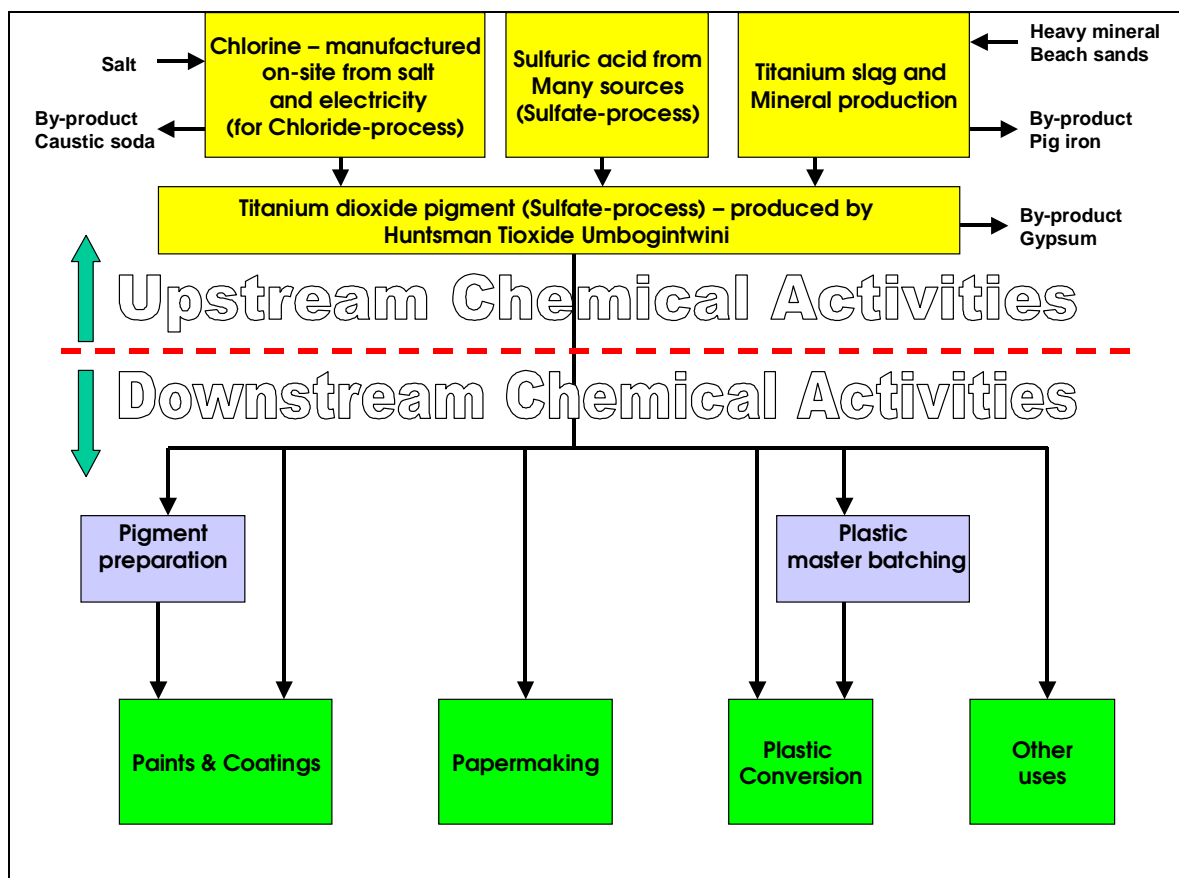
Titanium dioxide is the standard white pigment used principally in paints, paper, inks and plastics. It is the most important pigment in the world, accounting for about 70% of total volume. The pigment is made by processing a variety of titanium-containing minerals such as ilmenite, rutile, leucoxene or titanium slag. The leading supplier of titanium feedstock is Australia (33% of total global supply), followed by South Africa (17%), Canada (13%) and Norway (10%).

b) Value chain

Titanium dioxide is made by treating titanium-rich ore with either chlorine or sulfuric acid, followed by further processing. For cost- capital outlay reasons, chloride-process plants continue to be favoured over sulfate plants in industrialized countries, particularly for new production facilities. Operators of sulfate-process plants have had to invest in reducing the environmental impact to extend operating lives through projects like effluent treatment of waste acid streams through the manufacture of co-products like Gypsum which is used in the construction industry. In addition, rutile pigment from the chloride process has been growing.

The value chain for titanium dioxide pigments is summarised in the diagram below:

Figure 6.1: Titanium dioxide Value Chain



c) Applications and Global Market Size

In 2004, global titanium dioxide pigment production grew to 4 million metric tons with an estimated value of \$8 billion. (Source: IBMA)

The major consuming industries for TiO₂ pigments are mature sectors in the developed world—surface coatings, paper and paperboard, inks and plastics. Therefore, the consumption of TiO₂ tends to parallel general economic trends. Paint and coating applications account for the largest global share (around 75%), while inks and plastics and paper accounting for most of the rest.

d) Impact of different product grades or performance specifications on market applications

In terms of technology used, chloride and sulphate based pigment can be substituted in around 80% of applications. Around 10% of the market can only use chloride-based pigment [e.g. automotive paints], while 10% prefers to use sulphate process pigment [e.g. inks]. Sulfate-grade has a different crystal structure [amorphous; less abrasive and softer], while chloride grade is more crystalline and harder. There are also further grade specifications in terms of particle size and distribution, as well as surface coatings applied. Generally, however, the major grade accounts for around two-thirds of the market.

e) Level of competition in supply for major geographic export markets for upstream products

There is about sixty plants worldwide (outside of China) making titanium dioxide with an average capacity of 60 thousand metric tons per year. In recent years, the industry has been restructuring toward consolidation, but not new capacity. The top six producers now account for about 80% of total worldwide capacity.

6.2. SA Market structure and shares of upstream chemical producers

6.2.1. Domestic industry structure

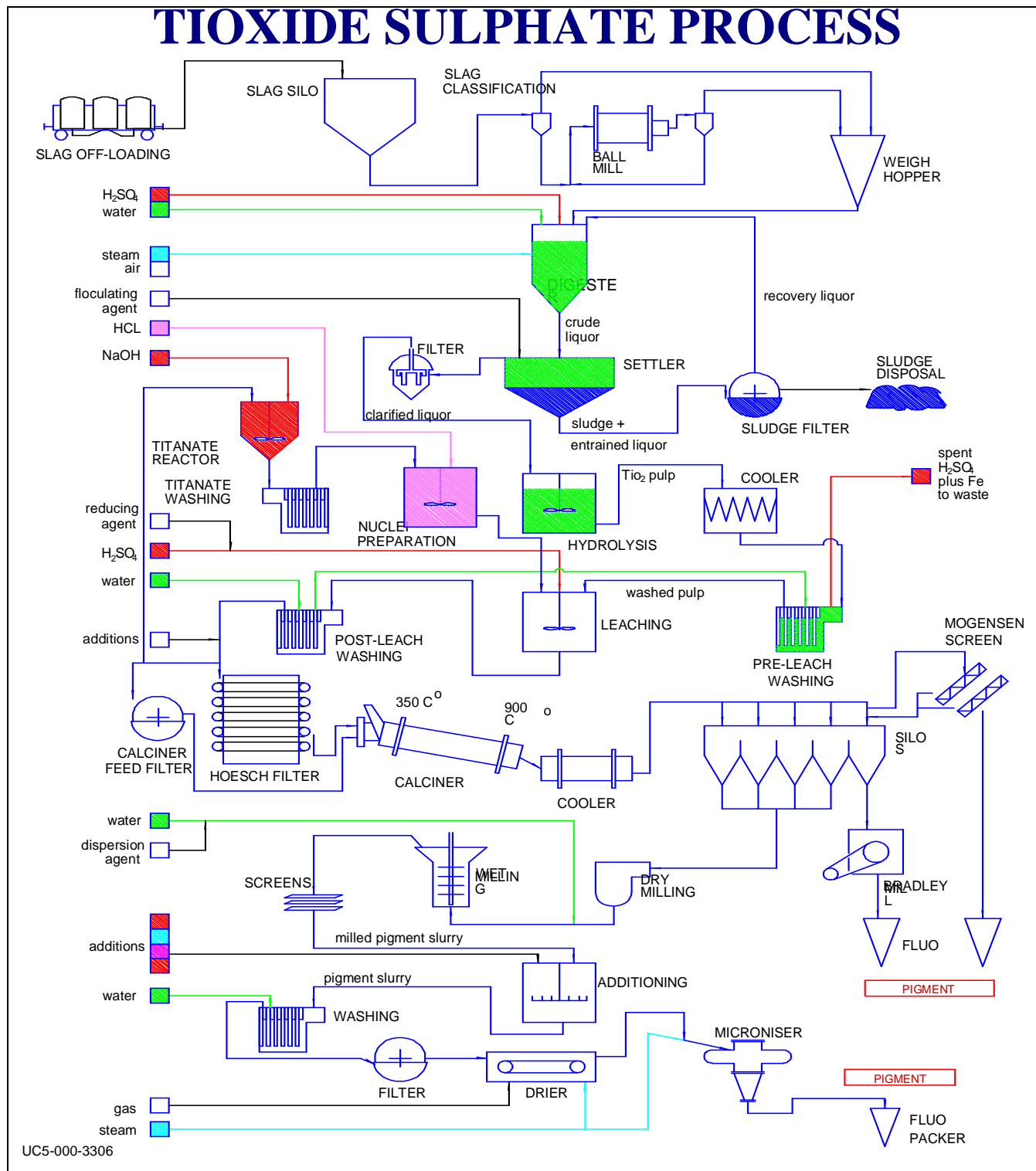
a) Feedstock for Titanium pigment production

Titanium feedstock is typically obtained from natural deposits of heavy mineral sands, which contain titanium ores together with other minerals such as Iron and Zircon. This titanium bearing ores, mainly ilmenite or rutile types can be used directly in pigment manufacturing, depending upon the ore concentration and purity. Around one-third of global titanium ore is supplied as a slag produced from lower grade ores. This slag is then used for pigment manufacturing. SA is a major global source of titanium feedstock, accounting for around 17% of the total global supply, and 50% of particularly titanium slag. The operations include Richards Bay Minerals and Ticor in Richards Bay and Namaqua Sands in Saldanha Bay.

b) Titanium dioxide pigment Production

Titanium dioxide pigment in SA is only manufactured by one operation, namely Huntsman Tioxide at Umbogintwini. The plant is based on sulfuric acid technology and is relative old, and small, in terms of other global operations. Production capacity is in the order of 35 000 tpa, but one-third of the plant is currently mothballed due to a decline in exports, caused mainly by the strong Rand.

Figure 6.2: Huntsman Tioxide Flow Diagram

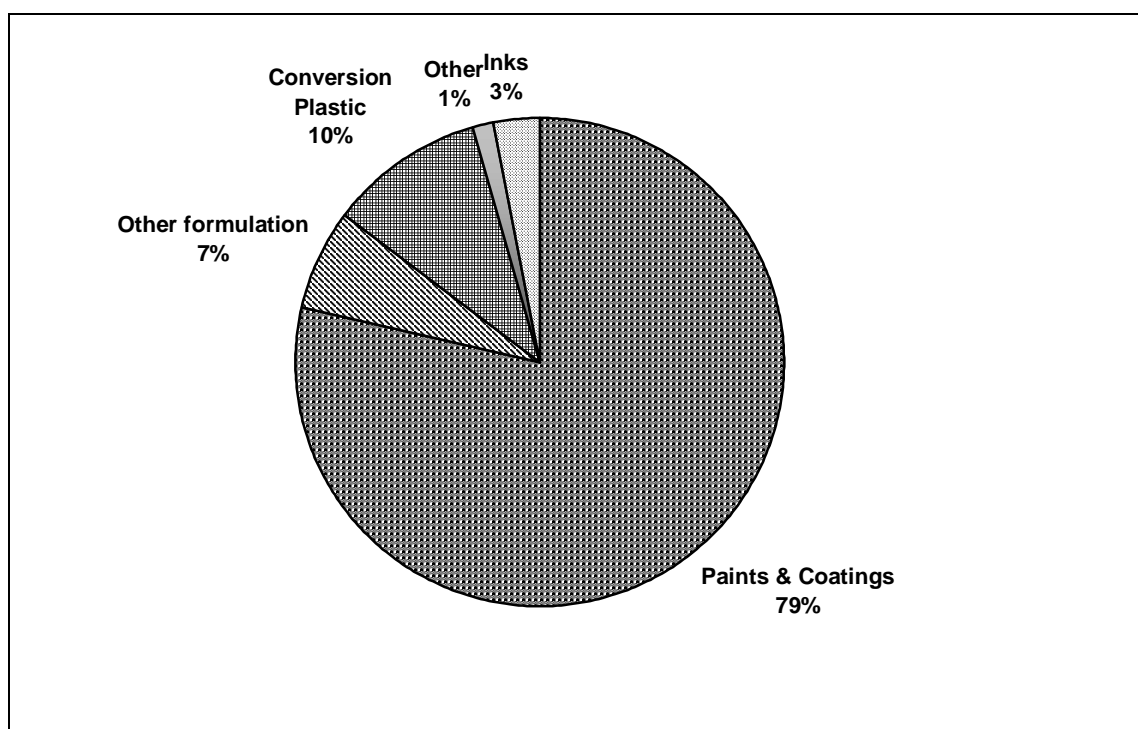


Huntsman Tioxide manufactures only one general purpose grade that meets the needs of the local industry, particularly for coatings applications.

c) Titanium Pigment Market

The SA market size in 2004 for Titanium dioxide pigment used mainly in paints, inks, plastics and paper is estimated at 24 000 tons. The breakdown of the market is demonstrated in the following diagram.

Figure 6.3: South African Titanium dioxide pigment Market Breakdown



6.2.2. The effect of import tariffs, anti-dumping duties and any other regulatory factors affecting pricing

There is an import duty of 10% applicable to titanium dioxide pigments

6.2.3. The global nature of the industry

Titanium dioxide is produced in a large range of grades [e.g. coatings, inks, special coated grades, etc] but in general is regarded as a commodity product [especially for the major coatings

grade] that is well-traded in large volumes (2.8 million tons/annum – 115 times the SA market) around the globe, demonstrating its global nature.

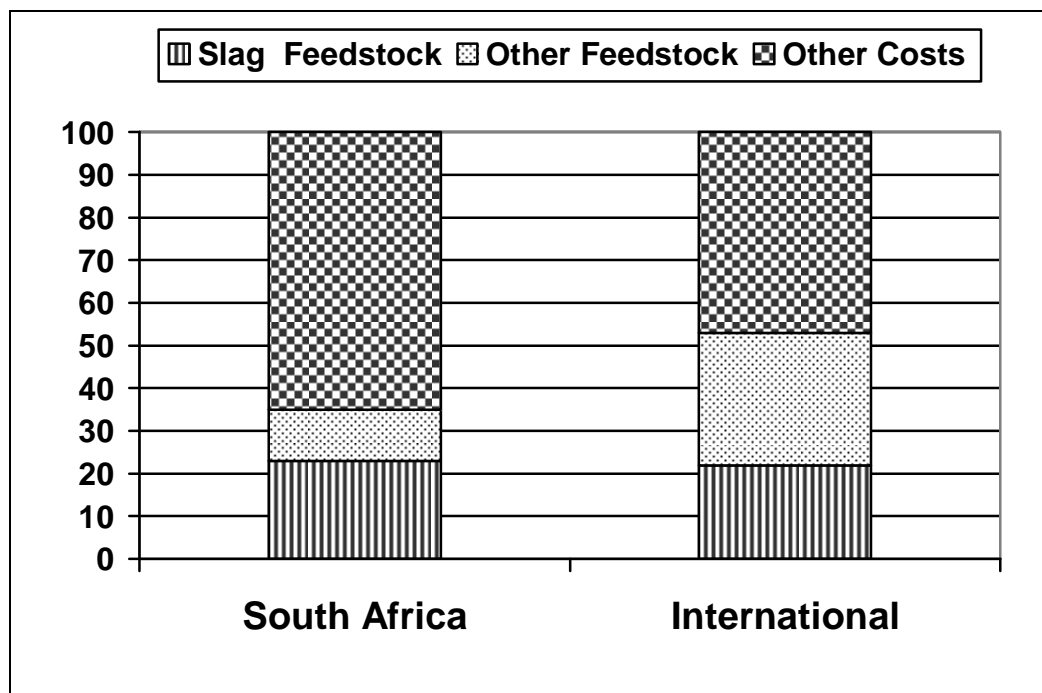
6.3. Costs and pricing of upstream chemicals products

6.3.1. The cost structure of the industry and global comparison

The relative cost structures for the SA based operations, compared with standard global titanium pigment operations are shown in the figure below. It should be noted that the SA operation is relatively old and small in capacity, as well as based upon older sulphate-based technology, compared to newer plants that are based upon chloride technology.

The international titanium pigment information is based on IBMA data – US low-cost operation.

Figure 6.4: Relative Titanium Dioxide Pigment Cost Structures – SA and International (USA)



Based upon these cost structures, feedstock in SA's case is a lower portion of total costs, while other costs, which include variable and fixed manufacturing costs, but no depreciation, are higher in SA's case. This indicates that SA's overall cost per ton of pigment is significantly higher than international low-cost producers.

6.3.2. SA Production Advantages & Disadvantages

Production advantages include:

- Existing plant the only manufacturer on the continent
- Only local producer in SA
- World class Product grade
- Existing plant art of multinational - access to world class, best practice technologies, methodology's and expertise

Disadvantages for the local manufacturing operation include:

- Capacity, small plant in world scale terms, which impact on competitive manufacturing unit cost
- Old plant, commissioned 1962 - a temperamental mixture of continuous and batch processing impact on fixed manufacturing unit cost
- Unique technology, chemical processing experience from other industries not easily applied in the TiO₂ plant and at least 2 to 3 years of in house experience is required to begin to gain an understanding of the complex interactions on site.

6.3.3. Upstream pricing practices with respect to downstream domestic purchasers

The local titanium dioxide pigment producer sells polymer products to customers in markets which include the Republic of South Africa and other African countries, as well as other regions. Their policy is to sell at the market price prevailing in each of these regions at any time, and this also applies to sales in South Africa. Titanium dioxide is a commodity item and hence pricing is driven by world demand and supply.

The difference between market pricing and import parity pricing is that in the case of the former prices change continuously based on the cheapest available source at a particular point in time. In the case of import parity pricing, the price is calculated on the basis of a published price in a specific region or country and the ultimate price is formula-based. Furthermore, in the case of market pricing, customers monitor prices from all major trading regions and the lowest price

available at any point in time is then used by them as a basis for negotiations with their polymer supplier.

There is a rebate mechanism in place for large customers that are based on volumes. An estimated 55% of all sales of locally produced product are to large customers. Customers that order less than a full truck load of product (32 tons) are supplied via regional distributors.

6.4. Major downstream industries that purchase upstream products

6.4.1. End-use structure

The local titanium dioxide pigment market of 24 000 tons/annum in 2004 is supplied mainly by Huntsman Tioxide, with imports accounting for around 28% of the market. The end-use structure for titanium dioxide pigment is segmented into the grade of pigment used, as well as the end-product. Coatings/paints account for 79% of consumption, followed by plastics with 10% and inks with 5%. The coatings sector consists of around 200 manufacturers, of which the top 15 accounts for around 75% of the market. The plastics sector consists of a relatively small number of masterbatch producers, which in turn supply the large converting sector.

The major titanium dioxide pigment is a grade for general coatings/paints applications, which accounts for around 70% of the market. Around 55% of the market is represented by large converters that buy in full truck loads.

6.4.2. Impact of feedstock cost on total cost structure

No downstream respondent feedback received.

6.4.3. Organisation of downstream players

The major downstream sector, coatings/paints is well organised via the South African Paint Manufacturers Association (SAPMA), while the second most important sector, plastics is organised through the Plastics Federation.

6.4.4. Downstream sector ability to influence input prices received

No downstream respondent feedback received.

6.4.5. Duty Structures and anti-dumping measures

Downstream products from titanium dioxide pigments, such as water-based paints have a duty of 10%, similar to the upstream pigments. In the case of plastic products, where tariff protection is applicable the rate is in the order of 15 – 20%, which is higher than the 10% applicable to pigments.

6.5. International competitiveness of South African chemicals pricing

6.5.1. Introduction

It is important in the analysis of pricing that a common understanding of pricing principles is agreed upon, especially in the context of a comparative analysis. The main issue that is involved is the concept of an inland price for products, which is the price paid by local customers in a particular country.

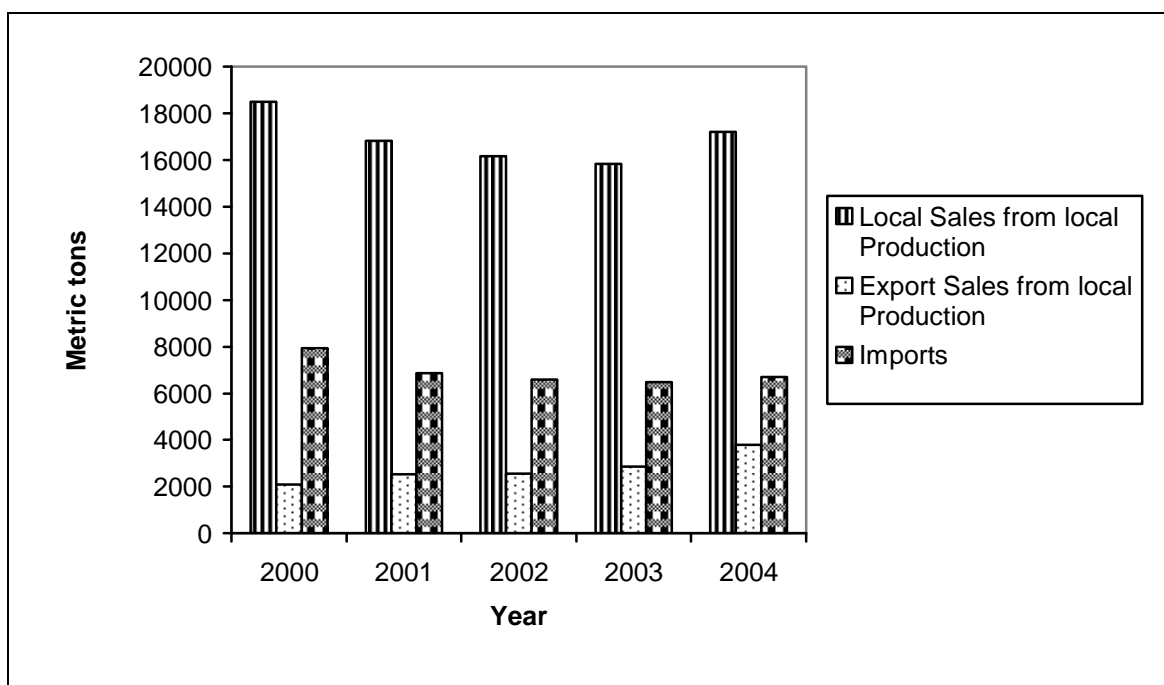
The competitiveness of South African chemicals pricing is dealt with under the following headings:

- Historical SA feedstock market volumes and pricing levels
- Comparison of SA inland prices for feedstock with international prices
- Historical sales levels for key downstream products
- Basis for SA pricing calculations
- Key differentiation factors for purchasing feedstock
- Operations: (Upstream/ Downstream: Basis for operation [e.g. 24/7]; Average age and original cost of equipment; Capacity utilisation; Workforce)
- Assessment of global competitiveness of downstream producers
- Ability for downstream to expand product range based on lower feedstock prices
- Impact of current pricing practices (Skills; Wages; Technology; Long-term sustainability; Import replacement)

6.5.2. Historical SA feedstock market volumes and pricing levels

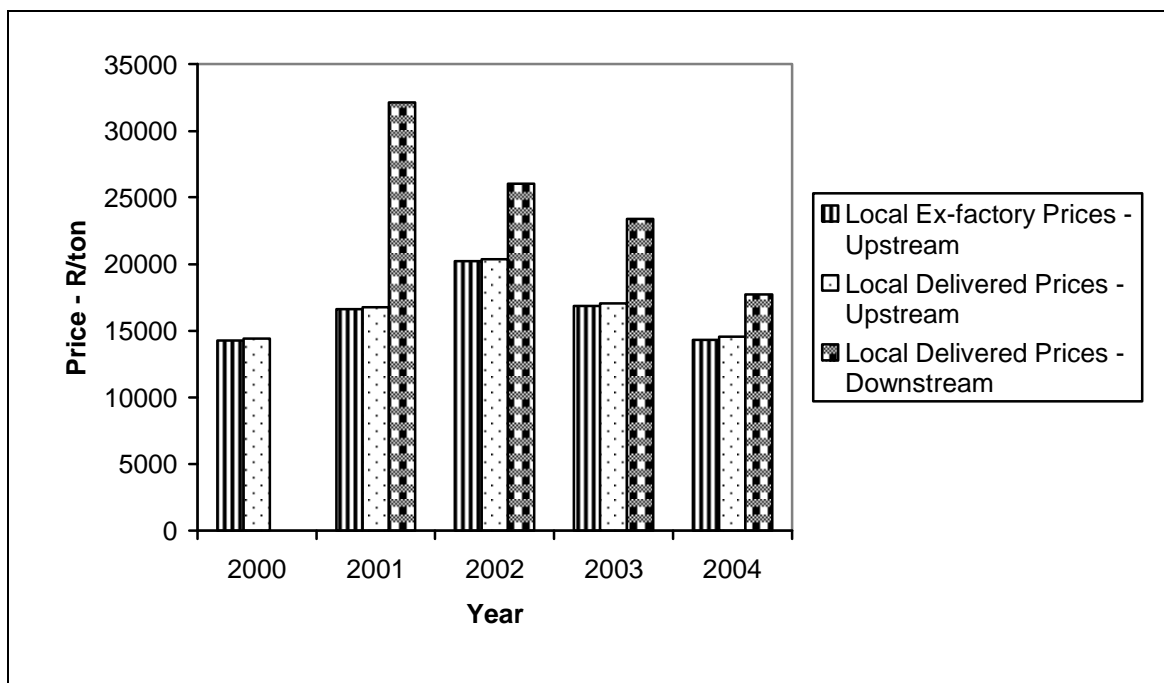
The historical local and export sales volumes of titanium dioxide pigments, as well as average delivered prices are shown in the figures below. For commercial sensitivity no actual data values are published on the chart.

Figure 6.5: Historical Local & Export Volumes – Titanium dioxide pigments



Local sales from local production decreased from 2000 – 2003, with an increase in 2004. Exports showed an average growth of around 16% per annum over the period.

Local delivered prices based upon total volumes and total values for the respective years are shown in the figure below and reveal that ex-factory prices and local delivered prices have been declining as a result of the strengthening of the Rand since prices reached a peak in 2001:

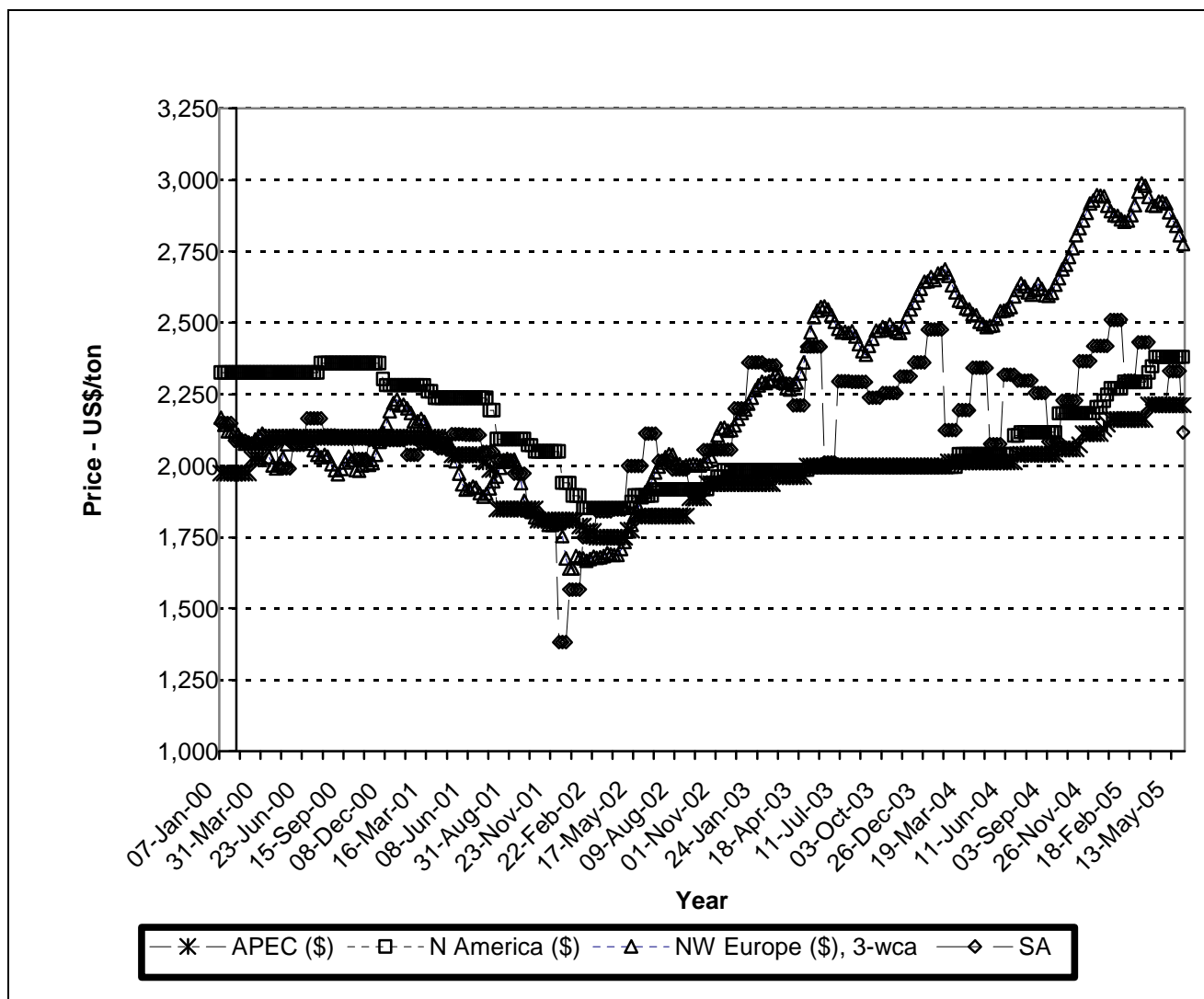
Figure 6.6: Historical Local Delivered Prices (Excluding VAT) – Titanium dioxide pigments

Note: Downstream data was based on a small sample size. The difference between upstream and downstream prices can be attributed to not all downstream companies having participated in the study and that to the fact that downstream companies also buy polymer from other companies, such as traders and other importers, who were not part of the upstream sample participating in the study.

6.5.3. Comparison of SA inland prices for feedstock with international prices

The background to international pricing as well as sources for data is discussed in [Chapter 1](#) and [Appendix 3](#) based on polymers. The trend and the general relationships are more important to gain insight into the fundamentals than a comparison of prices in a particular month.

Figure 6.7: SA and International Titanium dioxide pigments Domestic Prices



The average prices over the period shown above are as follows:

- APEC (Asia Pacific): \$2,002/ton
- N. America: \$2,125/ton
- North West Europe: \$2,276/ton
- SA (South Africa): \$2,134/ton

Prices paid by South African downstream users are generally in line with prices paid in the regions included in the comparison.

6.5.4. Historical sales levels for key downstream products

Titanium dioxide pigment is used to manufacture a large range of end-products, including all kinds of coatings, plastic products, inks and many other products.

No information was received from downstream respondents pertaining to the historical growth of product categories.

6.5.5. Basis for SA Downstream Products pricing calculations

No information was supplied by downstream respondents.

6.5.6. Key differentiation factors for purchasing feedstock

No information was supplied by downstream respondents.

6.5.7. Downstream Operations

No information was supplied by downstream respondents.

6.5.8. Assessment of global competitiveness of downstream producers

No information was supplied by downstream respondents.

6.5.9. Ability for downstream to expand product range based on lower feedstock prices

No information was supplied by downstream respondents.

6.5.10. Impact of current Titanium dioxide Pigments pricing practices

Skills

The upstream respondent commented that the strong Rand results in a huge impact on local revenue in SA as selling prices are dollar based with a SA Rand based manufacturing base. The result has been difficulty in retaining skills and developing skills which have a cost element to the business.

Wages

The upstream respondent commented that the decrease in revenue constrains their ability to offer market related salaries with a consequence that they lose valuable skills.

Technology

The upstream respondent commented that with their poor profitability capital is a major constraint for technology improvements and further investments.

Long-term sustainability

The upstream respondent feels that their long-term sustainability is dependent on their ability to be profitable through the commodity price cycles as well as currency fluctuations.

Import replacement

No information was supplied by downstream respondents.

6.6. Impact of pricing on downstream purchasers - Demand Elasticity

6.6.1. Introduction

From a practical perspective, most titanium dioxide pigments are used in the paints industry. In this application titanium dioxide pigments accounts for around 20 – 25% of raw material costs, or around 10 – 13% of selling prices. At retail level titanium dioxide pigments accounts for only around 5% of the price. It is therefore unlikely that a decrease in titanium dioxide pigment prices will significantly increase demand for paints.

6.7. Impact of pricing on downstream purchasers – EVC

6.7.1. Introduction

Given the relationship that exists between sales volumes and price, the challenge is to find an equitable method of comparing the impact on the financial performance of upstream and downstream businesses of the titanium pigments sector of the chemical industry brought about by changes in selling prices and sales volumes. The measure used must be unbiased and objective, and based on readily available data.

The measure that meets the above criterion that has been used in this study is Economic Profit, also known as Economic Value Created (EVC). A basic introduction and description of EVC and the methodology employed is shown in [Appendix 2](#).

6.7.2. Assumptions

For the purposes of this study the following principles have been applied:

The **weighted average cost of capital (K)** would normally vary across industries and over time. As will be demonstrated below in the **Upstream Sensitivity graph**, EVC is *relatively* insensitive to variations in K in the industries measured.

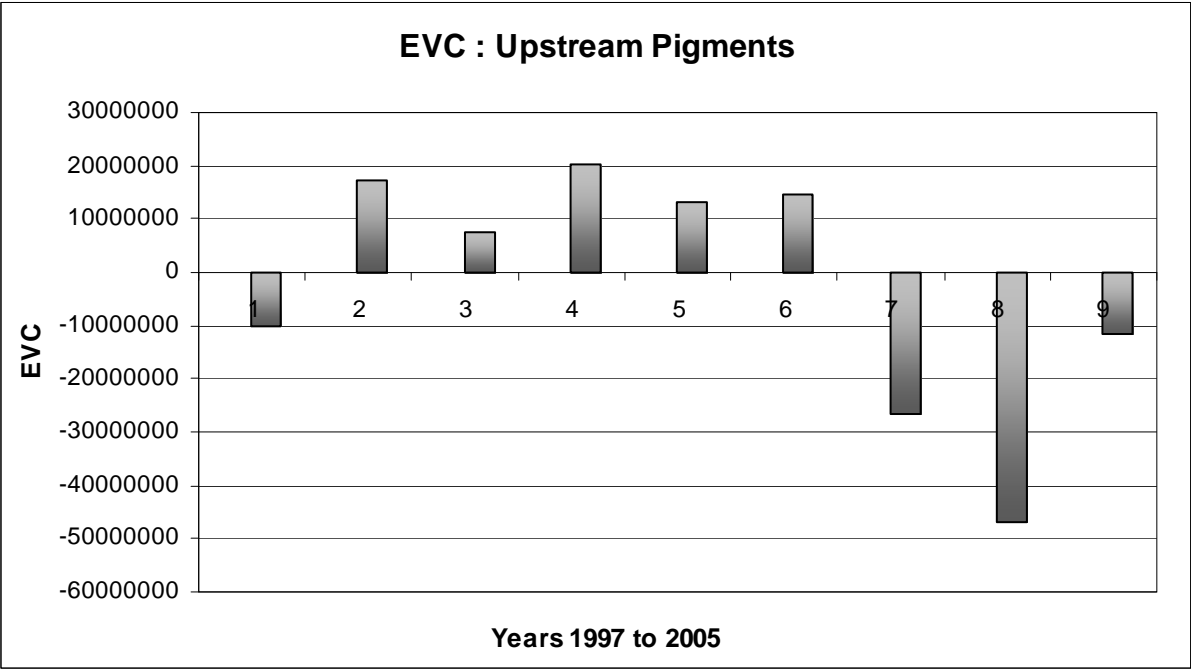
This study seeks to determine the relative impact of pricing policies between upstream and downstream protagonists. Accordingly the view was taken that a single K could be applied as a consistent-and-equal benchmark for all companies in the study. This approach eliminates the moving benchmark effect of applying a different K to each company in each year.

Determination of K - Weighted average cost of capital %	
Target debt as % of capital	50
Risk free rate of return %	12
Market rate of return %	20
Risk index (beta)	1.5
Cost of equity %	24
Marginal debt rate %	15
Marginal corporate tax rate %	30
Cost of debt %	10.5
K, Weighted average cost of capital %	17.25

6.7.3. Actual EVC results for upstream companies.

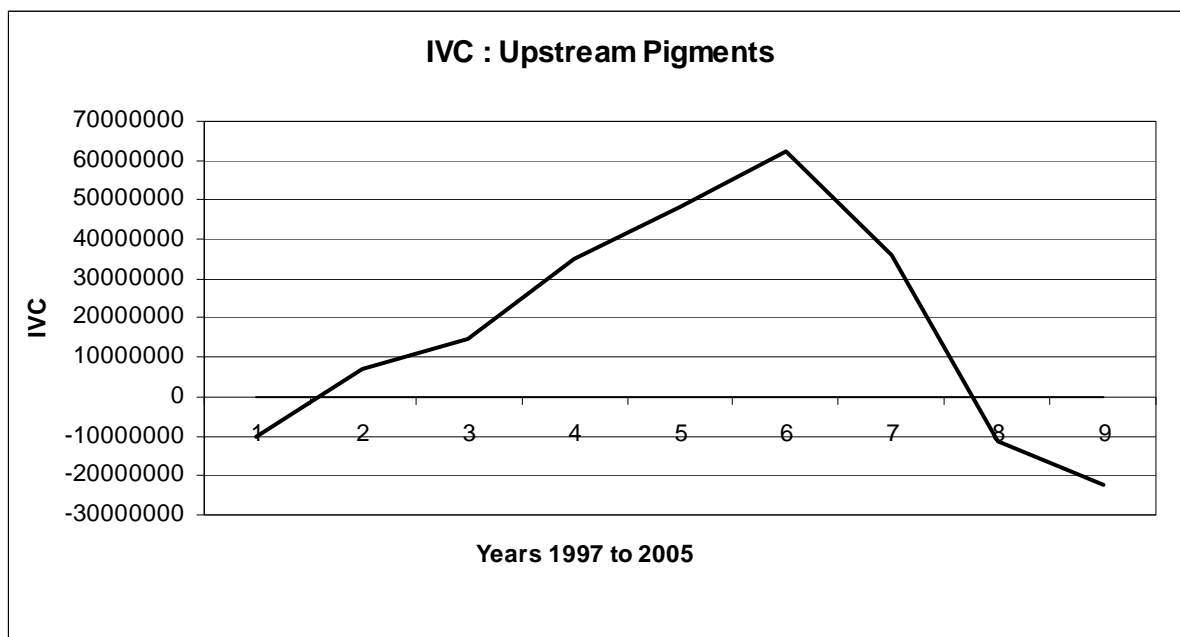
The following EVC graph represents the actual values calculated in each year between 1997 and 2005 for upstream pigments. The graph indicates that for the first 6 years with the exception of 1997 recorded returns that were higher than the weighted average cost of capital, K. However, from 2003 to 2005 the returns have been lower than the weighted average cost of capital.

Figure 6.8: EVC Results – Upstream Pigments



However the IVC graph that follows will show that the lower returns in 2003 and 2004 were significantly large as to outweigh the years of gains accumulated up to 2002, and IVC became negative in 2005.

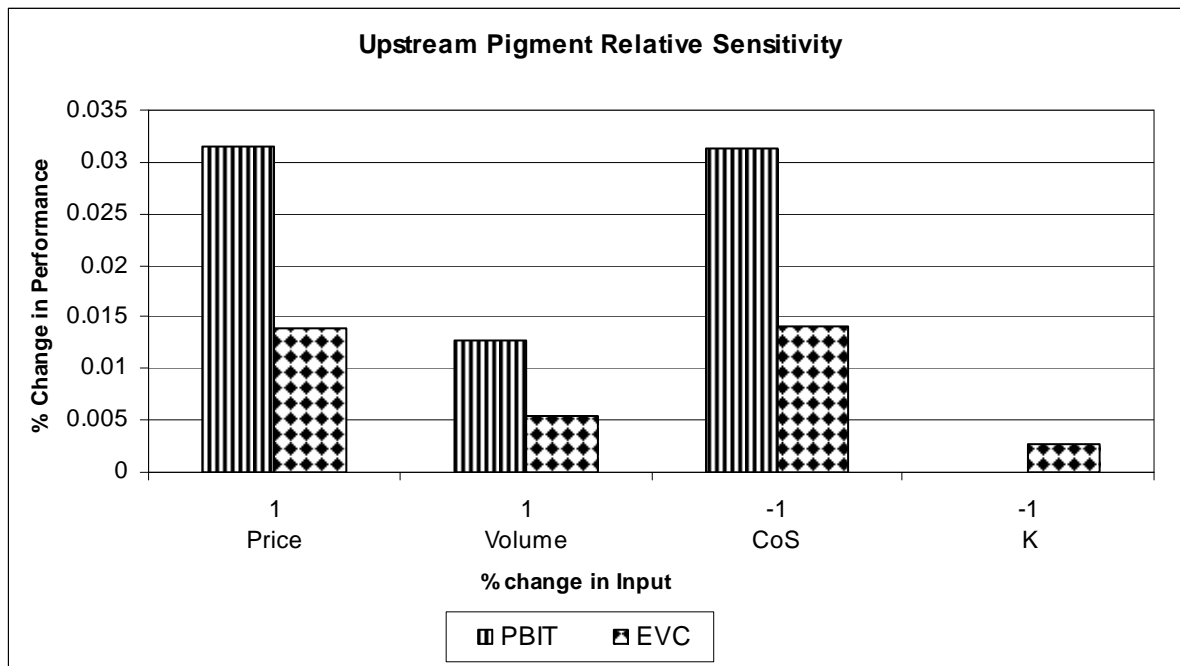
Figure 6.9: IVC Results – Upstream Pigments



The following graph illustrates the relative sensitivity of EVC and Profit before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K in upstream pigments.

The bar groups indicate by what percentage PBIT and EVC would change for a one percent improvement in Prices or Volumes or Cost of Sales or K.

Figure 6.10: Sensitivity of EVC and Profit before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K – Upstream Pigments



Note that the inverse of what this graph shows is also true. That is, PBIT and EVC would change by the same percentage points but in the opposite direction for a one percent decline in Prices or Volumes or one percent increase in Cost of Sales or K.

Note the following:

- EVC is insensitive to K
- EVC (and PBIT) are relatively insensitive to Sales Volume
- EVC (and PBIT) are relatively sensitive to Selling Price
- EVC (and PBIT) are relatively sensitive to Cost of Sales

6.7.4. Downstream Pigments

No data was supplied for analysis.

6.8. Conclusions – Titanium dioxide

Production capacity for TiO₂ pigments in SA is around 35 000 t/a. The SA market size in 2004 for TiO₂ pigments used in local applications such as paints was estimated at 24 000 tons. This indicates an excess in capacity. However, this goes for the general grade that is used mainly in paints and coatings. There are also imports of other pigment grades that account for about 28% of the market.

The South African operation is relatively old and small in capacity, as well as based upon older sulphate-based technology, compared to newer plants elsewhere in the world that are based upon chloride technology. This makes South Africa's overall cost per ton of pigment significantly higher than international low-cost producers.

TiO₂ pigments are a commodity item and hence pricing is driven by world demand and supply. The outcome is that the most competitive supplier sets the price and is maybe better referred to as market pricing, as opposed to formula-driven IPP. Therefore TiO₂ pigments prices prevailing in South Africa are based on that of the most competitive supplier at any point in time. Local prices are referenced on the prices of imports.

There is a rebate mechanism in place for large customers that are based on volumes. An estimated 55% of all sales of locally produced product are to large customers.

A comparison of South Africa's inland prices with international prices showed that prices paid by South African downstream users are generally in line with prices paid in the regions (Asia Pacific, North West Europe, and North America) included in the comparison.

The reality test has shown that South Africa is consuming around 0.6% of global TiO₂ pigments, which is in line with South Africa's share of global GDP. The sector can therefore be regarded as relatively developed.

From a practical perspective, most titanium dioxide pigments are used in the paints industry. In this application titanium dioxide pigments accounts for around 20 – 25% of raw material costs, or around 10 – 13% of selling prices. At retail level titanium dioxide pigments accounts for only around 5% of the price. It is therefore unlikely that a change in titanium dioxide pigment prices will significantly change demand for paints.

For titanium dioxide pigments an EVC analysis was conducted for 1997 to 2005 for the single upstream company. The analysis indicates that for the first 6 years starting in 1997, with the exception of 1997 recorded returns were higher than the weighted average cost of capital, K. However, from 2003 to 2005 the returns have been lower than the weighted average cost of capital. The lower returns between 2003 and 2005 outweighed the returns made in the earlier years to the extent that the IVC became negative by 2005.

7. ACRYLIC ACID AND ESTERS

7.1. Market definition of upstream chemical products

a) Introduction

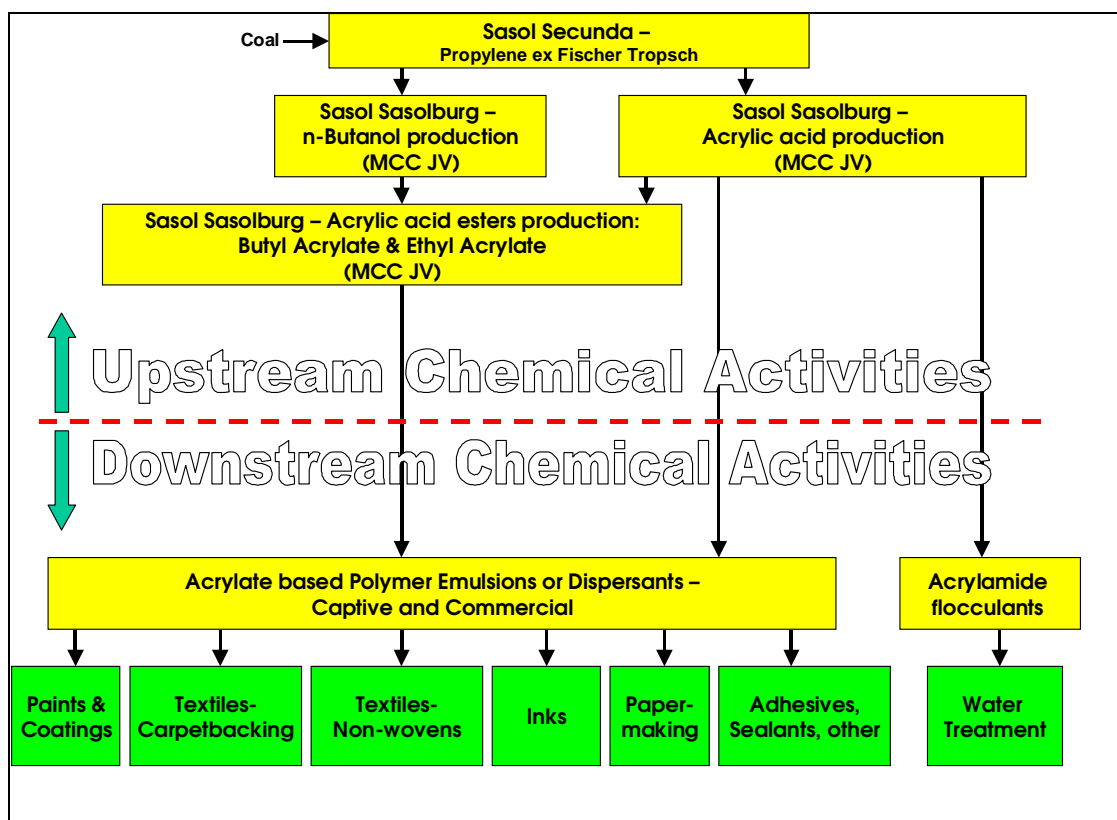
Acrylic acid and esters are perhaps the most versatile series of monomers for providing performance characteristics to thousands of polymer formulations. They are flammable, reactive, volatile liquids based on an alpha, beta-unsaturated carboxyl structure.

Incorporation of varying percentages of acrylate monomers permits the production of thousands of formulations for latex and solution copolymers, copolymer plastics and cross-linkable polymer systems. Their performance characteristics—which impart varying degrees of tackiness, durability, hardness and glass transition temperatures—promote consumption in many end-use applications.

b) Value chain

Acrylic acid and n-butanol are made by Sasol, in a JV with MCC, in Sasolburg from propylene supplied by pipeline from Sasol Secunda. Acrylic acid is purified to glacial acrylic acid, and then sold on for the production of polymer emulsion as well as water treatment chemicals. No super absorbents are made as yet in SA. The balance of the acrylic acid is converted to butyl acrylate and ethyl acrylate, using the n-butanol as well as ethanol. This is also sold to the emulsion polymer producers, as well as exported. The value chain for acrylic acid and esters is summarised in the diagram below:

Figure 7.1: Acrylic acid and Esters Value Chain



c) Applications and Global Market Size

World demand for crude acrylic acid was 3.5 million metric tons in 2003, worth \$4.2 billion. Around 55% of the crude acrylic acid is converted to acrylate esters and 30% to super absorbents [mostly on-site]. Total demand for commodity acrylate esters amounted to 3.5 million metric tons, worth \$4.6 billion. (Source: SRI Consulting)

Major markets for the esters include surface coatings [60% of total], textiles [15% of total], adhesives [12% of total] and plastics. Polyacrylic acid or copolymers find applications in super absorbents, detergents, dispersants, flocculants and thickeners. Super absorbent polymers (SAPs) are used primarily in disposable diapers.

d) Impact of different product grades or performance specifications on market applications

Crude acrylic acid is not commercially sold, but converted on-site to glacial (purified) acrylic acid. Commercially sold glacial acrylic acid and esters are regarded as pure, commodity chemicals, and typically have a purity of 99% plus. There is therefore no impact of different product grades or performance specifications on market applications.

e) Level of competition in supply for major geographic export markets for upstream products

The largest global producers of acrylic acid are BASF – 23% market share - (with plants in the United States, Brazil, Belgium, Germany, and Malaysia), followed by Rohm and Haas/StoHaas – 20% market share - (United States and Germany), Dow – 14% market share - (with plants in the United States, Germany and Mexico), Nippon Shokubai – 11% market share - (United States, Japan and Indonesia), ATOFINA (France), Mitsubishi Chemical Company (MCC) (Japan and a JV with SA's Sasol) and Formosa Plastics (Taiwan).

7.2. SA Market structure and shares of upstream chemical producers

7.2.1. Domestic industry structure

a) Feedstock for Acrylic acid and Acrylate Esters production

Sasol manufactures acrylic acid from propylene monomer, while Acrylate Esters require n-butanol [also made from propylene] and ethanol in addition to acrylic acid. Propylene supply in SA is concentrated with only two suppliers, namely Sasol Secunda and Sapref [Shell/BP] in Durban. Sasol's capacity is currently around 530 000 t/a and Sapref around 32 000 t/a. However, Sapref's supply in 2003 was only 20 000 t/a. There is a possibility of further propylene extraction in Durban. The Sasol Project Turbo that was approved in late-2003 will add a further 430 000 t/a propylene capacity. Sasol, using feedstock from their Fischer Tropsch process, captively makes industrial ethanol in large quantities.

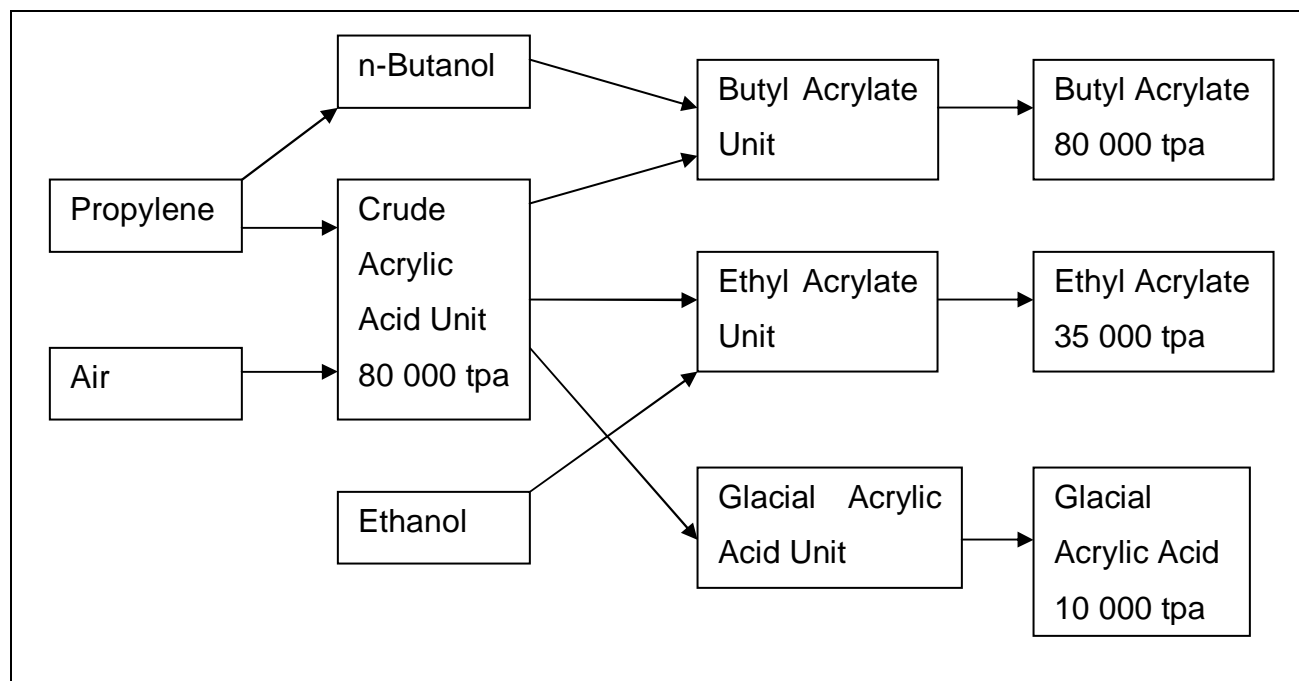
b) Acrylic acid and Acrylate Esters Production

The Sasol Dia Acrylates (SDA) joint venture was established in September 2002 after an intensive period of negotiation between Sasol and Mitsubishi Chemical Corporation (MCC) of Japan. The reasons for the creation of the joint venture were fairly simple. MCC contributed world class technology, operating experience and existing acrylic acid and acrylates markets. Sasol contributed competitive feedstock, a global sales distribution network and a brown field chemical site. Together these strengths created a globally competitive acrylic acid and acrylates industry player.

The SDA joint venture total capital cost was R2 454 million including working capital. The major portion of the investment was expended in Sasolburg at the Midland site to construct four plants, namely the crude acrylic acid, butyl acrylate, ethyl acrylate and glacial acrylic acid plants.

The complex was commissioned beginning in February 2004. Initially crude acrylic acid and finally butyl acrylate and ethyl acrylate was commissioned. Glacial acrylic acid was commissioned in quarter 3 of 2004.

Figure 7.2: Acrylic Acid & Acrylate Esters – Sasol Dia Acrylates JV Flow Diagram



c) Acrylic acid and Acrylate Esters Market

The SA market for acrylic acid is relatively small, as no super absorbents are being made as yet. Acrylic acid, in the form of glacial acrylic acid, is used primarily to manufacture water treatment chemicals, as well as emulsion polymers. The estimated consumption is 2 200 tons per annum. Acrylate esters are mainly used to manufacture emulsion polymers in SA. The total consumption of butyl acrylate is around 22 000 tons/annum, and ethyl acrylate around 1000 tons/annum.

7.2.2. The effect of import tariffs, anti-dumping duties and any other regulatory factors affecting pricing

There is no tariff protection for any of the products in this category.

7.2.3. The global nature of the industry

Glacial acrylic acid as well as acrylate esters are only supplied in one grade per product and in general is regarded as a commodity product that is produced by many countries and is well-traded in large volumes (2.3 million tons/annum – 90 times the SA market) around the globe, demonstrating its global nature.

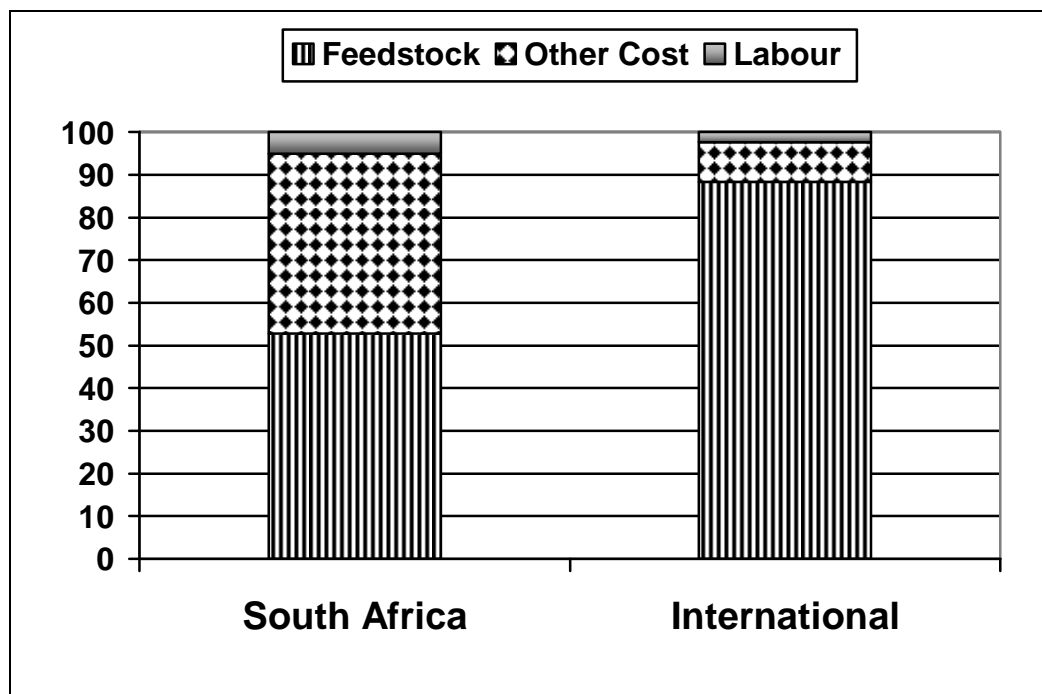
7.3. Costs and pricing of upstream chemicals products

7.3.1. The cost structure of the industry and global comparison

The cost structure of SA based operations is not directly comparable to international glacial acrylic acid as well as acrylate esters operations in that the SA producer has an integrated operation that are manufacturing n-butanol as well as acrylates.

The relative cost structures for the SA based operations compared with standard global butyl acrylate operations are shown in the figure below. The international butyl acrylate information is based on SRI consulting data – US Gulf Coast.

Figure 7.3: Relative Glacial Acrylic Acid & Acrylate Esters Cost Structures – SA and International (US Gulf Coast)



Based upon these cost structures, feedstock in SA's case is a lower portion of total costs, while other costs, which include variable and fixed manufacturing costs, but no depreciation, are higher in SA's case. It should be noted in SA's case the feedstock used is propylene, ethanol and captive butanol, while in the international case the feedstock is acrylic acid and butanol. The transfer cost mechanism of the SA feedstock stream has not been analysed in this report.

7.3.2. SA Production Advantages & Disadvantages

SA advantages include:

- Cost competitive propylene feedstock based upon Fischer Tropsch synthetic fuel upstream operations.
- Globally competitive n-butanol, acrylic acid and esters production technology and facilities

SA disadvantages include:

- Relatively small local and regional market.
- Long distance from attractive export markets.

- Inland location of production facilities.

7.3.3. Upstream pricing practices with respect to downstream domestic purchasers

The pricing philosophy described below was introduced by the local producer as part of a market entry strategy to enable market growth aligned with business objectives and may be revisited in future as market conditions change. The following factors are taken into account when setting the domestic price.

Base Price - Calculation of Global Market Price

The local producer's domestic price is comparable with prices in USA and Asia and is derived from the published ICIS LOR data as follows: The average of the lowest values quoted for North West Europe (Free Delivered) and Asia Pacific on a CIF basis of the preceding week's published prices at time of determination. No costs are added to the USD Price in terms of Import Parity Pricing input factors.

Local market conditions are taken into account to ensure that the local producer remains competitive in the SA market.

Conversion to South African Rand Price

The average historic exchange rate for the month preceding the calculation period is used to convert the USD price to Rands.

.

Validity and Notification Price Period

Prices are quoted with a 30 day notification period and are valid for one calendar month.

Regional Pricing

The price is adjusted by a regional transport differential which is based on actual costs incurred to transport product to the respective geographical regions.

Bulk to Drum Differential

A standard Bulk to Drum Differential fee is applied which is not based on volume off-take.

Credit Terms

Standardised Credit Terms is applicable to all customers and is 30 days from date of statement.

Price Differentiation

No price differentiation based on amongst others, volume off-take has been applied other than regional transportation differences and this is also applicable to distributors.

Export Incentives

Export incentives are considered in cases where additional products in the form of Acrylates or beneficiated downstream products are exported out of RSA to support the growth initiatives of local industry.

Rebates and discounts

No rebate or discount schemes have been implemented as well as standardised payment terms to all customers irrespective of size.

Upstream supplier's view on Actual Pricing Mechanism Versus Import Parity Pricing

The local producer responded that they do not apply an Import Parity pricing mechanism to the industry but rather a market pricing philosophy.

An import parity price is a mechanistic formula driven calculation and is done by specifically calculating a price based on what it would have cost to import the product based on internationally published price data and is thus a proxy or estimate of the local delivered price of a competitive imported product to a downstream customer, this would potentially include all inward transport and other real costs that would be associated with importing the product into South Africa.

If an IPP methodology was to be used the input factors that would form part of the calculation will be as outlined below in a typical IPP calculation.

Table 7.1: Glacial Acrylic Acid & Acrylate Esters – Import Parity Price Calculation

Product
FOB Rotterdam USD
FOB US Gulf
Average FOB USD Price
Exchange Rate
Average FOB ZAR Price
Ocean Freight Rotterdam
Ocean Freight US Gulf
Ocean Freight Average
Portnet Cargo Dues
Disbursement Fees
Storage Cost
Surveying Cost
Insurance
Financing Cost
Import margin(As a % of FOB)
Import margin ZAR Value
Durban Import Parity Landed Price

The difference between market pricing and import parity pricing is that in the case of the former prices change continuously based on the cheapest available source at a particular point in time. In the case of import parity pricing, the price is calculated on the basis of a published price in a specific region or country and the ultimate price is formula-based. Furthermore, in the case of market pricing, customers monitor prices from all major trading regions and the lowest price available at any point in time is then used by them as a basis for negotiations with their polymer supplier.

7.4. Major downstream industries that purchase upstream products

7.4.1. End-use structure

The local glacial acrylic acid market of 2 000 tons/annum in 2004 is supplied mainly by imports, with Sasol Polymers accounting for around one-third of the market. The main use of glacial acrylic acid is in water treatment chemical manufacturing, which accounts for around 35% of the market, followed by dispersion polymers with 33%, and emulsifiers with 23%.

The local butyl acrylate market of 22 000 tons/annum in 2004 is supplied mainly by Sasol Polymers, with imports accounting for around one-third of the market. The main use of butyl acrylate is in dispersion polymers manufacturing. These dispersions are used, in turn, in coatings, textiles, adhesives, paper manufacturing and other uses.

The local ethyl acrylate market of 22 000 tons/annum in 2004 is supplied mainly by Sasol Polymers, with imports accounting for around one-third of the market. The main use of butyl acrylate is in dispersion polymers manufacturing. These dispersions are used, in turn, in coatings, textiles, adhesives and other uses.

In dispersion polymer production there are only a few companies in SA, with the major ones being BASF, Revertex, Rohm & Haas, Bohme, Clariant and Makeean.

7.4.2. Impact of feedstock cost on total cost structure

No respondent information available.

7.4.3. Organisation of downstream players

No respondent information available.

7.4.4. Downstream sector ability to influence input prices received

No respondent information available.

7.4.5. Duty Structures and anti-dumping measures

Acrylic dispersions, tariff 39.06.90.20, have a tariff of 10%. These include most of the products made from glacial acrylic acid and acrylate esters. Downstream products from these dispersions, such as water-based paints also have a duty of 10%.

7.5. International competitiveness of South African chemicals pricing

7.5.1. Introduction

It is important in the analysis of pricing that a common understanding of pricing terminologies is agreed upon, especially in the context of a comparative analysis. The main issue that is involved is the concept of an inland price for products, which is the price paid by local customers in a particular country [which can be based on a delivered, or ex-factory basis], compared to export prices, which are the export based prices for producers in a particular country. This comparison of pricing competitiveness depends on whether the country is a net exporter or net importer.

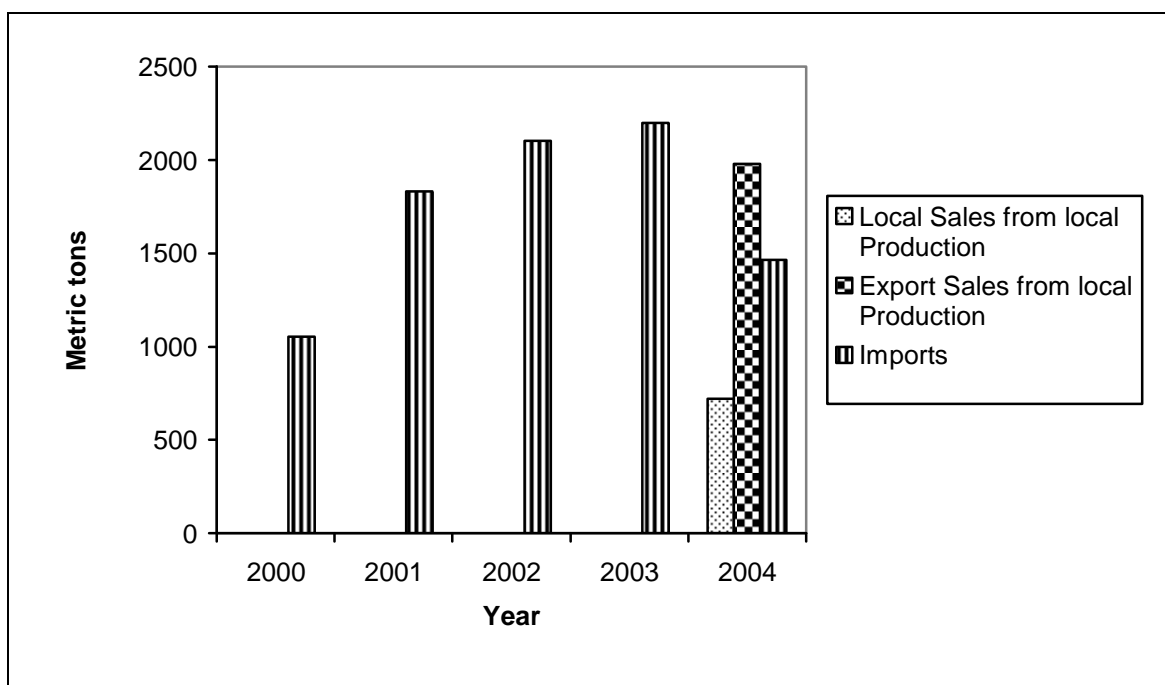
The competitiveness of South African chemicals pricing is dealt with under the following headings:

- Historical SA feedstock market volumes and pricing levels
- Comparison of SA inland prices for feedstock with international prices
- Historical sales levels for key downstream products
- Basis for SA pricing calculations
- Key differentiation factors for purchasing feedstock
- Operations: (Upstream/ Downstream: Basis for operation [e.g. 24/7]; Average age and original cost of equipment; Capacity utilisation; Workforce)
- Assessment of global competitiveness of downstream producers
- Ability for downstream to expand product range based on lower feedstock prices
- Impact of current pricing practices (Skills; Wages; Technology; Long-term sustainability; Import replacement)

7.5.2. Historical SA feedstock market volumes and pricing levels

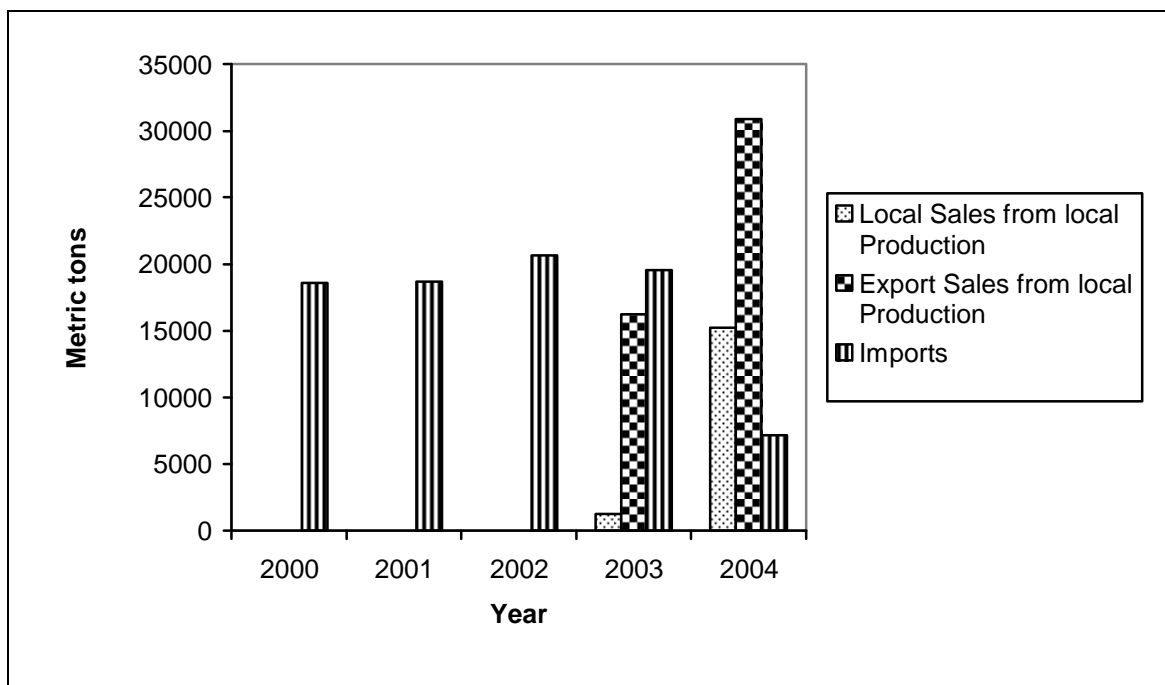
The historical local and export sales volumes of glacial acrylic acid as well as acrylate esters, as well as average delivered prices are shown in the figures below. For commercial sensitivity no actual data values are published on the chart.

Figure 7.4: Historical Local & Export Volumes – Glacial acrylic acid



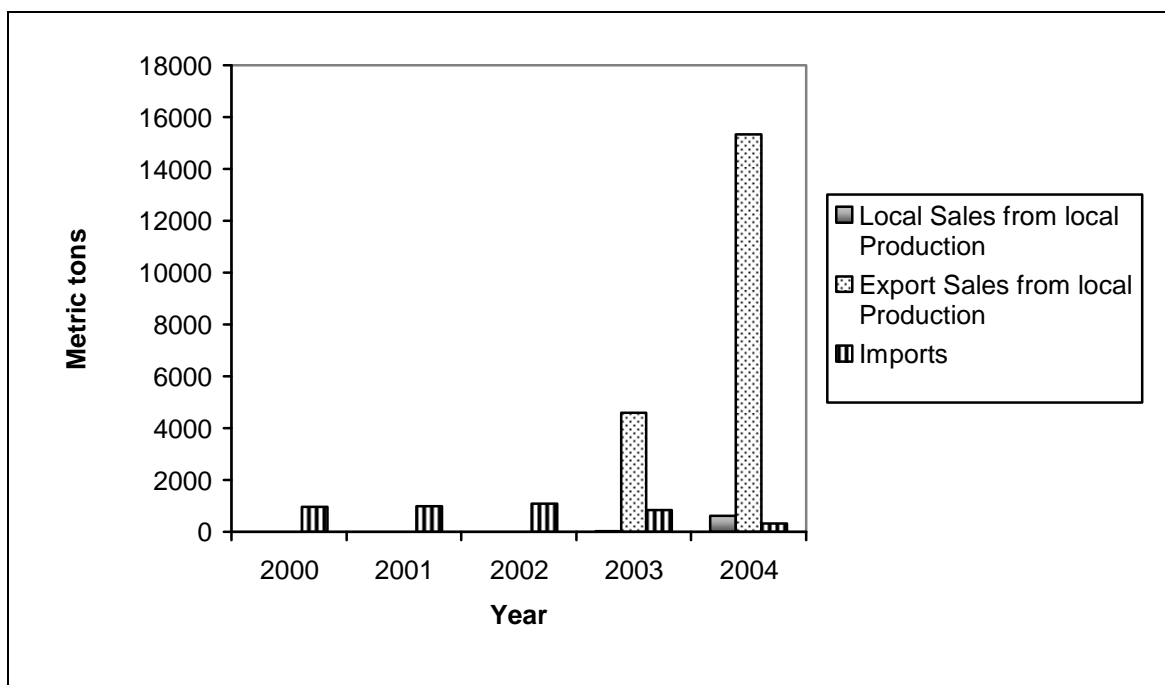
Local sales from local production only appeared in 2004, while total consumption is showing steady growth.

Figure 7.5: Historical Local & Export Volumes – Butyl acrylate



Local sales from local production only appeared in 2003, while total consumption is showing steady growth.

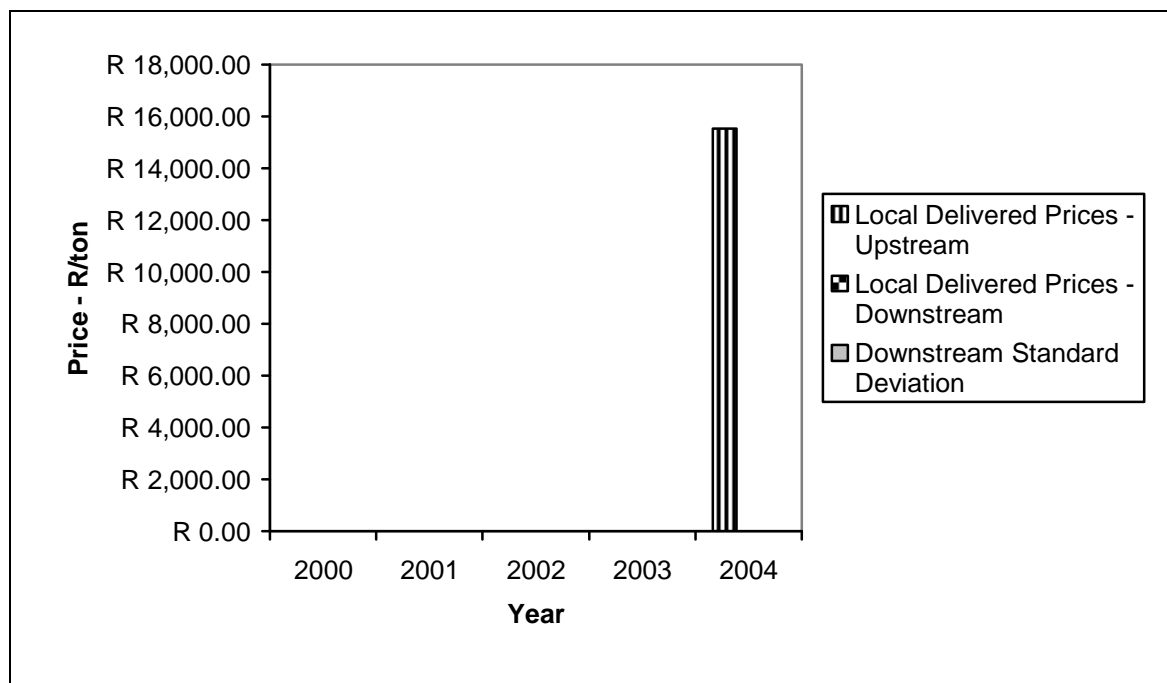
Figure 7.6: Historical Local & Export Volumes – Ethyl acrylate



Local sales from local production only appeared in 2003, while total consumption is more or less constant.

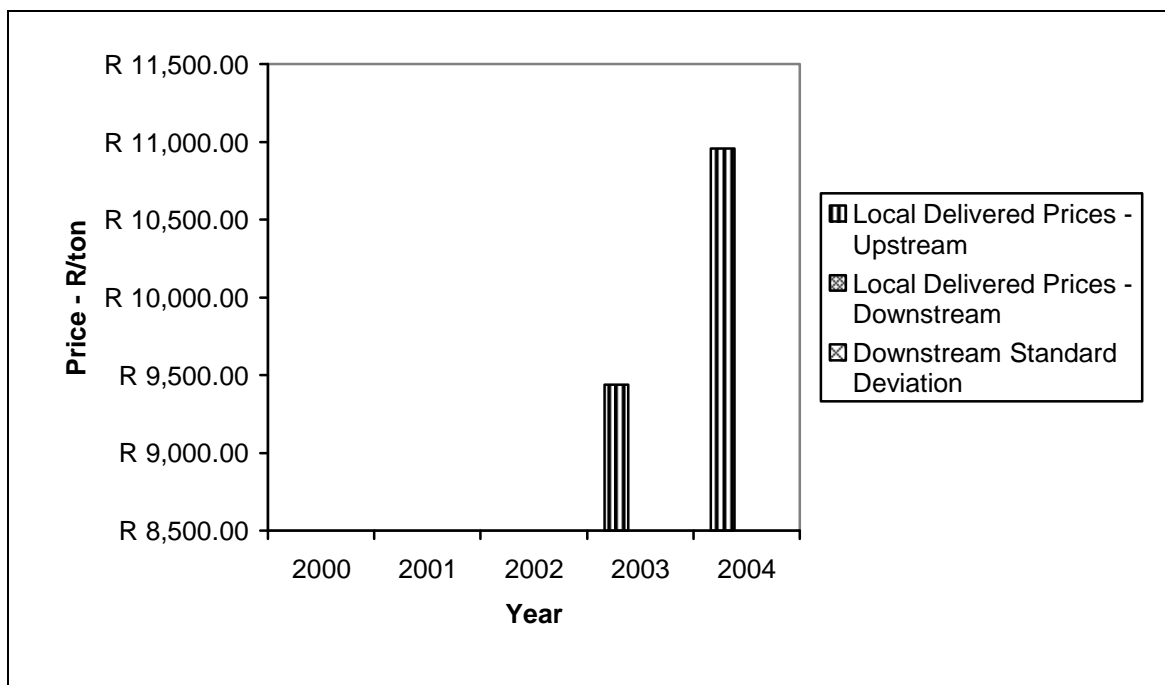
Local delivered prices based upon total volumes and total values for the respective years are shown in the figure below (ex-factory prices are not available as glacial acrylic acid as well as acrylate esters are sold on a delivered basis):

Figure 7.7: Historical Local Delivered Prices (Excluding VAT) – Glacial acrylic acid



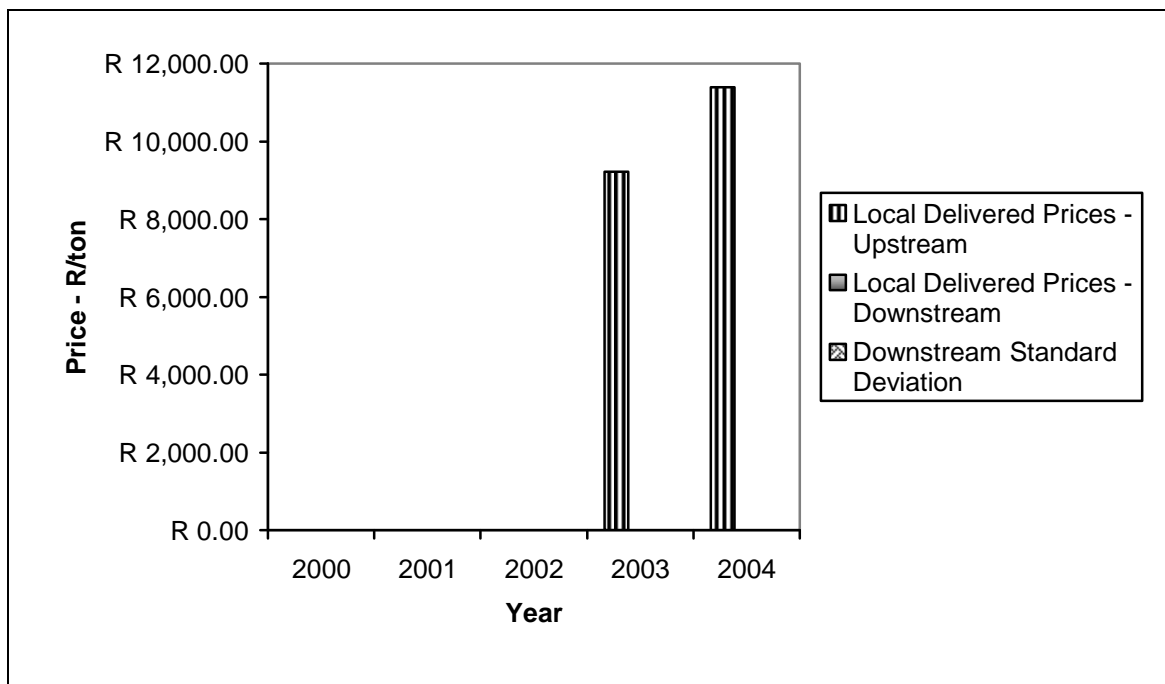
Note: No Downstream data available; Local supply only commenced in 2004

Figure 7.8: Historical Local Delivered Prices (Excluding VAT) – Butyl acrylate



Note: No Downstream data available; Local supply only commenced in 2003

Figure 7.9: Historical Local Delivered Prices (Excluding VAT) – Ethyl acrylate

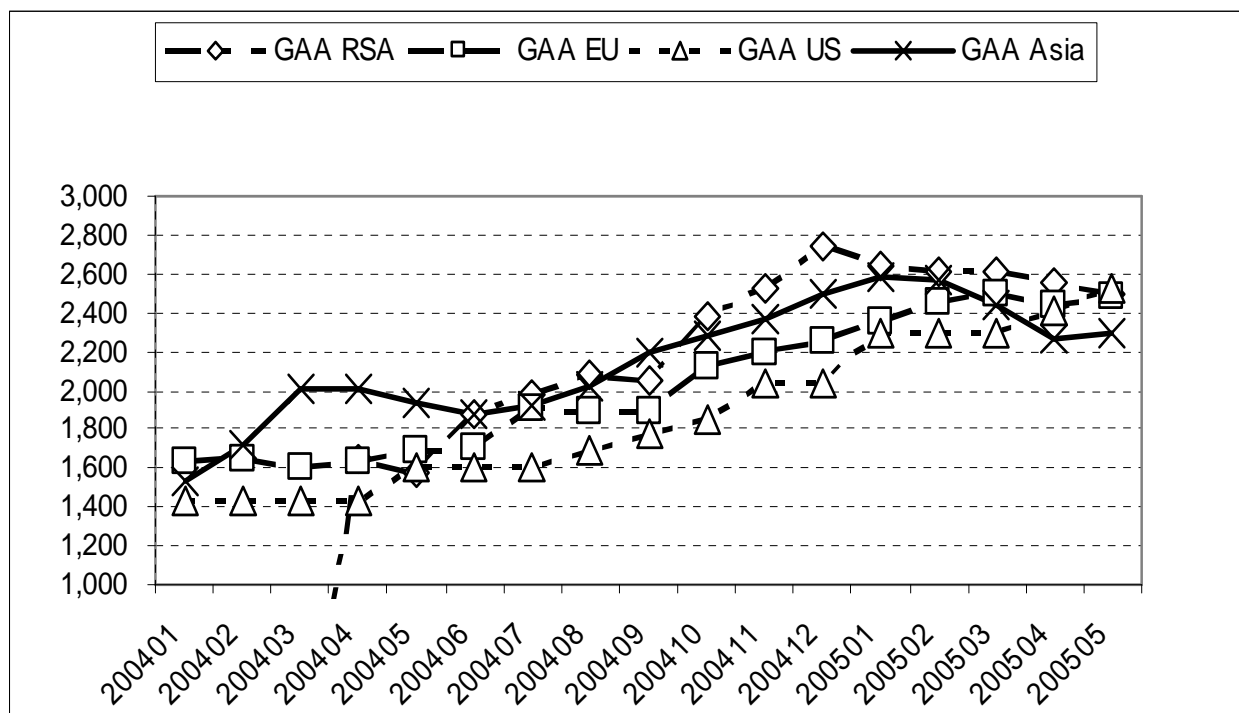


Note: No Downstream data available; Local supply only commenced in 2003

7.5.3. Comparison of SA inland prices for feedstock with international prices

The background to international pricing as well as sources for data is discussed in [Chapter 1](#) and [Appendix 3](#) based on polymers. The trend and the general relationships are more important to gain insight into the fundamentals than a comparison of prices in a particular month.

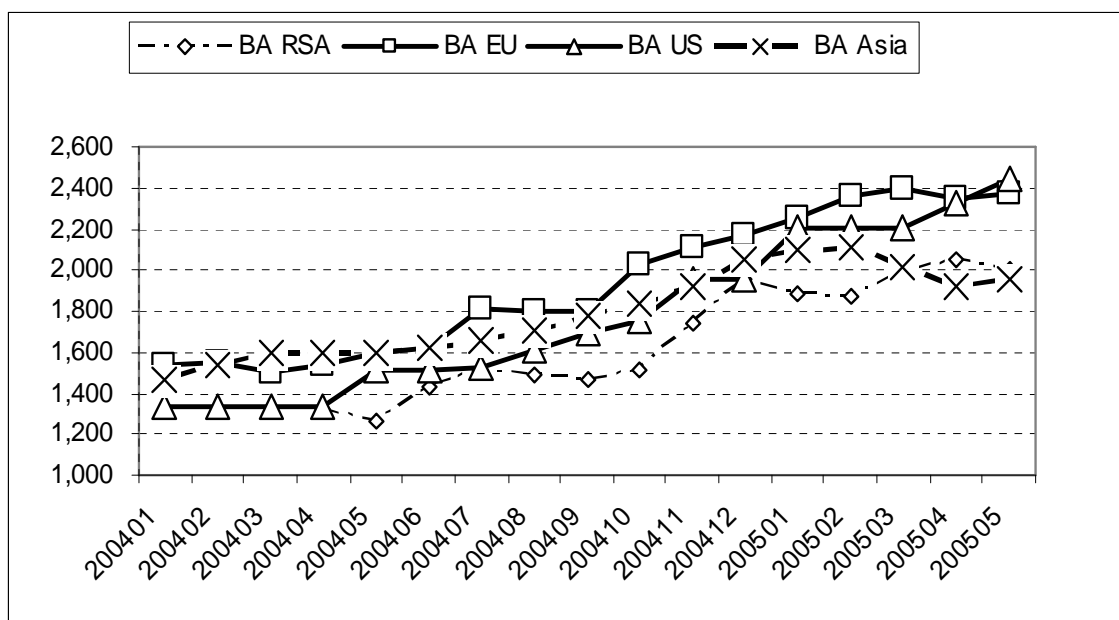
Figure 7.10: SA and International Glacial Acrylic Acid Domestic Prices



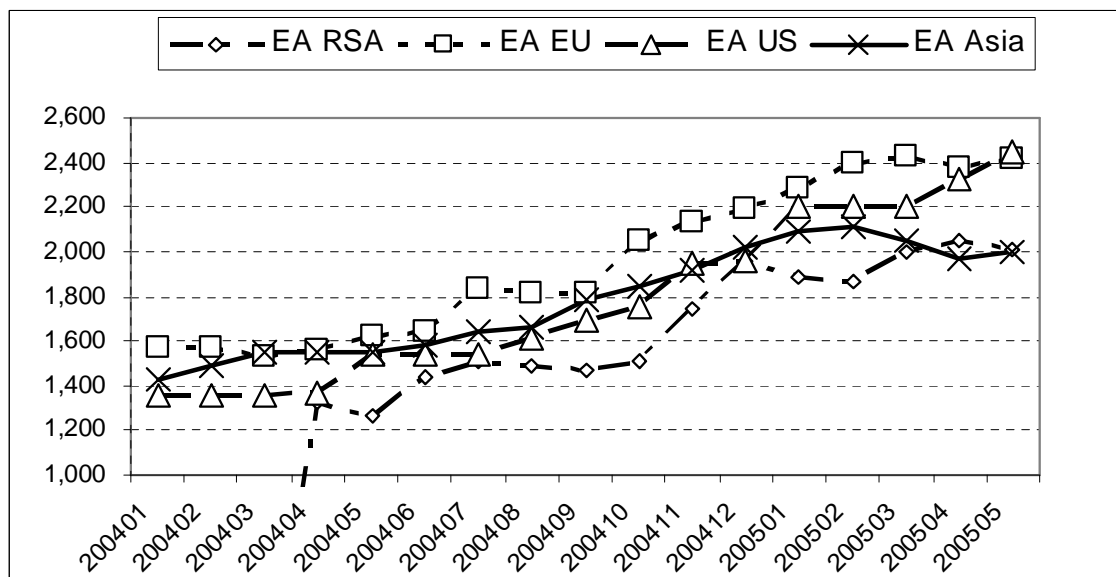
The prices in the figure above are based upon the following data supplied by ICIS LOR:

- RSA: Delivered cost of SDA
- Europe (EC): Northwest Europe Freight Delivered Spot Price
- USA: Freight Delivered Contract Price
- Asia: Combination of North East and South East Asia CIF price

Glacial acrylic acid is the last product introduced by SDA, and initial pricing for local customers have been above international domestic prices, but this gap has been closed towards May 2005.

Figure 7.11: SA and International Butyl acrylate Domestic Prices

Since its introduction into the SA market by SDA, butyl acrylate domestic prices in SA have been consistently below, or at the lower end of international prices.

Figure 7.12: SA and International Ethyl acrylate Domestic Prices

Since its introduction into the SA market by SDA, ethyl acrylate domestic prices in SA, similarly to butyl acrylate, have been consistently below, or at the lower end of international prices.

7.5.4. Historical sales levels for key downstream products

No downstream response.

7.5.5. Basis for SA Downstream Products pricing calculations

No downstream responses.

7.5.6. Key differentiation factors for purchasing feedstock

No downstream responses.

7.5.7. Downstream Operations

No downstream responses.

7.5.8. Assessment of global competitiveness of downstream producers

No downstream responses.

7.5.9. Ability for downstream to expand product range based on lower feedstock prices

No downstream responses.

7.5.10. Impact of current pricing practices

Skills

Upstream respondents commented regarding the effect of the upstream investment in acrylate capacity on skills. Significant technology transfer took place into SA from MCC in Japan. This included the butanol plant built by Sasol as a necessary investment for feedstock to be available for the SDA acrylic acid and acrylates complex. Technology for both the butanol plant and the acrylic acid and acrylates complex was supplied by MCC who is one of only three entities world wide to possess the technology to build and operate acrylic acid and acrylates plants.

The operating expertise and technology provided by MCC during the past year was critical to assist SDA to improve its operations capacity utilisation rates. SDA did unfortunately experience significant operational difficulties during the first year of operation and was forced to declare a *force majeure* during October 2004. Extensive technical support from MCC together with an intensive focus by Sasol technical and operations staff have resulted in significant improvements to the plant operations rate during the last six months.

The knowledge gained by local South African operations staff will prove invaluable in the future as the complex is expanded by building a second train.

Wages

Upstream respondents commented that the direct and indirect jobs created as a result of the SDA investment alone are estimated at 3400 jobs. The wages earned by these direct and indirect jobs created are rather difficult to estimate, but are no doubt significant in terms of the SA economy and especially in terms of the local Sasolburg economy.

Technology

Upstream respondents commented that the MCC JV also has allowed SDA access to potential downstream industry technology. This includes emulsions and super absorbent polymer (SAP). Sasol and / or SDA have guaranteed access to technology to build a second train. This would effectively double the capacity of crude acrylic acid as well as increases the capacity of the downstream derivatives. Sasol and / or SDA have also received assurances that technology for emulsions manufacture as well as for super absorbent polymer manufacture could be made available to SA, should a suitable business case be developed.

Long-term sustainability

As mentioned previously in this document, the establishment of SDA by Sasol and MCC has resulted in a global acrylic acid and acrylates production facility being based in South Africa. Both Sasol and MCC have identified this business as core and strategic to their long term growth. It has

been identified as adding significant value to Sasol feedstock and as an appropriate investment to develop the downstream chemical business focus areas of Sasol and MCC.

Import replacement

Upstream respondents view is that there has been a significant impact here as prior to SDA coming on line in Q2, 2004, all BA, EA and GAA were imported. During the last 12 to 18 months SDA has reached a strong market position in BA in RSA. The estimate of local market share for BA during 04/05 was 68% and currently closer to 75%.

7.6. Impact of pricing on downstream purchasers - Demand Elasticity

From a practical perspective, most acrylic acid and esters are eventually used in the paints, adhesives and other industries in the form of emulsion polymers. In this application acrylic acid and esters accounts for around 3 –5% of raw material costs, or around 2 –3% of selling prices. It is therefore unlikely that a decrease in acrylic acid and esters prices will significantly increase demand for paints and other products.

7.7. Impact of pricing on downstream purchasers – EVC

No sufficient data is available for reasonable analysis. The upstream operation has only being operating for two years, while none of the downstream respondents provided any information.

7.8. Conclusions – Acrylic acid and acrylates

Production capacity for acrylic acid and esters in SA is around 105 000 t/a. The SA market size in 2004 for acrylic acid and esters used in local applications such as emulsions was estimated at 25 000 tons. This indicates a significant excess in capacity.

The cost structure of the South African operation is not directly comparable to international glacial acrylic acid as well as acrylate esters operations, in that the South African producer has an

integrated operation that is manufacturing n-butanol as well as acrylates. Also, the feedstock used in the South African operation for acrylic acid and acrylate esters is propylene and captive butanol, while in the international case the feedstock is acrylic acid and butanol.

The local producer's domestic price is comparable with prices in USA and Asia and is derived from the published ICIS LOR reference data as follows: The average of the lowest values quoted for North West Europe (Free Delivered) and Asia Pacific on a CIF basis of the preceding week's published prices at time of determination. No costs are added to the USD Price in terms of Import Parity Pricing input factors. Local market conditions are also taken into account to ensure that the local producer remains competitive in the South African market.

Butyl acrylate and ethyl acrylate domestic prices in SA have been consistently below, or at the lower end of international prices. Glacial acrylic acid is the last product introduced by the local producer, and initial pricing for local customers have been above international domestic prices, but this gap has been closed towards May 2005.

The reality test has revealed that South Africa is consuming around 0.7% of global acrylic acid and esters, which is in line with SA's share of global GDP. The sector can therefore be regarded as relatively developed.

From a practical perspective, most acrylic acid and esters are eventually used in the paints, adhesives and other industries in the form of emulsion polymers. In this application acrylic acid and esters accounts for around 3 –5% of raw material costs, or around 2 –3% of selling prices. It is therefore unlikely that a change in acrylic acid and esters prices will significantly change demand for paints and other products.

Insufficient data is available for reasonable analysis. The upstream operation has only been operating for two years, while none of the downstream respondents provided any information.

8. GLOBAL REALITY TEST

8.1. Introduction

The analysis of the value chains in chapters 2 to 7 provides a view of the issues affecting the value chains including the relative effect of pricing practises. The analysis in this chapter is providing insight regarding the relative development status of the value chains in South Africa compared to other countries.

In terms of assessing the impact of pricing practices on the development of the downstream chemical sector, it is also necessary to determine an approach that evaluates the relative development of downstream chemical sectors for a range of countries, and compare that with the status in South Africa.

This comparison will then identify any significant underdevelopment of the SA downstream sectors. A demonstrated underdevelopment indicates that market growth drivers, of which feedstock pricing is one, have worked together to lead to the underdevelopment. Similarly, a demonstrated development in SA that is in line with comparable countries indicates that that market growth drivers have resulted in a level of downstream development that is in line with the status of the SA economy in general.

This comparison of relative development of downstream chemical sector is called the “Reality Test” within the context of this study. For selected Upstream/Downstream combinations, these are simply tests to set the scene for the review of the pricing practices of the upstream chemical producers.

The focus has been on applying a Reality Test for the polymer conversion sector of the study (chapters 2 to 4). There are several reasons for this:

- As a group, the polymers represent the most value of all the intermediate products included in the study.
- Polymer conversion is a relatively large employer

- There is a perception that the polymer conversion sector in South Africa is under-developed by comparison with other developing economies.
- Accurate consumption data of polymers for most countries is available

A comparison of the Per Capital GDP vs. Per Capita Polymer Usage for all countries is a well-established “Reality Test” for which data is available. It attempts to see if there is any correlation between the “stage and size of economic development” (as measured by per capita GDP) with the “size of the polymer conversion sector” (as measured by per capita polymer converted within the economy).

8.2. Reality Test for Polymer Conversion: The Country Comparison of Polymer Consumption

A wide sample base of 98 countries, inclusive of SA, has been selected. Data on the domestic usage of the selected polymers, i.e. for conversion into plastic products for sale into the domestic market or for export, has been sourced from independent sources (Tecnon and CMAI). Data on country population and GDP has been sourced from the IMF and the World Bank.

The following correlations/analysis has been undertaken:

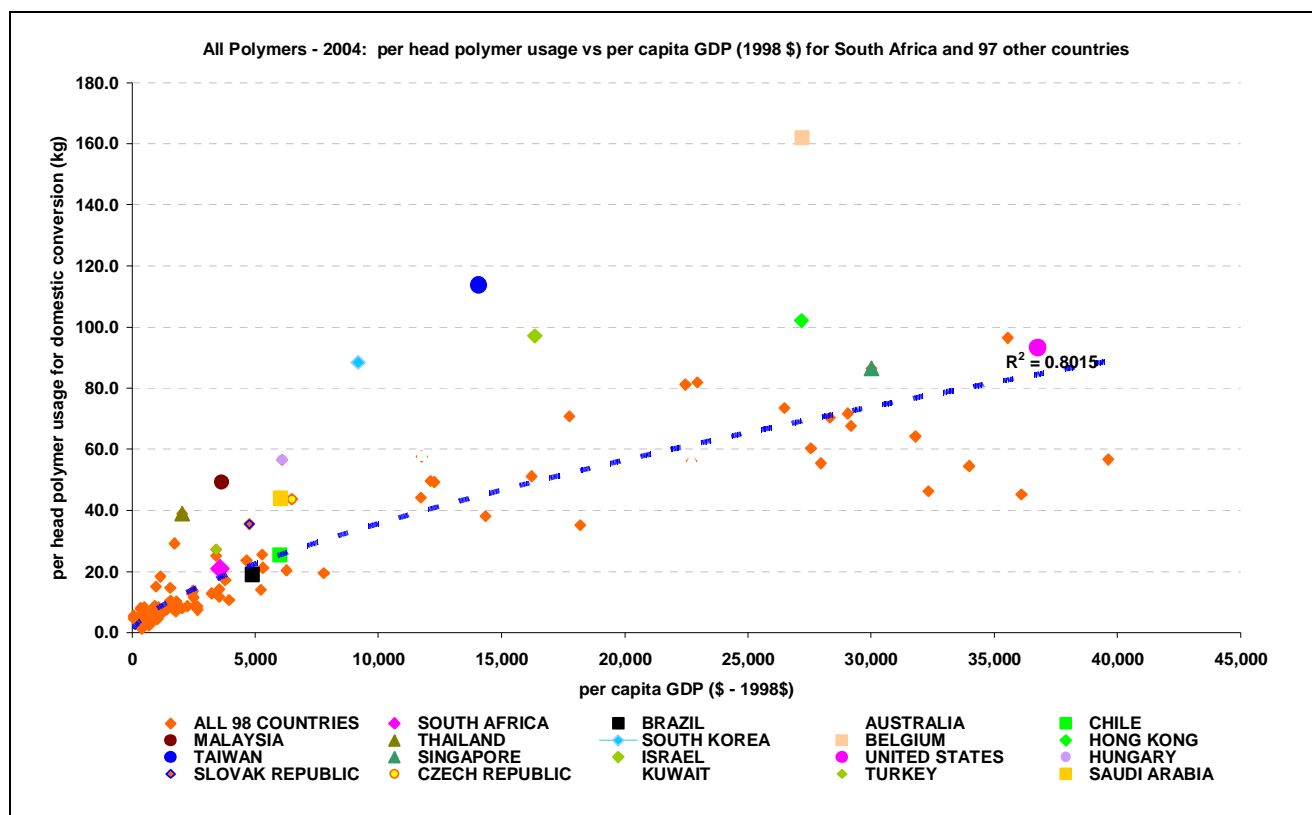
- **For all 98 Countries:** Per Capita GDP vs. Per Capita Polymer Usage for all Polymers (LDPE + LLDPE + HDPE + PVC + PP) in Total for 2004
- **For all 98 Countries:** 2004 Change over 1985: Per Capita GDP vs Per Capita Polymer Usage for all Polymers (LDPE + LLDPE + HDPE + PVC + PP)
- **For all Countries with Populations > 15 Million and < 50 Million (32):** Per Capita GDP vs Per Capita Polymer Usage for all Polymers (LDPE + LLDPE + HDPE + PVC + PP) in Total for 2004
- **For all Countries with Populations > 15 Million and < 50 Million (32):** Per Capita GDP vs Per Capita Polymer Usage for all Each of the Polymers Individually (LDPE, LLDPE, HDPE, PVC & PP) for 2004
- **For Selected Countries:** Contribution of Polymer Conversion to GDP (1985 to 2004)

8.3. Per Capita GDP vs. Per Capita Polymer Usage for all Polymers

The Per Capita GDP vs. Per Capita Polymer Usage for all Polymers for 2004 is shown in the chart below. This includes the following polymer types:

- LDPE
- LLDPE
- HDPE
- PVC
- PP

Figure 8.1: All Polymers - 2004: Per Head Polymer Usage vs. Per Capita GDP (1998 \$) for South Africa and 97 other countries



The R-Square for the correlation is above 0.8. This means that there is a high correlation between the per capita consumption for (all) polymers and the per capita GDP.

The first conclusion of relevance is that it is economic activity within an economy that pulls through demand for plastic products and primary polymers. Secondly, the level of polymer usage, or consumption in South Africa in 2004 (i.e. the state of the polymer conversion sector) is not out of line. This is confirmed by SA's position slightly above the trend line. There are a number of countries that have a higher per capita polymer usage than that indicated by the "trend line". The explanation for these specific countries' position is as follows:

- **Belgium:**

- Antwerp has always been a hub for the production of petrochemicals and polymers. From the formation of the European Union, a number of petrochemical majors (e.g. Exxon Chemical and BP Chemical) invested heavily in polymer conversion to supply the European market with polymers from their plants in Antwerp.
- It is the easy access (in terms of logistics costs) to other EU countries that has led to the establishment of Belgium as a converter of polymers and exporter of plastic products to the EU.
- It has a cluster of carpet producers (based on PP) that export to the rest of Europe (and elsewhere). Two of the carpet producers are back-integrated into their own world scale PP plants.

- **Hong Kong:**

- Despite no domestic source of polymers, a vigorous polymer conversion industry was established because of the massive markets in China and other Asian countries and the exports of consumer products (primarily toys containing plastic parts) to the USA and Europe.

- **South Korea and Taiwan:**

- Initially, the polymer conversion industries were based on (mostly) imported polymer.
- Both countries have developed vigorous manufacturing sectors that export the bulk of production (cars, industrial products, white goods and consumer electronics) that contain plastic components.
- In some areas (e.g. flooring based on PVC) some of the polymer producers have developed leading edge conversion technology and products to serve the international market.

- **Singapore, Malaysia and Thailand:**

- The development of the ASEAN common market provided easy market access (firstly) for the converters in Singapore. With the development of the petrochemical industries in Malaysia and Thailand (and the tax-based very generous incentives provided to attract investment in petrochemicals and polymer conversion), there was massive investment in polymer conversion capacity.
- Investment in polymer conversion in the 1990s was done on a very large scale and with modern equipment – hence the rapid growth in per capita polymer usage.
- There has been a policy within ASEAN to develop export manufacturing bases and this has drawn in locally converted polymers

- **Kuwait and Saudi Arabia:**

- Both countries have large polymer plants and access to low cost feedstock for polymers (ethane).
- In order to maximise local beneficiation of exported polymers, both countries established Export Processing Zones (with associated tax incentives) to stimulate investment in polymer conversion. Polymer has been supplied at lower-than-market prices. This is not WTO compliant and when the countries join the WTO the prices are likely to be challenged.

- **Slovak Republic, Czech Republic and Hungary:**

- When labour costs began to increase in Germany and a number of other EU countries, manufacturing capacity (including polymer conversion) was relocated to East European countries after 1989.
- The polymer conversion industries in these countries have become a base for the expanding East European economies.

- **Israel:**

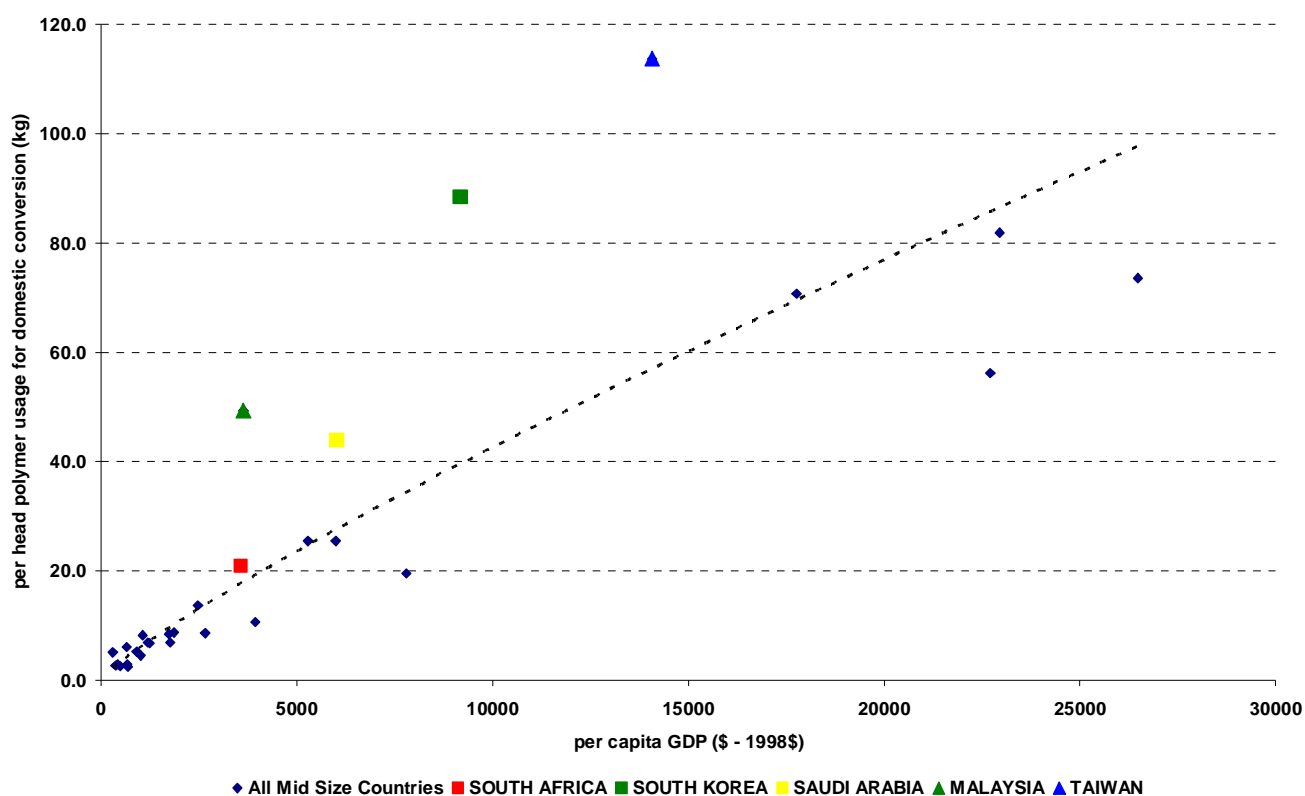
- The country has developed a system of drip irrigation to conserve water usage for its agricultural sector based on plastic products developed in Israel. The country exports these products and has established plants in other countries (including in the Western Cape) to produce irrigation products.
- Plastic netting is used on a large scale in market gardening.

The conclusion to be drawn from the countries mentioned above is that polymer conversion in the country that eventually gets incorporated into more exports of consumer goods is the one that leads the polymer conversion sector to be at the highest level of development. Therefore for the South African polymer conversion sector to reach a higher level of development more than this reality test suggests, South Africa needs to export more finished goods which have plastic components.

8.4. Per Capita GDP vs. Per Capita Polymer Usage for all Polymers - Data for All Mid size Countries

The Per Capita GDP vs. Per Capita Polymer Usage for all Polymers for 2004 data for South Africa and All Mid size Countries (populations >15 million and <50 million) is shown in the chart below.

Figure 8.2: All Polymers - 2004: Per Head Polymer Usage vs. Per Capita GDP (1998 \$) for South Africa and All Mid size Countries (populations >15 million and <50 million)



The R-Square for the correlation is above 0.87. This is even higher than for the total sample, illustrating that SA's development in downstream polymer conversion is more or less what is expected when compared to countries of similar size.

When comparing SA for against the same mid-size countries for the individual polymers, the following correlations are observed:

- LDPE: R-Square = 0.7635
- LLDPE: R-Square = 0.696
- HDPE: R-Square = 0.8559
- PVC: R-Square = 0.7689
- PP: R-Square = 0.8311

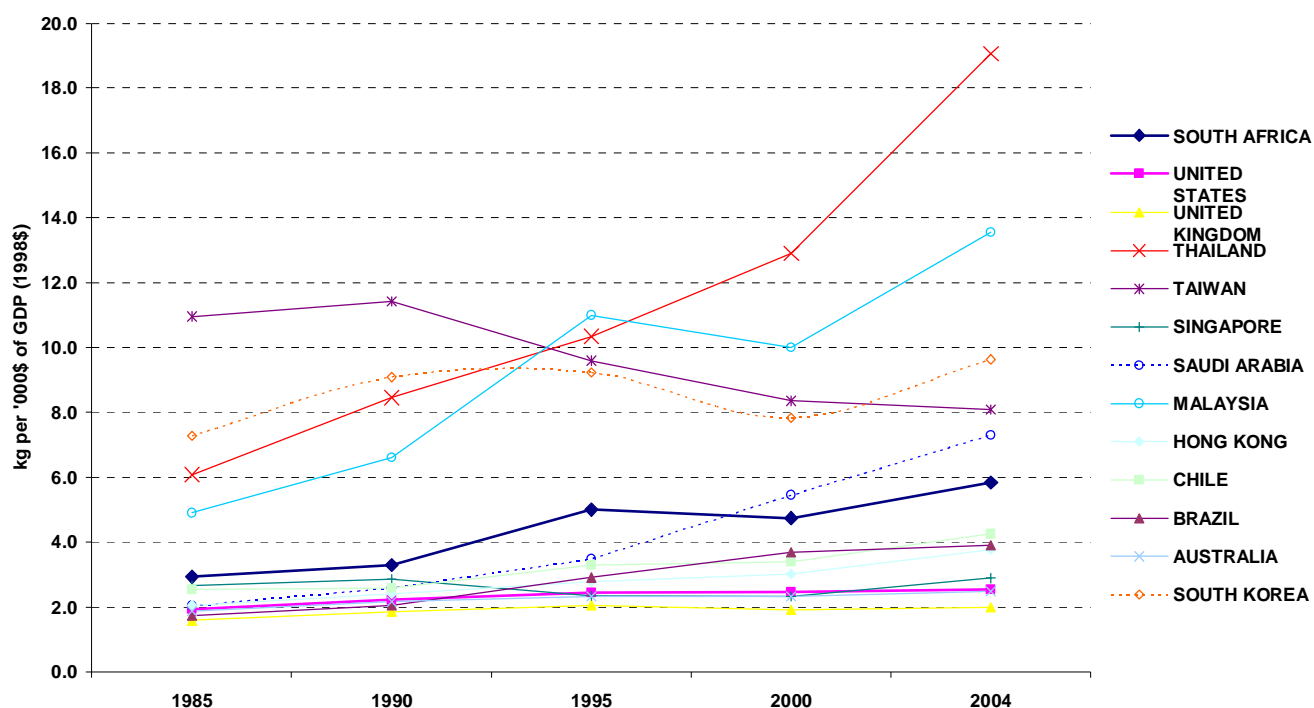
The results of the correlation for individual polymers, but limited to 30 mid size economies, are broadly similar to the correlation for total polymers and for all 98 countries. South Africa in general is positioned either on, or slightly above the trend line for the individual polymers, except for LLDPE and HDPE where SA is around 50% above the trend line, indicating relatively well-developed markets for these particular polymers. The relatively lower position of LLDPE and HDPE could be attributed to the substitution of LLDPE for LDPE in many applications and for HDPE it is mainly due to the plastic bag legislation that was implemented a few years ago.

A comparison with South Africa shows that the same countries/economies, namely Taiwan, Malaysia, Saudi Arabia, South Korea and Poland have higher per capita polymer usage than the “trend line” would dictate. Unlike South Africa, these countries have developed vigorous manufacturing sectors that export the bulk of production that contain plastic components. There is scope for the South Africa polymer production and conversion industries to learn from countries with high per capital polymer usage to develop and implement strategies to increase per capita usage in South Africa. If the South African polymer conversion sector is to reach a higher level of development than where it is at the moment, South Africa needs to export more finished goods which have plastic components.

8.5. Polymer Conversion: Historical Growth in Contribution to GDP

The historical growth in the relative contribution of polymer conversion to GDP is shown below for SA, as well as a number of other selected countries.

Figure 8.3: All Polymers - 2004: Per Head Polymer Usage vs. Per Capita GDP (1998 \$) for South Africa and All Mid size Countries (populations >15 million and <50 million)



The contribution of polymer conversion to GDP varies considerably for the selected counties. In South Africa, the contribution from polymer conversion to GDP is growing.

The rapid growth in Thailand and Malaysia is a result of the developments in polymer production, the emergence of the ASEAN Free market Area and a government policy to stimulate petrochemicals production and polymer conversion using generous tax breaks.

8.6. South Africa versus Chile – Polymer Conversion

A specific case in terms of the Reality Test is the relative position of South Africa Versus Chile. Chile has no domestic polymer industry, but it has easy access to imported polymer at a relatively low cost from both the Americas and Asia. Import duties are generally below 10% [6% for the US due to a FTA], and there are also a number of export processing zones where no duties are payable for re-exported plastic products. The relative position for the two countries in terms of the development of the plastic products sector is shown in the following table:

Table 8.1: Per Capita Polymer Usage vs. Per Capita GDP for RSA and Chile - 2004

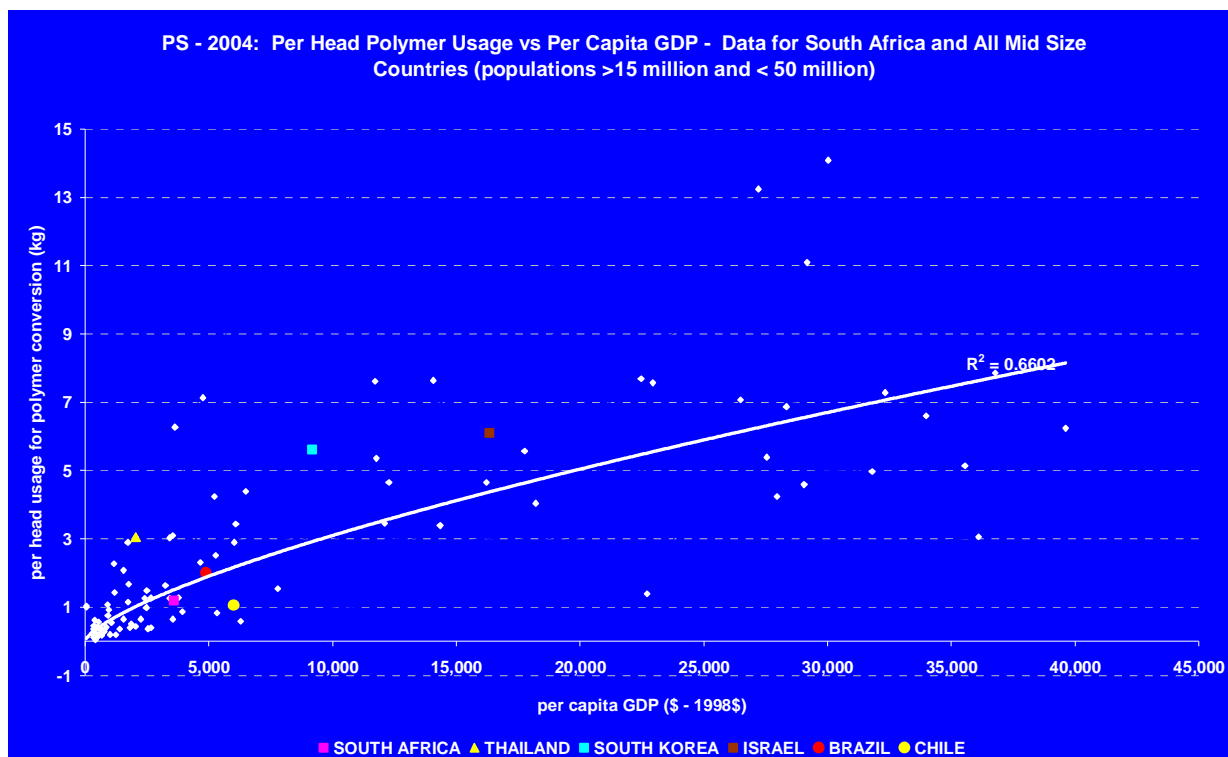
South Africa			Chile		Ratio: South Africa/Chile
Polymer	Per Capita GDP in 2004 (\$ - 1998\$)	Per Capita polymer use (kg)	per capita GDP	per capita polymer use (kg)	Per Capita Polymer consumption/GDP
LDPE	3,576	3.8	5,999	5.9	1.080471
LLDPE	3,576	3	5,999	2.3	2.188138
HDPE	3,576	5.4	5,999	7.3	1.240944
PVC	3,576	3.8	5,999	4.9	1.300975
PP	3,576	4.9	5,999	5.1	1.611786
All Polymers	3,576	20.9	5,999	25.4	1.380365

From this table it is clear that the downstream SA plastic products sector is significantly better developed than Chile, except for LDPE. This could be accounted for by the fact that SA has to import a significant portion of LDPE polymer due to lack in local upstream capacity. A conclusion that can be drawn from the numbers is that the availability of locally manufactured polymer is more important for the development of the downstream conversion sector than the access to polymer on a fully-imported basis at a competitive price.

8.7. Polystyrene – A fully imported Polymer for SA

Polystyrene is a polymer that is not manufactured in SA, and imports are on a completely duty-free basis from all countries. Some production occurred in the past, but operations closed down due to lack of competitiveness against imported product.

Figure 8.4: Polystyrene - 2004: Per Head Polymer Usage vs. Per Capita GDP (1998 \$) for South Africa and All Mid size Countries (populations >15 million and <50 million)



It is significant to notice that for polystyrene the position of the local industry is below the average [as represented by the R^2 – line], compared to all the other polymers that are locally manufactured in SA, where SA is above the average. This analysis seems to indicate that notwithstanding the fact that polystyrene can be freely imported with no duties, the development of the local polystyrene market is lagging behind those polymer types that are locally manufactured. This means the local manufacturing of other polymer types has contributed positively to the development of the local polymer conversion sector.

8.9. Conclusions

The strong correlation between polymer consumption and GDP (economic activity) in a country has been demonstrated. The higher the GDP, the more polymers are used within the economy. In relation to its GDP, consumption of polymers in South Africa is within a range that economists would accept as “natural or normal”.

However, there are countries that have a level of polymer consumption that is above the trend line. In all cases, there are reasons for this. The polymer industry in South Africa (Upstream and Downstream) can learn from developments in some of these countries to grow polymer usage above what can be expected from a growth in the GDP.

The indications are, based on SA's position versus Chile, as well as the state of the polystyrene conversion sector in SA, that the development of the downstream polymer conversion industry is more dependant upon the actual availability of local polymer than the free importation of polymer at low cost.

Lessons for South Africa going forward is that the country has to develop strategies to ensure the existence of vigorous manufacturing sectors that export the bulk of production that contain plastic components as well come up with government policy that stimulates petrochemicals production and polymer conversion.

The other value chains (apart from polymers) were not evaluated at the same level of detail for purposes of the reality test. However, some basic conclusions can be made as shown in paragraphs that follow below.

Regarding the fertilizer value chain, South Africa is consuming around 0.65% of global ammonia, which is in line with South Africa's share of global GDP. In the case of phosphate rock South Africa's share of consumption is around 1.2%, which is relatively higher than the contribution to global GDP. This means therefore that the sector can be regarded as developed.

South Africa is consuming around 0.6% of global TiO₂ pigments, which is in line with South Africa's share of global GDP. The titanium pigments sector can therefore be regarded as developed.

In the case of acrylic acid and esters value chain, South Africa is consuming around 0.7% of global acrylic acid and esters, which is in line with South Africa's share of global GDP. This means

the sector is developed even without the local manufacturing of super-absorbents, which is globally a major application for acrylic acid.

9. DRIVERS FOR GROWTH IN THE DOWNSTREAM CHEMICAL SECTOR

9.1. Introduction

Drivers for growth in the downstream chemical sector tend to be universally applicable, with the only difference being the relative importance of these drivers, as impacted upon by local circumstances.

Previous work conducted by Terry Le Roux, a member of the consultant's consortium, has identified the major drivers that specifically impact upon the development of the downstream polymer conversion sector, which is a key focus of this study.

These previous work included the following:

- Helping the government in the Northern Territory (Australia) establish a polymer conversion industry in a new industrial park outside Darwin. The focus of the initiative was to persuade/motivate converters in Hong Kong relocate their factories to Australia ahead of the change of status for Hong Kong.
- In working for the Government of Bahrain to establish a polymer conversion industry based on polymers that would be made on a new petrochemicals complex.
- Managing the joint Taiwanese/RSA Government Initiative that looked at areas of cooperation between South Africa and Taiwan in the areas of petrochemicals and polymer conversion.

In all cases, the work involved visits to factories and interviews with potential converters (large and small).

9.2. Identification of Drivers

Based upon previous work done, the major drivers for the expansion of the downstream polymer conversion industry in a country are as follows:

- Strong Domestic Demand for Plastic Products used in the Economy for Domestic Consumption

- Existing (or Potential) Demand for Plastic Products used in Components or Products that are Exported
- Relatively Good Access or Proximity to Export Markets for Plastic Products
- Polymers at Competitive Prices
- Local Availability of Polymers (from a local supplier)
- Cost and Availability of Conversion Machinery
- Cost and Availability of Skilled Workers
- Creation of business enabling environment by Government, low Taxes and Government Help to Access Export Markets
- Vigilance on Illegal Imports
- Rigorous and timeous investigations into dumping
- Innovation and Entrepreneurship of the Converters

These drivers work in concert to impact on growth and development, although the relative impact differs between the drivers.

It should be noted that these drivers are also applicable to most of the other value chains as far as the development of their downstream sectors are concerned. For example, in Titanium dioxide pigments and acrylate esters, the major downstream sector is the paints industry. In the paints industry the identified drivers are fairly similar to the polymers, although the weightings would be different.

The fertilizer feedstock value chain is impacted by a number of other drivers, including climatic conditions and agricultural commodity prices.

9.3. Weightings of Drivers

Based upon the Consultants' experience, the following weightings can be allocated to the identified drivers for downstream development:

Scale 1 to 5, where:

- Weight 5 = high relative impact on downstream development
- Weight 1 = small relative impact on downstream development

Table 9.1: Drivers for Downstream Plastic Conversion Development – Proposed Weightings for a Developing Country

Drivers for Downstream Development	Category	Weight (1-5)
1. Large domestic market for plastic end-products	Market related	5
2. Large exporter of industrial & consumer end-products containing plastic components		5
3. Geographic proximity to large export markets for plastic products		4
4. Availability of locally manufactured polymers	Polymer feedstock related	3
5. Availability of polymer at competitive prices		5
6. Innovation capability amongst polymer converters	Converter Issues	2
7. Cost & availability of technologically advanced conversion equipment		3
8. Availability & cost of trained and qualified technical personnel		2
9. Low taxes and the existence of business enabling environment	Government Related	2
Total		31

Based upon the allocated weightings, the relative importance of the categories is as follows:

- Market related: 14/31 or 45%
- Polymer feedstock related: 8/31 or 26%
- Converter Issues: 7/31 or 16%
- Government Related: 2/31 or 6%

It is clear from this assessment that the most important category for the successful development of a downstream polymer industry is market related, and that competitive pricing of polymer plays a role, but in proportion to all the other factors. The success or health of a conversion industry is therefore not determined by a single driver, but a combination of drivers. Development of a successful downstream beneficiation strategy therefore needs to take all the factors into account. By enforcing an improvement of one factor, such as polymer pricing, without addressing the other factors will not result in the desired development of the downstream sector.

It should be noted that the weighting given is subjective to the extent that others could differ and might give a different weight to each of the drivers.

The most important factor determining the health and growth prospects for downstream sectors such as polymer conversion and paints formulation is the robustness of the overall economy, including the sectors exporting manufactured goods. This is borne out by the strong correlation between per capita polymer usage with per capita GDP, as demonstrated in the "reality test".

9.4. South Africa's Relative Position

The Consultants' estimated from past experience a relative position for SA regarding the identified drivers. This proposed scoring is shown below:

Scale 1 to 5, where:

- Weight 5 = relative high or good performance for a country
- Weight 1 = relative low or poor performance for a country

Table 9.2: Growth Factor Weightings for Downstream Plastic Conversion

Drivers for the Development of a Polymer Conversion Industry	Country Scores (0 – 5)						
	RSA	Taiwan	South Korea	Saudi Arabia	Malaysia	Poland	Chile
A large domestic market for the plastic product	2	3	3	2	2	2	2
Large exporter of industrial and consumer goods	2	5	5	1	2	2	1
Proximity to large export markets for plastic products	2	5	5	2	4	4	2
Local availability of polymers	4	4	4	5	5	2	1
Availability of polymer at competitive prices	3	3	3	5	4	2	2
Innovation capability of polymer converters	3	4	4	2	3	3	3
Cost and availability of modern processing equipment	1	5	5	1	2	2	1
Availability and cost of trained and qualified technical personnel	2	5	5	2	2	3	2
Low taxes and the existence of business enabling environment	2	4	3	4	3	2	2

The relative scores given to the selected countries are indicative of the gaps that exist between the best performing countries compared to the rest. For example, in terms of a large domestic market, all the selected countries are fairly similar, scoring at average or below. However, in terms

of a large export market of end-products, countries such as Taiwan and South Korea have excellent scores compared to SA, which is below average.

By applying the weightings to the relative scores, the country's presumed position in terms of ability for the downstream sector to develop can be demonstrated. For example, the weighting for a large domestic market for downstream products is 5/5, or 100%. If this weighting is multiplied by the country's score for the same factor, the relative country position in terms of country score, as well as the other factors is obtained. By adding the relative scores for all the factors together for each country, the overall propensity for a country to support downstream developments can be demonstrated. This is shown below:

Table 9.3: Propensity for Downstream Development

Drivers for the Development of a Polymer Conversion Industry	Weighted Country Scores						
	RSA	Taiwan	South Korea	Saudi Arabia	Malaysia	Poland	Chile
A large domestic market for the plastic product	10	15	15	10	10	10	10
Large exporter of industrial and consumer goods	10	25	25	5	10	10	5
Proximity to large export markets for plastic products	8	20	20	8	16	16	8
Local availability of polymers	12	12	12	15	15	6	3
Availability of polymer at competitive prices	15	15	15	25	20	10	10
Innovation capability of polymer converters	6	8	8	4	6	6	6
Cost and availability of modern processing equipment	3	15	15	3	6	6	3
Availability and cost of trained and qualified technical personnel	4	10	10	4	4	6	4
Low taxes and the existence of business enabling environment	4	8	6	8	6	4	4
Total	72	128	126	82	93	74	53

The results of the weighted scores (based on the consultant's weightings and the country comparison scores) seem to confirm the results of the Reality Tests.

The results of the country scores supports the conclusions on the per capita polymer usage vs per capita GDP country comparisons that, those countries with high per capita polymer usage have

large markets/demand for plastic products because of activities within the economy (including exports of manufactured products).

For the South African downstream polymer conversion sector the results of table 9.3 above are instructive in terms of what to do to stimulate downstream development. What the table shows is that there are a host of important issues other than pricing that lead to the development of the polymer conversion sector. For example, Saudi Arabia scored the highest point (100%) when it comes to availability of polymer at competitive prices. However, that competitive (pricing) advantage on its own does not make Saudi Arabia the most developed polymer converting country. This is because Saudi Arabia scored relatively worse on two equally important issues; which are availability of a large domestic market and a large exporter of industrial and consumer goods. The major option for stimulating growth for the South African polymer conversion sector is therefore to look at improving the country's performance on other drivers (other than pricing) like large exporter of industrial and consumer goods amongst others. This conclusion is also confirmed by the results of the reality test as shown in chapter 8.

Other major options for stimulating growth of the South African downstream polymer conversion sector are:

- Ensuring local availability of polymers
- Ensuring availability of polymer at competitive prices
- Promotion of exports of industrial and consumer goods
- Reducing freight logistics costs
- Increasing innovation capability of polymer converters
- Supporting investment in modern processing equipment
- Supporting skills development
- Improvement in business environment

It is also necessary to take cognisance of measures employed by other countries to support their downstream sectors. For example, in response to increased imports from China (in particular especially those manufactured in the export processing zones), the EC and USA took trade

measures such as the implementation of quotas and strong vigilance on dumping. In SA's case the Government has not taken any action within the targeted value chains despite increasing imports from China.

9.5. Other important factors

The study also considered the impact of other factors that could affect the sustainability of the value chains, like skills development, technology, long term sustainability and import replacement. A summary of the findings on these particular factors is presented below.

9.5.1. Skills development

Although pricing practices are not considered to have a direct influence on skills development, as is the case with any manufacturing sector, the shortage of skills, particularly in the engineering field, can be seen as a constraint to both upstream and downstream sub sectors in all value chains. Skills development in the value chains under consideration are within the mandates of the MERSETA and the CHIETA and matching the supply of skills to the demand remains a challenge to both SETAs.

9.5.2. Technology

Ongoing technological innovation is required to ensure that the local polymer industry keeps pace with global developments in polymer technology. In some value chains like fertilizers and titanium dioxide, the existing downstream technology is relatively old, resulting in significant increased investment in technology improvements, particularly, in order to meet increasingly stringent environmental requirements. For others like the relatively new acrylate plant significant technology transfer took place from the Joint Venture partner.

9.5.3. Long-term sustainability

Concerns have been expressed that the long-term sustainability of the downstream sector is threatened by the economies of scale and high capital re-investment in China in particular and the consequential import of lower priced finished plastic goods into the domestic market.

As has been demonstrated in the reality test, demand for plastic goods follows GDP growth. If national GDP growth continues to follow the current trend, the local polymer industry will be required to expand its operations to meet the increased demand. This can only be achieved if all parts of the polymer value chain are profitable and the invested capital (equipment and skills) is adequately rewarded.

10. POLICY OPTIONS FOR PRICING PRACTICE

10.1. Review and Conclusions of Global comparison and micro-economic outcomes

10.1.1. Introduction

This section of the report reviews the findings of the global comparison and micro-economic outcomes for each of the products. In terms of the global comparisons, the review firstly evaluates the development position of the downstream sectors compared to other countries of comparable size, as was identified in the Reality Test [mainly polymers]. The next review item is the competitiveness of the SA domestic prices compared to international prices, including the impact of current duty and anti-dumping structures. This includes an assessment of the accuracy of data as supplied by upstream and downstream respondents.

The review of the micro-economic outcomes includes the effect of current upstream pricing practices on the downstream products in terms of skills, wages, technology, long-term sustainability and import replacement. It also addresses the relative importance the upstream feedstock plays in the overall cost structure of downstream companies, including differences between large and smaller downstream companies.

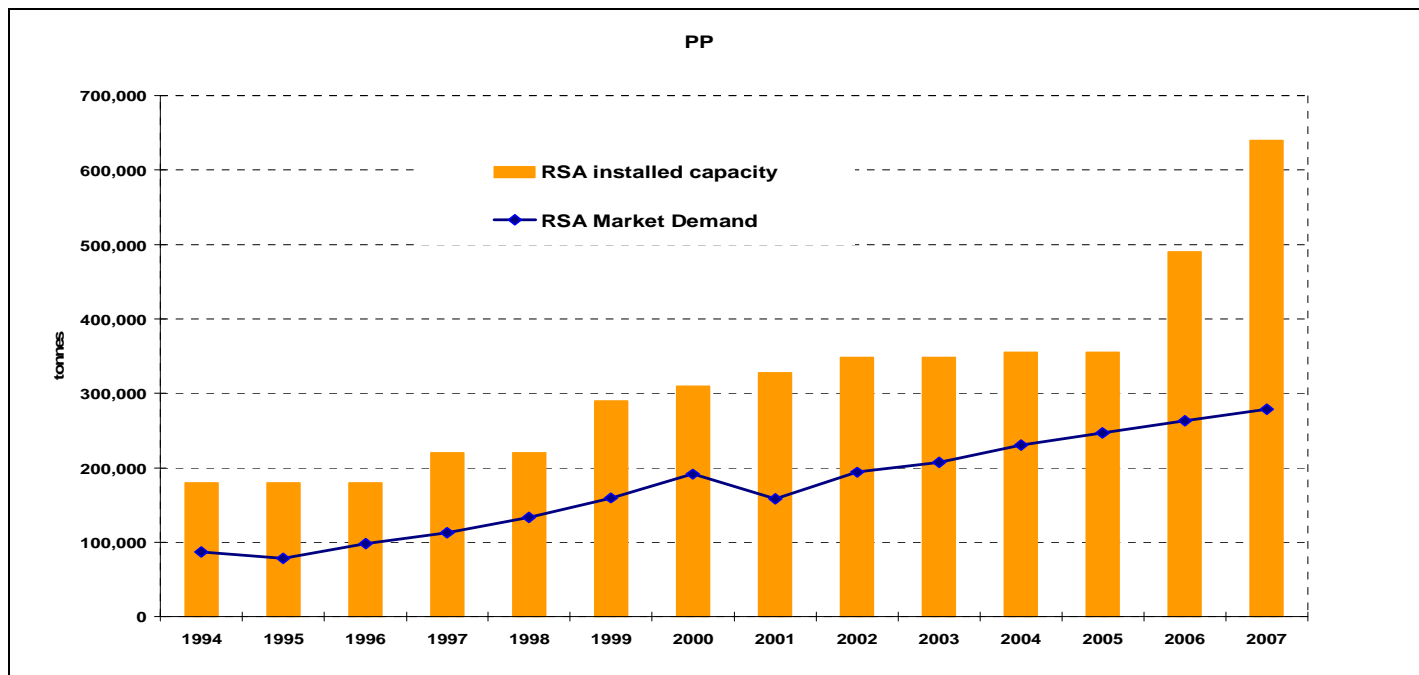
The realistic price elasticity for the various products, based upon the market conditions prevailing in SA is also reviewed, as is the relative profitability of the upstream and downstream businesses covered by the study

10.1.2. Polypropylene

a) Supply/demand Balance

Production capacity for PP in SA is around 355 000 tpa, increasing to 685 000 tpa by completion of Sasol's Project Turbo. The SA market size in 2004 for polypropylene primary polymer used in local plastic conversion was estimated at 223 000 tons, of which 93.7% was supplied by local producers. This indicated significant excess capacity as the chart below shows.

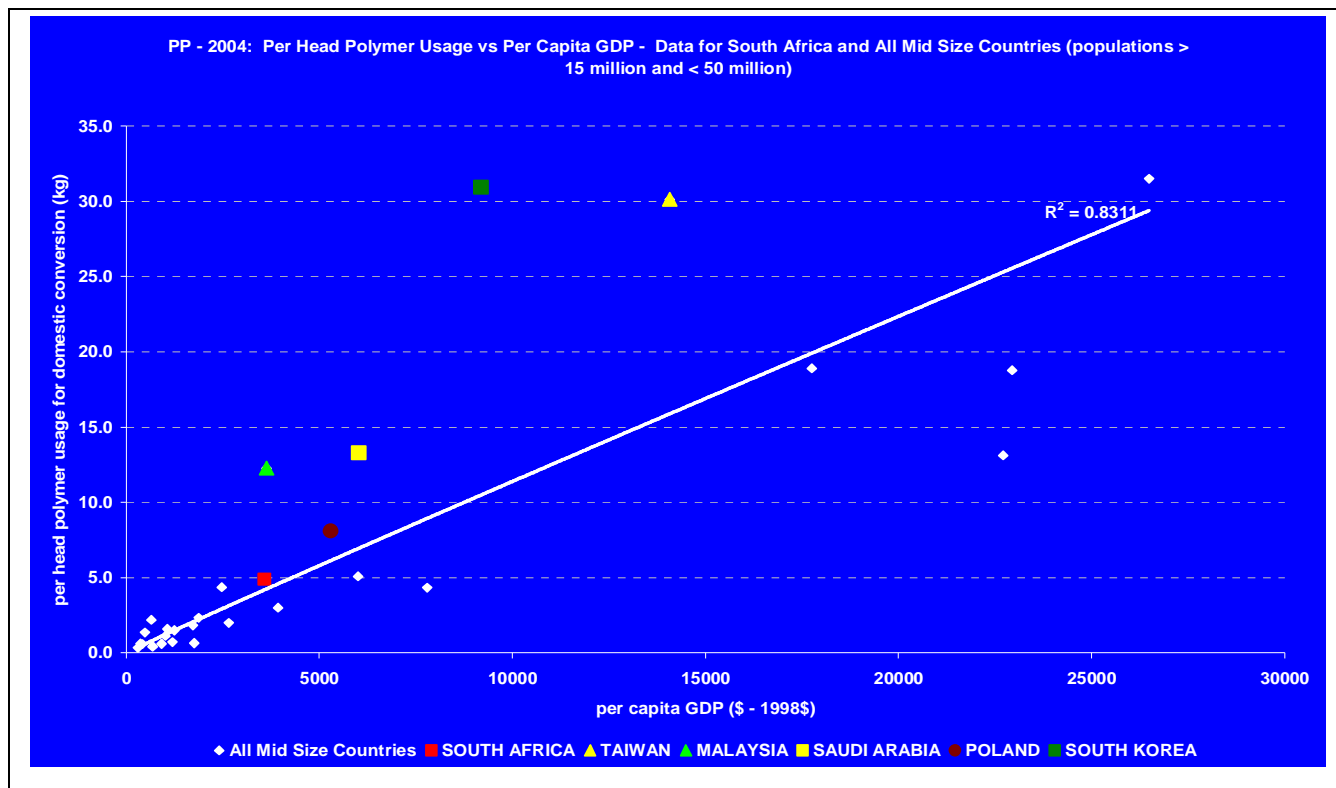
Figure 10.1 PP installed Capacity and Domestic Demand in South Africa (1994 – 2007)



A comparison of South Africa's domestic and export prices with those domestic and export prices of other countries/regions has revealed that excess domestic production capacity as in the case of Polypropylene in South Africa is no guarantee for setting domestic prices.

b) Global Reality Test

The global reality test for PP showed the following result:



The conclusion is therefore that SA's PP conversion industry is not lagging in terms of development, taking into account SA's current state of economic development.

Countries such as South Korea and Taiwan, that have highly developed conversion industries, have developed vigorous manufacturing sectors that export the bulk of production (cars, industrial products, white goods and consumer electronics) that contain plastic components.

c) Local Pricing Mechanism

The PP pricing mechanism prevailing in South Africa is one where the price is negotiated, based on offers in an open market where products are readily traded across national boundaries. The outcome is that the most competitive supplier sets the price and it is better referred to as market pricing, compared to formula-driven IPP.

Local suppliers do not select a particular price from a particular region and rigorously apply that to determine its price to the South African domestic market. They are driven by market dynamics

and reacts to the lowest price imports being offered by competitive suppliers to its customers. Prices of locally manufactured substitute materials, such as paper, metal and glass, are also monitored and considered for the market sectors where they compete as alternatives to polymers.

d) International Pricing Competitiveness

Domestic prices supplied by upstream and downstream respondents showed a good correlation, taking into account the difference in average prices between large, bulk purchasers and smaller consumers as well as the fact that the downstream sector does not buy from a single supplier.

Based upon the analysis of SA domestic PP prices compared to a number of major competing countries, including China, US, NW Europe and India, the main conclusions are as follows:

- Prices around the world are linked.
- In any month, there can be a very wide variation in the prices.
- Prices paid by South African converters are always in the range of prices that prevailed in the countries or regions covered in the analysis, mostly at the lower end of the range. In the latter period of the analysis China is the most competitive (lowest priced market) in the world. In the early part of the period under review, the prices in South Africa were much lower than those in China and India.

A comparison of South Africa's domestic and FOB prices with those domestic and FOB prices of other countries/regions has revealed that in a country where there is excess domestic production capacity as in the case of Polypropylene in South Africa, the FOB price of the polymer exported is usually lower than the price at which it is sold to domestic users. The further away the export market, the higher the price differential between the domestic price and the FOB price. However, as the above comparison shows, the price paid by export and domestic customers is very similar. The converse is also true, that is, the closer the export market the smaller the price differential. The comparison also showed that when the export demand increases faster than domestic, and there is limited amount of polymer available for export, the differential between the domestic and FOB prices is smaller and in some instances non-existent.

e) Demand Elasticity

The results of this study indicated for PP that a 10% decrease in price would result in a 2% increase in market size, and vice versa. The implication is that for PP any price change will result in a less than proportional change in market size. From a practical perspective the conclusion is that for 80% plus of the applications, PP polymer constitutes such a small fraction of the end-product price (or installed cost) that price changes cannot impact on the demand elasticity.

f) EVC

Due to the integration of production facilities, it was not possible to obtain the required information for the EVC analysis at individual product level. The analysis was therefore conducted on the combined polymers upstream and downstream sectors for the period 1997 to 2005.

For **upstream** polymers, the EVC analysis indicated that the return on capital was frequently lower than the weighted average cost of capital, K. This is a clear indicator that the current pricing practices of the upstream sector are not resulting in high levels of profitability, as measured against the total cost of capital, namely K.

For **downstream** PP, despite all efforts no company provided historical financial data for EVC analysis.

10.1.3. Polyethylene

a) Supply/demand Balance

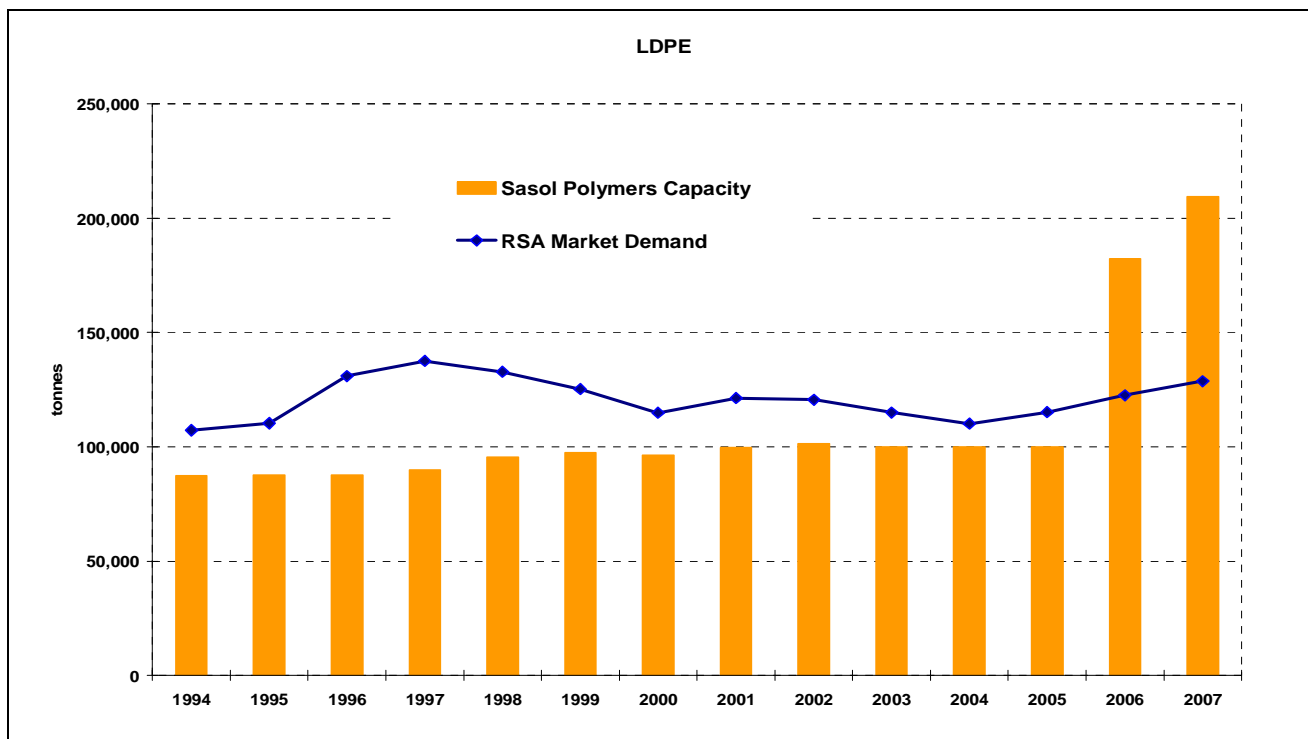
The SA market size in 2004 for polyethylene primary polymer used in local plastic conversion was estimated as follows:

- LDPE: 135 000 t/a
- LLDPE: 139 000 t/a
- HDPE: 158 000 t/a
- **Total: 432 000 t/a**

LDPE

The current polymer production capability of the LDPE plant is 100 000 t/a. With Sasol's Project turbo fully implemented, LDPE capacity will increase to 220 000 t/a, LLDPE will operate at full capacity.

Figure 10.2 LDPE Installed Capacity and Domestic Demand in South Africa (1994 – 2007)



It can be seen that for the period 1994 – 2006 (when the new capacity of Sasol Polymers comes on stream), South Africa has been a net importer of LDPE. From 2006 the country will be a net exporter of LDPE. Demand for LDPE has been stagnant over the period to 2005. The main reasons are:

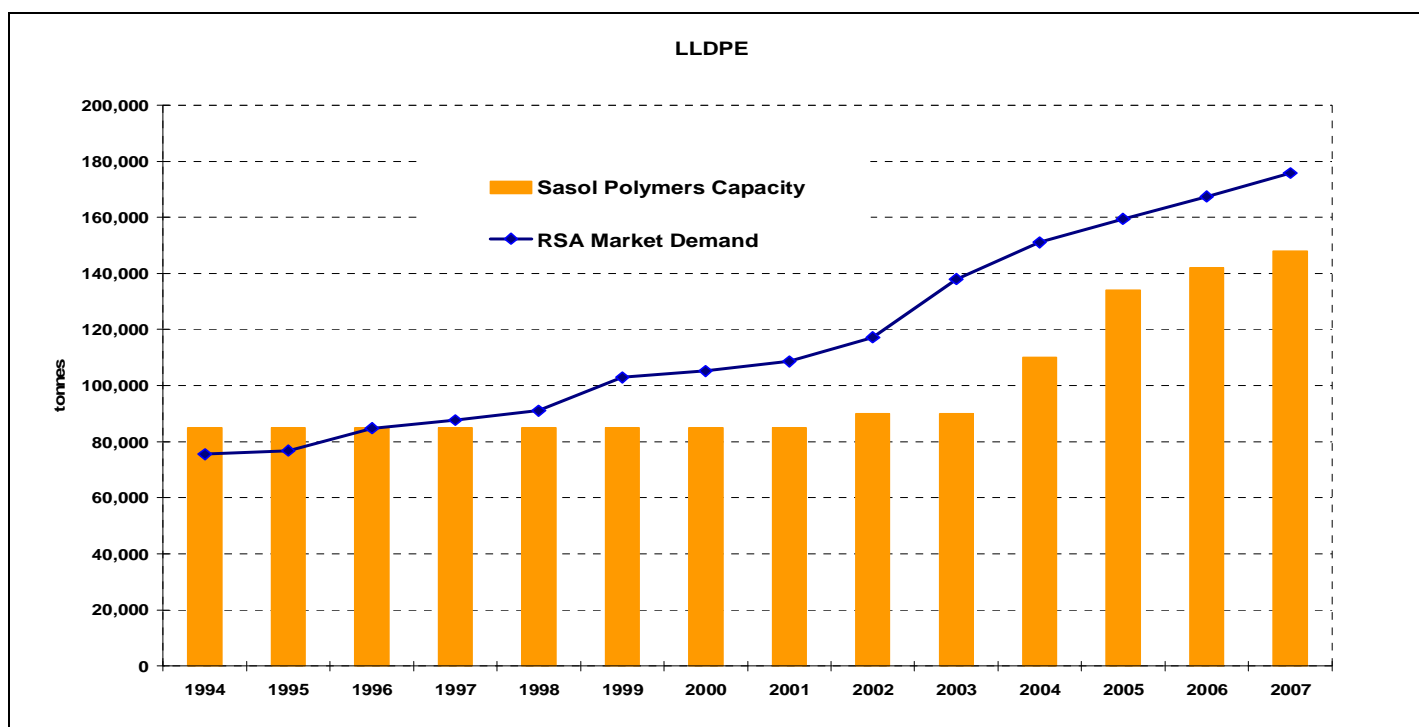
- The substitution of LLDPE for LDPE in many applications. The converters have slowly been switching from LDPE to LLDPE. Part of the reason for the switch to LLDPE (a common phenomena globally, leading to reduced LDPE growth rates), is that over the period the properties of LLDPE have improved and, specifically for South Africa, the active marketing of LLDPE by Sasol Polymers as it had capacity in excess to the local market.

- Internationally, the price of LDPE in relation to LLDPE has risen due to the reduced availability of LDPE on the international market.

LLDPE

The current polymer production capacity of the LLDPE plant is 150 000 t/a. However, LLDPE production currently is limited to approximately 100 000 t/a based on ethylene availability. With Sasol's Project turbo fully implemented, LLDPE will operate at full capacity.

Figure 10.3 LLDPE installed Capacity and Domestic Demand in South Africa (1994 – 2007)

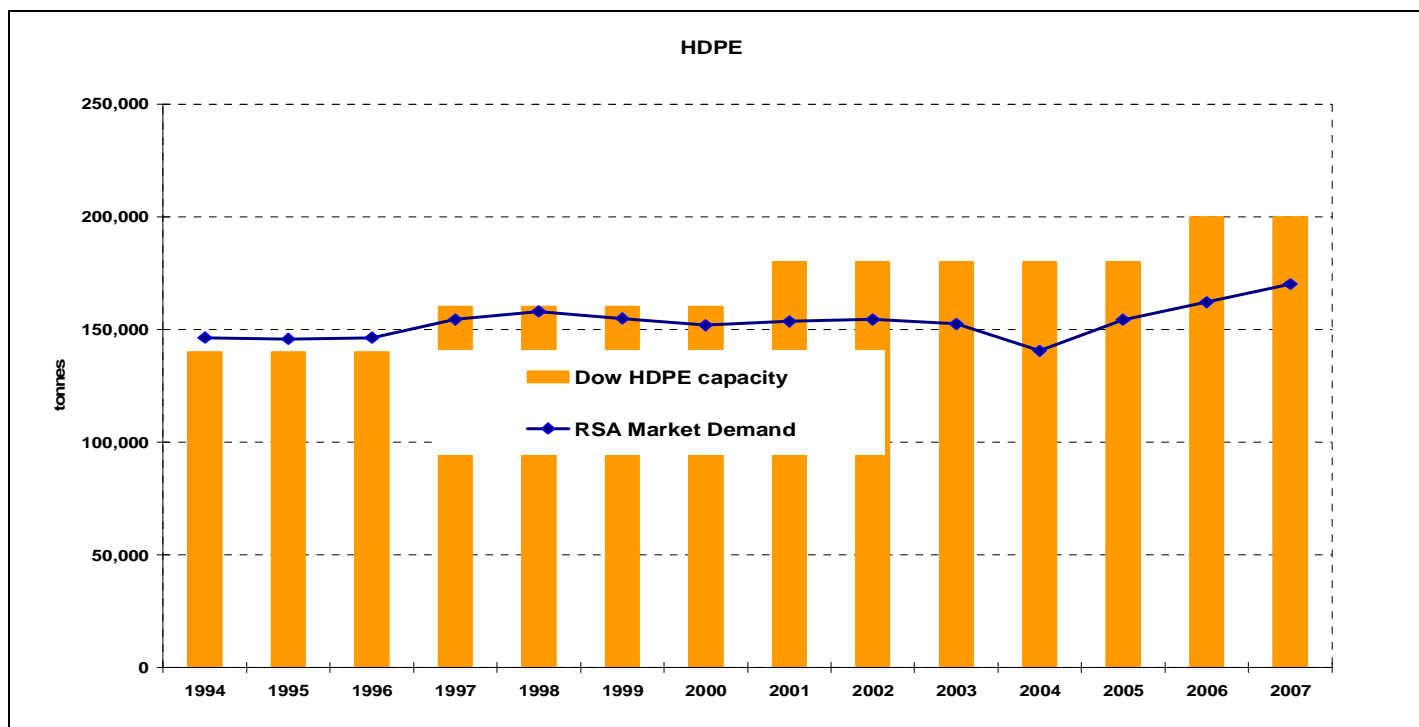


South Africa has been a net importer of LLDPE and is expected to continue to be a net exporter even after Sasol Polymers new capacity comes on stream. The strong demand for LLDPE is primarily the result of new generation LLDPE being produced by Sasol Polymers that has competed with (and taken market share from) LDPE and HDPE.

HDPE

HDPE capacity is 160 000 t/a. Except for a few years in the period, South Africa has had a structural surplus in HDPE capacity. Demand for HDPE fell in 2004, mainly due to the decision by the Government to restrict the use of plastic shopping bags – a major market for HDPE. Demand is expected to increase from 2006 once the effect of the legislation on plastic shopping bags has worked its way through the system.

Figure 10.4 HDPE installed Capacity and Domestic Demand in South Africa (1994 – 2007)



b) Global Reality Test

The global reality test for polyethylene showed that SA's level of conversion is slightly above the level that can be expected from a country with SA's level of economic development.

c) Local Pricing Mechanism

The polyethylene pricing mechanism prevailing in South Africa is one where the price is negotiated based on offers in an open market where products are readily traded across national

boundaries. The outcome is that the most competitive supplier sets the price and it is better referred to as market pricing, compared to formula-driven IPP.

d) International Pricing Competitiveness

Domestic prices supplied by upstream and downstream respondents showed a good correlation, taking into account the difference in average price between large, bulk purchasers and smaller consumers as well as the fact that the downstream sector does not buy from a single supplier.

Based upon the analysis of SA domestic polyethylene prices compared to a number of major competing countries, including China, US, NW Europe and India, the main conclusions are as follows:

- Prices around the world are linked.
- In any month, there can be a very wide variation in the prices.
- Prices paid by South African converters are always in the range of prices covered, mostly at the lower end of the range.
- In the latter period of the analysis China is the most competitive (lowest priced market) in the world.

A comparison of South Africa's domestic and FOB prices with those domestic and FOB prices of other countries/regions has revealed that in a country where there is excess domestic production capacity of polyethylene, the FOB price of the polymers exported is usually lower than the price at which it is sold to domestic users. The further away the export market, the higher the price differential between the domestic price and the export price. However, as the above comparison shows, the price paid by export and domestic customers is very similar. The converse is also true, that is, the closer the export market the smaller the price differential. The comparison also showed that when the export demand increases faster than domestic and there is limited amount of polymer available for export, the differential between the domestic and FOB prices is smaller and in some instances non-existent.

e) Demand Elasticity

The results of this study indicated for LDPE that a 10% decrease in price would result in a 3% increase in market size, and vice versa. For LLDPE the respective data shows that a 10% decrease in price would result in a 7% increase, and vice versa. The implication is that any price change will result in a less than proportional change in market size. From a practical perspective the general conclusion for polyethylene polymers is therefore that for in excess of 80 - 90% of end-use applications there is no significant demand elasticity.

f) EVC

It was not possible to obtain the required information for the EVC analysis at individual product level. The analysis was therefore conducted on the combined polymers upstream and downstream sectors for the period 1997 to 2005.

For **upstream** polymers, the EVC analysis indicated that the return on capital was frequently lower than the weighted average cost of capital, K. This is a clear indicator that the current pricing practices of the upstream sector are not resulting in high levels of profitability, as measured against the total cost of capital, namely K.

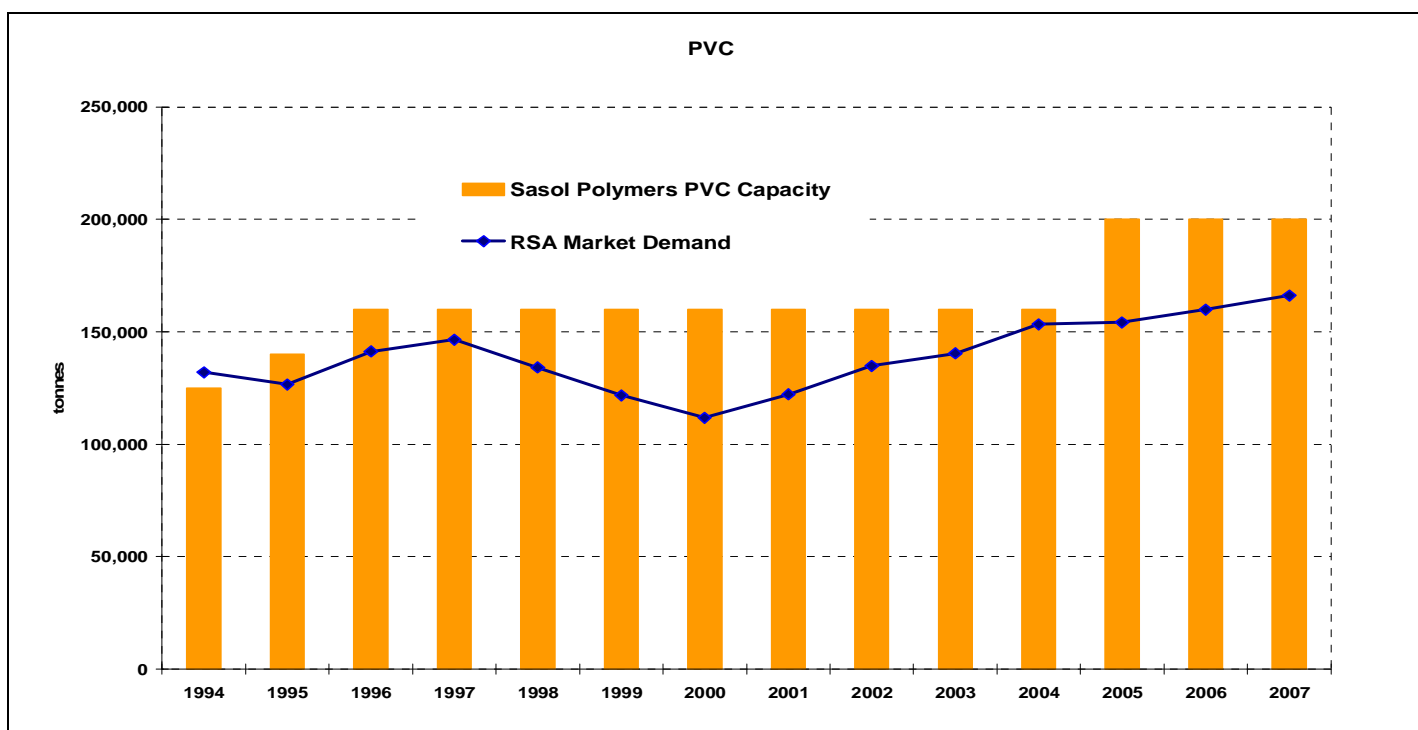
For **downstream** polyethylene a reasonable survey response was obtained. In total four companies, accounting for around 30% of the polyethylene market, provided financial data. However, some of the financial data (two companies) did not correspond historically with the information provided by upstream companies. Although statistically insignificant, the EVC analysis of combined polymers indicates that the return on capital was lower than the weighted average cost of capital, K in every year except 1997 and 1999. This situation means that the downstream sector companies that responded are not making super profits either.

10.1.4. Polyvinylchloride

a) Supply/demand Balance

Production capacity for PVC in SA is around 200 000 t/a. The SA market size in 2004 for PVC primary polymer used in local plastic conversion was estimated at 156 000 tons. This indicated some excess capacity.

Figure 10.5 PVC installed Capacity and Domestic Demand in South Africa (1994 – 2007)



Demand for PVC fell in the period 1994 – 2000 because of the poor performance of the construction sector, which is a major use of products made from PVC (e.g. pipes and electrical cables). With the improvement in the housing sector and the investment in infrastructure by the central and provincial governments, demand has picked up.

b) Global Reality Test

The global reality test for PVC showed that SA's PVC conversion industry is not lagging in terms of development, taking into account SA's current state of economic development.

c) Local Pricing Mechanism

The PVC pricing mechanism prevailing in South Africa is one where the price is negotiated based on offers in an open market where products are readily traded across national boundaries. The outcome is that the most competitive supplier sets the price and it is better referred to as market pricing, compared to formula-driven IPP.

d) International Pricing Competitiveness

Domestic prices supplied by upstream and downstream respondents showed a good correlation, taking into account the difference in average price between large, bulk purchasers and smaller consumers.

Based upon the analysis of SA domestic PVC prices compared to a number of major competing countries, including China, US, NW Europe and India, the main conclusions are as follows:

- Prices around the world are linked.
- In any month, there can be a very wide variation in the prices.
- Prices paid by South African converters are always in the range of prices covered, mostly at the lower end of the range.

A comparison of South Africa's domestic and export prices with those domestic and export prices of other countries/regions has revealed that in a country where there is excess domestic production capacity of PVC, the FOB price of the polymer exported is usually lower than the price at which it is sold to domestic users. The further away the export market, the higher the price differential between the domestic price and the export price. However, as the above comparison shows, the price paid by export and domestic customers is very similar. The converse is also true, that is, the closer the export market the smaller the price differential. The comparison also showed that when the domestic market is tight and there is limited amount of polymer available for export, the differential between the domestic and export prices is smaller and in some instances non-existent.

e) Demand Elasticity

The results of this study indicated for PVC that a 10% decrease in price would result in a 10% increase in market size, and vice versa. The implication is that the increase in market size will be no more than proportional.

From a practical perspective the large impact of product substitution caused by aggressive market share growth of PET (Saturated polyester) in packaging applications, the PVC bottle packaging category is subject to demand elasticity.

The general conclusion for PVC polymer is therefore that for most end-use applications there is no significant demand elasticity, with the notable exception of packaging bottles.

f) EVC

Due to the integration of production facilities, it was not possible to obtain the required information for the EVC analysis at individual product level. The analysis was therefore conducted on the combined polymers upstream and downstream sectors for the period 1997 to 2005.

For **upstream** polymers, the EVC analysis indicated that the return on capital was frequently lower than the weighted average cost of capital, K. This is a clear indicator that the current pricing practices of the upstream sector are not resulting in high levels of profitability, as measured against the total cost of capital, namely K.

For **downstream** PVC, despite all efforts, only one company provided financial data and the data did not corresponded historically with the information provided by upstream companies.

10.1.5. Fertilizer feedstock

a) Supply/demand Balance

Production capacity for ammonia in SA is around 660 000 t/a, and for phosphate rock 3.3 million t/a. The SA market size in 2004 for ammonia used in local applications such as ammonium nitrate was estimated at 710 000 tons. This indicates a shortage in capacity, which is made up from

imports. The SA market for phosphate rock was 1.7 million t/a in 2004, which indicates an excess in capacity.

b) Global Reality Test

SA is consuming around 0.65% of global ammonia, which is inline with SA's share of global GDP. In the case of phosphate rock SA's share of consumption is around 1.2%, which is relatively higher than the contribution to global GDP.

c) Local Pricing Mechanism

SA inland or domestic ammonia prices are directly linked by means of the formula-applied pricing mechanism to international prices. There is no import duty on ammonia. The phosphate rock price is indexed upon the CFR [freight delivered price] price of phosphate rock in India. Effectively local phosphate prices in 2005 were at a discount of 30.6% compared to India.

d) International Pricing Competitiveness

Actual delivered ammonia prices in SA during the period 2000 – 2004 were around 5.1% higher than the US Gulf Coast prices, and 17.6% higher than Indian CFR prices. In the case of phosphate rock [taking into account variances in BPL levels], SA delivered prices are historically well below Indian CFR prices, which exclude Indian inland delivery costs. Ex-factory SA prices are either below or similar to Moroccan export prices.

e) Demand Elasticity

Demand for Fertilizers responds negatively to price changes with a small elasticity of -0.38 . Demand responds positively to GDP with an elasticity of 1.49. Demand of fertilizers also responds positively to rainfalls with a small elasticity of 0.04.

f) EVC

The intrinsic value analysis illustrated that the downstream fertilizers sector had returns that were higher than the cost of capital by 2005 while in the upstream fertilizers sector the returns were lower at the same time. This seems to illustrate an inversely proportional relationship between upstream and downstream financial performance.

10.1.6. Titanium dioxide pigments

a) Supply/demand Balance

Production capacity for TiO₂ pigments in SA is around 35 000 t/a. The SA market size in 2004 for TiO₂ pigments used in local applications such as paints was estimated at 24 000 tons. This indicates an excess in capacity.

b) Global Reality Test

SA is consuming around 0.6% of global TiO₂ pigments, which is slightly below SA's share of global GDP.

c) Local Pricing Mechanism

TiO₂ pigments are sold at the market price prevailing in South Africa. TiO₂ pigments are a commodity item and hence pricing is driven by world demand and supply. The outcome is that the most competitive supplier sets the price and it is better referred to as market pricing, compared to formula-driven IPP.

There is a rebate mechanism in place for large customers that are based on volumes. An estimated 55% of all sales of locally produced product are to large customers.

d) International Pricing Competitiveness

The average prices over the period shown above are as follows:

- APEC (Asia Pacific): \$2,002/ton
- N. America: \$2,125/ton
- North West Europe: \$2,276/ton
- SA (South Africa): \$2,134/ton

Prices paid by South African downstream users are generally in line with prices paid in the regions included in the comparison.

e) Demand Elasticity

From a practical perspective, most titanium dioxide pigments are used in the paints industry. In this application titanium dioxide pigments accounts for around 20 – 25% of raw material costs, or around 10 – 13% of selling prices. At retail level titanium dioxide pigments accounts for only around 5% of the price. It is therefore unlikely that a decrease in titanium dioxide pigment prices will significantly increase demand for paints.

f) EVC

For titanium dioxide pigments an EVC analysis was conducted for 1997 to 2005 for the single upstream company. The analysis indicates that for the first 6 years starting in 1997, with the exception of 1997 recorded returns were higher than the weighted average cost of capital, K. However, from 2003 to 2005 the returns have been lower than the weighted average cost of capital. The lower returns between 2003 and 2005 outweighed the returns made in the earlier years to the extent that the IVC became negative by 2005. No historical financial information on **downstream** titanium dioxide pigments has been provided.

10.1.7. Acrylic acid and esters

a) Supply/demand Balance

Production capacity for acrylic acid and esters in SA is around 105 000 t/a. The SA market size in 2004 for acrylic acid and esters used in local applications such as emulsions was estimated at 25 000 tons. This indicates a significant excess in capacity.

b) Global Reality Test

SA is consuming around 0.7% of global acrylic acid and esters, which is in line with SA's share of global GDP.

c) Local Pricing Mechanism

The local producer's domestic price is comparable with prices in USA and Asia and is derived from the published ICIS LOR reference data as follows: The average of the lowest values quoted for North West Europe (Free Delivered) and Asia Pacific on a CIF basis of the preceding week's

published prices at time of determination. No costs are added to the USD Price in terms of Import Parity Pricing input factors.

d) International Pricing Competitiveness

Butyl acrylate and ethyl acrylate domestic prices in SA have been consistently below, or at the lower end of international prices. Glacial acrylic acid is the last product introduced by the local producer, and initial pricing for local customers have been above international domestic prices, but this gap has been closed towards May 2005.

e) Demand Elasticity

From a practical perspective, most acrylic acid and esters are eventually used in the paints, adhesives and other industries in the form of emulsion polymers. In this application acrylic acid and esters accounts for around 3 –5% of raw material costs, or around 2 –3% of selling prices. It is therefore unlikely that a decrease in acrylic acid and esters prices will significantly increase demand for paints and other products.

f) EVC

Insufficient data is available for reasonable analysis. The upstream operation has only been operating for two years, while none of the downstream respondents provided any information.

10.2. Description of Identified Policy Options and impact upon upstream and downstream sectors

10.2.1. Introduction

The available policy options to deal with upstream pricing practices have to be contextualised within the broader policy framework that is already in place. Government's broader industrial development policy focuses upon three main areas, namely:

- Driving down costs
- Increased value adding
- Increased employment and equity

In addition, the existing policy framework also contains the following:

- The prioritisation of the chemical sector within government's current industrial strategy for spearheading growth and development for the country as a whole
- **the dti** chemical sector development strategy, which highlights the focus upon downstream development and beneficiation of abundant feedstock while also ensuring contribution of the chemical sector in terms of Government's economic aspirations, namely competitiveness, investment, exports, job creation and equity.

Although the downstream sample size was low, the policy options were workshopped. Where the options related to pricing mechanisms it is recognized that the assessment could have been compromised by the small sample size. Further policy options based on constraints to downstream developments and other conclusions of the study which are also presented and evaluated would not be affected by sample size.

The policy options are presented within the context of the overarching constraints to economic growth as identified in the Accelerated Shared Growth Initiative as set out below:

- Relative currency volatility
- Cost and efficiency of national logistics system
- Shortage of suitably skilled labour and disjointed spatial settlement patterns
- Barriers to entry and competition on sectors of the economy
- Regulatory environment and burden on small business
- Deficiencies in state organisation, capacity and strategic leadership
- Size of domestic market and distance from major global markets.

The likely outcomes of these policy options are then tested against the results of the demand elasticity models drivers, as well as the relative impact these options would have on the profitability of the upstream and downstream sectors. From these results recommendations are made of the possible policy options that would have the most significant contribution to the strengthening and development of the complete value chain.

It is recognised that at national level interventions are being developed and implemented to address the identified constraints. The micro economic constraints identified in ASGISA are mirrored in the drivers identified above and the policy options below focus on the drivers that can be influenced at a sectoral level.

10.3. Ensuring local availability of polymers

The study revealed that local availability of polymer in fact played a stronger role in the development of the downstream industry than the price of the feedstock. Any policy options that could affect the continued existence of the upstream industry therefore need to be considered with great care.

Government has initiated a review of competition policy, and proposals in this regard will be published for public comment. In considering this approach in the sectors covered by the study, it is important to consider the impact of such approaches on existing domestic investment in the upstream sectors.

Government has also indicated its intention to consider other policy options to influence up-stream pricing practices. These policy options include:

- Removal of import tariff protection for products priced in terms of IPP.
- Linking future fiscal support to non-discrimination between domestic and export prices
- Withholding of imposition of anti-dumping and countervailing duties on products priced in terms of IPP.

However the above intention has been qualified as being applicable to pricing practices that are unfair. The study has shown that in all cases, upstream players are not making excessive profits and are pricing in terms of general global practice for these value chains, which means that current upstream pricing practices cannot be categorised as unfair. Due to the small sample size

of downstream respondents it was not possible to draw any broad conclusions of the extent of the profitability of the downstream.

As the removal of import tariff protection is the only option about which sufficient information is available to make an assessment, it is the only one that is discussed further in this report.

For the value chains included in the study, duty protection is currently only applicable to the polymer products and titanium pigments (10% in all cases). In the other value chains the existing rate of duty is 0%. Duties can be amended as follows:

- Complete removal of existing duties
- Reduction of duties
- Capping of duties, for example 10% up to a maximum of R500/ton
- Differential approach based on number of domestic suppliers

The impact of these options has to be assessed in the light of the outcome of the preceding analysis. The immediate effect of duty lowering, or removal, is for local feedstock prices to fall, based upon competitive pressure from imports. Import duties are inherent in the market price and therefore their removal will lead to price reduction. The demand elasticity evaluation has indicated that these lowered prices will not result in significant market expansion. In terms of profitability, the upstream sector will be negatively affected.

This will, however, not lead to an increase in profitability of the downstream, as it is expected that end-customers will insist on price adjustments as soon as they become aware of feedstock price decreases. Also, as concluded above, the sales volumes will not increase materially due to the low elasticity in the markets. The effect is therefore that downstream profitability would not necessarily improve.

Upstream profitability could however decline. The EVC calculations for polymers indicate that a 1% price decrease will result in around 5% decline in PBIT, and 11% in EVC. A roughly 10%

decline will thus result in a 50% lowering of profitability and 110% reduction in EVC (this is possible as EVC can be negative) and will hence substantially impact future investment. This intervention would thus impact negatively on the local availability of feedstock, thus reducing this positive driver of downstream development. The result of this is that investment in upstream could be compromised, the extent depending on other factors described in this chapter.

In this regard, consideration should be given to the scenario, which could ultimately arise as a result of this intervention, namely no local polymer production and all polymers are imported. The polymer conversion industry would be significantly exposed to the global supply and demand balances which would manifest itself in reliability of supply and would significant expose the domestic market to price fluctuations and polymer merchants wishing to take advantage of the import situation. In addition, current import logistics capacity is insufficient to handle the importation of these vast quantities of polymer raw materials and the market would likely switch to the importation of semi finished goods and final products which would significant damage the South African polymer conversion industry.

10.4. Ensuring availability of polymer at competitive prices

In effect, this driver of downstream development is not simply a question of the price paid for the feedstock but includes factors like, technical support in the application of the product by the supplier, support in the safe handling and storage of the product, reduced need to store large quantities and availability at short notice.

It is possible for government to intervene and set the price for these commodities and in this regard could introduce a range of options which could include:

- Incorporation of domestic prices applied in other countries into domestic pricing models, and
- Use a pricing model for locally made feedstock to take into account that manufacturing costs are based on local factors [e.g. coal costs] and not crude oil.

These interventions would of course go beyond the government's current macroeconomic policy and could have negative unintended consequences in other sectors as a result of erosion of investor confidence.

In other countries, like, China, Taiwan and South Korea (to name just three) where government has proactively supported the development of downstream industries, interventions focussed in promoting investment rather than regulating pricing practices.

In addition the assessment of demand elasticity has shown that in most of the value chains demand is inelastic as far as movements in prices are concerned. Reducing feedstock and end-product prices along the value chain is therefore not going to lead to significant growth in the overall market size.

10.5. Promotion of exports of industrial and consumer goods

The prioritisation of the chemical sector within government's current industrial strategy for spearheading growth and development for the country as a whole has been further developed in **the dti** chemical sector development strategy, which emphasizes downstream development and beneficiation of feedstock while also ensuring contribution of the chemical sector in terms of Government's economic aspirations, namely competitiveness, investment, exports, job creation and equity.

Government strategies recognise the reality demonstrated in the reality tests in this study, namely that the market for downstream products has reached the economic level expected for the national GDP level. Growth in these sectors must therefore be driven by exports of beneficiated products or by sectors that are high consumers of polymers.

The chemical sector summit agreement and the chemical sector development strategy both identify the need for the chemical sector to increase downstream beneficiation of both domestic natural and manufactured raw materials. One of these is the potential downstream beneficiation of polypropylene, which has been prioritised as a result of anticipated increased production volumes

of primary polypropylene polymer. In this regard the need to focus on growing export markets for beneficiated polypropylene projects is an important departure point.

This proposal entails the identification and implementation of downstream beneficiation products involving the “downstream-from-the-downstream” sectors. A good example is the manufacturing of automotive bumpers, which would require the support of both the automotive manufacturers, as well as the aftermarket parts and services sectors. It is clear that the trend will be increasingly in this direction. Sasol Polymers currently provides technological support to the polymer conversion industry at their Polymer Technology Centre in Modderfontein. This centre could be leveraged for developing technologically sophisticated polypropylene products for exports. The government’s support for the automotive industry via the MIDP could also be leveraged to obtain buy-in and co-operation for the end-use sectors.

Preliminary exploration into the potential development of polypropylene value chain with the downstream sector has revealed a number of critical success factors for export beneficiation, which include:

- Existence of well developed channels to the market through for example, ownership by a shareholder who is also the customer or distribution channel; relationship with an international company;
- Existence of a strong export culture and many years of international trading experience and the relationships associated with that;
- Access to technical and commercial skills from a relationship with an international partner;
- Ability to produce more sophisticated products, where this can be demonstrated and technical and product support is included as part of the offering, rather than commodity type products with little product or service differentiation;
- Long term commitment to markets to facilitate recovery of investment in compliance with stringent technological requirements in some markets;
- Reliable raw material supply
- Access to competitive price for raw materials;

- Facilitated access to government export incentives; and
- Protection against unfair imports

The chemical sector development strategy recognises that the current range of incentives available for growth and development of the sector may not be sufficiently well targeted to the needs of the sector if growth targets are to be achieved. Successful interventions in other countries should be used as benchmarks for improving domestic supply side measures.

All such incentives should be summarized and packaged in a format that is readily available and easily understood, particularly to small investors and potential overseas investors.

The whole package should be promoted both in South Africa and abroad as the importance of external links is borne out from the survey. It is likely that new foreign investment will be necessary in order to get sufficient increase in beneficiated exports that is desired, and that it will be necessary to attract strong participants who are already active in the target markets.

Another approach to export-focused downstream beneficiation is to identify and develop product-based clusters, involving the “downstream-from-the-downstream” sectors. Such products include:

- Low value high volume products where the majority of the output is exported
- Products of global excellence
- Products that may be packed with other products to maximise freight logistic cost efficiency
- End-use products that will grow at multipliers to general economic growth

In respect of upstream players, a commitment to the additional effort required to support more domestic customers than is the case for export, would be required.

10.6. Reducing freight logistics costs

The cost and efficiency of the national logistics system has been identified as one of the binding constraints to growth and although it is being addressed at a national level, some specific sectoral interventions are proposed. In addition national initiatives should be vigorously encouraged.

a) Supply chain price agreements

The proposal is to obtain supply chain price agreements: A large converter that also buys-in components from smaller converters negotiates single polymer price for all. This would entail all participating converters to pay the minimum price, based upon bulk volumes. There would be, however, additional costs for the smaller converters in terms of bulk-braking and own transportation. This approach could be encouraged on a voluntary basis amongst downstream players, but the overall benefit is expected to be small.

b) Shared approaches to logistics

The geographic disadvantage for downstream SA exporters can be countered by innovative logistic approaches whereby, for example, lightweight plastic products can be transported with heavier metal based products to optimise container space. The policy option is therefore for Government to support such logistic activities, which will increase competitiveness in the export market.

10.7. Increasing innovation capability of polymer converters

The Chemical Sector Summit Agreement includes an agreement to strengthen support for innovation in the sector as a whole. It is proposed that mechanisms to support innovation in all value chains be investigated and implemented.

Transfer of technology by international investors and relationships between upstream and downstream players which promote innovation should be promoted through specific incentives.

a) Supporting investment in modern processing equipment

The policy option is for Government to incentivise in a targeted way downstream operations to invest selectively in technologically advanced equipment in order to improve competitiveness, but also to develop innovative, high value-added products. Investment in generic equipment should be discouraged.

c) Supporting skills development

It is proposed that the specific skills development demands from these value chains, be incorporated into the sector skills plans of the MERSETA and CHIETA and that the Government representatives of the boards of these SETAs ensure that this is done.

Scarce skills identified in these sector skills plans should be prioritised as part of the JIPSA initiative.

d) Improvement in business environment

In addition to the ongoing national initiatives in this regard, specific sectoral policy interventions that could be considered to support this driver include tax incentives, support for export and innovation. It should be recognised that countries where downstream sectors are thriving generally have relatively low taxes and promotion of a favourable business environment by government.

10.8. Increased duty protections for downstream products

The downstream sectors generally already have duty protection. For example, in plastic products, there are duties in place for most of the tariff headings, typically in the 15 – 20% range. The increased duty protection would serve to counter the high cost of feedstock, by increasing product prices. This will improve the profitability of end-use sectors, as well as replace imports to an extent. Demand for product is not expected to decrease significantly due to price inelasticity. This would further result in increased local upstream feedstock consumption. However, it may result in

a decrease in exports, as downstream converters would tend to become less competitive in export markets. This option is, however, in contradiction with general trade liberalisation, and is unlikely to find favour.

The major advantage is expected to be in downstream profitability, with some market growth based upon import substitution. This growth is not sustainable, and downstream competitiveness will decline. There will be no driver to decrease costs and improve efficiencies for competitiveness in the export market.

10.9. Fast-track approach to anti-dumping investigations at downstream level

This proposal is primarily aimed at assisting downstream companies that are affected by anti-dumping activities from importers. By fast-tracking these activities it will be possible for downstream companies to improve their market share, as well as profitability, leading to an environment that will be more conducive to investment.

A fast-track approach to anti-dumping investigations at downstream level could have a positive effect on all value chains both up and downstream.

10.10 Prevention of illegal imports

In addition to the fast tracking of antidumping investigations, a more comprehensive approach to prevention of illegal imports should be developed and implemented on the basis of a partnership approach between Government and stakeholders.

APPENDIX 1: DEMAND ELASTICITY

Introduction

In order to make valid comparisons of the impact of selling price changes on both the upstream and downstream levels of sectors of the chemical industry, it is necessary to determine the relationship that exists between selling price changes, and changes in sales to customers. Technically, this relationship is known as the "elasticity of demand". Figure 1 below provides an example of a demand elasticity curve. Price changes are reflected on the vertical x-axis, whilst the corresponding changes in quantities sold are reflected on the horizontal y-axis. Both price and sales changes are reflected in percentages.

Figure A1.1: Example of a Demand Elasticity Curve

Figure 1 indicates that, for each percentage increase in price, there is a corresponding decrease in sales volume. As such, the demand elasticity curve falls from left to right.

This study has calculated an *historical* and a *projected future* demand elasticity curve for both of the upstream and downstream businesses analysed.

Calculating the Historical Demand Elasticity Curves

In order to calculate an historical demand elasticity curve and both upstream and downstream respondents were asked to provide information on up to ten historical price changes. Table 1 below reflects the details of the information that respondents were required to provide.

Table A1.1: Historical Price and Sales Change Input Data

	Most Recent Selling Price Change	- 1	- 2	- 3	- 4	- 5	- 6	- 7	- 8	- 9
Selling price Change Date										
Selling price Change %										
Gross Sales Value										
Change in Capacity Utilisation %										
Change in Employment %										
Reason for Selling price Change										

The above table required that respondents reflect the date of each selling price change, i.e. the month and year of each selling price change. Selling price changes were provided as percentage changes, i.e. - 5%, + 10%, etc, and not Rand value changes.

In providing gross sales value, respondents were required to provide the total value of sales that occurred between each selling price change date, i.e.

- Most recent selling price change date: March 2005
- Next most recent selling price change date (i.e. - 1): April 2004
- Total gross sales value for the period April 2004 to February 2005: R 37 million

Using this information, it was possible to calculate a percentage change in gross sales value from one price change period to the next.

In providing capacity utilisation percentages, respondents were required to provide the percentage utilisation of their total production capacity that resulted from each change in price and gross sales value, i.e. Period 1: 70% capacity utilisation, Period 2: 80% capacity utilisation, etc. Similarly, respondents were also required to provide the percentage change in the number of people they employed that resulted from each change in price and gross sales value.

In providing reasons for selling price changes, respondents were required to select from one of the following alternatives:

- Normal, inflation-based periodic selling price increase
- Selling price change necessitated by a change in the Rand/US\$ exchange rate
- Selling price change necessitated by a change in local interest rates
- Selling price change necessitated by a change in raw material input prices
- Change in Market prices
- Other

Historical price and sales volume change data provided by the respondent companies was subjected to statistical analysis and separate historical demand elasticity curves were calculated for the upstream and downstream companies. In each instance, a single demand elasticity curve was calculated for each level of a particular sector.

Calculating Projected Future Demand Elasticity Curves

In order to calculate projected future demand elasticity curves, respondents were required to provide an estimate of what they thought would happen to their sales volumes over the next 12 to 18 months if they were to either increase or decrease their selling prices by the percentages reflected in the table below. In doing so, respondents were asked to assume that no other possible factors that could influence customers' buying decisions would change during this period (i.e. Rand/US\$ exchange rates, local interest rates, product quality, the launch of substitute products, customer product preferences, etc).

Table A1.2: Projected Future Price and Sales Change Input Data

Percentage Selling Price Change	Sales Volume to Local Customers (SVLC) %	Sales Volume to Export Customers %	Import Replacement Sales as a Percentage of SVLC %
+ 20%			
+ 10%			
+ 5%			
0%			
- 5%			
- 10%			
- 20%			

Table 2 indicates that respondents were required to provide projections of changes in sales volumes to both selling price increases and price decreases. Furthermore, respondents were also required to provide separate projections of sales volumes to local customers and export customers, as well as an estimate of the percentage of sales volume to local customers that would result from import replacement sales, i.e. assuming a respondent had indicated that sales volume to local customers would increase by 30% as a result of a 20% decrease in its selling price, they would indicate that approximately 70% of the 30% increase in sales volume would be accounted for by import replacement sales.

Projected future price and sales volume change data provided by respondents was subjected to statistical analysis, and separate projected future demand elasticity curves were calculated for the upstream and downstream levels of a particular sector. In both cases, one demand elasticity curve was calculated for each level.

Demand Elasticity Results for Polymers

Empirical findings from a recent study by Fedderke (2005) suggested that price elasticity of demand in Sasol's polyethylene low density (LDPE) as well as linear low density (LLDPE), polyvinyl chloride (PVC) and polypropylene (PP) markets in South Africa is respectively (in

absolute terms) 0.3, 0.7, 1, and 0.2 %. These results suggest that for example in the PVC market, a 1% decrease in the price would result in a proportional increase in the market size.

This report is concerned with testing the results mentioned above by applying the same methodology, on the same sample period but using a slightly different set of variables. Given time constraints and the problem with the availability of data, the following exercise only tests the results for the PVC market.

Figures (see data from Sasol) suggest that Sasol has substantial market power in the PVC market in South Africa throughout the sample period. Economic theory states that under substantial market share profit maximization, with negligible marginal cost of production, demands operating on the domestic demand curve where the price elasticity of demand is unity in absolute terms. That is 1 % increase in price will bring about a 1% decline in the demand for PVC and *vice-versa*.

Methodology and Data

Considering the interactions that exist between supply and demand of output in determining the equilibrium price and quantity in the market, isolating the impact of price on demand requires that the demand and supply curves in the market be separately identified. As in the study by Fedderke (2005), Multivariate Vector Error Correction methodology is used in this case to estimate both the demand and the supply side of the PVC market simultaneously using monthly observations on the sample-period 1994-2004.

The following time series were obtained from Sasol and used in natural log transform except for the import duties on PVC.

1. Sasol PVC production for the domestic market (tons) denoted LPVCtDS;
2. Domestic price of PVC (R/ton) denoted LPricept;
3. Import duties on PVC (percent) denoted NetDut;
4. Total cost of input into production (R) denoted LinputTot;
5. Exports of PVC (tons) denoted by LExport.

In addition, the index of “Composite business cycle leading indicator of South Africa” (LIncome), and the index of “Electric current generated” (LUrban) were obtained from the South African Reserve Bank Quarterly bulletin. These two series are used in natural log transform and stand as proxy respectively for the level of aggregate economic activity and urbanization rate in South Africa.

Estimation results

The first step in the modeling process using the Vector Error Correction model is to determine the order of integration of all the variables to be included in the analysis. All the variables used to model the PVC markets are integrated of order one. This is to say that the variables are non-stationary in levels, but their first-differences are stationary. Table 1 indicates that ADF test statistics with drift, but without trend, fail to reject the null hypothesis of unit root at 5% level when the variables are considered in first difference.

<i>Variable</i>	<i>Level</i>	<i>Critical value</i>	<i>First difference</i>	<i>Critical value</i>
LPVCtDS	-0.796	-2.886	-12.396*	-2.886
LPricept	-0.833	-2.884	-10.929*	-2.884
LIncome	-2.188	-2.884	-5.698*	-2.884
LUrban	-0.696	-2.884	-15.715*	-2.884
NetDut	-0.838	-2.884	-3.847*	-2.884
LinputTot	-0.235	-2.894	-4.063*	-2.894
LExport	-1.548	-2.890	-10.287*	-2.890

Table 1: ADF test statistics with drift, but without trend. An asterisk (*) denotes rejection of the null of unit root at the 5% level.

After being satisfied that all variables are $I(1)$, Maximal Eigenvalue Test statistic is used in the next step to test for number of cointegrating vectors. The results of the test in Table 2 indicate the presence of two cointegrating vectors, with two lag intervals in first differences.

Hypothesized Nos of CE(s)	Eigenvalue	Max-Eigen Stat	0.05 Crit. Val.	Prob.**
None *	0.449352	48.32936	42.77219	0.0110
At most 1 *	0.379624	38.67181	36.63019	0.0285
At most 2	0.290424	27.79010	30.43961	0.1033
At most 3	0.205336	18.61676	24.15921	0.2358
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Table 2: Maximal Eigenvalue Test Statistics. Trend assumption: No deterministic trend. Series: LPVCTDS, LPRICEPT, LINCOME, LURBAN, NETDUT, LINPUTTOT, LEXPORTS.

$$\Pi_{z_{t-k+1}} = \begin{bmatrix} 11 & 21 \\ 21 & 22 \\ 31 & 23 \\ 41 & 24 \\ 51 & 25 \\ 61 & 26 \\ 71 & 27 \end{bmatrix} \begin{bmatrix} 1 & 12 & 13 & 14 & 0 & 0 & 0 \\ 1 & 22 & 0 & 0 & 25 & 26 & 27 \end{bmatrix} \begin{bmatrix} LPVcDS \\ LPRicept \\ LIncome \\ LUrban \\ NetDut \\ LInputTot \\ LExport \end{bmatrix}$$

The results for the different tests then lead to the following structural specification for the VECM:

Proceeding without restrictions on the α -matrix of short-run coefficients yields the results presented in Table 3 for model 1, model 2, and model 3.

Note that:

1. Model 1 is estimated with no restriction on the β -matrix of long-run coefficients
2. Model 2 is estimated with the price elasticity of demand for PVC set to -1
3. Model 3 is estimated with the price elasticity set to -1 and assuming that variable costs are not material to the supply decision.

	Model 1		Model 2		Model 3	
	β		β		β	
LPVctDS	1.00	1.00	1.00	1.00	1.00	1.00
LPricept	1.26 (0.27250)	-0.82 (0.18553)	1.00	-0.73 (0.15622)	1.00	-1.19 (0.03211)
LIncome	-3.97 (0.67688)	0.00	-3.45 (0.40727)	0.00	-3.57 (0.40083)	0.00
Urban	-0.38 (0.45123)	0.00	-4.42 (0.40399)	0.00	-0.30 (0.39760)	0.00
NetDut	0.00	0.81 (0.16967)	0.00	0.75 (0.13608)	0.00	0.78 (0.19828)
LInputTot	0.00	-0.29 (0.14777)	0.00	-0.35 (0.12383)	0.00	0.00
LExport	0.00	0.13 (0.02968)	0.00	0.11 (0.02466)	0.00	0.12 (0.03589)

Table 3: PVC estimation results

These are the main results presented in Table 3 from the estimation of the Vector Error Correction model:

- Demand for PVC responds *negatively* to “price” with an elasticity of -1.26 , -1 , -1 respectively in model 1, 2, and 3. The coefficients are statistically significant.
- Demand responds *positively* to “income” with an elasticity of 3.97 , 3.45 , and 3.57 respectively in model 1, 2, and 3. The coefficients are also all statistically significant.
- Demands also respond *positively* to “urbanisation” but the coefficients are not significant.
- Supply responds positively to “price” in all three models with elasticity: 0.82 , 0.73 , and 1.19 . All coefficients are statistically significant.
- Supply responds *negatively* to “import duties” with an elasticity of -0.81 , -0.75 , and -0.78 respectively in model 1, 2, and 3. The coefficients are statistically significant.
- Supply responds *positively* to “input cost” with elasticity of 0.29 and 0.34 in model 1 and 2. Although the coefficients are statistically significant, they are theoretically incoherent.

- Finally as one could theoretically expect, supply on domestic market responds *negatively* to export in the three models with elasticity: -0.13, -0.11, and -0.12. All coefficients are statistically significant.

It can be concluded that the findings of the analysis in this report are also supportive of the results in Fedderke's study that the best estimate of the price elasticity of demand in the PVC market is not statistically different from -1 . This is also true for the sign of other variables in the model.

However, results do differ with respect to exports. Contrary to the positive relation between exports and output supplied in the study by Fedderke, the present study found a negative relation between exports and output supply. This is theoretically plausible if one considers the drivers of the export decision in the petrochemicals markets. In this industry exports are switch of domestic output from domestic markets to foreign. Hence the negative relationship between exports and output supplied.

APPENDIX 2: ECONOMIC VALUE CREATED (EVC)

Introduction

Given the relationship that exists between sales volumes and price (as measured in this study by the demand elasticity curves described in Appendix 1), the challenge is to find an equitable method of comparing the impact on the financial performance of upstream and downstream businesses of the selected sectors of the chemical industry brought about by changes in selling prices and sales volumes. The measure used must be unbiased and objective, and based on readily available data. It must also be:

- Applicable to all types of business - upstream and downstream businesses, trading and manufacturing businesses, etc.
- Insensitive to size of business,
- Applicable to capital or labour intensive businesses,
- Unaffected by age of assets in upstream or downstream business,
- Applicable across vertically integrated businesses, and
- A validated, proven methodology

The measure that meets the above criterion that has been used in this study is Economic Profit, also known as Economic Value Created (EVC).

Historic approach

In order to eliminate the subjective bias implicit in forecasting, and to deal with issues related to the age of and the future replacement cost of assets in different businesses, the methodology used was to measure the impact, had prices and volumes been changed historically.

EVC defined

EVC is an economic, not an accounting concept. In order to measure it, one must look not only within the company, but also into the industry and the economy. Economic value created is a practical measure of the company's operating performance that correlates with the value of the

company. What makes it so relevant is that it takes into account a cost that conventional measures exclude, namely, the cost of equity. Economic value created is simply the before interest and after tax operating profit, R , minus the total annual cost of capital, K . It is expressed as follows.

$$EVC = R - K$$

In this model,

R is the stream of cash available to the providers of capital, and

K is the total cost of the capital used, including the cost of equity and debt

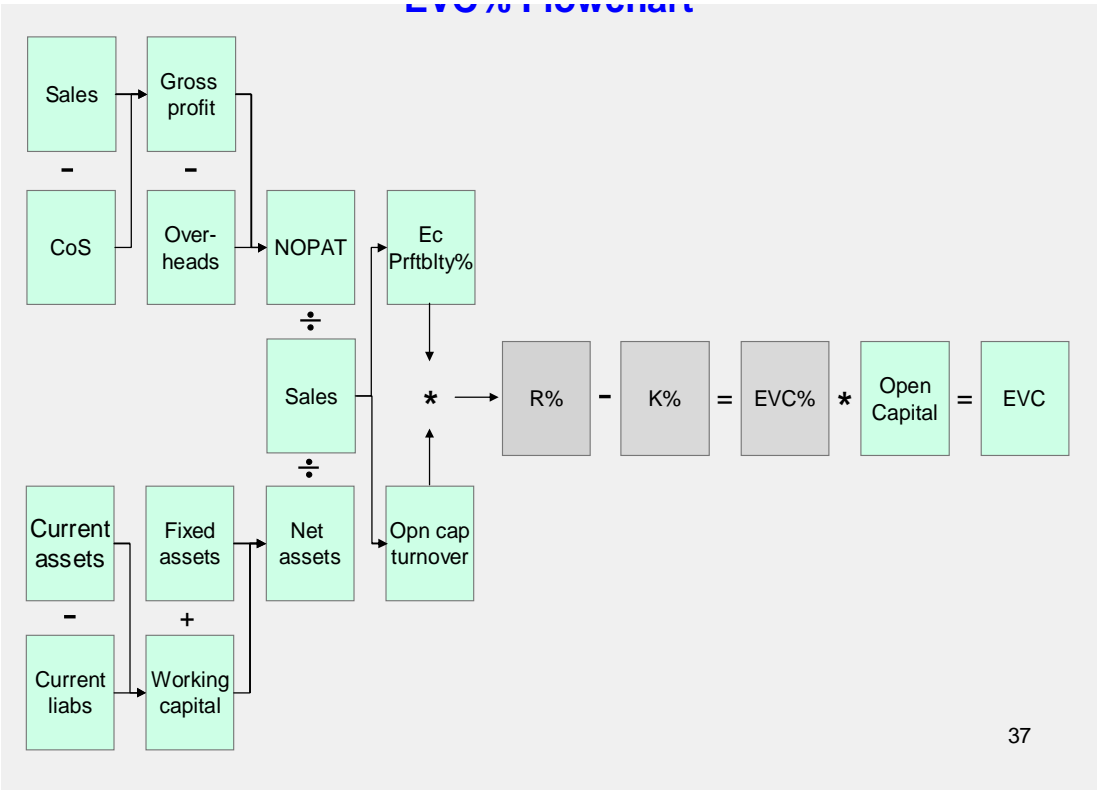
The **weighted average cost of capital (K)** would normally vary across industries and over time. EVC is *relatively* insensitive to variations in K in the industries measured.

This study seeks to determine the relative impact of pricing policies between upstream and downstream protagonists. Accordingly the view was taken that a single K could be applied as a consistent-and-equal benchmark for all companies in the study. This approach eliminates the moving benchmark effect of applying a different K to each company in each year.

Determination of K - Weighted average cost of capital %	
Target debt as % of capital	50
Risk free rate of return %	12
Market rate of return %	20
Risk index (beta)	1.5
Cost of equity %	24
Marginal debt rate %	15
Marginal corporate tax rate %	30
Cost of debt %	10.5
K, Weighted average cost of capital %	17.25

Computing EVC

The following flowchart and simplified figures demonstrate how EVC is computed. Note that the figures used are for demonstration purposes only, and do not represent an actual business. In the example provided, it can be seen that a normal accounting measure does not take the cost of equity into account, whereas the EVC computation takes this cost into account. Note also the fact that the accounting measure shows a profit, whilst the EVC method shows a loss. This is an important observation and demonstrates the impact on performance of taking into account all business costs.



Profit & loss			Balance sheet		
	Accounting	Financial		Opening	Closing
Sales	100 000	100 000			
CoS	55 000	55 000			
GP	45 000	45 000			
Overheads	20 000	20 000			
PBIT	25 000	25 000			
Int. @ 20% of 40 000	8 000	N/A	Equity	60 000	70 200
Profit after interest	17 000	N/A	Debt	40 000	40 000
Tax @ 40%	6 800	10 000	Capital	100 000	110 200
NPAT	10 200	N/A			
NOPAT	N/A	15 000			
Cost of debt	N/A	4 800			
Cost of equity	N/A	14 400			
EVC	N/A	(4 200)			

How much EVC is enough?

K is by definition, the opportunity cost of capital. It is the minimum, risk adjusted return expected by business owners/providers of capital. Therefore the minimum return (R) a company should aim for is K. Any return above K represents “value created”, whilst any return below K represents “value destroyed”.

EVC can take account of performance over time

Because EVC is an all inclusive measure, it can be used to measure performance over time. When EVC is measured across many time periods, it is referred to as the “Market Value Created”, MVC.

MVC is simply the present value of each year’s EVC. The system is intrinsically consistent as the discount rate applied is K, the same value that is used in determining EVC.

Data Agglomeration

In essence, the objective is to determine the impact of import parity pricing across both the upstream and downstream elements of the chemical industry. Accordingly, financial data from upstream companies in the research sample has been agglomerated, as was the financial data from downstream companies. The effect is that no single company can be identified in the report.

Note Well

The word “Profitability” has been used frequently by Government as a proxy for value or profit in the CPG meetings. Profitability is a defined ratio meaning “Profit Before Interest and Tax / Sales”. Accordingly in the context of determining overall performance, or value created, it is not applicable.

Value Creation

Accounting measures do not correlate well with share price. The accounting model is precise but inadequate. Value creation is a long term economic, not an accounting, concept. Value creation takes account of risk and the cost of equity and looks beyond the company into the market. As an economic measure it can also be used to take account of the time value of earnings. Although accounting measures are precise they do not measure value. Therefore when an accounting measure is used as a proxy for value it will be precisely wrong. EVC is the closet proxy for measuring value and therefore the choice is between being precisely wrong or approximately right.

Correlating Measures of Value With Actual Share Price

The following table shows the most frequently used measures used to predict share price and the correlation with actual share price. (Modigliani and Miller –Nobel Prize research)

Measure	Correlation with actual share value
EVA (which we call EVC)	50%
Return on Equity	35%
Cash Flow Growth	22%
Earnings per Share Growth	18%
Asset Growth	18%
Dividend Growth	16%
Sales Growth	9%

Highest Correlation

It is quite clear from the table that EVC provides the highest correlation with actual share price. It is not a short term accounting measure. It is a long term economic measure that takes account of business earnings, capital employed, intrinsic company risk, extrinsic market risk, the cost of equity and debt and the time value of money. It is not precise but it provides the closest proxy available for actual share price. It will provide the same result as IRR (the internal rate of return) but is easier to follow on a year by year basis.

Other Measures Used to Predict Share Price

- **Net Profit after Tax, (Not Profitability).** Profit is a one year accounting measure that takes no account of the capital employed
- **Return on Net Assets.** This is the same as Return on Capital. They are one year accounting ratios and do not apply for longer terms
- **Return on Equity.** This is an accounting ratio which does take account of capital gain or dividends received by shareholders. Therefore it does not as the name suggests measure the actual return to shareholders, is also limited to the short term.

Market Value Created

The actual market value of a company is the price of all its shares in the market. In an efficient market the actual market value will equal the intrinsic or calculated value. The difference between actual market value and its net assets is market value created (or destroyed). In this report intrinsic value has been calculated using the net present value of each years EVA. This is a classic method and if rigorously applied will give the same result as IRR. No other method available to date will yield a better proxy for value.

Key References

Key references used to determine the most appropriate measure of value are;

- Hamanda, R. S. 1972. *The effects of the Firms Capital Structure on the Systematic Risk of Common Stock*. Journal of Finance May: 435-452.
- Modigliani, F, and Miller, M.H. 1961. *Dividend Policy, Growth and the Valuation of Shares*. Journal of Business, October: 411-433
- Mike Ward & Allan Price, 2007. *Turning Vision into Value*. Van Schaik
- Stewart, B. IIG. 1991. *The Quest for Value*. London: Harper-Collins.

EVC Results for Combined Polymers

Due to the integration of production facilities, it was not possible to obtain the required information for the EVC analysis at individual product level. The analysis was therefore conducted on the combined polymers upstream and downstream sectors for the period 1997 to 2005.

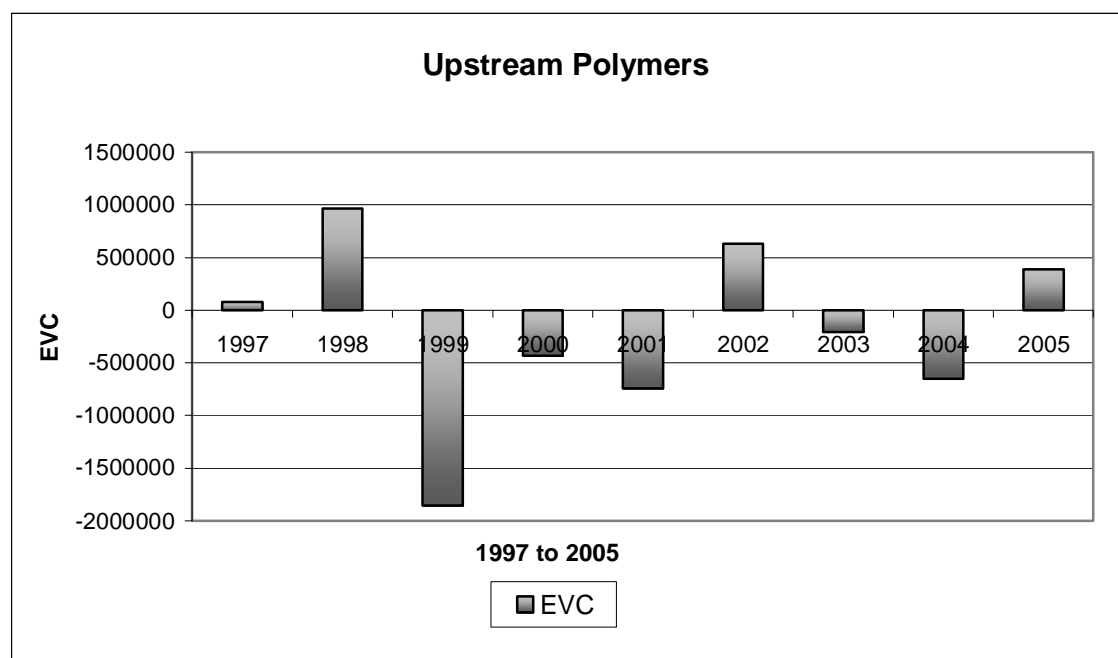
Upstream Polymers

The following EVC graph represents the actual EVC values in each year between 1997 and 2005 for upstream polymers. The graph indicates that the return on capital was less than the weighted average cost of capital as measured by K (17.25) more frequently than it was equal or above K. However, this does not mean the upstream has been making losses. This is a clear indicator that the current pricing practices of the upstream sector are not resulting in high levels of profitability, as measured against the total cost of capital, K. It should be noted furthermore that the EVC

values shown on the graph below represent both upstream polymers manufacturers, namely, Dow Plastics and Sasol Polymers.

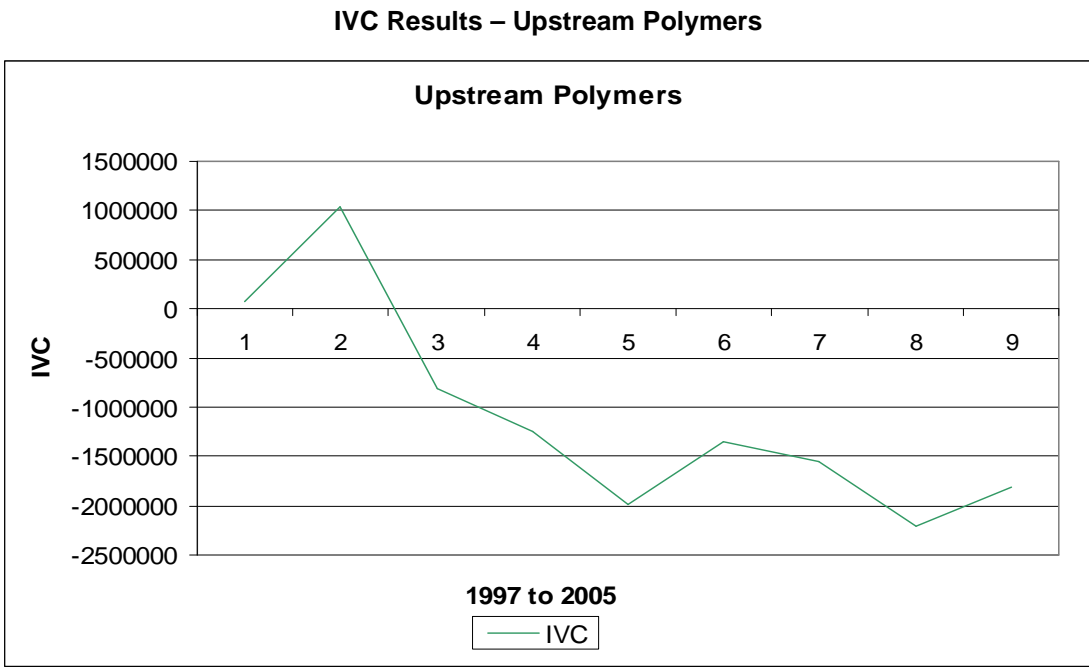
In the case of Sasol, the focus for this study was on Sasol Polymers, the polymers manufacturing unit within the group and not on the whole group. Therefore profits of Sasol Limited as a group cannot be equated to those of Sasol Polymers. Sasol Polymers, situated within Sasol's chemical businesses, is a separate company within Sasol Group, and has a supply agreement for raw material from another Sasol Group company, Sasol Synfuels. The supply of these raw materials is based upon a pricing mechanism that is related to the equivalent fuel value. Therefore, Sasol Synfuels sells the feedstock at a price that they would have realised in the marketplace if it was converted to saleable fuels. This means there is no cross-subsidization between fuels and polymers businesses.

EVC Results – Upstream Polymers



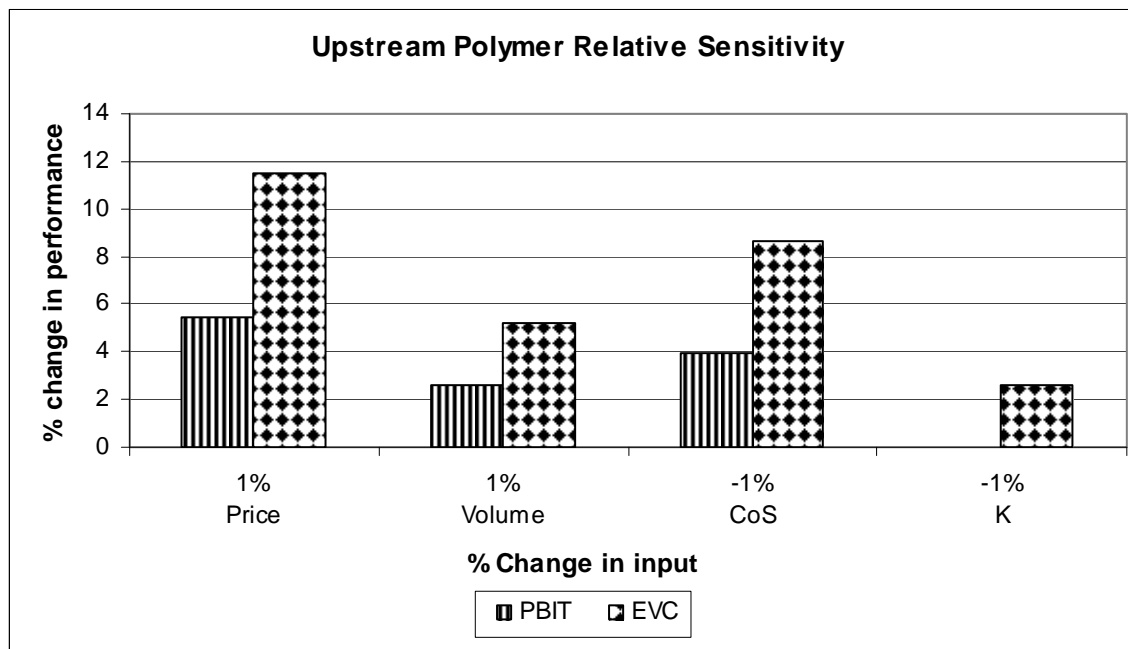
The following IVC graph represents the intrinsic value calculated for upstream polymers. IVC is starting capital plus the cumulative value of each year's EVC, discounted to present time. In this instance, "present time" is 1997.

The graph illustrates the cumulative effect of economic value calculated by the end of each year between 1997 and 2005. When EVC calculations shows returns that are lower than K, the weighted average cost of capital over long periods of time as in the polymer business below it becomes increasingly more difficult to reverse the accumulated returns that are lower than K. The intrinsic value shows large accumulated returns that are below K by 2005.



The following graph illustrates the relative sensitivity of EVC and Profit before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K in upstream polymers. The bar groups indicate by what percentage PBIT and EVC would change for a one percent improvement in Prices or Sales Volumes or Cost of Sales or K. (Note: The inverse is also true, i.e. a 1% decrease in values)

Sensitivity of EVC and Profit Before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K – Upstream Polymers



Note that the inverse of what this graph shows is also true. That is, PBIT and EVC would change by the same percentage points but in the opposite direction for a one percent decline in Prices or Volumes or one percent increase in Cost of Sales or K.

Note the following:

- EVC is relatively insensitive to K
- EVC (and PBIT) are relatively insensitive to Sales Volume
- EVC (and PBIT) are very sensitive to Selling Price and Cost of Sales

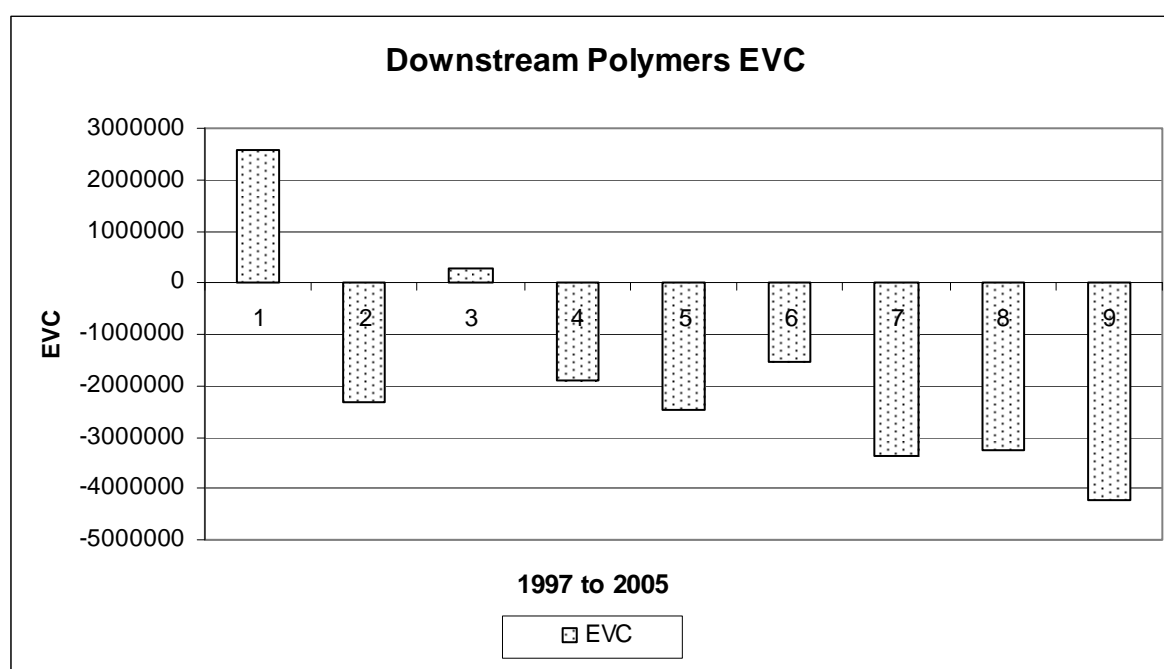
Downstream Polymers

No financial data was received for Polypropylene EVC analysis. In total four companies, accounting for around 30% of the polyethylene market based on consumption volumes, provided financial data. However, some of the data (two companies) did not correspond historically with the information provided by upstream companies. For PVC, only one company provided financial data

and the data did not corresponded historically with the information provided by upstream companies.

The following EVC graph represents the actual values calculated in each year between 1997 and 2005 for combined downstream polymers. The graph indicates that the return on capital as measured against the cost of capital, K, was below K in every year except 1997 and 1999. However, this does not mean the downstream has been making losses all these years.

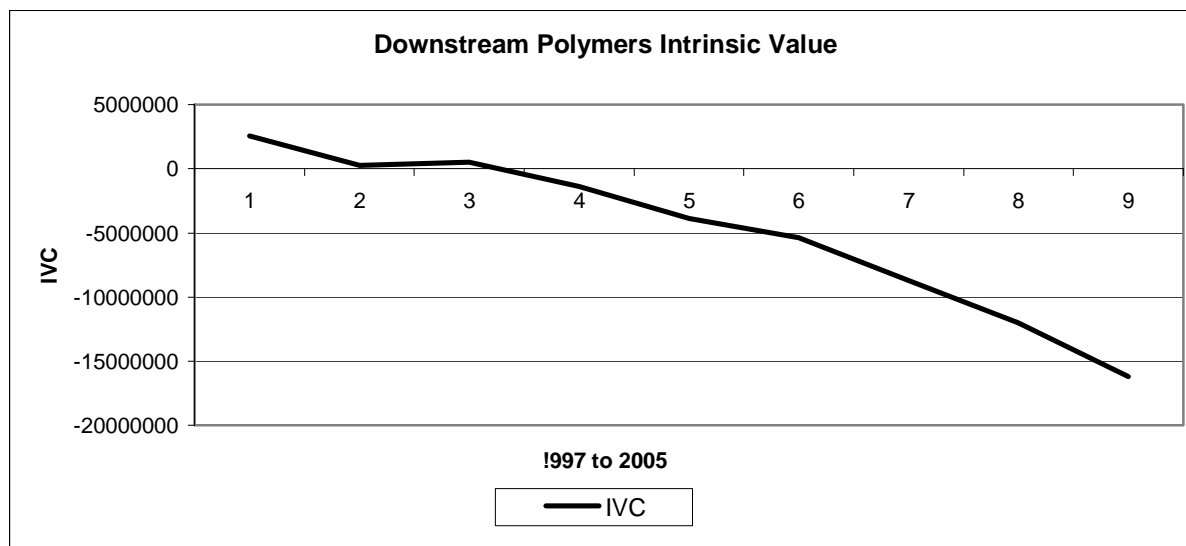
EVC Results – Downstream Polymers



Note: This graph represents all polymers' historical 9 years data as given by 3 respondents, which is equivalent of 6% of the market based on their consumption of polymers and not sales. Four other respondents provided financial data for shorter (5 years or less) time periods.

The following IVC graph represents the intrinsic value calculated for downstream polymers. The graph illustrates the cumulative effect of calculated returns by the end of each year. The IVC graph shows returns consistently lower than K by 2005.

IVC Results – Downstream Polymers

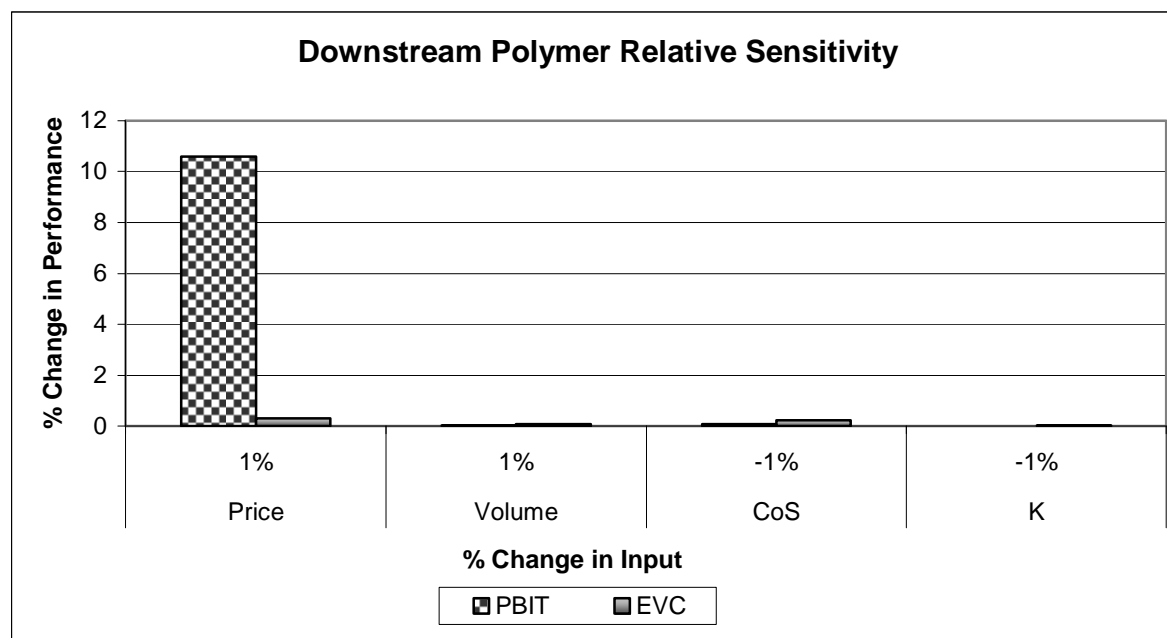


Note: This graph represents all polymers' historical 9 years data as given by 3 respondents, which is equivalent of 6% of the market based on their consumption of polymers and not sales. Four other respondents provided financial data for shorter (5 years or less) time periods.

The following graph illustrates the relative sensitivity of EVC and Profit before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K in downstream polymers.

The bar groups indicate by what percentage PBIT and EVC would change for a one percent improvement in Prices or Volumes or Cost of Sales or K.

Sensitivity of EVC and Profit before Interest and Tax (PBIT) to Selling Price, Sales Volume, Cost of Sales and K – Downstream Polymers



Note that the inverse of what this graph shows is also true. That is, PBIT and EVC would change by the same percentage points but in the opposite direction for a one percent decline in Prices or Volumes or one percent increase in Cost of Sales or K.

Note the following;

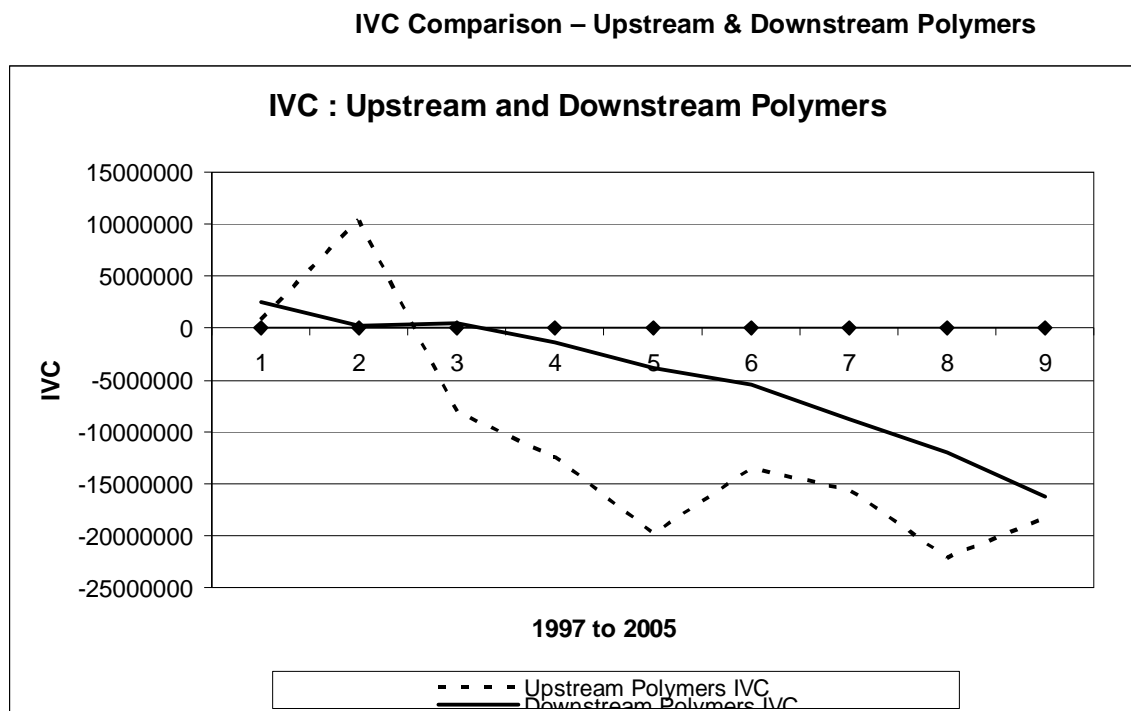
- EVC is insensitive to K
- EVC (and PBIT) are insensitive to Sales Volume
- EVC (and PBIT) are insensitive to Cost of sales
- EVC is relatively sensitive to Selling Price
- PBIT is very sensitive to Selling Price

It can be expected that a symmetrical result will be obtained for a one percent decline or increase in Prices or Volumes or Cost of Sales or K.

Although statistically insignificant, the EVC analysis of combined polymers indicates that the return on capital was lower than the weighted average cost of capital, K in every year except 1997 and 1999. This situation means that the downstream sector is not making super profits either.

IVC Compared in Upstream and Downstream Polymers

The following graph illustrates the intrinsic value calculated for upstream and downstream polymers.

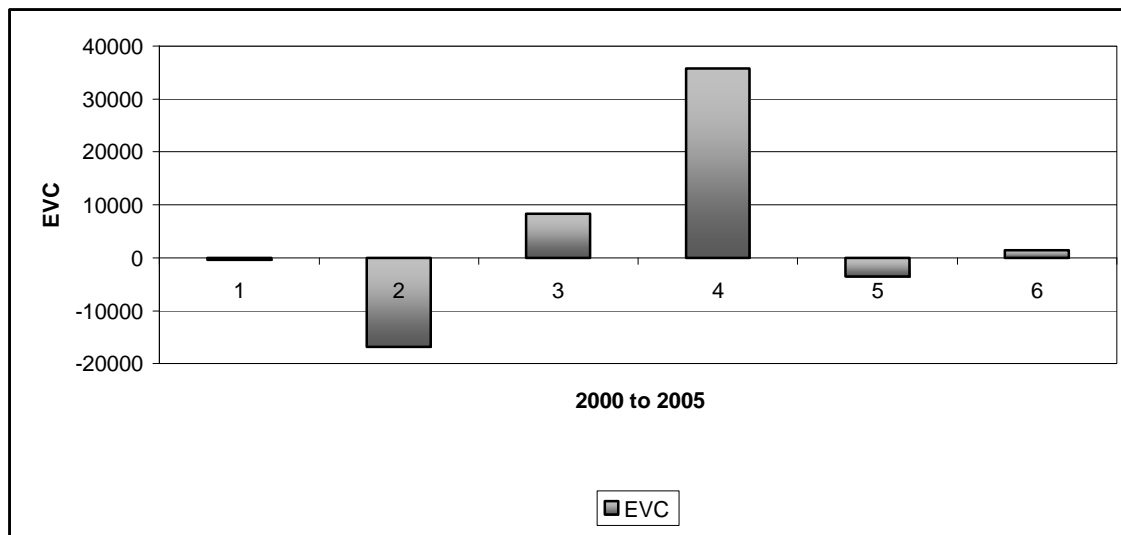


The graph clearly illustrates that both upstream and downstream companies have been getting returns that are below K (the weighted average cost of capital) consistently.

EVC of Publicly Traded Downstream Company

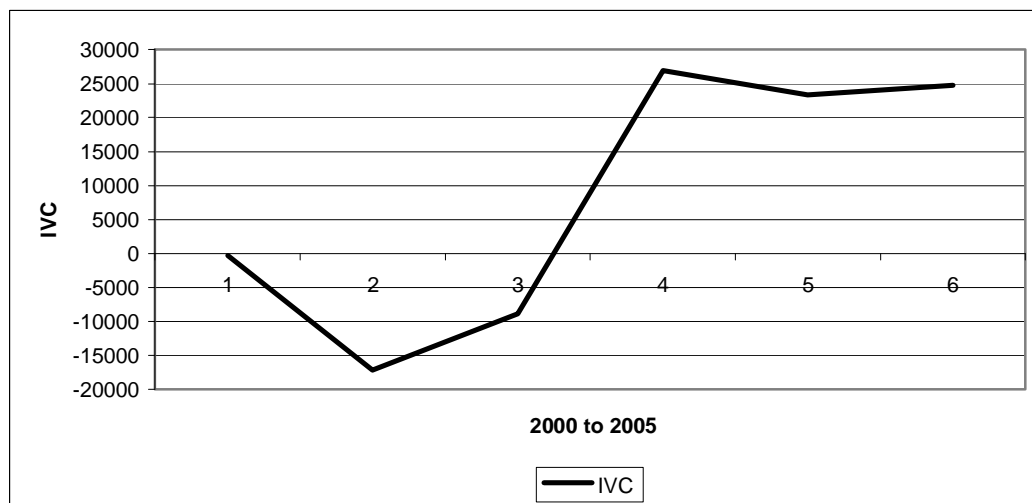
As a result of lack of data from the downstream companies, a set of results from one of the listed companies on the Johannesburg Stock Exchange was used for an additional EVC analysis, the results of which are shown in the following graph. The EVC graph represents the actual values calculated for combined polymers in each year between 2000 and 2005 for this listed company. The graph indicates that the business is volatile, indicating large swings in the EVC value year by year. This is confirmation that the results should not be seen in isolation but rather throughout the full commodity cycle.

EVC Results – Publicly Traded Downstream Company



For the listed company, the IVC graph that follows show that the higher than K (cost of capital) return recorded in 2003 outweighed the years when returns were lower than K, and IVC has remained positive through 2005. Again, this is a case of little data (5 years) that does not cover the full commodity cycle. Also, this particular company was active in acquisitions.

IVC Results – Publicly Traded Downstream Company



APPENDIX 3: DISCUSSION ON INTERNATIONAL PRICING MECHANISMS - REFERENCE PRICES FOR POLYMERS

1. Introduction

The primary purpose of this section is to set out and discuss the way the prices for polymers are set/established in developing countries by linkage to a Reference Price.

A Reference Price is a price for a polymer that is quoted in \$ per tonne by a major supplier for full container loads with reference to a particular point; CFR Hong Kong, FOB US Gulf Coast port or FOB NW Europe port (Rotterdam). These Reference Prices are published by a number of independent services, of which ICIS LOR and Platts Polymerscan are the most well known.

B. The Need to Distinguish between Developed and Developing Regions and Countries

B.1 Developed Countries or Regions

It is necessary to distinguish between the large developing countries/regions of USA/Canada, Western Europe and Japan from all other countries. The reason is that these countries (or regions in the case of Western Europe) have very large markets in relation to the quantity of product that is available from countries that export polymers. The countries/regions are largely self-sufficient in supply. However, there are (very) limited imports into and exports from these countries in relation to the size of the domestic market. While individual polymer users in each of these countries could import product from (say) the Middle East, the quantum of these imports in relation to the size of the market is such that the price of the imports would have no noticeable impact on the market price within the region.

As a consequence, three regions of USA/Canada, Western Europe and Japan have tended to become markets where the price of polymers is set by local supply/demand issues and there is no need for the prices in these markets to be determined by reference or link to a Reference Price.

B.2 Developing Countries or Regions

Developing countries or regions (South Asia, SE Asia, North Asia, Africa and South America) are much more open to imports than the larger markets. Over the years, the market price in each of these countries (including the price in South Africa) has become set by reference to a “Reference Price” that is reported/published by one of several polymer price reporting companies/agencies.

C. The Reference Prices

There are three Reference Prices that have evolved and are used as the basis for setting prices in developing countries and regions. These are:

- **CFR Hong Kong:** Polymer producers with product available for the large importing region of North and SE Asia will offer product (i.e. quote prices for large parcels of polymer) on a CFR Hong Kong basis even though the product does not get shipped to Hong Kong. In reality, “CFR Hong Kong” is a theoretical point somewhere in the South China Sea that becomes a reference point and price for developing a CIF Price for any port in the region.

For example, if ICIS LOR or Platts Polymerscan (two companies offering price reporting services) quote a CFR Hong Kong price of (say) \$1,500 per tonne for a polymer, individual producers of polymer will quote a delivered port price (say CIF Mumbai) in relation to the quoted CFR Hong Kong Reference Price. A polymer producer in Saudi Arabia would quote a CIF Mumbai price that would deliver the same net-back price (i.e. FOB Saudi port) as selling on a CFR Hong Kong basis. As a consequence, a polymer producer in South Korea would have to meet the CFR Mumbai price quoted by the Saudi producer.

For all countries in the Asia Pacific and East African (including South Africa and Australia) have prices that fall within the “control/influence” of the CFR Hong Kong Reference Price. In other words, the CFR Hong Kong price sets/influences the market price in each of the countries in South Asia, SE Asia, North Asia, East & Southern Africa and Oceania (Australia and New Zealand).

It is important and necessary to be aware that at any point in time, there will be parcels of product that will be sold below that which is determined/dictated by the CFR Hong Kong price.

- **FOB US Gulf Coast (in the USA):** Having said that the USA is not a large exporter of polymers, there are limited exports. However, an FOB USGC price is quoted and the CFR South American port price is determined by the FOB USGC price plus shipping cost. The FOB USGC price can be higher or lower than the domestic price of polymer in the US market.

Even for polymer supplied to South America out of the Middle East, the CFR South American port is set by reference to the FOB USGC price. This situation has prevailed for some time and it is not known for how long it will continue.

- **FOB North Western Europe:** Having said that Western Europe is not a large exporter of polymers, there are limited exports. However, an FOB North Western Europe port price is quoted and a limited number of countries have their CFR port price determined by the NW Europe price – these countries are in North Africa and in the Eastern Mediterranean (primarily in Turkey).

Even for polymer supplied to countries in North Africa and the Eastern Mediterranean out of the Middle East, the CFR port price is set by reference to the FOB NW Europe price. This situation has prevailed for some time and it is not known for how long it will continue.

D. Links between the Three Reference Prices

D.1 The Reference Prices from 1994 - 2005

Figures 9 – 13 give the Reference Prices from ICIC LOR for each month from January 1994 – July 2005 for each of the polymers covered in the Study.

Figure 1:
LDPE: Monthly Reference Prices for 1994 - 2005

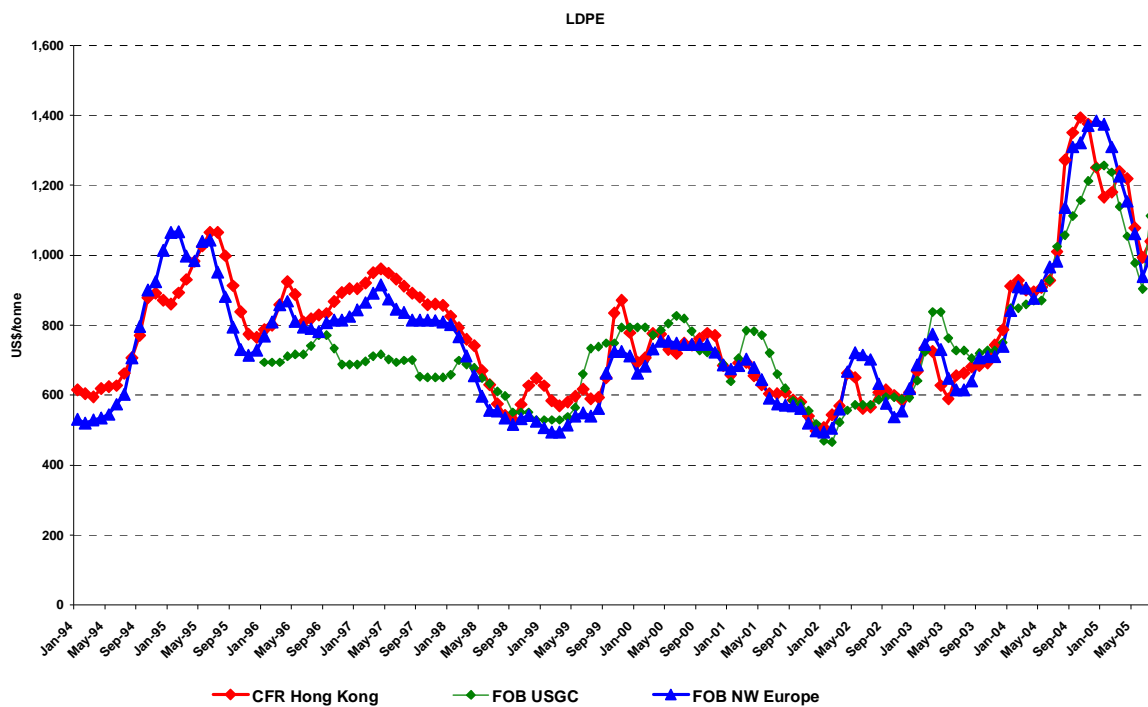


Figure 2:
LLDPE: Monthly Reference Prices for 1994 - 2005

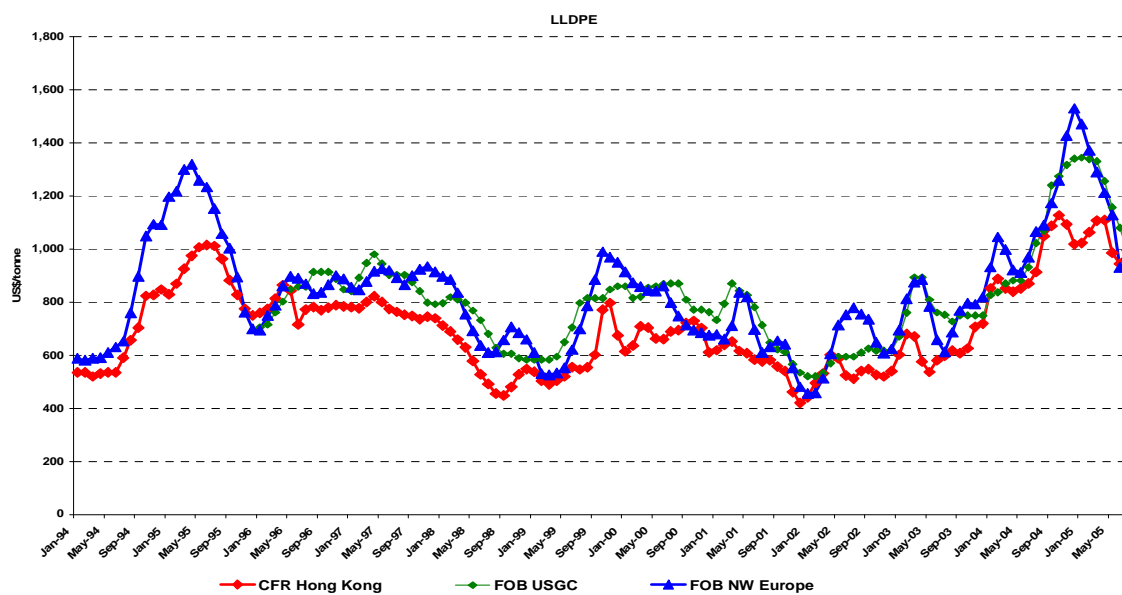


Figure 3:
HDPE: Monthly Reference Prices for 1994 - 2005

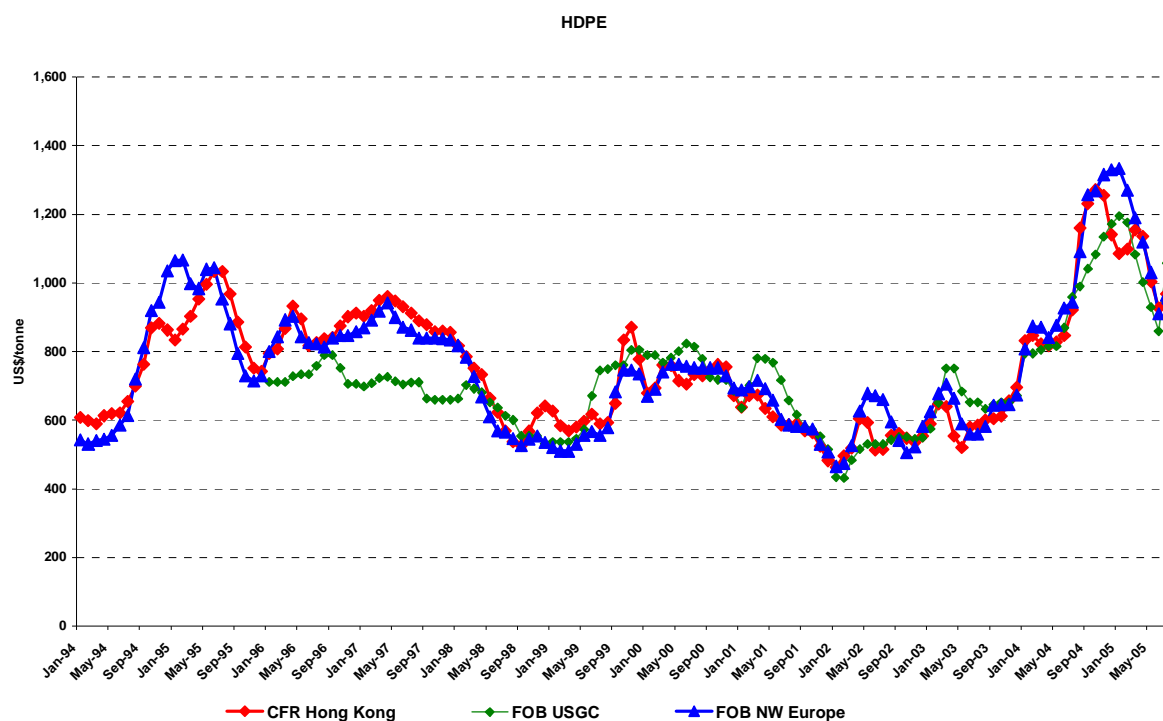


Figure 4:
PVC: Monthly Reference Prices for 1994 - 2005

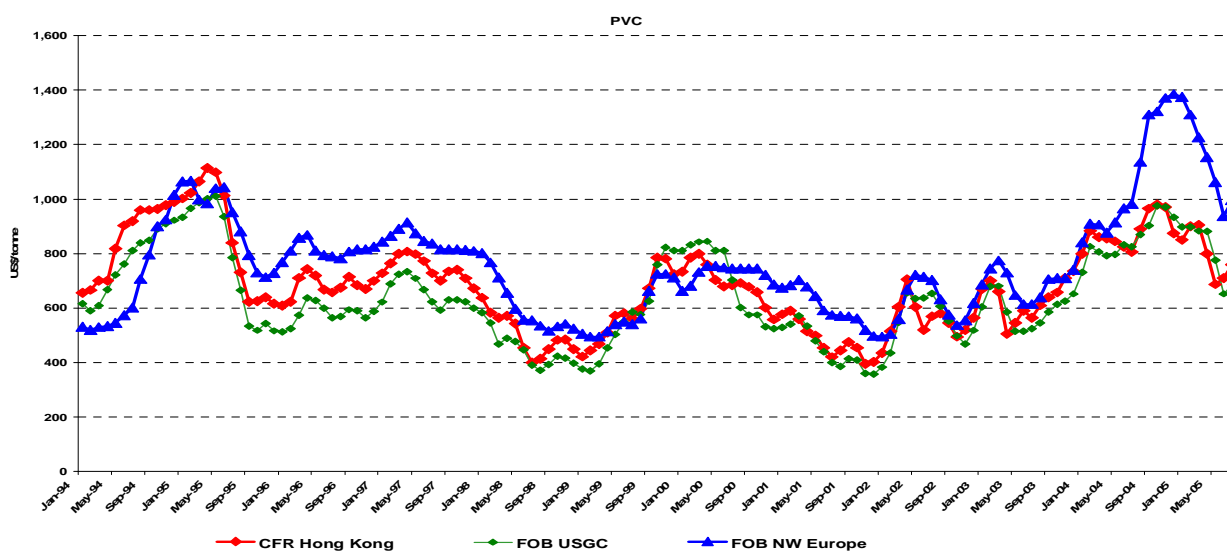
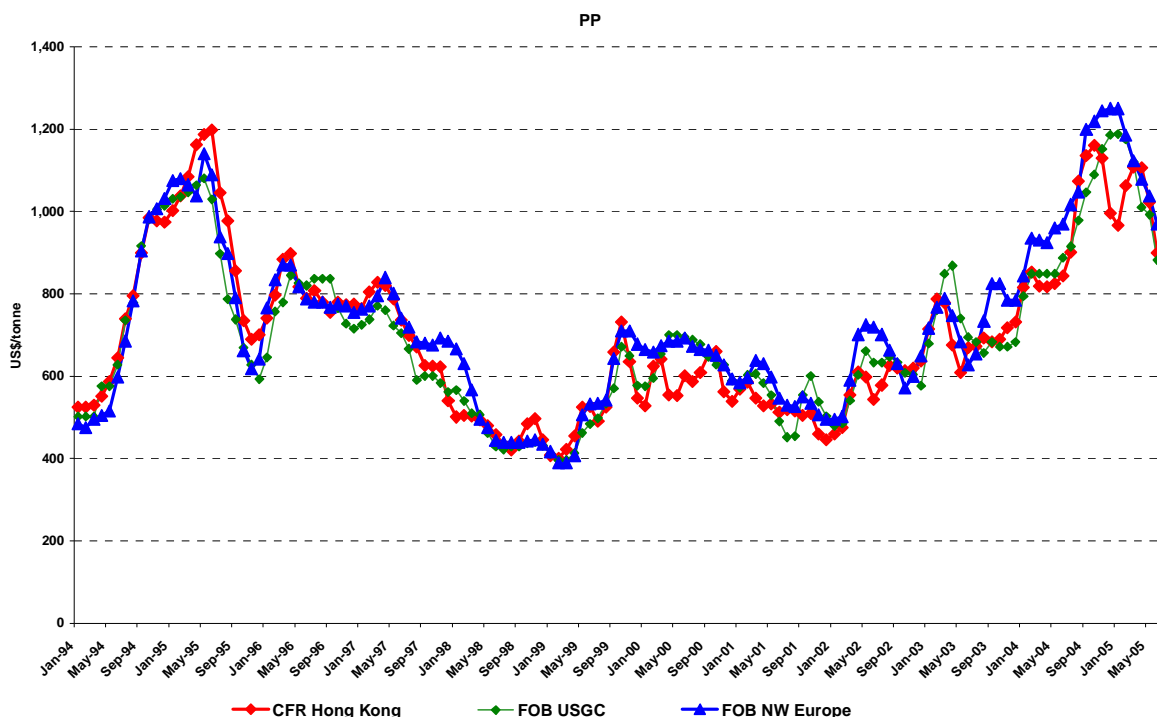


Figure 5:
PP: Monthly Reference Prices for 1994 - 2005



D.2 The Reference Prices from 1994 – 2005: Relevance for the Study

From reviewing the history of the Reference Prices over the period 1994 – 2005, the consultant proposes the following observations that are considered of relevance to the Study:

- Generally, the prices between the three Points of Reference are linked.
- In general, the CFR Hong Kong Reference Price is either the lowest of the three or close to the lowest price. As the prices in South Africa are linked to the CFR Hong Kong price, they are linked to the lowest of the three Reference Prices
- There are periods when the difference between the highest and lowest of the Reference Prices is large – as much as \$200 per tonne. This is an important feature of the international polymer industry – shortages in a particular region can push up prices and it is not always possible for polymer users in the high-price region to easily source product from a region where the prices are lower, or for exporters to switch from supplying a lower-priced region to

a region where the price is high. While market prices are transparent, product does not move easily and readily from one part of the world to another.

E. Export and Import Prices

E.1 Domestic Prices vs Export Prices for the USA and NW Europe

An important feature of the polymer industry is that in any country that has a surplus in any polymer, the price at which the polymer is exported is different (and usually lower) than the price at which it is sold to domestic users even after allowing for transport and other logistics costs.

Figure 6 shows a comparison of the domestic price and the export price for the polymers covered for the USA and NW Europe. Only these two regions are covered, because ICIS LOR provides a consistent price series for these two countries.

A study of the comparison between the domestic and export prices in the USA and NW Europe over the ten year period shows that:

- For all polymers and for both regions, the export price is usually lower than the domestic price.
- However, there are periods when the export price is very close to or actually higher than the domestic price. This takes place when the domestic market is tight and there is limited amount of product available for export.

E.2 Domestic Prices vs Export Prices in Other Countries

In all other countries that have a surplus in a particular polymer, the price at which the locally produced polymer is sold into the domestic market will differ from the price at which it is exported. The reason is that the price in the domestic market is set by an import parity price (plus duties and a range of other costs) which is linked to the Reference Price in the region while the export price is set by the need to compete with other exporters.

As an example, Thailand produces all the major polymers and currently has surplus for most of the polymers. The surplus is exported to China and Australia (among other countries). The domestic price evolves/develops with reference to the CFR Hong Kong Reference Price because potential exporters to Thailand (from Malaysia, Singapore, South Korea and Saudi Arabia) seek to place parcels of product into the Thai market at a CFR Thai Port price that gives them the same net-back price (FOB Port of Origin) as exports to China (the largest importing country in the region). The Thai producers will meet/match the price at which imports are competing in the local market on an import parity basis (at the point of consumption by the customer). However, it needs to be appreciated that in deriving the import (parity) price which sets the price the local producers have to compete with, a range of costs need to be taken into account. These are; landing & clearing, import duties, transport to the user, finance costs and any other costs unique to Thailand.

Thai polymer producers with product to export (to China for example) will need to compete with producers in SE Asia and producers in the Middle East. The FOB Thai Port (the export price) is set by the CFR China Port price that is directly linked to the CFR Hong Kong Reference Price.

APPENDIX 4: POLYPROPYLENE CONVERTERS

Many companies are involved in Polypropylene conversion. These include:

A P S Plastics (Pty) Ltd	Hilfort Plastics	Polisak (Pty) Ltd.
African Commerce Dev	Huhtamaki South Africa	Polyoak Packaging (Pty) Ltd
Alplas	Industrial & Consumer Plastics (Pty) Ltd	Polytex/Marley
Ampaglas Holdings (Pty) Ltd	International Trade	Precision Valve
Audi / Volkswagen Sa	Irenco Plastics (Pty) Ltd	Premier Hangers CC
Belgotex Carpets	Itb Manufacturing	Pristine Industrial
Best Engineering (Pty) Ltd	Jel-Ex Cc.	Prolectra Packaging
Brits Bag Manufacturers	Kaymac Structural Foam	S V A Electronics (Pty) Ltd
Burcap Plastics (Pty)	Kohler Flexible Packaging	SA Leisure (Pty) Ltd
Calibre Plastics (Pty) Ltd	L and K Poly Products	SA Polypropylene Yarn (SAPY)
Caronessa Industrial	Linpac Materials Handling	Safepak (Pty) Ltd.
Chemcraft (Pty) Ltd.	Macniel Pipe Manufacturing	Sakkor Manufacturing
Chin Ho Industrial (Pty) Ltd	Marco Plastics (Pty) Ltd	Sakpro (Pty) Ltd (Was Multiknit Products)
Chuang's Strapping (Pty) Ltd	Marcom Plastics (Pty) Ltd	SCP Polycloth Manufacturers
Clipsal	MCG Industries (Pty)	Sheet Plastics (Pty) Ltd
Consol Ltd. Rigid Pa	Metal Box Beverage Cap (Was Metal Box	Silver Ruby Trading
Contactim (Pty) Ltd	Mono Containers)	Slavepack Holding (Was Slavins -
Cordustex	Naeem Food Industry	Industria)
Dimbaza Fibres (Pty) Ltd	Nampak Tubes And Tubs	Slavepak (Pty) Ltd
Durban Bag	New Age Plastics Cc.	Smiths Manufacturing
Elvinco Plastics (Pty) Ltd	NJ Injection Moulder	South African Fibre Manufacturers
Eurocelt (Durban) Cc	NM Packaging Cc.	South African File Manufacturers
Evernu Plastics (Pty) Ltd	Nouwens Carpets (Pty) Ltd	Southern Ropes (Pty) Ltd
Exactocraft (Pty) Ltd	Nu Plastics Cc	Southpoint Industries
Feltex Ltd.	Nu World Industries (Pty) Ltd	Spilo (Pty) Ltd.
Flex-O-Thene Plastics	Nu-World Industries	Spunchem International
Formosa Plastic (Pty) Ltd	Ocean Plastics Cc	Stripes Industries (Pty) Ltd
Frame Textile Group	Pailpac (Pty) Ltd.	Sunnyway Bop Inc.
G E A Aircooled Systems	Palm Stationery Manu	Taiplas Bag Manufacturers
Gap Mouldings (Pty) Ltd (Was Gap	Panacea Polymers (Pty) Ltd	Technoplastics
Plastics)	Pandrol	Telplast (Pty) Ltd.
GM Poly Manufacturers	Perma Products (Pty) Ltd	Tiger Rope Manufacturers
Gold Sun Industries	Petzetakis	Toyota
Goodyear/Tycon	Plastall Gundle	Treofan South Africa
GUD Filters Durban	Plastamid	Trespaphan
GUD Mann & Hummel Filter Systems	Plastform	Tufbag
(Pty) Ltd	Plastic Industries (Pty) Ltd	Tupperware Southern Africa
Helix Trading Cc.	Plastic Industries S	U F I Bag S A (Pty) Ltd
Herber Plastic (Pty) Ltd	Plasticwrap (Pty) Ltd	Unity Industrial Cc.

Usabco (Pty) Ltd.

Veridical Traders 6

Xactics

Van Leer

Wang On Fibres - Newcastle

APPENDIX 5: POLYETHYLENE CONVERTERS

There are a large number of polyethylene converters in SA. These include the following companies:

AEL	ITB Manufacturing	PI Plastics Cc
Afripack	Jojo Tanks (Pty) Ltd	Plastall Gundle
Agriplas	Kahn & Kahn (Pty) Ltd	Plastic Blown Containers (Pty) Ltd
Alnet	Kaymac Roto Moulders - Willowton	Plasticwrap - Ndabeni
Alplas	Kohler Flexible Packaging	Polyfilm Convertors
Ampaglass Sa	KPI Group	Polyoak (Pty) Ltd (T/A Dairypak)
ATC	Leader Packaging Cc	Polypak
Atlas Plastics	LH Lategan & Atlas Plastics (Pty) Ltd	Prima Toys
Berry And Spence	Lomotek Polymers	Razco Plastics Industries (Pty) Ltd
BIC (SA)	LR Plastics	Rhino Plastics - Port Elizabeth & Epping
City Packaging	MBSA	Safa (Pty) Ltd
Clariant	Megapak	Safepak
Consol	Nampak Flexible - Ndabeni (Was Kohler	Sealed Air
Custom Colour & Performance	Flexible Packaging)	Smile Education Systems
Masterbatch	Nampak Liquid Packaging - Industria	Sondor Industries - Ndabeni
Dart Industries (Pty) Ltd	Nampak Polyfoil - Spartan	Tetra Pak Liquid Packaging
Durban Bag	Netafim	Tiger Plastics
East Rand Plastics	New Era Plastics	Transpaco Flexible (Was Plastafrica)
Emas	Nitex & Alan Nicholl	Tristar Plastics (Pty) Ltd
Everest Plastics	Noorsaheb Plastics Cc	Tropic
Fakpro Ltd (Division Of Nitex)	NSA Africa (Pty) Ltd (Was Campbell	Uniplastics
Flexible Packaging Convertors	Gardwel)	Usabco (Addis)
Flex-O-Thene Plastics	Nu Plastics Cc	Van Leer
GP Packaging	Packaging Consultants	Venkpak
Gundle Api (Pty) Ltd (Was	Panbro Plastics	White Point
Amalgamated Plastics Industries)	Pandrol	Xactics
Huhtamaki (Was Mono Containers)	Performance Masterbatch	
Italpac	Pioneer Plastics	

APPENDIX 6: PVC CONVERTERS

There are a large number of PVC converters in SA. These include the following companies:

2 To 5 Plastics - Industria
Aberdare - Pretoria
Amiantit
Apex Leads CC
Atlantic Forming - Jet Park
Boudene (Pty) Ltd T/A Intramed (Was Pharmacare Intramed)
Cinqplast-Plastop (Pty) Ltd - Denver
Dpi - Chamdor
Dunlop Ltd - Benoni
Fenner SA
Finland Textiles (Pty) Ltd (Was Ag Laminators)
Hella (SA) (Pty) Ltd- Uitenhage
Hellerman Titon
HK Manufacturing
John Whittle Components
Kohler Versapak
Marley SA - Elandsfontein
Natal Trim CC (Was Natal Tool & Die)
Ogatin (Pty) Ltd (Was Internatio)
OTH Beier
Petzetakis
Plastiprofile (Pty) Ltd
Sasol Polymers (Was PVC Compounders) - Modderfontein
Rehau - Ford Jackson
Resinite
Shave & Gibson (Pty) Ltd
Swan Plastics
Switchboard Utilities
Transparent Packaging (Pty) Ltd
Vynide
Watex
Wayne Plastics (Division of Feltex Ltd)
WR Grace Africa
Xactics – Prospecton