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SOUTH AFRICAN CHEMICAL SECTOR REPORT ON SKILLS DEVELOPMENT AND THE GOVERNMENT'S NEW ECONOMIC POLICY PRIORITIES

Sector Studies
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SOUTH AFRICA **SOUTH AFRICAN CHEMICAL SECTOR REPORT ON SKILLS DEVELOPMENT AND THE GOVERNMENT'S NEW ECONOMIC POLICY PRIORITIES**

Research Conducted for the Department of Labour

Ozone Business Consulting (Pty) Ltd

in association with:

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ACRONYMS AND GENERAL DEFINITIONS

Acronym/ General Definition	Description
ABET	Adult Basic Education and Training
AEL	African Explosives Limited
AsgiSA	Accelerated and Shared Growth Initiative of South Africa
B Degree	Bachelor Degree
B Tech	Bachelor of Technology
bbl/d	Barrels per Day
BEE	Black Economic Empowerment
Black	African, Asian and/or Coloured
BPR	Biofuels Research Programme
B.Sc.	Bachelor of Science
CAIA	Chemical and Allied Industries Association
CDC	Coega Development Corporation
CEF	Central Energy Fund
Chemserve	Chemical Services
CHIETA	Chemical Industries Training and Education Authority
CMCS	Chemical Marketing & Consulting Services cc
Critical Skills	Specific key or generic and top-up skills within an occupation.
CSP	Customised Sector Programme
dti	Department of Trade and Industry
DME	Department of Minerals and Energy
DoE	Department of Education
DoH	Department of Health
DoL	Department of Labour
DST	Department of Science and Technology
ECSA	Engineering Council of South Africa
e.g.	exempli gratia (for example)
Enref	Engen Refinery
ESDA	Employment Skills Development Agency
etc.	et cetera (and other things)
ETQA	Education and Training Authority
EU	European Union
FET	Further Education and Training
FOB	Free on Board
GDP	Gross Domestic Product
HET	Higher Education and Training
HG	Higher Grade
Highly Skilled	Professional, semi-professional and technical occupations; Managerial, executive and administrative occupations.
HSRC	Human Sciences Research Council
IDZ	Industrial Development Zone
i.e.	id est (that is)
JV	Joint Venture
Jipsa	Joint Initiative for Priority Skills Acquisition
KZN	Kwazulu Natal
Maths	Mathematics

Acronym/ General Definition	Description
Matric	Grade 12
MCC	Medicines Control Council
MERSETA	Manufacturing, Engineering and Related Services Training Authority
M.Sc.	Master of Science
NCV	National Certificate Vocational
NECSA	Nuclear Energy Corporation of South Africa
NBI	National Business Initiative
NQF	National Qualifications Framework
NRF	National Research Fund
NSF	National Skills Fund
O_3bc	Ozone Business Consulting (Pty) Ltd
OG & CM	Oil, Gas and Chemical Manufacturing Companies
OG & CM ASTP	Oil, Gas and Chemical Manufacturing Companies Artisan Skills Training Project
OTC	Over-the-counter
p.a.	per annum
PFSA	Plastics Federation of South Africa
PG	Post Graduate
Ph.D.	Doctor of Philosophy
R&D	Research & Development
RPL	Recognition to Prior Learning
SA	South Africa / South African
SADC	Southern African Developing Community
SANERI	South African National Energy Research Institute
SAPC	South African Pharmacy Council
SAPIA	South African Petroleum Industry Association
SARS	South African Revenue Services
Scarce Skill	Occupations in which there is a scarcity of qualified and experienced people.
SCE	Senior Certificate Examination
SEIFSA	Steel and Industries Federation of South Africa
Semi/unskilled	Consists of all the occupations that are neither highly skilled nor skilled occupations.
SETA	Sectoral Education & Training Authority
SG	Standard Grade
SIC	Standard Industrial Classification
Skilled	Clerical and sales occupations; Service occupations; Transport, delivery and communications occupations; Production foremen and production supervisors; Artisan, apprentice and related occupations.
SME	Small and Medium Enterprises
SMME	Small Medium and Micro Enterprises
SNF	Shutdown Network Forum
SNF ESDLE	Shutdown Network Forum Employment and Skills Development Lead Employer
SOE	State Owned Enterprise
SSP	Sector Skills Plan
StatsSA	Statistics South Africa
tpa	Tons per Annum
USA	United States of America
WSP	Workplace Skills Plan

PREAMBLE

The primary aim of this project was to contribute to the attainment of greater alignment between skills development strategies and the development requirements of the South African (SA) chemical sector, in particular with the launch of the Accelerated and Shared Growth Initiative of South Africa (AsgiSA) and the release of the new National Industrial Policy Framework.

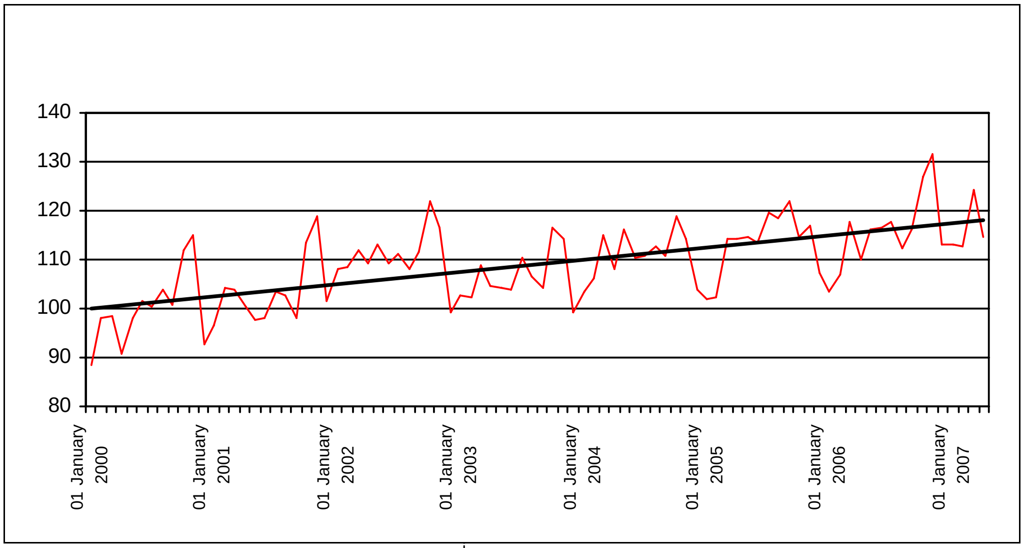
The AsgiSA initiative aims to half unemployment and set targets of annual growth rates on 4.5% or higher from 2005 to 2009 and 6% or higher from 2010 to 2014.

Manufacturing Gross Domestic Product (GDP) however reduced from constituting 25% of national GDP in the past to about 20% of national GDP currently, which is an indication that the services sector has mainly contributed to the high growth rate in GDP over the past few years[i].

Growth in the consumption of chemical products has always been similar to growth in the manufacturing GDP, because the he chemical sector touches every part of the economy, such as agriculture, automotive, construction, consumer products, food, health care, mining, paper, textiles, water treatment, etc. as chemical products are used in all of these sectors.[ii]

The growth rate of manufacturing GDP was 4% on average between 2004 and 2007. Apart from a handful of individual enterprises such as Sasol, the overall production growth rate of the SA chemical sector was however lower than manufacturing GDP at an average growth rate of 2% per annum between 2004 and 2006[i], as illustrated in Chart A.

Chart A: Chemical sector manufacturing volume output (2000 = 100)



Source: Statistics South Africa (StatsSA) [i]

The low production growth rate in the SA chemical sector is because of a world tendency that high manufacturing volumes tend to be in countries with competitive feedstock advantages, e.g. crude oil and other raw materials, and SA is at a competitive disadvantage with many feedstocks that need to be imported.[ii]

The chemical sector is also stagnant in terms of job creation[iii], due to efficiency improvement as well as a general trend towards automation and capital intensiveness.[ii]

This highlights the need for future skills development to be directed towards areas of active investment, as well as further downstream development in sub-sectors that have proven to be feasible.

The focus of this project was therefore firstly on identifying future capital investments together with the perceived skills constraints to achieve these investments and to operate the new production sites.

Secondly, for the development of the downstream chemical sector, the focus was on sub-sectors prioritised for development in the Chemical Sector Development Strategy[iv] that forms part of the Department of Trade and Industry's broader industrial policy framework[v].

An analysis was made in the Chemical Sector Development Strategy[iv] of the various sub-sectors' potential, based on their economic potential and the level of difficulty in successfully changing the institutional issues necessary to realise the sub-sector's potential. This led to key action programmes to promote certain sub-sectors that showed the most potential, namely the promotion of greater production in local pharmaceutical products and the promotion of downstream plastic products production.

Other key action programmes in this strategy include a titanium beneficiation initiative as well as a fluorochemical expansion initiative, but these two initiatives are both still being investigated for their feasibility.[v]

Excluded from this report are skills constraints in the current day-to-day running of operations, unless they would specifically influence future developments. Both the Chemical Industries Training and Education Authority (CHIETA) and the Manufacturing, Engineering and Related Services Training Authority (MERSETA) that are the two Sectoral Education & Training Authorities (SETAs) related to the chemical sector, have done critical and scarce skills analyses on the current day-to-day running of operations that are available from their websites (www.chieta.org.za and www.merseta.org.za). The CHIETA covers the bulk of the chemical sector, while plastic and rubber conversion is part of the MERSETA.

The chemical sector is of a highly technical nature, and for this reason a list of chemical and/or technical definitions is provided next, in order to understand the sector more clearly throughout the course of reading this report. It should however be noted that some of the chemicals cannot be described in lay terms as they are used as raw materials in other chemical compounds – for these products the technical explanation is therefore provided.

CHEMICAL AND/OR TECHNICAL DEFINITIONS

Technical or Chemical Term	Definition
Acrylic Polymer	A thermoplastic and transparent plastic, often used as an alternative to glass.
Acrylonitrile-Butadiene-Styrene (ABS)	A class of composite plastics used to make car bodies and cases for computers and other appliances.
Active Ingredient	Materials in a product essential for the application for which the product is designed.
Alpha Olefins	An olefin where the double bond is at the alpha position, that is, between the two end carbons of the carbon chain.
Alloy	An alloy is a homogeneous mixture of two or more elements, at least one of which is a metal, and where the resulting material has metallic properties.
Aluminium Sulphate	A white crystalline compound used mainly in papermaking, water purification, sanitation, and tanning.
Ammonium Nitrate	A colourless, crystalline compound derived from nitric acid and ammonia and used mostly for fertilizers and commercial explosives.
Antiretroviral (ARV)	Antiretroviral drugs inhibit the reproduction of retroviruses. The best known of this group is HIV, the causative agent of AIDS.
Argon	A colorless, odorless, inert gaseous element constituting approximately one percent of Earth's atmosphere, from which it is commercially obtained by fractionation for use in electric light bulbs, fluorescent tubes, and radio vacuum tubes and as an inert gas shield in arc welding.
Aromatic Chemical	Relating to an organic compound containing at least one benzene ring or similar ring-shaped component, e.g. benzene, toluene, xylene and naphthalene.
Barrel (b)	A standard international petroleum industry volumetric measure equal to 42 United States gallons or 159 litres.
Beneficiation	Crushing and separating ore into valuable substances or waste by any of a variety of techniques.

Technical or Chemical Term	Definition
Benzene	A colourless, flammable, liquid aromatic hydrocarbon, derived from petroleum and used in or to manufacture a wide variety of chemical products. It is also called benzine or benzol.
Biodiesel	A form of diesel derived in part from renewable sources such as soya beans.
Blow Moulding	A method of fabricating hollow plastic objects, such as bottles.
Calcium Cyanide	A gray or black compound, used to kill insects and rodents.
Captive	Manufacturing of a product to be used in-house as a raw material for the manufacturing of another end product.
Carbon Black	Any of various finely divided forms of carbon derived from the incomplete combustion of natural gas or petroleum oil and used to reinforce rubber and as an ingredient in inks, paints, crayons, and polishes.
Carboxymethyl Cellulose	A derivative of cellulose that in the form of its sodium salt is used as a thickening, emulsifying, and stabilizing agent and as a bulk laxative in medicine.
Cardiovascular	Of, relating to, or involving the heart and the blood vessels.
Catalysis	Increase in speed of a chemical action due to presence of a small quantity of a substance which is unchanged at the close of the reaction.
Catalyst	Usually a metal or metal-containing material used to accelerate a reaction between two or more chemical elements or compounds. A catalyst is not generally changed in the process, although its efficacy may reduce with time.
Catalytic Cracker	A chemical reactor for converting oils with high boiling points into fuels with lower boiling points in the presence of a catalyst.
Caustic Soda	A strongly alkaline compound, used in the manufacture of chemicals and soaps and in petroleum refining. Also called sodium hydroxide.
Chemical Reaction	Interactions in which atoms exchange or share electrons, forming new chemicals.
Chlorine	A highly irritating, greenish-yellow gas, capable of combining with nearly all other elements, used widely to purify water, as a disinfectant and bleaching agent, and in the manufacture of many other chemical compounds.
Coal-to-Liquids (CTL)	Liquid fuel is produced from coal through a chemical process plant that converts conventional pulverized coal to carbonaceous liquid fuels and byproduct hydrogen-based gases.
Coded Welder	Welders that are required to work on statutory equipment such as that associated with high pressures, hazardous chemicals and other specialised applications are required by legislation to pass a coding test.
Composite	Two or more substances, each discretely observable, and rationally combined so that some property or combination of properties can be produced.
Cresol	Organic compounds that are methylphenols. Depending on the temperature, cresols can be solid or liquid because they have melting points not far from room temperature.
Crude Oil	Unrefined petroleum.
Cyanide	Salt of hydrocyanic acid, e.g. calcium cyanide.
Emission	A substance discharged into the air, especially by an internal combustion engine.
Emulsion	A mixture of two immiscible fluids, one being dispersed in the other in the form of fine droplets.
Essential Oil	A volatile oil, usually having the characteristic odour or flavour of the plant from which it is obtained, used to make perfumes and flavourings.
Ester	Esters are a class of chemical compounds and functional groups.

Technical or Chemical Term	Definition
	Volatile esters often have a pleasant smell and are found in perfumes, essential oils, and pheromones, and give many fruits their scent.
Ethanol	An alcohol obtained from the fermentation of sugars and starches or by chemical synthesis. It is the intoxicating ingredient of alcoholic beverages, and is also used as a solvent, in explosives, and as an additive to or replacement for petroleum-based fuels.
Ethical	Relating to a drug dispensed solely on the prescription of a physician.
Ethylene	A colourless, flammable hydrocarbon gas used in SA as feedstock for producing polyethylenes and polyvinyl chloride.
Expanded Polystyrene	A foamed styrene plastic that has a high resistance to heat flow and a high mechanical strength.
Extract	Product of vegetable or animal origin obtained by treatment with a solvent.
Extrusion	The act or process of shaping by forcing through a die.
Fatty Acids	Any of a large group of monobasic acids, especially those found in animal and vegetable fats and oils.
Fluorine	A pale-yellow, highly corrosive, poisonous, gaseous element, the most reactive of all the elements, used in a wide variety of industrially important compounds.
Fluorochemical	A chemical compound containing fluorine, especially a fluorocarbon.
Food Acids	Acids used in food products such as tartaric acid.
Formulation	The mixing of compounds which do not react in order to get a mixture with the desired characteristics
Gas-to-liquids (GTL)	A petrochemical term referring to a process technology that entails the conversion of natural gas or methane into a liquid transportation fuel and related hydrocarbons such as diesel and naphtha.
Generic Medicine	A generic medicine is one that contains identical amounts of the same active ingredient, in the same strength and in the same dosage form that has been approved by the regulatory authorities as the patented product. It must also produce an equivalent effect on the body as the brand-name counterpart.
Greenfield	New capital investment.
Guar	The guar bean or cluster bean is the source of guar gum.
Hydrocarbon	The simplest organic compound, containing only hydrogen and carbon atoms.
Hydrochloric Acid	A clear, colourless, fuming, poisonous, highly acidic aqueous solution of hydrogen chloride, used as a chemical intermediate and in petroleum production, ore reduction, food processing, pickling, and metal cleaning. It is found in the stomach in dilute form.
Hydrofluoric Acid	A colorless, fuming, corrosive, dangerously poisonous aqueous solution of hydrogen fluoride, used to etch or polish glass, pickle certain metals, and clean masonry.
Hydrogen	A colorless, highly flammable gaseous element, the lightest of all gases and the most abundant element in the universe, used in the production of synthetic ammonia and methanol, in petroleum refining, in the hydrogenation of organic materials, amongst others.
Hydrogen Peroxide	A colourless, heavy, strongly oxidizing liquid, capable of reacting explosively with combustibles and used principally in aqueous solution as a mild antiseptic, a bleaching agent, an oxidizing agent, and a laboratory reagent.
Injection Moulding	A manufacturing technique for making parts from both thermoplastic and thermosetting plastic materials in production.
Inorganic Chemical	Substances which are not carbon compounds, with the exception of the oxides and sulphide of carbon.
Intermediate	Organic product to be subjected to further chemical treatment to

Technical or Chemical Term	Definition
	produce finished products such as dyes and pharmaceuticals.
Jatropha Curcas	A shrub that can be used in the production of biodiesel.
Lacquer	Any of various clear or colored synthetic coatings used to impart a high gloss to surfaces.
Linear Alkylbenzene (LAB)	An organic compound produced in a process involving benzene and long-chain paraffins. LAB is used as an intermediate for producing surfactants used in the detergent industry.
Liquefied Petroleum Gas (LPG)	Gaseous petroleum gases such as propane, butane and pentane pressurised in liquefied form and used for heating applications.
Low Density Polyethylene (LDPE)	A thermoplastic made from oil used in the production of various plastic products.
Maintenance	The work of keeping something in proper condition; upkeep.
Manganese	A gray-white or silvery brittle metallic element, It is alloyed with steel to increase strength, hardness, wear resistance, and other properties and with other metals.
Methane	Methane is a gas that occurs naturally in petroleum wells and natural-gas fields. Coal gas also contains a large proportion of methane.
Monomer	A chemical such as ethylene or propylene capable of being converted into a long-chain polymer or a synthetic resin by combining with itself or other similar molecules or compounds.
Naphtha	A generic term for a flammable, light distillate or hydrocarbon feedstock, or a mixture of light hydrocarbons, used for gas or petrochemical manufacture.
Naphthalene	A white crystalline compound, derived from coal tar or petroleum and used in manufacturing dyes, moth repellents, and explosives and as a solvent.
Natural Gas	A mixture of hydrocarbon gases in the Earth's crust containing methane and other chemical compounds.
Nitric Acid	A colourless, corrosive, fuming and unstable liquid, which is an important intermediate for producing ammonium nitrate and its derivatives.
Nitrogen	A nonmetallic element that constitutes nearly four-fifths of the air by volume, occurring as a colorless, odorless, almost inert gas in various minerals and in all proteins and used in a wide variety of important chemical products.
Nitrous Oxide	A colourless gas, used as a mild anaesthetic in dentistry and surgery.
Octane	The octane rating is a measure of the auto ignition resistance of petrol and other fuels used in spark-ignition internal combustion engines. It is a measure of anti-detonation of a gasoline or fuel.
Olefins	Any of a class of unsaturated open-chain hydrocarbons such as ethylene and propylene.
Organic Chemicals	A broad class of substances containing carbon and its derivatives. Many of these chemicals will frequently contain hydrogen with or without oxygen, nitrogen, sulfur, phosphorus, and other elements.
Petrochemical	Chemical present in or derived from natural gas or crude petroleum by physical refining or a chemical reaction.
Phenol	A caustic, poisonous, white crystalline compound, derived from benzene and used in resins, plastics, and pharmaceuticals and in dilute form as a disinfectant and antiseptic. Also called carbolic acid.
Phosphate	A derivative of phosphoric acid. Phosphates are important in metabolism and are frequently used in fertilizers.
Phosphoric Acid	A clear colourless liquid, used in fertilizers, detergents, food flavoring, and pharmaceuticals.
Pigment	A substance used as coloring.
Plasticizer	Any of various substances added to plastics or other materials to

Technical or Chemical Term	Definition
	make or keep them soft or pliable.
Polyethylene	A common plastic comprising of long-chain ethylene molecules. Polyethylene is mostly used to produce packaging materials, pipe and moulded fittings and sheath wire and cable.
Polyethylene Terephthalate (PET) (Saturated Polyester)	A thermoplastic polymer resin of the polyester family that is used in synthetic fibres; beverage, food and other liquid containers; and other applications.
Polymer	A compound whose molecule is formed from a large number of repeated units of one or more compounds of low molecular-weight (monomers). Synthetic polymers are used extensively in plastic products production.
Polymer Converter	Manufacturer of plastic products through various conversion processes.
Polyol	Polyols are obtained from many plant and animal sources and are synthesized by a variety of methods. Its primary use in SA is in the production of polyurethane.
Polypropylene (PP)	A common plastic derived from the polymerisation of propylene. It is used for automotive components, furniture, self-hinged containers, medical equipment, carpet backings and woven bags.
Polystyrene	A rigid clear thermoplastic polymer that can be molded into objects or made into a foam that is used to insulate refrigerators and in other applications.
Polyurethane	Any of various resins, widely varying in flexibility, used in tough chemical-resistant coatings, adhesives, and foams.
Polyvinyl Chloride (PVC)	A tough, white, solid thermoplastic that can be softened with plasticizers. It is used for cables, footwear and for moulding bottles and other packaging forms.
Propylene	A colourless, gaseous hydrocarbon obtained from petroleum cracking among other petrochemical processes.
Reagent	A substance consumed during a chemical reaction.
Renal Dialysis	The application of the principles of dialysis for treatment of renal (kidney) failure.
Resin	Semisolid or solid, complex, amorphous mixture of organic compounds that has no definite melting point and no tendency to crystallize. Resins may be of vegetable or animal origin or synthetic. Resins are used in as varnishes, and adhesives, and as an important source of raw materials for organic synthesis.
Rotational Moulding	A versatile process for creating many kinds of mostly hollow plastic parts.
Rubber Converter	Manufacturer of rubber products through various conversion processes.
Silicates	Any of numerous compounds containing silicon, oxygen, and one or more metals.
Solvent	A liquid that dissolves another substance or substances to form a solution.
Speciality Chemicals	Chemical produced for a specialised use such as paints, adhesives, inks, etc.
Styrene Butadiene Latex	Styrene-butadiene latex is a water-based polymer produced by emulsion polymerisation from styrene and butadiene. Major uses of styrene-butadiene latex include carpet backing and paper coating.
Styrene Butadiene Rubber	Styrene-butadiene rubber is a high molecular weight polymer. Styrene-butadiene rubber is widely used in automobile and truck tyres, belting, flooring, wire and cable insulation, and footwear.
Surfactant (Surface Active Agent)	A soluble chemical compound such as a detergent or soap that is added to a liquid to increase its spreading or wetting properties by reducing its surface tension.
Synthesis	The formation of more complex chemical compounds or molecules

Technical or Chemical Term	Definition
	from simpler compounds or molecules through chemical reactions.
Synthetic Fuel	A synthetic fuel is any liquid fuel obtained from coal and natural gas in South Africa. It can also sometimes refer to fuels derived from other solids such as tar sand, waste plastics, or from the fermentation of biomatter.
Tartaric Acid	A crystalline organic compounds, used to make cream of tartar and baking powder, as a sequestrant, and in effervescent beverages and photographic chemicals.
Thermoplastic	A thermoplastic substance is adequately rigid at normal temperatures and under normal conditions of stress but is capable of deformation under heat and pressure.
Titanium	A strong, low-density, highly corrosion-resistant, lustrous white metallic element that occurs widely in some rocks and is used to alloy aircraft metals for low weight, strength, and high-temperature stability.
Titanium Dioxide	A white powder, used as an exceptionally opaque white pigment.
Toll Manufacture	An arrangement in which a firm (that has specialised equipment) processes raw materials or semi-finished goods for another firm.
Toluene	A colorless flammable liquid, obtained from coal tar or petroleum and used in aviation fuel and other high-octane fuels, in dyestuffs, explosives, and as a solvent for gums and lacquers.

CHAPTER 1: CHEMICAL SECTOR PROFILE

1.1 Source of sectoral information

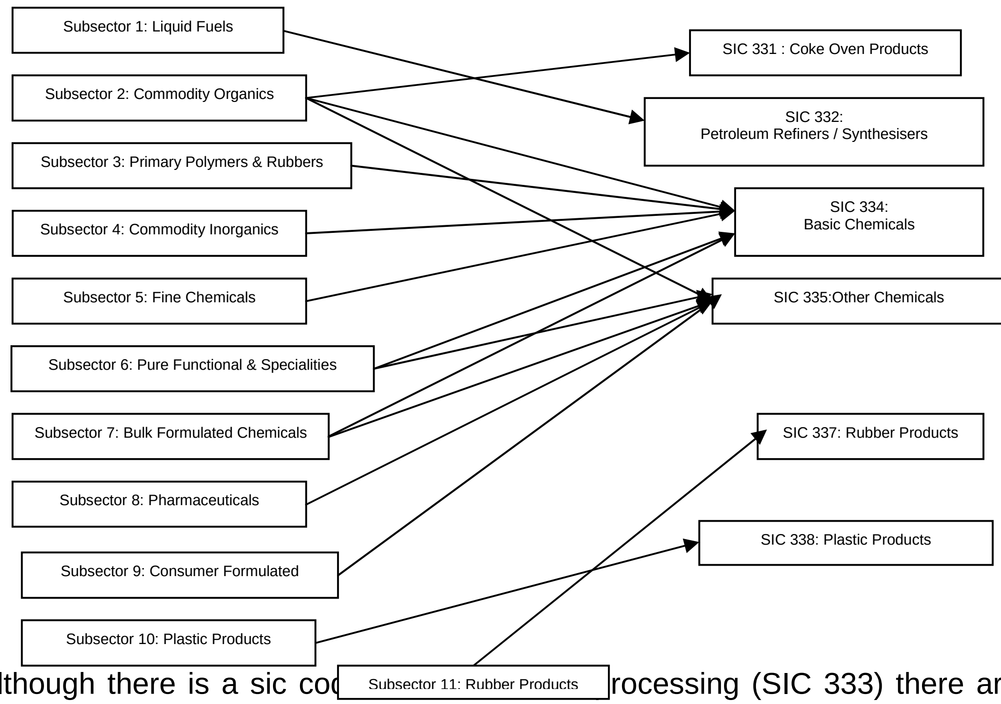
Ozone Business Consulting (Pty) Ltd (O_3bc) is a specialist market research and business consulting operation specialising in the chemical and related sectors regarding market information amongst others. O_3bc was formed from Chemical Marketing & Consulting Services cc (CMCS) in 2003. CMCS/O_3bc has over 20 years experience in the structure of the chemical sector, and therefore most of sectoral profile information was obtained from the CMCS/O_3bc data base.[ii]

1.2 Chemical sector classification in South Africa

The South African (SA) chemical sector is the largest of its kind in Africa and is highly complex and diversified. The classification of the sector is based on 11 sub-sectors that were developed as part of a Customised Sector Programme (CSP)[vi] of the Department of Trade and Industry (dti). The CSP Business Unit comprises of programmes for the development of priority sectors in support of the dti's Integrated Manufacturing Strategy and Government's microeconomic reform strategy.[v]

These 11 sub-sectors are regarded as the most appropriate classification of the sector from a strategic and business perspective and are comparable with the Standard Industrial Classification (SIC) classification, which is generally used for statistical reporting, but it is not useful for a strategic approach to the industry. This relationship is summarised in Figure 1.1.

Figure 1.1: Strategic and SIC classification of the chemical sector

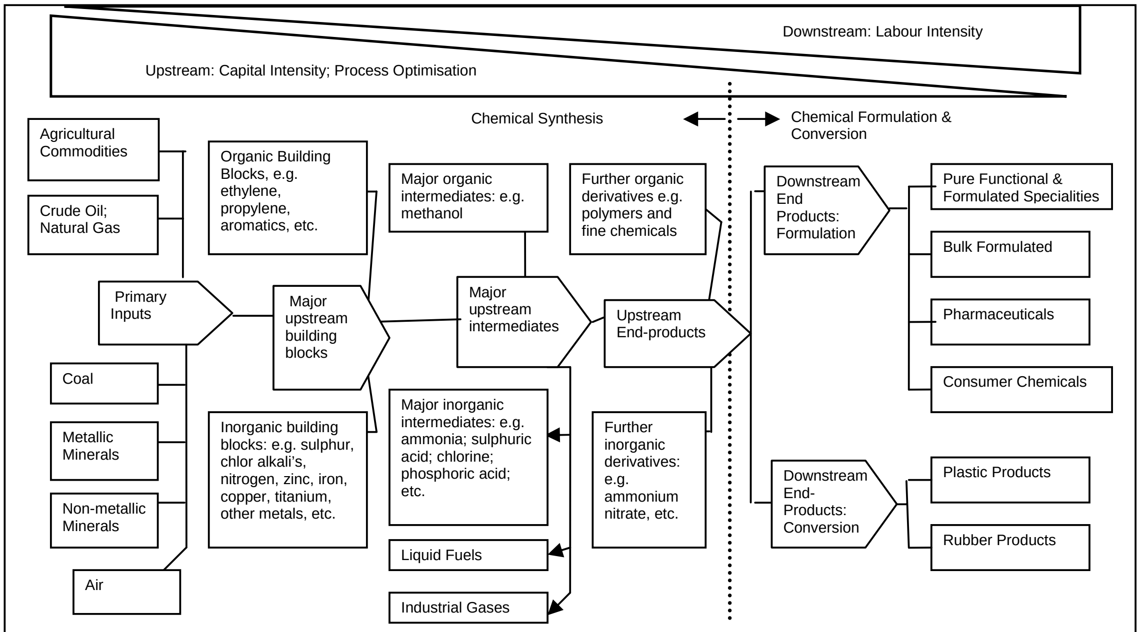


Although there is a sic co[illegible]rocessing (SIC 333) there are currently no such operations in SA. There are however currently talks in the news on future uranium enrichment for potential nuclear energy production.

1.3 **Chemical sector value chain**

Figure 1.2 illustrates the chemical sector value chain, which is discussed in more detail in the following paragraphs.

Figure 1.2: Chemical sector value chain



Source: CMCS/O_3bc [ii]

1.4 Upstream chemical sector in South Africa

1.4.1 *Production processes*

Upstream operations are typically capital intensive and have chemical synthesis production processes that are controlled by automated process control. World-class plants that take advantage of operational efficiencies are used. The relevant sub-sectors are liquid fuels, commodity organics, primary polymers and rubbers, commodity inorganics, and fine chemicals.

The upstream chemical sector is not well structured to accommodate Small, Medium and Micro Enterprises (SMMEs) except in the case of associated products such as lubricants and biofuels in the liquid fuels sub-sector and essential oils in the fine chemicals sub-sector.

In SA upstream chemical manufacturing is concentrated among a few players, with some product categories only having one producer. Some product examples and the major manufacturing operations in SA for the sub-sectors that form part of the upstream chemical sector are discussed below.

1.4.2 *Liquid fuels*

Liquid fuels include products such as diesel, petrol, jet fuel, paraffin, and liquefied petroleum gas. The six local producers are:

- Imported Crude Oil Refineries: Chevron (Caltex), Engen Refinery (Enref), Natref [Sasol Joint Venture (JV) with Total SA] and Sapref (Shell and BP)
- Synthetic Fuels Manufacturers: Sasol Synfuels and PetroSA

There are a couple of farmers producing biofuels for their own use in SA, but not on a commercial scale. Biodiesel SA is the only current identified producer of biodiesel for use by the public in vehicles; the biodiesel is produced from used cooking oils. The implementation of the Biofuels Industrial Strategy of the Department of Minerals and Energy (DME)[vii] might however lead to the creation of other small agricultural-based plants. Biofuels development is also supported by the three chemical incubators[1] in SA.

In downstream associated products such as lubricants, the lubricant blending plants of the major oil companies shown above dominate the sector, but there are also some 20 smaller, and sometimes highly specialised lubricant producers. The major oil companies import synthetic lubricants because the volumes are too small to justify local manufacturing.

1.4.3 *Commodity organics*

Commodity organics are pure, relatively low-cost organic type chemicals. Products generally referred to as petrochemicals also form part of this category. These chemicals are used as raw materials in other chemical products as well as for direct uses in end products.

Sasol is the dominant or only producer in SA in many of the major commodity organic products. The major SA operations and products are shown in Table 1.1.

Table 1.1: Commodity organic product examples and major SA operations

Product examples	Major SA operations
Alpha Olefins	Sasol
Aromatic Chemicals (Benzene, Toluene and Xylenes)	Enref
Cresols	Sasol and Suprachem
Ethanol	Sasol and NCP Alcohols
Ethylene	Sasol
Fatty Acids and Derivatives	Chemical Services (Chemserve) Industrial Oleochemical Products
Linear Alkylbenzene	Senmin and Shell Chemicals
Naphthalene	Suprachem
Phenols	Merisol
Propylene	Sapref and Sasol
Solvents	Sasol
Waxes	Sasol

Source: CMCS/O_3bc [ii]

1.4.4 *Primary polymers and rubbers*

[1] Refer to the Chemin Case Study in Chapter 5 for more information on chemical incubators.

This sub-sector includes all polymer and rubber products in primary forms for use by polymer and rubber converters. The major primary polymer and rubber operations with their manufactured products are listed in Table 1.2.

Table 1.2: Primary polymer and rubber product examples and major SA operations	
Product examples	**Major SA operations**
Acrylic Polymer	Lucite Industries
Polyethylenes	Sasol Polymers and Safripol
Polypropylene	Sasol Polymers and Safripol
Polyurethanes	Bayer, CH Chemicals, Industrial Urethanes
Polyvinyl Chloride (PVC)	Sasol Polymers
Polyethylene Terephthalate (PET) (Saturated Polyester)	Hosaf Fibres, SANS Fibres
Nitrile Latex	Synthetic Latex Company
Polybutadiene Rubber	Karbochem
Styrene Butadiene Rubber and Latex	Karbochem and Synthetic Latex Company

Source: CMCS/O_3bc [ii]

1.4.5 *Commodity inorganics*

Commodity inorganics are pure, relatively low-cost inorganic type chemicals. These chemicals are used as raw materials in other chemical products such as fertilisers and explosives, as well as for direct uses in end products.

The variety of categories in this sub-sector ensures that no single company dominates the sub-sector as a whole, although Sasol does have a prominent position in many of the categories. The major products and producers of these products are shown in Table 1.3.

Table 1.3: Commodity inorganics product examples and major SA operations	
Product examples	**Major SA operations**
Aluminium Sulphate	Aluminium Chemicals, Chemserve Plaaskem and Chem Alum
Ammonia	Sasol Nitro and African Explosives Ltd (AEL)
Ammonia	Sasol and AEL
Ammonium Nitrate and Nitric Acid	Sasol Nitro, AEL and Omnia
Carbon Dioxide	NCP Alcohols, Illovo Sugar, Sasol and PetroSA
Chlor-alkali's such as Chlorine, Caustic Soda and Hydrochloric Acid	Arch Water Treatment, NCP Chlorchem, Sasol Polymers, Mondi Paper (captive) and Zetachem
Chrome salts and acids	Lanxess
Cyanides	Sasol Polymers
Fluorine and Hydrofluoric Acid	Pelchem [part of the Nuclear Energy Corporation of SA (NECSA)]
Hydrogen Peroxide	Alliance Peroxide
Industrial Gases such as Argon, Hydrogen, Nitrogen, and Oxygen	Afrox, Air Liquide, Air Products, PetroSA and Sasol
Manganese Chemicals	Manganese Metal Company, Delta EMD, Samroc
Phosphates	Foskor, Omnia and Sasol
Phosphoric Acid	Foskor and Omnia
Silicates	Ineos Silicas and Cord
Sulphur	Sasol, Chevron, Enref, Natref and Sapref
Sulphuric Acid	Sasol, Foskor, Chemical Initiatives and Others
Titanium Dioxide	Huntsman Tioxide

Source: CMCS/O_3bc [ii]

1.4.6 *Fine chemicals*

Fine chemicals are relatively high value pure chemicals that are typically used as active ingredients in formulated products such as pharmaceuticals and agricultural chemicals. The SA fine chemicals sub-sector is not focusing on the manufacturing of intermediates as commercial products. Where intermediates are manufactured, they are typically manufactured captive for conversion into end products.

The major players are Fine Chemical Corporation that makes pharmaceutical actives, Dow Agrosciences that makes pesticide actives and Illovo Sugar that makes flavour chemicals. There are also other smaller operations including essential oil producers that are supported by the chemical incubators[1] Chemin and Sedichem.

1.5 **Downstream chemical sector in South Africa**

1.5.1 *Production processes*

Downstream operations are typically labour intensive and generally consist of formulation production processes as well plastic and rubber conversion processes. Pure functional chemicals could also have synthesis reactions, but these are on a smaller scale than in the upstream sub-sectors.

The sub-sectors that form part of the downstream chemical sector include pure functional and formulated speciality chemicals, bulk formulated chemicals, pharmaceuticals, consumer formulated chemicals, as well as plastic and rubber products.

The majority of operations in the downstream chemical sector can be regarded as smaller or medium sized, and it can therefore be regarded as making a significant contribution to SMMEs. The chemical incubators[1] support new operations in the downstream chemical sector.

The major bulk formulated chemical operations (excluding organic and speciality fertilisers) are however capital intensive because these operations mostly manufacture captive raw materials (inorganic commodities). The major pharmaceutical and consumer chemical producers that contribute to the bulk of the output of these two sub-sectors are also capital intensive, as well as the tyre manufacturers in the rubber conversion sub-sector and some large plastic converters.

Some product examples and the major manufacturing operations in the SA downstream chemical sector are listed below.

1.5.2 *Pure functional and formulated speciality chemicals*

There are more than 500 identified manufacturers of pure functional and speciality chemicals in SA. This excludes integrated manufacturers that form part of large chemical complexes such as Sasol.

The largest and most diverse company in this sub-sector is Chemical Services (Chemserve) that have various manufacturing divisions in SA. Apart from Chemserve, this sub-sector is highly fragmented as a whole in terms of products, which prevents concentration of production. In large product categories there are major companies such as Dulux and Plascon (i.e. paints manufacturers) that have a large market shares, but are not dominating.

The products (with the total number of identified operations in brackets) and the major manufacturers of speciality chemicals are as follows:

- Adhesives and Sealants (40-50): Adhesive Technologies, Henkel, National Starch, Norcross, Pekay Chemicals, Permoseal, Pratley Polymer Manufacturing
- Agricultural Chemicals such as pesticides (40-50): Bayer Crop Science, Dow AgroSciences, Kombat, Chemserve Plaaskem, Syngenta
- Building and Construction Chemicals (50-60): ABE Construction Chemicals, Cemcrete, Darachem, Derbigum, Durham, Multi Construction Chemicals, Pekay Chemicals, Sika, Stoncor
- Flavours (15): Cranbrook Flavours, Givaudan, International Flavours and Fragrances, McCormick SA, Symrise
- Industrial Cleaning Chemicals (50-60): Chemserve Systems, Johnson Diversey, Dynachem, Ecolab, Safic
- Inks (40): Coates, Continental Printing Inks, Eagle Inks, High-Tech Inks, Keep Inks, Sicpa Inks, Solchem
- Lacquer Thinners (3): Crest Chemicals, Engen, Sasol
- Metal Treatment Chemicals (10-15): Chemetall, Chemserve Systems, E.S. Mowatt, Henkel Surface Technology, Metabrite, Metalchem
- Paints and Coatings (160-180): AECI Coatings, Barloworld Plascon, Chemical Specialities, Ferro (powder coatings), Dulux, Powder Lak (powder coatings), Promac Paints, Prominent Paints, Sago Industries
- Pulp and Paper Chemicals (7): Buckman Laboratories, Paperkem, Chemserve SA Paper Chemicals, T & C Chemicals, Zetachem
- Textile Chemicals (10): Actichem, Avco Chem, Böhme Africa, Buckman Laboratories, CHT Chemicals, Rudolph Chemicals
- Water Treatment Chemicals (10-15): Buckman Laboratories, Chemserve Improchem, Süd Chemi, Syntachem, Vivendi Water Systems, Zetachem

Pure functional chemicals are used primarily for their functional properties. The products (with the number of identified operations in brackets) and the major manufacturers of pure functional chemicals are as follows:

- Catalysts (3): Metallica Chemicals, Süd Chemie Sasol Catalysts, Süd Chemi Zeolites
- Emulsions (15 excluding captive manufacturers): Arkem, Clariant, Colas, Makeean Polymers, Rohm & Haas, Romatex trading as Gold Reef,

Permoseal (captive), SC Johnson Wax, Paints & Coatings Formulators (captive), Sasol Wax, Tosas

- Fluorochemicals (1): Pelchem
- Food Acids (2): Brenn-O-Kem, Isegen
- Inorganic Pigments (3): Algorax (Carbon Black), Huntsman Tioxide (Titanium Dioxide), Rolfes Colour Pigments International
- Mining Chemicals (4): Chemserve Industrial Urethanes, Isegen, Sasol, Chemserve Senmin
- Plasticizers (2): Isegen, NCP Chlorchem
- Polyols: Chemserve Industrial Urethanes
- Polyphosphoric Acid (2): Chemiphos, Soyo Chemicals
- PVC Stabilisers: Associated Additives, Chemserve Systems
- Resins (20 excluding paint manufacturers): ACM Wood Chemicals, Chemicals & Research, Cray Valley Resins, Formalchem, Formica SA (captive), HA Falchem, KZN Resins, Minova, NCS Resins, Owens Corning, (captive), Paints & Coatings Formulators (captive), Chemserve Plaaskem, PRP Resins, Chemserve Resinkem, Schenectady, Scott Bader
- Rubber Chemicals (2): Lanxess, Orchem
- Surfactants (8): Chemserve Akulu Marchon, Buckman Laboratories, CH Chemicals, Chemserve Chemical Initiatives, Industrial Distillers & Refiners, Investchem, Tenside Chemicals, Zetachem in Durban

1.5.3 *Bulk formulated chemicals*

Bulk formulated chemicals are formulated products compounded from high-volume commodity-based chemicals, including explosives and fertilisers.

The major players in SA are:

- Explosives: AEL, Omnia, Sasol Nitro and Somchem
- Fertilisers**:** Foskor, Omnia and Sasol Nitro

There are also around 20-30 smaller fertiliser manufacturers including bulk blenders such as Plaaslike Boeredienste, smaller blenders and organic fertiliser manufacturers, such as Atlas Organic Fertilisers and Agrofert.

1.5.4 *Pharmaceuticals*

This sub-sector includes all formulated pharmaceuticals and other medicinal products in a form for final use or application.

There are about 90 registered pharmaceutical operations at the Medicines Control Council (MCC) in SA, of which only a couple have local production facilities. This excludes manufacturing and wholesale pharmacies that only does the repacking of materials, which are estimated at about 90 and 360 operations respectively.

There is a high concentration of generic pharmaceuticals production by a few companies such as Adcock Ingram and Aspen Pharmacare. Although there are many patented producers, these companies tend to dominate in specific therapeutic categories of medicines. Other major identified SA manufacturers are: Aventis, Be-Tabs, Cosi Pharmaceuticals, Enaleni Pharmaceuticals, Glaxo Smithkline, Johnson & Johnson, Novo-Nordisk, Sandoz, and Schering Plough.

1.5.5 *Consumer formulated chemicals*

Consumer formulated chemicals include products such as soaps, household and cleaning products, cosmetics, toiletries, etc. There are about 150 identified household and cleaning product manufacturers and about 80 identified cosmetics and toiletries manufacturers in SA.

There is a large concentration of production in this sub-sector, in particular in the household and cleaning products category, by a few major companies such as Unilever, Chet Chemicals and Colgate Palmolive. These operations are more capital intensive than the rest of the operations in this sub-sector.

The other major household and cleaning products manufacturers include: Bliss Chemicals, Classiclean, Cosi Consumer, Polagric, Reckitt Benckiser, Salt Sales Agencies, SC Johnson Wax, and Tweefontein Enterprises.

The major cosmetics and toiletries manufacturers include: Adcock Ingram Homecare, Amka Products, Chet Cosmetics, Colgate Palmolive, Designer Group, Johnson & Johnson, Justine-Avon, Le-Sel Research, L'Oreal, National Brands, Prime Product Manufacturing, Quality Products, Revlon SA, Sara Lee, Unilever, and Wella.

1.5.6 *Plastic conversion*

This sub-sector includes all plastic products converted from primary polymers by means of conversion processes such as injection moulding, blow moulding, extrusion, or others. Typical products include packaging materials, wire and cable casings, pipes, film and sheeting, appliances, construction materials, footwear, automotive products, and others.

Due to the fragmented structure of this sub-sector, in terms of both polymer types converted as well as product types, the concentration of production is fairly low. There are around 800 identified plastic converters in SA incorporating various processes. This number includes fibre manufacturers from polymer raw materials.

Some major identified operations include: Aberdare SA PVC, African Cables, Alnet, Alplas, Ampaglass, Astrapak [with more than 20 manufacturing sites in SA], ATC, Atlantic Forming, Automa Multi-Styrene, Circuit Breaker Industries, Clipsal, Consol Plastics, Cordustex, Crabtree Electrical Accessories, DPI Plastics, Durban Bag, Everest Plastics, Feltex, Flex-O-Thene, Gundle API, Heb Cooler, Hella, Hellerman Titon, Hosaf Fibres, Huhtamaki, Irrigaplas, Isolite, ITB Manufacturing, Leader Packaging, Lounge Foam, LR Plastics, Lucite Industries, Marconi, Marley, Mattex, MCG Industries, Modek, Multotec, Nampak [divisions include Liquid Packaging, Megapak, Petpak and Polyfoil], National Urethanes, OTH Beier, Pandrol, Petzetakis, Plastall Gundle, Polyoak, Quadro Plastics, Resinite SA, SA Leisure, SA Polypropylene Yarn, SAFA, Sagex, SANS Fibres, Sheet Plastics, Smiths Plastics, Spunchem, Technoplastics, Tufbag, Usabco, Van Leer, Venture SA, Vitafoam, and Vyanide

1.5.7 *Rubber conversion*

This sub-sector includes all rubber products made from primary rubbers, such as tyres, conveyor belting, and other rubber products.

Production is concentrated amongst the few major tyre and belting producers namely: Bridgestone/Firestone, Dunlop Tyres, Continental Tyres, and Goodyear/Tycon.

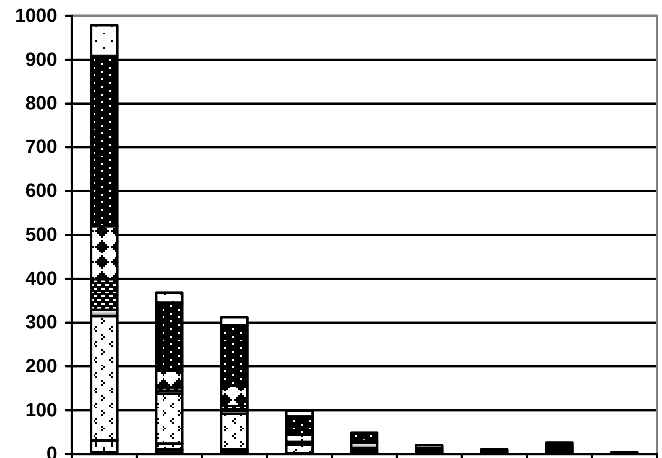
There are also around 130 identified other rubber product manufacturing sites in SA, including retreaders that do their own compounding. These operations are mostly labour intensive. Major identified rubber converters include: Bandag, Batco, Dunlop Industrial, Latex Surgical Products, Leader Tread, Natal Rubber Compounders, Palmer Rubber, Plant Protection, Polar Retreading, Rubbertek, and Tensile Rubber.

1.6 **Provincial distribution of the South African chemical sector**

Chart 1.1 illustrates the distribution of the South African chemical operations across the nine provinces. The following principles were used in listing these operations:

- Operations are listed under their major output category (e.g. a refinery that also produces chemicals is only listed under liquid fuels)
- Associated fuel products (e.g. lubricants and others) are listed under speciality chemicals
- Operations that manufacture captive chemicals for other end products are listed under their end products (e.g. an operation that manufactures formaldehyde captive for resins is listed under pure functional chemicals)
- Operations that manufacture chemical products but fall outside the chemical sector (e.g. a sugar mill that manufacturers ethanol as a by-product) are not listed as they are part of other SETAs

Chart 1.1: Geographic spread of chemical manufacturers



	Gau-teng	Kwa-Zulu Natal	Wes-tern Cape	Eas-tern Cape	Free State	North West	Lim - popo	Mpu-ma-langa	Nor-thern Cape
Rubber Conversion	70	22	18	12	2	6	2	5	2
Plastic Conversion	389	156	138	42	17	6	4	6	0
Consumer Chemicals	121	38	46	16	3	1	2	2	1
Pharmaceuticals	70	7	12	5	1	0	0	0	0
Bulk Formulated	14	7	6	1	12	5	1	4	1
Specialities	283	114	81	20	5	1	2	3	0
Fine Chemicals	2	1	1	0	1	0	0	0	0
Commodity Inorganics	25	12	5	1	1	1	0	3	0
Primary Polymers & Rubbers	0	3	1	0	4	0	0	1	0
Commodity Organics	5	6	2	1	2	0	0	1	0
Liquid Fuels	0	2	2	0	1	0	0	1	0

Source: CMCS/O_3bc Data Base (2007) [ii]

Sasol's integrated operations[2] were split into the following divisions that are listed separately in Chart 1.1, even though other sub-sectors might also fall under these divisions.

- Sasol Synthetic Fuels (Secunda) : Liquid Fuels
- Sasol Chemical Industries[3] (Sasolburg) : Commodity Organics
- Sasol Chemical Industries[3] (Secunda) : Commodity Organics
- Sasol Polymers (Sasolburg) : Primary Polymers & Rubbers
- Sasol Polymers (Secunda) : Primary Polymers & Rubbers

Most of the chemical manufacturing operations in SA are based in Gauteng, followed by Kwazulu Natal (KZN) and the Western Cape. The output volume of chemicals is however not similar per province, as it depends in the sub-sectoral output, which is discussed in the next section.

1.7 Manufacturing output and trade in South Africa

[2] Refer to the Sasol Case Study in Chapter 5 for more information.

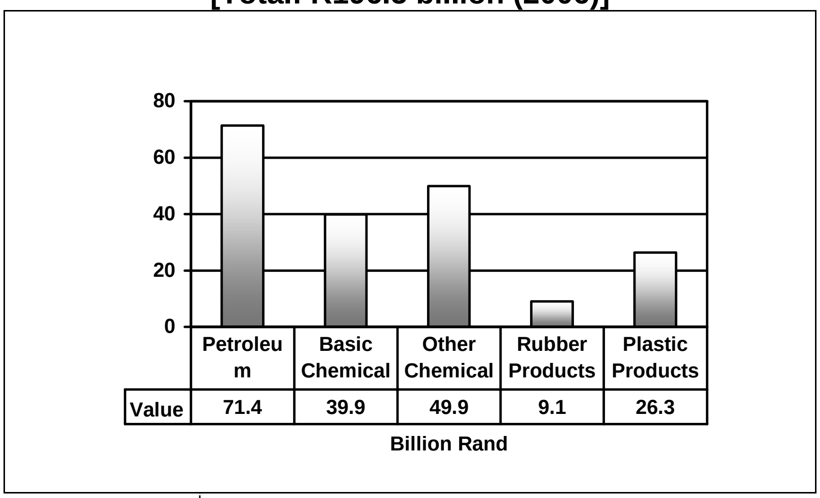
[3] Sasol Chemical Industries incorporate Sasol Solvents, Sasol Nitro, Sasol Olefins & Surfactants, Sasol Wax and Merisol.

The SA chemical sector constituted 20% of manufacturing GDP in 2006, which in turn constituted 16% of the total national GDP (i.e. 3% of GDP).[i]

StatisSA classifies the breakdown in chemical production according to the SIC classification and not according to the strategic classification of the dti.[4] It is therefore difficult to determine what the output of each strategic sub-sector was and could only be determined by a detailed market study with the relevant role-players.

The chemical sector value of production was around R196.5 billion for 2006, which is illustrated per SIC classification in Chart 1.2. Production figures for coke oven products were not available separately. Petroleum products accounted for more than one-third of the available output in 2006.

Chart 1.2: SA production of chemicals
[Total: R196.5 billion (2006)]

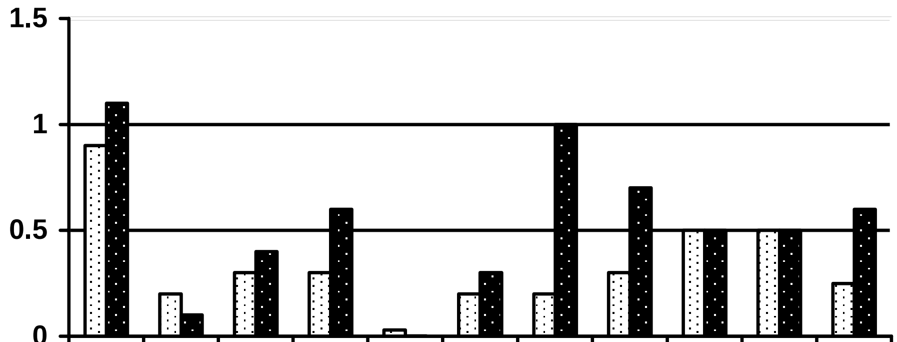


Source: StatsSA [i]

It is interesting to note the relative value contribution of each sub-sector to SA's GDP, and secondly SA's relative position in world production as illustrated in Chart 1.3. Given that SA's GDP is less than 1% of global GDP, it is noted that two sub-sectors (liquid fuels and bulk formulated chemicals) have a larger output that may be expected on the basis of our GDP. It could be speculated that SA has some relative advantages in these sub-sectors.

Chart 1.3:
Chemical sub-sector relative importance to SA GDP & world production

[4] Refer to Figure 1.1 that explains the relationship between the SIC and strategic classifications of the chemical sector.



	Liquid Fuels	Orga-nics	Polymer / Rubber	Inor-ganics	Fine Chemical	Function / Speciality	Bulk	Pharma-ceuticals	Con-sumer	Plastic	Rubber
SA GDP Contribution	0.9	0.2	0.3	0.3	0.03	0.2	0.2	0.3	0.5	0.5	0.25
% of World Production	1.1	0.1	0.4	0.6	0.002	0.3	1	0.7	0.5	0.5	0.6

Source: CMCS (2002/2003) [ii]

1.8 Trade Analysis

1.8.1 *Source of Trade Information*

All the trade information shown in the following paragraphs was obtained from the South African Revenue Services (SARS)[viii].

1.8.2 *Overall Trade Analysis*

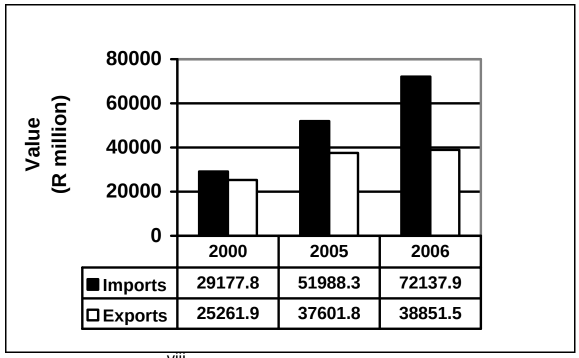
SA has a weak balance of payments position within the chemical sector. This is because the exports are principally low unit value commodity chemicals whereas imports are higher value fine and speciality chemicals.

The trade deficit in the chemical sector increased from R3.9 billion in the year 2000 to R33.3 billion in 2006 as illustrated in Chart 1.4. Recent statistics show a constant value in exports, but an increase in imports.

These figures exclude imports of crude oil, which is a mineral. Total crude oil imports in 2005 were 18.1 million metric tons worth R41.21 billion Free on Board (FOB). In 2006 crude oil imports increased to 21.7 million metric tons worth R64.5 billion FOB, which shows increased production volumes by the crude oil refineries.

The rise in the current trade deficit was mainly due to increased imports in liquid fuels and pharmaceuticals.

Chart 1.4: Trade in the chemical sector



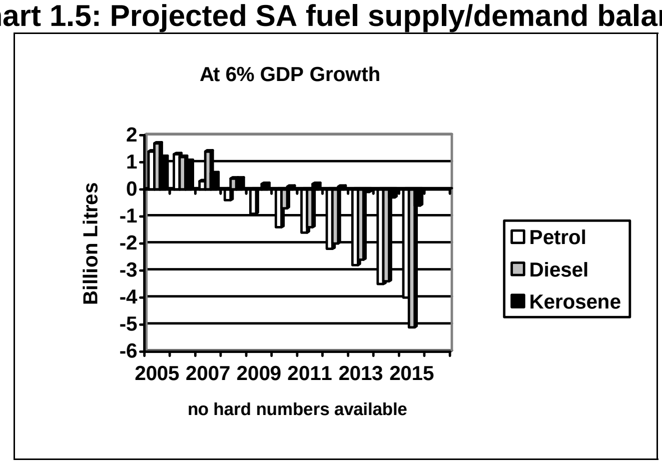
Source: SARS [viii]

1.8.3 *Liquid Fuels*

Growth in SA liquid fuels has been 4-5% per annum (p.a.) over the last few years[ix]. The industry is however currently expanding by incremental capacity extensions from existing plants, rather than large new Greenfield investments. The expected high GDP growth for SA is creating opportunities for new investment in the primary liquid fuels capacity, both from traditional oil refining and synthetic fuels perspectives.

Current liquid fuels shortages are being imported and are expected to increase as can be seen in Chart 1.5. In 2005 the sub-sector had a positive trade balance of R2.7 billion; in 2006 the trade balance was negative at R9.3 billion, which amounted to a 51% increase in volumes imported. Gauteng's future supply of fuels is a particular concern.

Chart 1.5: Projected SA fuel supply/demand balance



Source: Engineering News (October 27 – November 2 2006)
Fuel retail business growing faster than industry average. SA. [x]

Deloitte conducted an independent survey in the liquid fuels sub-sector and concluded that in the next 15-20 years refining capacity will need to double, import capacity will need to grow exponentially and a major infrastructure increase in pipelines and depots will be required in order to meet the increased demand.[xi]

Sasol plans to increase their liquid fuels production by 20% at Secunda or and is also investigating the opportunity of creating another coal-to-liquids (CTL) plant in SA, called Project Mafutha, which could expand the inland fuel supply.[2]

Oil majors are reluctant to build additional refinery capacity in SA; a refinery smaller than 250 000 barrels per day (bbl/d) would not be world scale, whereas Project Mafutha could get away with an 80 000 bbl/d and make provision for modular expansions.[xii]

Sustainability of the gas-to-liquids (GTL) refinery at PetroSA in Mossel Bay is a focal area for management, and work is under way to anchor the South Coast Gas Development that would provide interim relief in gas supplies until 2013. In parallel, there are also pre-feasibility investigations on the potential conversion of the refinery to either a liquefied natural gas or crude oil refinery. Should any of these projects go ahead, they are only expected to come on line in 2015/2016.[xiii]

The Coega Development Corporation (CDC) is also adjudicating expressions of interest for the construction of a new refinery in its Industrial Zone (IDZ) of which the two bidders are PetroSA and the Port Elizabeth-based project development firm Bidco[xiv].

1.8.4 *Pharmaceuticals*

Historical trade data in pharmaceuticals as obtained from SARS is summarised in Table 1.4. The trade deficit increased with R6.7 billion between 2005 and 2006; this was equal to 588 044 metric tons of product.

Table 1.4: Historical trade data for pharmaceutical products

Year	Imports	Exports	Trade Deficit
2005	1 750	556	- 1 194
2006	8 538	622	- 7 916

Source: SARS [viii]

The promotion of greater production in local pharmaceutical products is one of the key action programmes in the Chemical Sector Development Strategy[iv] that forms part of the dti's broader industrial policy framework.[v]

Major growth exists is the generics market and to increase local formulation capacity. This market however requires access to low-cost raw materials and large markets in order to be viable for manufacturing. A harmonised regulatory regime for Southern African Developing Community (SADC) would give SA based manufacturers easy access to a market of nearly 200 million people.[xv]

1.8.5 *Plastic Products*

The total imports of plastic products during 2006 were R4 679 million, while exports during the same period were R1 602 million. The sub-sector therefore had a negative trade balance of R3 077 million for the period.

The promotion of downstream plastics products production is one of the key action programmes prioritised for implementation of the Chemical Sector Development Strategy[iv] of the dti, which could lead to addressing the trade deficit in this sub-sector.

1.8.6 *Other Sectors*

All the trade data provided in the following paragraphs were obtained from SARS.[ix]

i) Commodity organics, inorganics and bulk formulated chemicals

Both the commodity organics and bulk formulated chemicals sub-sectors had positive trade balances in 2005 and 2006. The commodity organics sub-sector is a significant and growing exporter.[viii]

The commodity inorganics sub-sector had a positive trade balance of R1 602 million in 2005 but a negative trade balance of R1 063 million in 2006.

Lack of specific feedstocks for commodity inorganics such as alumina, sulphur and potassium drives large imports and there are further investment opportunities in areas where SA has feedstock advantages. This include all mineral sectors where SA is a major global player, such as gold, platinum group metals, manganese, chromium, vanadium, copper, antimony, phosphate rock and uranium. Benefaction of these minerals into value-added inorganic chemicals for the world market should have good viability. There are also further potential to recover chemicals from waste products such as copper and aluminium scrap, and the availability of natural gas form Mozambique could also provide an opportunity for further production of ammonia and derivatives.

ii) Primary polymers and rubbers

Total imports of products in this sub-sector during 2006 were R5 399 million, while exports during the same period were R2 284 million. The sub-sector therefore had a negative trade balance of R3 115 million for the period.

SA imports significant quantities of primary polymers and rubbers. Some of these that could offer local manufacturing opportunities include acrylonitrile-butadiene-styrene (ABS) and polystyrene. These import figures are however generally well below acceptable minimum capacities for these types of plants from an economies of scale perspective. This implies that significant exports would be required from any new investment. Exports would generally not be viable unless substantial protection is offered for inland sales by Government, or a very competitive feedstock position is developed. The feedstock for producing ABS and polystyrene would have to be imported currently.

ii) Fine chemicals

Total imports of products in this sector during 2006 were R5 260 million, while exports during the same period were R1 333 million. The sector therefore had a negative trade balance of R3 927 million for the period.

The fine chemical sub-sector is the most underdeveloped of the total SA chemical sector. The majority of imports are for pharmaceutical actives. This does not necessarily point to an opportunity. Actives in Antiretrovirals (ARVs) for example are changing too fast to set up a sustainable local production base, and research and development (R&D) would not be feasible competing with large multi-nationals.[5]

There should therefore rather be a focus on developing increased formulation capacity (e.g. in generic medicines) using fine chemicals in therapeutic categories that have a major focus on Africa, such as HIV/AIDS, Malaria and Tuberculosis.

iii) Pure functional, speciality and consumer chemicals

Manufacturing in SA occurs in most of the speciality and functional chemicals categories, but lack of specific feedstock such as organic and inorganic intermediates as well as an underdeveloped fine chemical sub-sector drives large imports. The sub-sector had a negative trade balance of R5 548 million in 2006.

The fine chemicals sub-sector is not expected to change as explained above, and there is also a worldwide trend that pure functional and formulated chemicals are tailor-made for their specific country and not for the export market, which SA follows. The consumer chemicals sub-sector follows the same trends, and it had a negative trade balance of R115 million in 2006.

The fluorspar value chain however has the potential to develop an integrated fluorine chemicals value chain, which is one of the key action programmes prioritised for implementation in the Chemicals Sector Development Strategy.[iv] This project is however still under feasibility investigations. Mining chemicals also offer SA an attractive home base to develop competitive products for the world market.

iv) Rubber Products

Total imports of products in this sub-sector during 2006 were R4 057 million, while exports during the same period were R1 894 million. The sub-sector therefore had a negative trade balance of R2 163 million for the period. In 2005 the trade deficit was R1 746 million.

The rubber conversion sub-sector in SA was previously regarded as uncompetitive, mainly due to old equipment, and small production runs. This

[5] Refer to Chapter 6 for more information on Research and Development

situation has been addressed by the multinational tyre companies, focusing on investment of new equipment, rationalisation of product lines and export development.

There has however been some impact on the traditional rubber market by plastics, which have replaced rubber used for e.g. flooring, garden hosing, footwear (soles of shoes), and sealing capacities using engineering plastics. It is however unlikely that the rubber industry will ever die out as there will always be specialised products required.

1.9 Global market overview

There are more than 80 000 officially registered chemical compounds globally, of which only around 300 of these are produced in SA.

The chemical sector is divided into two main segments based on margin and production volume. In general, commodity chemicals are produced at low margins, but in large quantities and against a common specification that is usually linked to composition. In recent years, fine chemicals have also become commodities, and margins have fallen drastically.

Higher margin products include those that are either patent protected or hard to produce, referred to as designer chemicals (e.g. speciality ceramics and ethical pharmaceuticals) or are complex formulated products sold against a performance specification and hence are difficult to copy (e.g. flavour mixtures and water treatment chemicals, also referred to as speciality chemicals).

In an outline only, the key characteristics and trends of the global chemical sector include the following:

a) Market conditions

The global outlook for growth in chemical sector output was forecast at 3.9% and 4.0% respectively for 2006 and 2007, following an average of 3.7% for 2003 to 2005. Within this scenario, Africa and the Middle East is forecast to show the highest growth in output at 7.5% p.a. followed by Asia/Pacific, including Japan, at 6.0% p.a. China will still be the highest growth economy at 11.9% p.a. North America and Western Europe are declining forces in global chemical output, and growth is projected at as below average 2.8% p.a.[xvi]

The chemical sector is predominantly mature and highly competitive with low margins. In 2000, 70% of global chemical production, and 65% of global chemical consumption, was located in Japan, the United States of America (USA) and the European Union (EU). High crude oil prices, and in particular high natural gas prices, are driving capacity away from Western economies towards resource-rich Middle-Eastern countries, as well as fast growing China and India. The increase in crude oil prices also reduced margins along the chemical value chain as producers battled to pass on cost increases to their customers.

The chemical sector is its own biggest customer with about 60% of production used in downstream manufacturing within the sector. In the commodity sector, market share is the determining measure and driver for performance.

The chemical sector touches every other sector of the economy, and therefore the overall performance of the global economy has a huge impact on the performance of the chemical sector, and vice versa. Increased competition from countries with significant competitive advantages such as access to markets and/or raw materials, will force down prices and margins. As a result, global production is moving to lower cost economies.

Globalisation and international trade are here to stay, with an increasing number of Free Trade Agreements coming into place, but regulatory compliance issues will hinder access to certain markets. In particular, concern for and practices affecting the environment are becoming significant conditions for market access coupled with a greater understanding and requirement of Life Cycle Analysis resulting in cleaner production as well as the use of renewable resources. Regulatory trends that favour one product or technology over another (e.g. emissions or the thickness of plastic bags) are generally becoming more strict, and compliance is necessary to stay in the game.

From the early 1990's, particularly from 1994 with the establishment of a new democracy in SA, there has been a focus to reintroduce the SA chemical industry into the global marketplace. Global competitive advantages and strategic positioning guided by focused R&D alliances and regional dominance are driving successful companies like Sasol today.

b) Feedstock trends

To a large extent, the chemical sector's feedstocks are organic substances, crude oil and gas, all of which are non-renewable resources that have shown significant price increases over the last few years. There are trends towards the use of natural products, and the use of waste streams and multiple feedstock options through multi-step synthesis reactions. There is also a significant trend towards CTL and GTL technology for fuel and feedstock production, which is Sasol's proprietary technology.

c) Manufacturing technology and innovation

Product substitution trends will result from newer technologies and products, while process improvement will be essential in order to meet increasing environmental, efficiency and quality standards; the sector is generally under pressure to improve its environmental record and its sustainability.

Catalysts and catalyst innovation will play an even greater role with already 60% of chemical production and 90% of chemical processes dependent on catalysis.

d) Business process and supply chain management/logistics

Market channels will become more direct with increasing preference for individual tailoring of products requiring an increasing level of sophistication, emphasis on customer relations, logistics, inventory management, in/out-bound resources management, and capacity reservation. There will be an increasing tendency to network and to develop more open and less rigid environments with flatter structures; flexibility will become standard.

e) Knowledge management

Companies are increasingly exploiting their intellectual property in addition to the sale of products and services. The ability to capture, share and use ideas or information generated within the business will increase.

f) Human resources

The chemical sector employs a significantly high proportion of engineers and scientists reflecting the high technical nature of the sector, but it is shedding jobs worldwide through technical innovation, consolidation, and greater economies of scale.

People will need to be more informed about a range of issues of not only "what you know" but "how do you apply it" and be quicker to link ideas and actions. There will also be a greater demand for employees with multi-skills.

CHAPTER 2: DEMAND FOR SKILLS

2.1 Introduction

This chapter provides an analysis of available employment and occupational data in the SA chemical sector over a 10-year period. Employment trends are discussed with reference to occupational categories, gender and race.

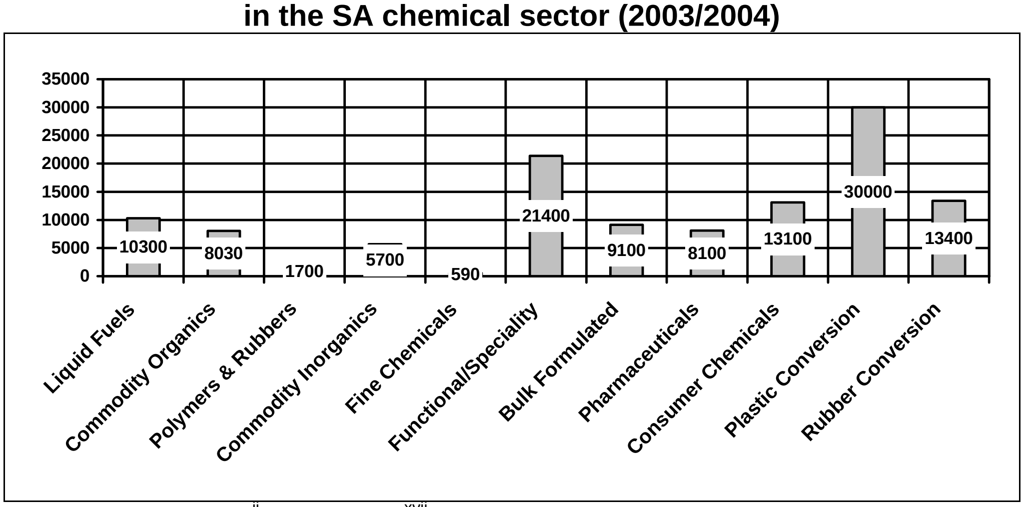
The demand for skills is not derived from this employment and occupational data. The reasons are that the chemical manufacturing sector is growing below GDP growth rates at an average of 2% p.a. between 2004 and 2006 and the workforce is also not growing significantly, with negligible changes in the skills required, as will be illustrated in this chapter.

The demand for skills that relates to the AsgiSA initiative to have accelerated growth rates to halve unemployment by 2014, will be based on active investment areas as well as downstream development priority areas.

2.2 Historical employment data

The chemical manufacturing sector employed about 121 400 people in 2003/2004 based on the CMCS/O_3bc data base[ii] and the Plastics Federation of South Africa (PFSA) data for the plastic conversion sub-sector. The distribution between the various sub-sectors can be seen in Chart 2.1. These estimates exclude chemical suppliers, but include pharmaceutical repackers. Sasol[2] Polymers' operations are included under the commodity organics sub-sector.

Chart 2.1: Estimated number of people employed in the SA chemical sector (2003/2004)



Sources: CMCS/O_3bc [ii] & the PFSA [xvii]

Based on Chart 2.1 the plastic conversion sub-sector contributes to almost a quarter on the estimated employment in the SA chemical sector, followed by functional and speciality chemicals at almost 20% of the total.

A first-order analysis was made on the gender and race distribution of employees from a survey conducted by the Human Sciences Research Council (HRSC) on behalf of the CHIETA as well as from the O_3bc data base[ii] in 2004. This analysis excluded the plastic and rubber conversion sub-sectors that are not part of the CHIETA, and included the glass sector that is part of the CHIETA. The details of this analysis per sub-sector is available from the CHIETA's historical 5-year Sector Skills Plan (SSP) [1 July 2004 - 30 June 2008].

From this analysis, African employees made up half of the total workforce but were more representative in the lower occupations, while females contributed to around one-third of the total workforce, with higher representation in clerical and sales and professional positions. The information is shown in Table 2.1. A Black employee is regarded as African, Asian and/or Coloured.

Table 2.1: Participation of Blacks and women in higher positions (2003/2004)

Broad Occupation	NQF* Level	% of total workforce	Race (%)				Gender (%)	
			African	Asian	Colou-Red	White	Male	Female
Managers	5-7	7	8	6	8	78	65	35
Professionals	5-8	8	12	8	15	65	57	43
Technicians & Associates	4-6	14	32	14	15	39	61	39
Clerical & Sales Workers	3-5	20	22	20	13	45	49	51
Artisans	2-5	7	37	14	9	40	76	24
Operators	1-4	29	72	17	5	6	76	24
Elementary	1-4	15	83	11	1	5	74	26
Total Workforce	-	**100**	**50**	**15**	**8**	**27**	**66**	**34**

* NQF is the National Qualifications Framework

Source: HSRC and O_3bc Study for the CHIETA (December 2003) *Skills Needs in the Chemical Sector.* South Africa. [xviii]

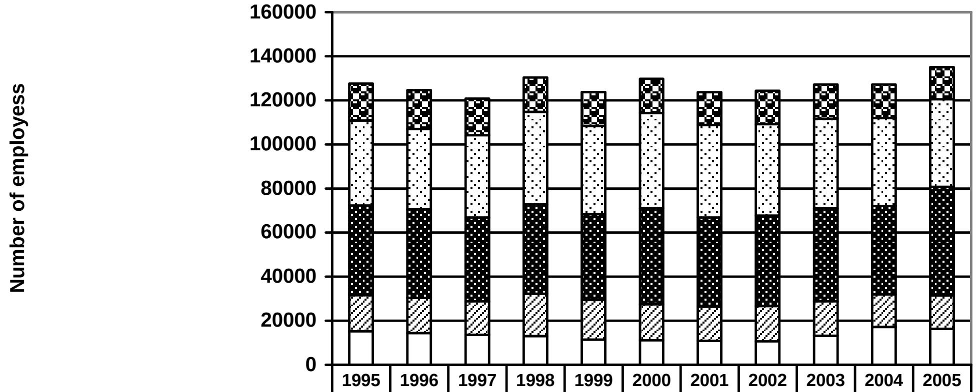
2.3 Ten year data analysis

2.3.1 *Overview*

The Quantec Labour Market Survey of the Reserve bank estimates the total employment in the SA chemical sector at an average of 127 200 between 2003 and 2004, which is illustrated in Chart 2.2.[6]

Chart 2.2: Historical employment in the SA chemical sector

[6] This is 6 000 people more than the CMCS/O_3bc estimate as illustrated in Chart 2.1. This could be due to chemical suppliers included in the Labour Market Survey data that are not directly linked to chemical manufacturing operations, as well as man-made fibre operations that are included in the Labour Market Survey data and excluded from the CMCS/O_3bc data.



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Rubber products [SIC 337]	16796	17630	16589	15559	15448	15544	14782	15064	15470	15293	14485
Plastic products [SIC 338]	38417	36494	37221	41942	40001	43135	42006	41514	40793	39855	39893
Other chemicals and man-made fibers [SIC 335-336]	40750	40060	38025	40509	38985	43577	40339	40987	42101	40103	49263
Basic chemicals [SIC 334]	16402	15943	15235	19260	17903	16311	15608	16150	15588	14848	15022
Coke and refined petroleum products [SIC 331-333]	15217	14482	13647	13071	11488	11210	10849	10584	13224	17123	16400

Year

Source: Quantec Labour Market Survey [iii], Reserve Bank [7]

Based on the Labour Market Survey data shown above, employment in the chemical sector grew at less than 1% on average p.a. between 1995 and 2005. Reasons for this could be due to efficiency improvements, and a general trend towards automation and capital intensiveness, especially in upstream chemicals.[ii]

A general growth rate in production output of below the GDP growth rate in the chemical sector could also be a factor. Although the consumption of chemicals would grow in line with manufacturing GDP due to the fact that chemicals touch almost every sector in the economy, there is a world tendency that high manufacturing volumes tend to be in countries with competitive feedstock advantages, e.g. crude oil and other raw materials. SA is at a competitive disadvantage with many feedstocks that need to be imported.[ii]

Gender and racial breakdowns of employees are only available from the Household (1996-1999) and Labour Force (2000-2005) Surveys done by StatsSA. [xix] The total estimated number of employees is much higher in these surveys than what O_3bc and the Labour Market Survey estimated, at an average of 198 500 employees p.a. between 1996 and 2005. The reason for this could be that people categorised themselves as working in the chemical sector when they did not.

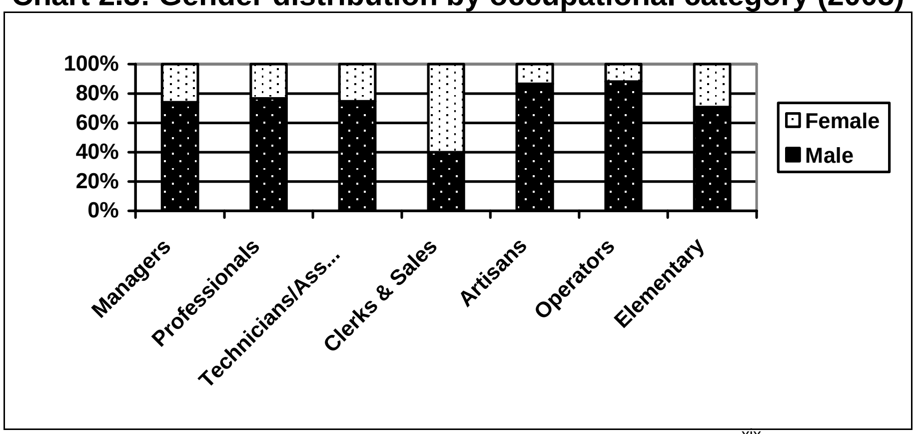
[7] The Labour Market Survey data provides a breakdown of employees based on the SIC classification and not according to the strategic classification of the dti (refer to Figure 1.1 that explains this). It is therefore difficult to determine what the employment figures are for of each strategic sub-sector based on this data.

People also categorised themselves as working in the informal sector, which contributed only to about 2% of the total number of employees in these two surveys. This data is excluded from all the analyses as most chemical operations are regarded as formal due to the nature of the raw materials and processes employed. The only sub-sector that could possibly play a role in informal employment is consumer chemicals (i.e. household and cleaning products and cosmetics and toiletries).

Due to the suspected unreliability of the Household and Labour Force surveys, only percentages are shown for the gender and racial breakdowns, and not any hard numbers. An overall gender and race analysis was made per occupational level based on 2005 information; details per SIC classification on this is not provided, due to irregular patterns identified from this data.

The distribution of males and females in the various occupations of the chemical sector has not changed much if 1996 is compared with 2005, based on this data. Females contributed just more than 20% in the higher and elementary positions and less on artisan and operational level. Clerical and sales positions were dominated by females at about 60% in 2005.

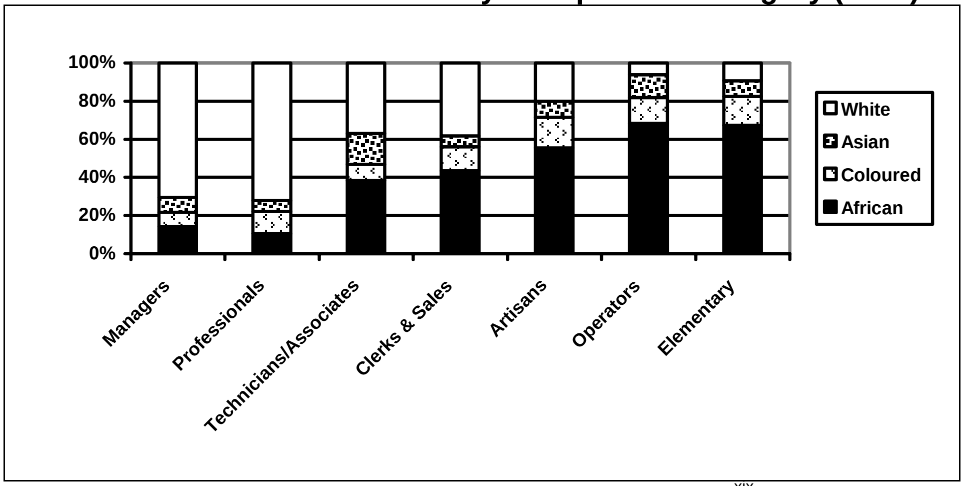
Chart 2.3: Gender distribution by occupational category (2005)



Source: Quantec Household and Labour Force Surveys, StatsSA. [xix]

The data in 1996 on racial distribution is questioned on its reliability as it shows more Black managers in that year than in 2005. Therefore only 2005 data is shown. White employees dominated top positions in 2005 based on this data, while Black employees dominated the lower positions in 2005.

Chart 2.4: Racial distribution by occupational category (2005)



Source: Quantec Household and Labour Force Surveys, StatsSA [xix]

The following sections provide an analysis of highly skilled, skilled and semi- or unskilled employees as extracted from the Labour Market Survey by the Reserve Bank.[iii] Data from the Household and Labour Force Surveys were not used due to their suspected unreliability and difference in numbers.

A short description of these skills levels are as follows:

a) Highly skilled

- Professional, semi-professional and technical occupations
- Managerial, executive and administrative occupations

b) Skilled

- Clerical and sales occupations
- Service occupations
- Transport, delivery and communications occupations
- Production foremen and production supervisors
- Artisan, apprentice and related occupations

c) Semi- and unskilled

Semi- and unskilled occupations consist of all the occupations that are neither highly skilled nor skilled occupations.

Core functions such as manufacturing, sales and administration are generally fulltime in the chemical sector, while services such as information technology, catering, cleaning services, security, as well as logistics are often outsourced on a contract basis.

2.3.2 *Coke and refined petroleum products*

Coke and refined petroleum products should include liquid fuels manufacturers as well as some commodity organics manufacturers[4]. These are upstream producers that mostly have chemical synthesis reactions in capital intensive manufacturing sites.

The educational levels of workers vary from highly qualified engineers, scientists, technologists, and technicians, to lower qualified process operators and general workers. Generally the managerial and marketing staff also needs to have technical skills.[vi]

Chart 2.5 shows the total number of workers in coke and petroleum products, as well the distribution between the skills levels of employees as obtained from the Labour Market Survey by the Reserve Bank.[iii]

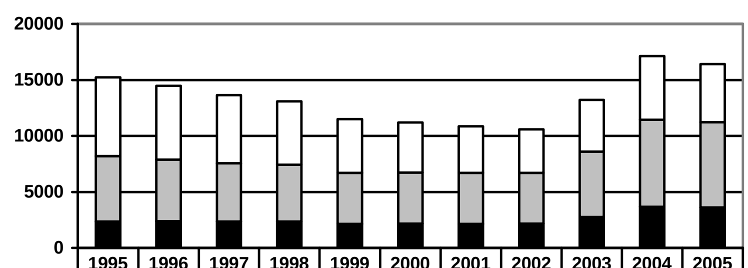
The average distribution of skills levels from 1996 to 2005 was as follows:

- Highly skilled : 19%
- Skilled : 42%
- Semi/unskilled : 39%

Skilled workers increased with 14% due to a similar decrease in semi- or unskilled workers, when comparing 1995 with 2005.

This could be due to a rise in qualification requirements in the upstream chemical sector, as mentioned by Corrie Botha, the Business Development Leader at NCP Chlorchem. [xx] He said that the chemical sites used to require grade 10 (NQF level 2) for plant operators, but because of the improvement of technology, automation and the higher demands put upon operating staff, especially for upstream chemicals, less manual type labour is required and the standards have been raised to Grade 12 (matric) with mathematics (maths) and science. Otto Pepler[xxi], the Project Director of Project TalentGro at Sasol, confirmed that operators at Sasol need maths and science on matric level.

Chart 2.5: Skills levels for coke and refined petroleum products



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Semi- and unskilled	7021	6590	6074	5648	4791	4490	4159	3874	4611	5678	5164
Skilled	5833	5512	5218	5070	4552	4556	4533	4548	5841	7766	7630
Highly skilled	2364	2380	2355	2353	2145	2163	2157	2163	2772	3678	3606

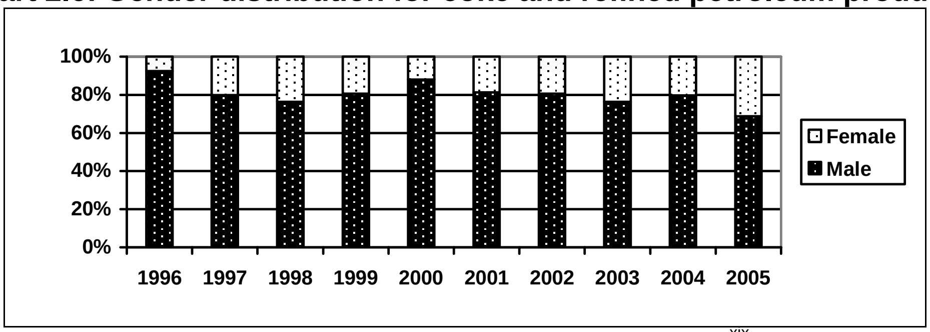
Source: Quantec Labour Market Survey, Reserve Bank [iii]

The average growth rate in employment was 1% p.a. over the period of analysis. The drop in employment in the middle of Chart 2.5 could have been when Sasol in Sasolburg stopped producing liquid fuels and when Mittal closed some coke ovens in Pretoria.[ii]

Increased employment volumes in 2004 and 2005 could have been because of expansions or new projects at Sasol as well as refinery upgrades to meet the clean fuels target for 2006.[xxii]

The contribution of female workers was on average 21% between 1997 and 2004 (excluding the year 2000 data). The increase in 2005 is questioned.

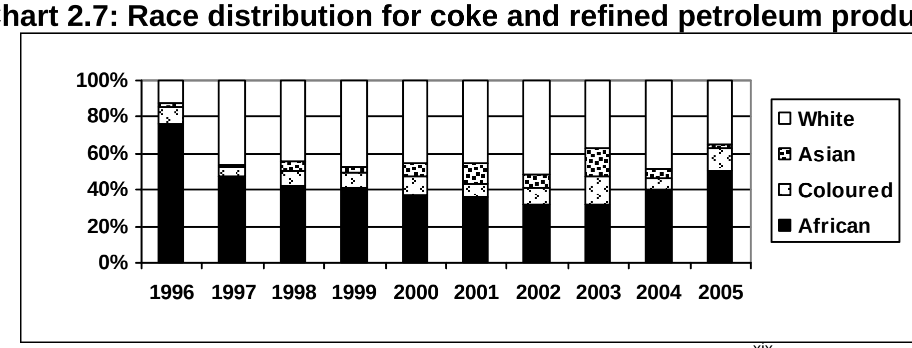
Chart 2.6: Gender distribution for coke and refined petroleum products



Source: Quantec Household and Labour Force Surveys, StatsSA [xix]

The contribution of Black employees seems to have stayed the same between 1997 and 2004 at an average of 50%, which might have increased in 2005 but this cannot be proven. The 1996 race distribution and downward trend of African employees are questioned.

Chart 2.7: Race distribution for coke and refined petroleum products



Source: Quantec Household and Labour Force Surveys, StatsSA [xix]

2.3.3 *Basic chemicals*

Basic chemicals should include mostly upstream chemical manufacturers, i.e. commodity organics, primary polymers and rubbers, commodity inorganics and fine chemicals. These operations mainly employ synthesis reactions in chemical intensive manufacturing sites. Basic chemicals could also include some pure functional operations that have synthesis processes as well as some large bulk formulated chemicals manufacturers.[4]

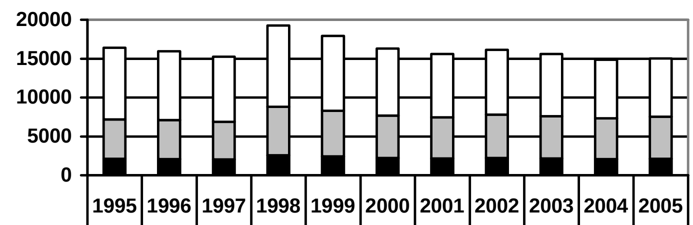
The educational levels of workers vary from highly qualified engineers, scientists, technologists and technicians, to lower qualified process operators and general workers that generally require matric or a similar qualification.

Smaller operations have less highly qualified staff, and rely upon technicians. Generally it is regarded that all workers have some basic skills level due to on-the-job training as well as other training mechanisms.[vi]

Chart 2.8 shows the total number of workers in basic chemicals, as well as the distribution between the skills levels of employees. The average distribution of skills from 1996 to 2005 has remained the same over the years according to the available data, which was as follows:

- Highly skilled : 14%
- Skilled : 33%
- Semi/unskilled : 53%

Chart 2.8: Skills levels for basic chemicals



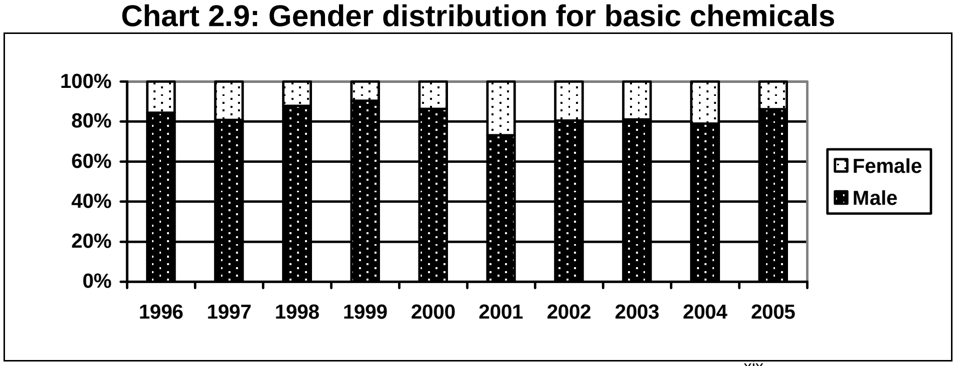
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Semi- and unskilled	9210	8852	8361	1044	9593	8637	8166	8349	7963	7493	7489
Skilled	5082	4994	4837	6209	5866	5433	5286	5559	5453	5277	5422
Highly skilled	2110	2097	2037	2606	2444	2241	2156	2241	2172	2078	2111

Source: Quantec Labour Market Survey, Reserve Bank [iii]

The average growth rate in employment for Basic Chemicals was less than 1% p.a. in the period of analysis, and was actually lower in 2005 than in 1995. This could be due to a general trend towards automation and capital intensiveness.[ii] Sasol however had large expansions and new capital investments[2] which could have increased the workforce numbers, but it is assumed that it is included in the previous section due to Sasol's integrated operations.

The gender distribution went up and down based on the available data, at an average of about 17% females over the period of analysis. This data is however questioned on its reliability.

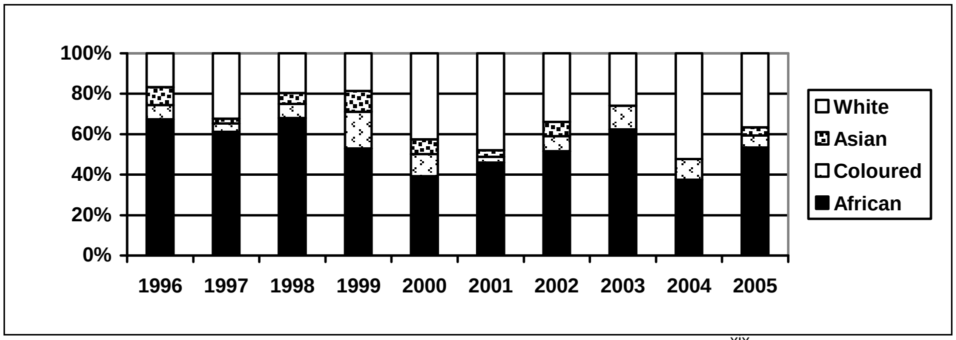
Chart 2.9: Gender distribution for basic chemicals



Source: Quantec Household and Labour Force Surveys, Stats, SA [xix]

The race distribution went up and down based on the data available, which is also questioned. A gradual increase in Black employees is rather expected.

Chart 2.10: Race distribution for basic chemicals



Source: Quantec Household and Labour Force Surveys, StatsSA [xix]

2.3.4 *Other chemicals and man-made fibres*

Other chemicals should include mostly downstream chemical manufacturers, i.e. pure functional and speciality chemicals, bulk formulated chemicals (smaller sites), pharmaceuticals, and consumer chemicals that mostly operate formulation processes[4]. These operations mostly have formulation processes in labour intensive manufacturing sites.

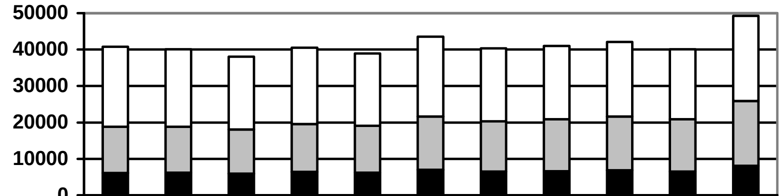
Skills requirements are mainly related to machine and plant operators, formulation technicians, plant superintendents, warehousing and distribution, maintenance, administration and general management. For pharmaceuticals, skills requirements also include technical managers, microbiologists and laboratory analysts.[vi]

Due to the formulation nature of this sector, there is a smaller focus upon process-related skills such as engineering, and more on commercial, professional (e.g. pharmacists) and scientific backgrounds. Manufacturing technicians are in high demand specifically for pure functional and speciality chemicals. Manufacturing is based on formulation, which generally requires a lower level of training. The major focus is on training related to the application of the end products and is mostly in-house based.[vi]

Chart 2.11 shows the total number of workers, as well the distribution between the skills levels of employees. The average distribution of skills from 1996 to 2005 has remained the same over the years according to the available data, which was as follows:

- Highly skilled : 16%
- Skilled : 34%
- Semi/unskilled : 50%

Chart 2.11: Skills levels for other chemicals and man-made fibres



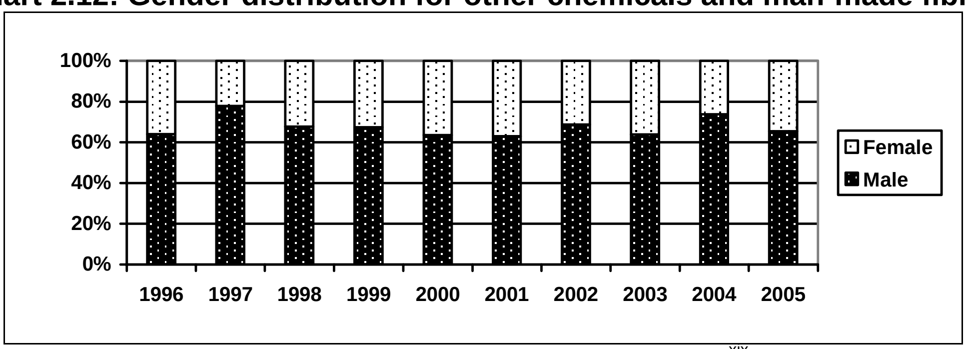
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Semi- and unskilled	21975	21288	19922	20937	19888	21952	20072	20147	20444	19237	23341
Skilled	12638	12601	12150	13159	12876	14631	13764	14206	14817	14327	17861
Highly skilled	6137	6171	5953	6413	6221	6994	6503	6634	6839	6538	8061

Source: Quantec Labour Market Survey, Reserve Bank [iii]

The average growth rate in employment was 2% p.a. over the period of analysis, which is similar to the overall production growth rate in the overall chemical sector. The jump in employees in 2005 is however questioned as there were not major new investments in this year.[xxii]

Women played a bigger role in other chemicals manufacturing than in basic chemicals at an average of 33% over the period of analysis.

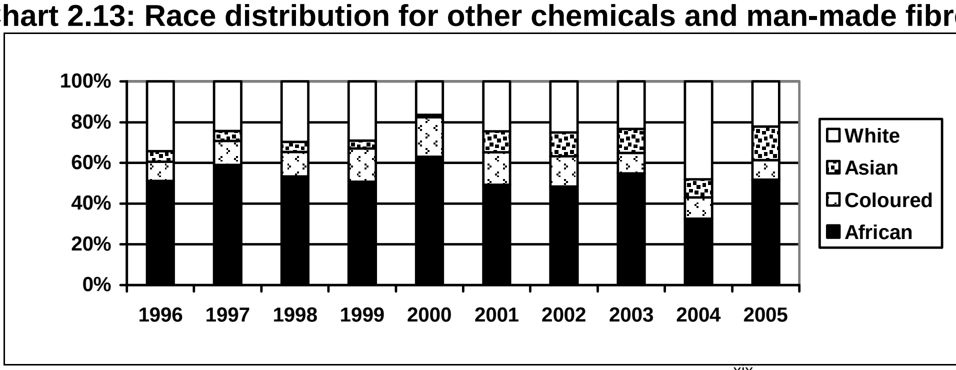
Chart 2.12: Gender distribution for other chemicals and man-made fibres



Source: Quantec Household and Labour Force Surveys, StatsSA [xix]

The race distribution went up and down according to the available data, which is questioned. A gradual increase in Black employees is rather expected.

Chart 2.13: Race distribution for other chemicals and man-made fibres



Source: Quantec Household and Labour Force Surveys, StatsSA [xix]

2.3.5 *Plastic products*

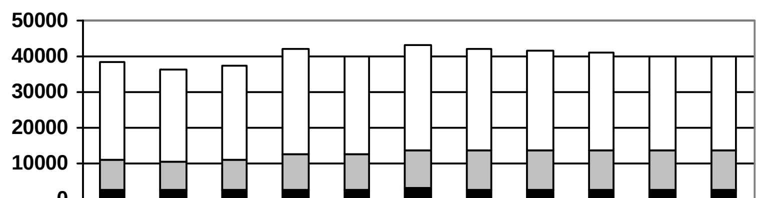
Plastic products are produced through various conversion processes such as injection moulding, blow moulding, extrusion, or others. Operations vary from large integrated capital intensive operations to small operations with one or two moulding machines per manufacturing site.

This sub-sector employs a low level of highly qualified engineers and scientists. The focus is on technicians and artisans, as well as a large number of lowly educated workers. Training in plastic processing are mostly provided in-house.[vi]

Chart 2.14 shows the total number of workers, as well as the distribution between the skills levels of employees. The average distribution of skills from 1996 to 2005 has remained the same over the years according to the available data, which was as follows:

- Highly skilled : 7%
- Skilled : 25%
- Semi/unskilled : 68%

Chart 2.14: Skills levels for plastic products



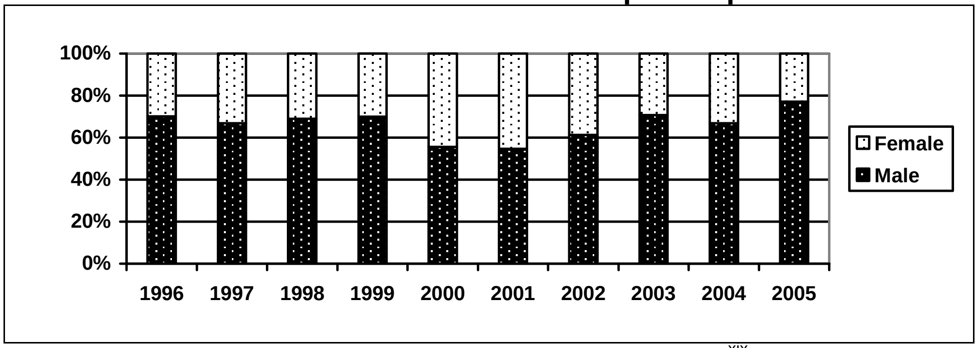
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
□ Semi- and unskilled	27388	25789	26071	29122	27536	29442	28430	27862	27148	26300	26102
▨ Skilled	8567	8326	8690	10016	9764	10755	10690	10777	10797	10750	10962
■ Highly skilled	2462	2379	2461	2805	2701	2939	2886	2875	2848	2805	2829

Source: Quantec Labour Market Survey, Reserve Bank [iii]

Growth in employment levels in plastic products went up and down according to the available data, which is questioned.

Women contributed to about one-third of employees in the plastic conversion sub-sector.

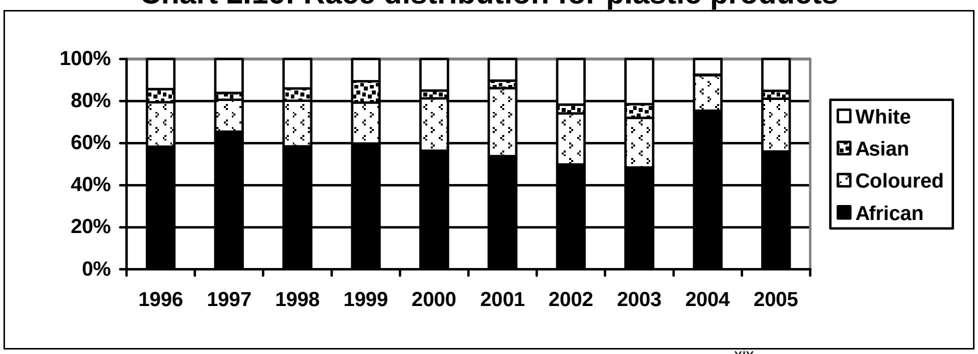
Chart 2.15: Gender distribution for plastic products



Source: Quantec Household and Labour Force Surveys, StatsSA [xix]

Much more Black people are employed in the plastic conversion sub-sector than in base and other chemicals, at an average of 85% over the period of analysis, based on the available data.

Chart 2.16: Race distribution for plastic products



Source: Quantec Household and Labour Force Surveys, StatsSA [xix]

2.3.6 *Rubber products*

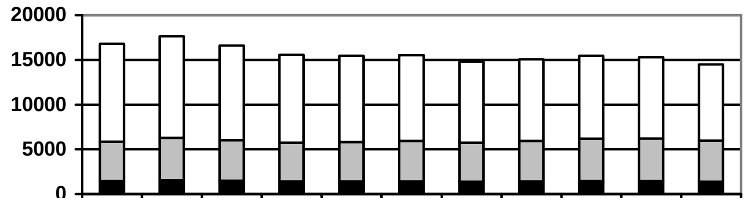
There are large capital intensive tyre manufacturers as well as smaller rubber converters in this sub-sector.

The sub-sector employs a low level of highly qualified engineers and scientists. The focus is on technicians and artisans, as well as a large number of lowly educated workers. Training in processing is mostly provided in-house.[vi]

Chart 2.17 shows the total number of workers, as well as the distribution between the skills levels of employees. The average distribution of skills from 1996 to 2005 has remained the same over the years according to the available data, which was as follows:

- Highly skilled : 9%
- Skilled : 29%
- Semi/unskilled : 62%

Chart 2.17: Skills levels for rubber products



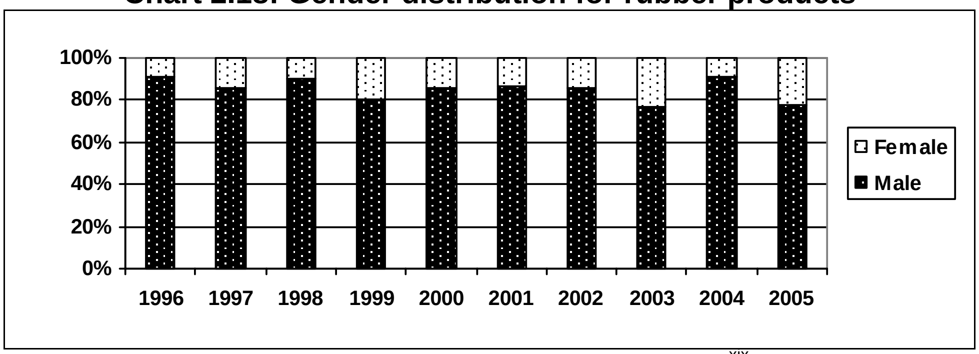
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Semi- and unskilled	10936	11356	10571	9810	9641	9603	9041	9122	9274	9076	8510
Skilled	4399	4717	4535	4343	4401	4516	4377	4543	4749	4777	4603
Highly skilled	1461	1558	1484	1405	1407	1426	1365	1400	1447	1439	1372

Source: Quantec Labour Market Survey, Reserve Bank [iii]

There was an average decrease of employment for rubber products of 1.4% p.a. over the period of analysis, according to the available data. This could be to the closure of smaller operations.

Females only contributed an average 15% of the workforce in the rubber products sub-sector over the period of analysis.

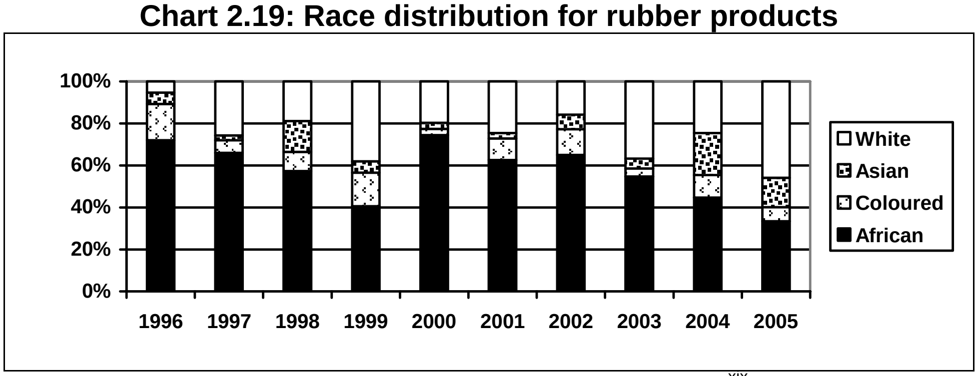
Chart 2.18: Gender distribution for rubber products



Source: Quantec Household and Labour Force Surveys, StatsSA [xix]

From the available data, it seems as if the contribution of Black employees decreased over the period of analysis, which is questioned.

Chart 2.19: Race distribution for rubber products



Source: Quantec Household and Labour Force Surveys, StatsSA [xix]

CHAPTER 3: SUPPLY OF SKILLS

3.1 Mathematics and science

3.1.1 *Introduction*

Study fields such as science and engineering, which is related to the chemical sector require maths and physical science. The following sections provide information on the Senior Certificate Examination (SCE) data for these subjects, maths and chemistry passes at public Further Education and Training (FET) colleges that are regarded as technical matric qualifications, as well as maths and science development initiatives in the chemical sector.

3.1.2 *Mathematics*

The total number of matric candidates passing maths on the SCE increased at an average annual growth rate of 5% between 1996 to 2005 from 108 910 in 1996 to 169 001 in 2005. The number of standard grade (SG) passes contributed to most of this growth, while the higher grade (HG) passes increased at a lower growth rate of only 2% p.a. The total number of HG passes were 26 383 in 2005 and the SG passes were 112 279 in 2005.[xxiii]

In addition to the above SCE passes in maths, there were an additional 8 550 passes of maths on NQF level 4 at the public FET colleges in 2005. The contents of the course differ from the SCE's in that it is adjusted to be more relevant to the technical outcome of the qualification that a candidate is doing. The number of passes at the public FET colleges increased at an average annual growth rate of 4% from 6 000 in 1996. There is no statistical data available from private FET colleges yet.[xxiv]

The racial breakdown of matric candidates writing HG maths on the SCE in 2005 was 59% African, 5% Coloured, 9% Asian and 27% White. There is a concern about the low pass rate of African candidates that was only 39% of the total number who wrote HG maths 2005. The pass rates of the other racial groups were 74% for Coloured candidates, 90% for Asian candidates and 95% for White candidates.[xxv]

3.1.3 *Physical science*

The total number of matric candidates passing physical science on the SCE increased at an average annual growth rate of 6% p.a. between 1996 and 2005 from 74 110 in 1996 to 129 358 in 2005. The number of SG passes contributed to most of this growth, while the HG passes increased at a lower growth rate of less than 2% p.a. The total number of HG passes were 29 965 in 2005 and SG passes were 73 667 in 2005.[xxvi]

In addition to the above passes in physical sciences, there were 147 passes in chemistry at public FET colleges in 2005, which increased from 116 in

1996. Chemistry is a component of the subject physical sciences in schools. The contents of the course differ from the SCE in that it is adjusted to be more relevant to the technical outcome of the qualification that a candidate is doing. There is no statistical data available from private FET colleges yet.[xxiv]

The racial breakdown of matric candidates writing HG physical science on the SCE in 2005 was 69% African, 3% Coloured, 7% Asian and 21% White. There is a concern about the low pass rate of African candidates that was only 31% of the total number who wrote HG maths 2005. The pass rates of the other racial groups were 71% for Coloured candidates, 82% for Asian candidates and 91% for White candidates.[xxiv]

3.1.4 *Development initiatives in the chemical sector*

Apart from the SA Government's funding initiatives to develop maths and science outcomes, various companies within in the chemical sector are also involved in such upliftment projects.

Some identified operations that are actively involved in maths and science development initiatives are discussed below. [xxvii] There could be many other initiatives in place that have not been identified.

AEL together with Tiso empowerment established the Tiso AEL Development Trust, which has launched a structured social investment campaign. One of the Trust's aims is the promotion of accounting, maths and science education.

Enref has pledged a number of years of support to the Technology Training Programme, a teacher training initiative aimed at teachers from previously disadvantaged schools, in conjunction with the KZN Education Department and Technology for All. This involved Enref's Saturday Supplementary Lessons Programme. Learners from grades 10-12 have attended free extra lessons in maths, biology and physics each Saturday to facilitate their studies. Particular attention was given to preparing matriculants for their final examinations.

Sapref and its sister company Shell Chemicals had joined forces to provide science kits for schools in the Merebank and Wentworth area. These kits would be used by learners in grades 10-12 comprised of mini chemistry equipment, electronics kits, spirit burners, electronic balance and power supply and would assist the schools with maths and science education.

The PetroSA Trust has a Mathematics, Science and Technology project involved in equipping schools with necessary equipment, and modifying buildings, where necessary, to accommodate proper science and computer laboratories.

Sasol is involved in several maths, science and technology projects and organisations in SA. Besides supporting several university and high-school school maths and science programmes, Sasol also runs two community resource centres, Osizweni near Secunda and Boitjhorisong at Sasolburg. These centres are focussed on bolstering high-school maths and science curricula and improving grade-12 pass marks. Sasol also sponsors the annual Sasol Techno X exhibition at Sasolburg and Scifest, the national science, engineering and technology festival in Grahamstown, as well as annual school science events in Mpumalanga, the Science, Engineering and Technology Week Exhibition and Eskom Expo for Young Scientists, as well as the Govan Mbeki Sasol Mathematics Programme at the Nelson Mandela Metropolitan University in Port Elizabeth.

3.2 **Sub-sectoral training**

Sub-sectoral training includes training initiatives that specifically focus on the requirements of each relevant chemical sub-sector. Although there are various universities and universities of technology offering courses related to the chemical sector such as chemistry and chemical engineering, there is a poor focus on providing a commercial understanding of the various sub-sectors.

For liquid fuels, commodity organics, primary polymers and rubbers, commodity inorganics, bulk formulated chemicals and pharmaceuticals the sophisticated nature of technology and processing require high-level training. This is mostly provided in-house by the operations and it involves international training for high-level workers. There is a high level of focus on process control, as well as on safety training. The Chemical and Allied Industries Association (CAIA) is also providing assistance with environmental training via the Responsible Care Program.[vi]

There is little focus on pharmaceuticals manufacturing by academic institutions. Industry-based training is provided on manufacturing best practices. Training has to be approved by the South African Pharmacy Council (SAPC) and the quality of courses is also controlled by it. The SAPC falls under the Department of Health (DoH).[vi]

There is no pure focus by academic institutions for formulated speciality and consumer chemicals or on pure functional chemicals. Manufacturing is based on existing formulations, which generally requires a lower level of training. The major focus is on training related to application technology and customer problem solving. Training is mostly in-house based.[vi]

The plastic and rubber conversion sub-sectors' focus is on technicians and artisans, as well as a large number of lowly educated workers. There is some focus on polymer processing by academic institutions such as Stellenbosch University. Training on processing are mostly provided in-house. The PFSA is also assisting with some training[8], while Sasol Polymers also has a polymer training facility.[vi] There are some independent training operations in the rubber sector that focus on lower level operational training.[xxviii]

[8] More details can be seen in the Plastics Federation Case Study in Chapter 5.

3.3 **Further education and training (FET) colleges**

3.3.1 *Introduction*

The only data available from the Department of Education (DoE) on FET colleges are on subjects entered and passed, and also only for public colleges. Private colleges' data is not available yet. Gender and race distributions are also not available.

This section only covers subjects that are directly related to the chemical sector on operational level. It therefore excludes any other technical trades that could be relevant to the chemical sector indirectly. FET subjects that were excluded from this analysis that could be linked indirectly to the chemical sector include: engineering science, plant engineering: factories, industrial orientation, industrial science, plant operation theory, factory organisation, supervision: industry, industrial organisation and planning, production/quality control, and control systems.

None of these skills were identified as scarce skills from this study or from the CHIETA's identified day-to-day scarce skills[xxix]. Engineers that were identified to be scarce for chemical sector developments have qualifications higher than NQF level 4 and therefore the Higher Education and Training (HET) supply data was rather analysed for these shortages.[9]

A subject that existed in 1996 but had no entrants from 1997 onwards is Coke and By-product Process Theory, while Fertiliser Manufacturing had no entrants from 2003 onwards. Subjects related to paints and plastics specifically also had very low numbers of entrants over the last 10 years and are therefore excluded from this analysis. It is expected that in-house training are more in practice in these categories than at the FET colleges.

The Department of Labour (DoL) has announced four routes people could take to train as artisans, which still needs to be gazetted before being legislated. This means that the subjects at the FET colleges alone will not be representative of the number of artisans trained, while the other information is not freely available without extensive research. The four routes are as follows:

- Standard Apprenticeships
- Recognition to Prior Learning (RPL) Apprenticeships based on workplace experience
- Registered Learnerships [NQF level 4]
- National Certificate Vocational (NCV) through FET colleges

The DoE is currently updating FET colleges, mostly in modernising workshops and physical resources. It is aiming to finalise the updating of training programmes for 22 priority artisanships by the end of 2008 and set to aside R600 million for bursaries for FET students between 2007 and 2010. Partnerships are actively encouraged to ensure colleges are responsive to industry demand.

[9] Refer to Chapter 7 for engineering skills shortages identified.

The 22 priority artisanships are:

- Engineering: Welders, Electricians, Fitters, Turners, Millwrights, Sheetmetal Workers, Biolermakers, Mechatronics, Mechanics, Toolmakers, Patternmakers
- Construction: Bricklayers, Plumbers, Carpenters, Joiners, Shutterhands, Steel fixers, Glaziers, Plasterers, Tilers
- Other: Sound technicians, Instrumentation and Electronics Technicians

Mr. Mike Macrae[xxx], the Manager of the Oil, Gas & Chemical Manufacturing Companies Artisan Skills Training Project[10], is of the opinion that riggers should also be added to the list of priority artisans, as they are particularly needed for expansion and/or maintenance projects in the chemical sector. Mr. Macrae is also concerned that the NCV curriculum might not meet the chemical sector's standards due to less practical training than in the other training routes, and because of construction being a key factor behind the FET recapitalisation programme that it might lead to training relevant mostly to the construction sector.

Although respondents from upstream operations such as NCP Chlorchem[xx] and Sasol[xxi] indicated that operators should have an NQF level 4 qualification, some downstream operations still employ lowly semi- or unskilled workers, such as the plastic and rubber sub-sectors[11]. For this reason the subjects passed that are relevant to the chemical sector are shown for all the available NQF levels on these subjects.

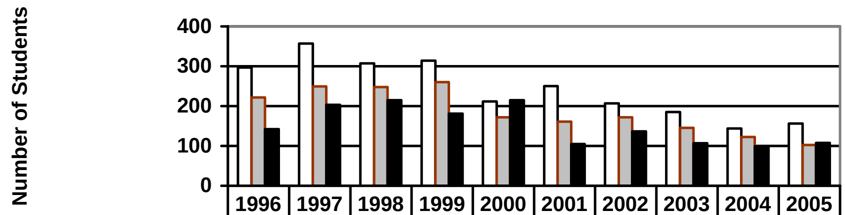
3.3.2 *Chemical laboratory technology (levels 1-3)*

There is a general decline in chemical laboratory technology passes over the period of analysis as can be seen in Chart 3.1. This specific skill has not been identified as a constraint in this study, but the CHIETA's latest SSP update on day-to-day scarce skills[xxix] shows that increasingly stringent requirements for access to export markets pose significant challenges to analytical requirements and that the dti has initiated a process to develop a strategy to promote laboratory services to support the chemical sector. It is therefore anticipated by the CHIETA that implementation of this strategy will lead to further demand for skills in this area.

[10] Refer to the Shutdown Network Forum Case Study in Chapter 5 for more information.

[11] Refer to Chapter 2 for more information on the distribution of skills levels in the various sub-sectors.

Chart 3.1: Chemical laboratory technology (Levels 1-3)



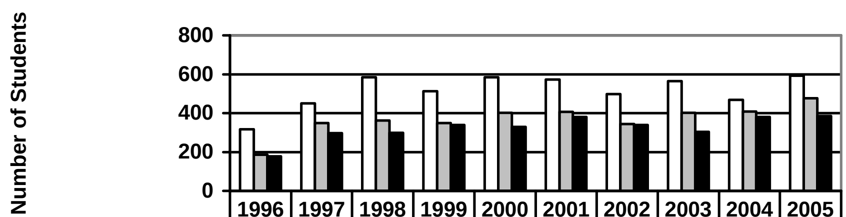
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Level 1 Passed	297	357	307	314	212	250	207	185	144	156
Level 2 Passed	222	249	248	260	172	161	172	145	123	102
Level 3 Passed	142	203	215	181	215	105	137	107	99	108

Source: Personal communication, DoE, April 2007 [xxiv]

3.3.3 *Industrial chemistry (levels 1-3)*

There has been an increase in industrial chemistry passes between 1996 and 2005. With chemical operators regarded as a scarce skill by the CHIETA in the current running of operations[xxix] this is a positive trend at the FET colleges as potential preparative subject for higher level subjects such as chemical plant operation.

Chart 3.2: Industrial chemistry (Levels 1-3)



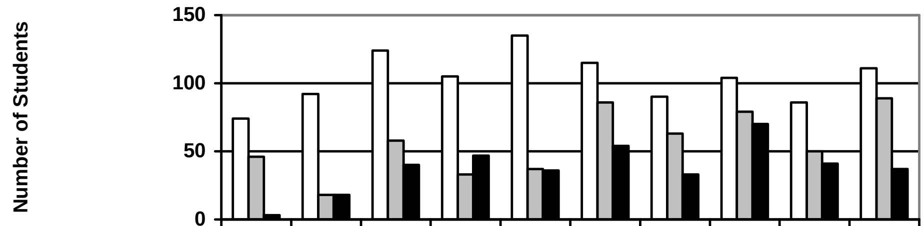
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Level 1 Passed	316	451	584	513	584	573	498	565	469	593
Level 2 Passed	186	350	363	350	402	406	345	401	408	477
Level 3 Passed	178	297	299	339	330	381	340	304	380	385

Source: Personal communication, DoE, April 2007 [xxiv]

3.3.4 *Chemical plant operation (levels 4-6)*

There has been up- and down movements in chemical plant operation passes over the period of analysis, although the outcome is more in 2005 compared to 1996. Chemicals plant operators however do not always need this subject as they generally need a matric with maths and science[xx/xxi]. They can therefore be trained as chemical plant operators after obtaining their matric certificates.

Chart 3.3: Chemical plant operation (Levels 4-6)



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Level 4 Passed	74	92	124	105	135	115	90	104	86	111
Level 5 Passed	46	18	58	33	37	86	63	79	50	89
Level 6 Passed	3	18	40	47	36	54	33	70	41	37

Year

Source: Personal communication, DoE, April 2007 [xxiv]

3.4 Higher education

3.4.1 *Introduction*

This section provides an analysis of graduation data from higher education institutions, i.e. universities and universities of technology, as obtained from the DoE. The focus is on fields of study related to the chemical sector.

For each subject area the data is split into NQF Level 5 [college and universities of technology: Bachelors of Technology (B Tech), national diplomas, and certificates or other diplomas], NQF level 6 [Bachelor Degrees (B Degree), Professional B Degrees and Post Graduate (PG) certificates/diplomas] and NQF 7-8 [Honours, Masters, and Doctorates].

3.4.2 *Chemistry*

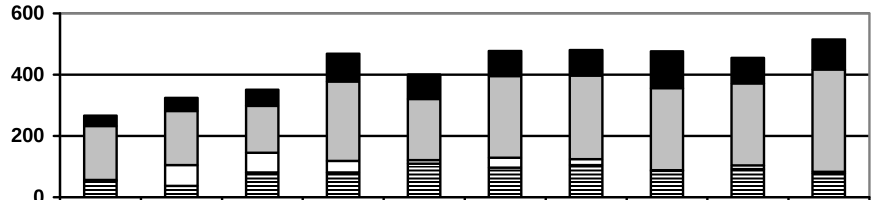
According to vacancy data from the Sunday Times Newspaper[xxxi] the average amount of chemists required was 101 people p.a. for the period April 2005 to March 2007. Charts 3.4 and 3.5 show that the supply in chemistry graduates is exceeding the demand.

a) NQF level 5 chemistry

There has been a gradual increase in NQF level 5 chemistry graduates, with national diplomas contributing to most of the qualifications.[12]

[12] FET passes in the subject chemistry was added, but this does not necessarily mean that a qualification in chemistry was obtained by these candidates.

Chart 3.4: NQF level 5 chemistry graduates



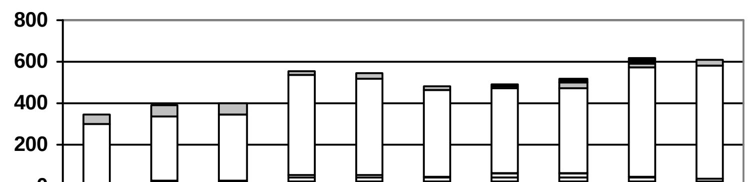
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
■ B Tech	35	44	53	92	80	82	83	120	83	98
▨ National Diploma	175	176	153	258	199	266	272	268	268	334
□ Certificate/Diploma	4	68	64	38	12	32	20	2	12	6
▤ FET Passes	53	37	81	81	110	97	105	86	92	77

Source: Personal communication, DoE, April 2007 [xxiv]

b) NQF level 6 chemistry

There has been a gradual increase in NQF level 6 chemistry graduates, with B Degrees contributing to most of the qualifications.[12]

Chart 3.5: NQF level 6 chemistry graduates



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
■ PG Certicate/Diploma	0	0	0	0	0	1	5	12	21	3
▨ Prof B Degree	51	54	53	22	25	16	16	26	17	23
□ B Degree	291	308	326	478	464	422	408	408	531	544
▤ FET Chemical Technology	7	26	23	54	56	42	62	68	46	38

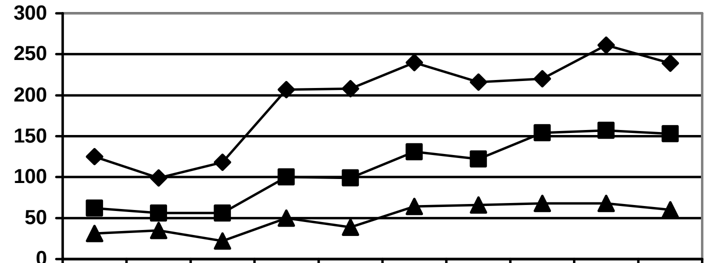
Source: Personal communication, DoE, April 2007 [xxiv]

c) NQF level 7 and 8 chemistry

The number of Honours, Masters and Doctorate chemistry graduates increased over the period of analysis, but however showed a flat line between 2003 and 2005. Due to there not being a high focus in R&D in the SA chemical sector[13] this is not regarded as a concern. Sasol[2] is the only operation in SA with high R&D levels, is also actively promoting skills development in this area.

[13] Refer to Chapter 6 for more information on R&D levels in the local chemical sector.

Chart 3.6: NQF level 7 and 8 chemistry graduates



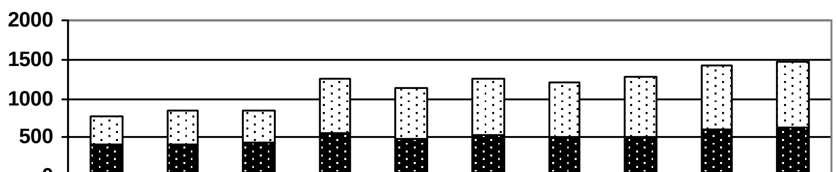
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Honours	125	99	118	207	208	240	216	220	261	239
Masters	62	56	56	100	99	131	122	154	157	153
Doctorate	31	35	22	50	39	64	66	68	68	60

Source: Personal communication, DoE, April 2007 [xxiv]

d) Gender distribution of chemistry graduates

Male graduates made up about 50% of the total chemistry graduates at HET institutions in 1996 and although their numbers increased a bit, their contribution went down to about 40% in 2005 due to the increase in the number of female graduates.

Chart 3.7: Chemistry gender distribution



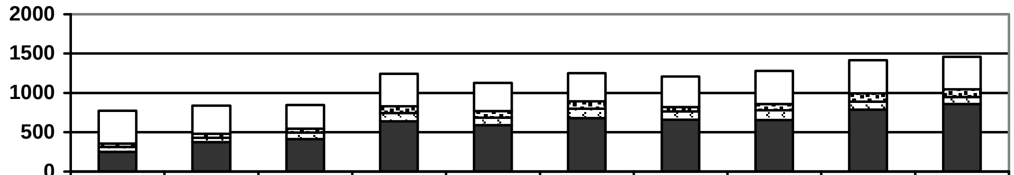
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Female	364	426	420	692	648	711	706	769	819	841
Male	410	414	426	553	477	542	501	508	599	619

Source: Personal communication, DoE, April 2007 [xxiv]

e) Racial distribution of chemistry graduates

The number of African graduates in chemistry was four times more in 2005 than in 2001, which is almost the only contributor to the increased number of total graduates in 2005.

Chart 3.8: Chemistry race distribution



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
White	419	362	300	415	359	361	388	418	423	416
Coloured	44	51	48	85	81	92	56	80	105	95
Asian	62	53	85	106	97	122	106	123	99	90
African	248	374	412	639	589	678	658	656	789	859

Source: Personal communication, DoE, April 2007 [xxiv]

3.4.3 *Chemical engineering and technology*

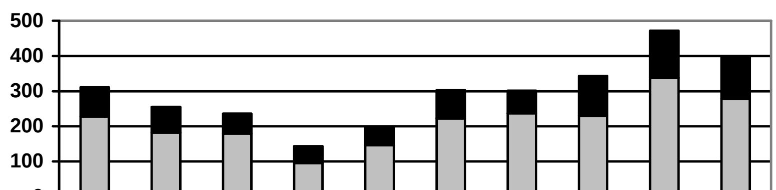
There were 711 registered professional chemical engineers at Engineering Council of South Africa (ECSA) on 31 August 2007. Professional engineers are university graduates with three years workplace experience. Registration is however not compulsory yet, and therefore there could be other professional chemical engineers working in SA currently.[xxxii]

a) NQF Level 5 and 6 chemical engineering and technology

Chemical Engineers with experience are regarded as a scarce skill, and not necessarily the graduate outcomes[xxxiii].

There has been a drop in chemical engineering graduates on NQF level 5 from 1996 to 1999, after which there was an increase again and another drop in 2005.

Chart 3.9: NQF level 5 chemical engineering and technology graduates

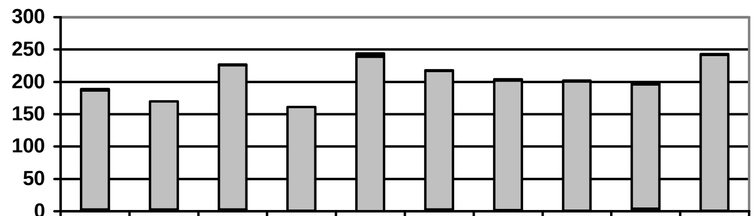


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
B Tech	83	73	56	48	53	80	64	113	135	120
National Diploma	228	182	180	96	146	223	235	230	336	278
Certificate/Diploma	0	0	0	0	0	0	2	0	1	0

Source: Personal communication, DoE, April 2007 [xxiv]

There was a high growth rate in NQF level 6 graduates 2004 and 2005.

Chart 3.10: NQF level 6 chemical engineering and technology graduates



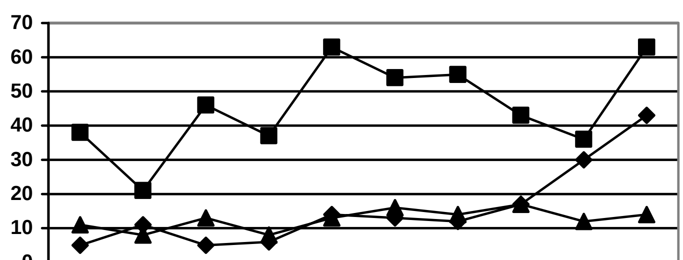
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
PG Certicate/Diploma	2	0	1	0	5	1	2	1	2	1
Prof B Degree	184	167	223	160	239	214	200	200	192	241
B Degree	3	3	3	1	0	3	2	1	4	1

Source: Personal communication, DoE, April 2007 [xxiv]

b) NQF level 7 and 8 chemical engineering and technology

There were a lot more Masters than Honours graduates over the period of analysis, showing irregular patterns, but there a high growth when 1995 and 2005 are compared with each other. Honours students also showed a sharp increase in the last few years, while the Doctorates remained fairly stable. There were no scarce skills identified in these higher levels from either the CHIETA's day-to-day scarce skills[xxix] or from this investigation, and Sasol[2] is also actively promoting skills development in this area.

Chart 3.11:
NQF level 7 and 8 chemical engineering and technology graduates



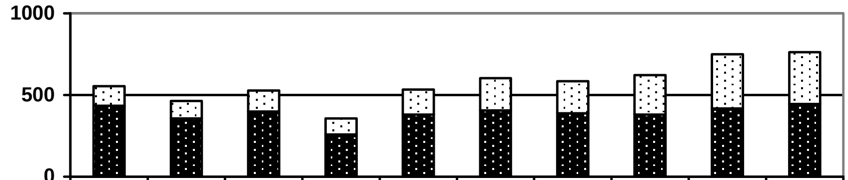
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Honours	5	11	5	6	14	13	12	17	30	43
Masters	38	21	46	37	63	54	55	43	36	63
Doctorate	11	8	13	8	13	16	14	17	12	14

Source: Personal communication, DoE, April 2007 [xxiv]

c) Gender distribution of chemical engineering and technology graduates

The number of male graduates remained fairly constant, but their contribution went down with about 20% due to increased numbers of female graduates.

Chart 3.12: Chemical engineering and technology gender distribution



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Female	121	108	129	98	153	199	196	241	332	318
Male	433	356	399	259	380	405	388	380	417	444

Source: Personal communication, DoE, April 2007 [xxiv]

d) Racial distribution of chemical engineering and technology graduates

The number of African graduates doubled between 1996 and 2005, which contributed mostly to the total increased number of graduates.

Chart 3.13: Chemical engineering and technology race distribution

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
White	235	197	221	164	185	169	162	138	146	166
Coloured	39	19	30	31	38	33	41	40	46	50
Asian	96	104	64	26	100	87	91	111	88	119
African	184	144	214	136	209	314	290	332	469	426

Source: Personal communication, DoE, April 2007 [xxiv]

3.4.4 *Pharmaceutical science*

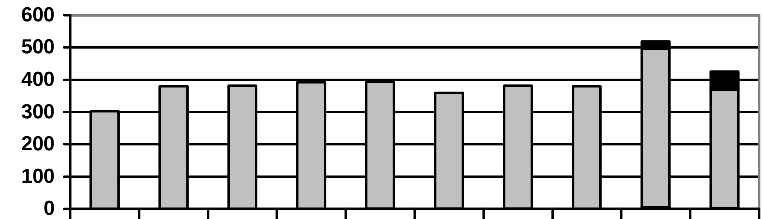
a) NQF level 5 pharmaceutical science

Pharmaceutical science graduates on NQF level 5 is very low, with only 35 in 1996, 24 in 1997, 29 in 1998, one in 1999, four in 2001, and 33 in 2004. It seems as if courses are rather taken on NQF level 6 and higher.[xxiv]

b) NQF level 6 pharmaceutical science

NQF level 6 pharmaceutical science graduates have stayed fairly constant over the period of analysis, with a sharp increase in 2004, and a decrease back to the average levels again in 2005. The average number of vacancies for pharmacists as identified from the Sunday Times Newspaper[xxxi] between April 2004 and March 2007 is however 636 p.a., which shows that the average annual supply of pharmacists p.a. currently does not meet the demand.

Chart 3.14: NQF level 6 pharmaceutical science graduates



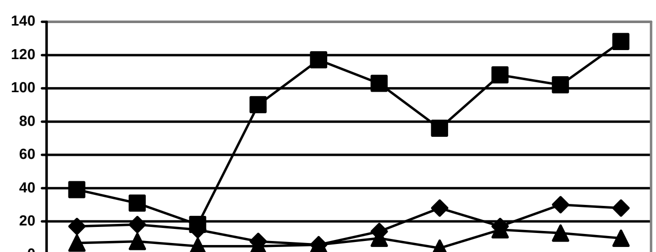
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
PG Certicate/Diploma	0	0	0	0	0	0	0	0	22	57
Prof B Degree	303	380	382	392	393	359	381	380	491	367
B Degree	0	0	0	0	1	1	1	0	6	2

Source: Personal communication, DoE, April 2007 [xxiv]

c) NQF level 7 and 8 pharmaceutical science

Masters students were higher in volume and increased at a higher rate than Honours students in pharmaceutical science. The Honours and Doctorate graduates seem to have remained fairly constant. Pharmaceutical science Masters graduates are regarded as scarce in the pharmaceutical sector, especially those that have a strong chemical background, and therefore the increased numbers are regarded as positive for further development of the pharmaceuticals sub-sector.[14]

Chart 3.15:
NQF level 7 and 8 pharmaceutical science



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Honours	17	18	15	8	6	14	28	17	30	28
Masters	39	31	18	90	117	103	76	108	102	128
Doctorate	7	8	5	5	6	10	4	15	13	10

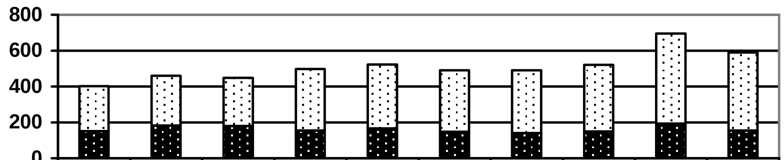
Source: Personal communication, DoE, April 2007 [xxiv]

d) Gender distribution of pharmaceutical science graduates

[14] Refer to the Adcock Ingram Case Study in Chapter 5 for more details.

The number of male graduates remained fairly constant over the period of analysis, while the female graduates contributed to the increased number of total graduates.

Chart 3.16: Pharmaceutical science gender distribution



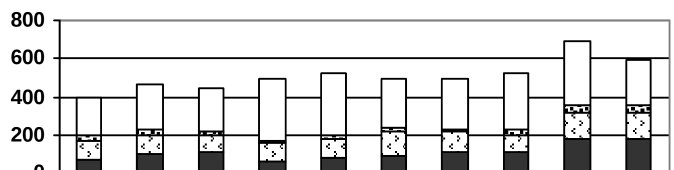
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Female	249	277	269	343	356	343	349	372	503	435
Male	152	183	180	154	167	148	141	149	193	155

Source: Personal communication, DoE, April 2007 [xxiv]

The contribution of African graduates has increased from 20% in 1996 to 30% in 2005, while the White graduates fell with the same percentage. Asians and Coloureds stayed approximately the same in their contribution for this period.

e) Race distribution of pharmaceutical science graduates

Chart 3.17: Pharmaceutical science race distribution



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
White	206	237	227	324	321	253	259	291	339	238
Coloured	28	24	20	10	24	21	16	29	44	36
Asian	95	98	95	107	101	127	104	94	130	134
African	71	102	107	55	75	90	110	107	182	182

Source: Personal communication, DoE, April 2007 [xxiv]

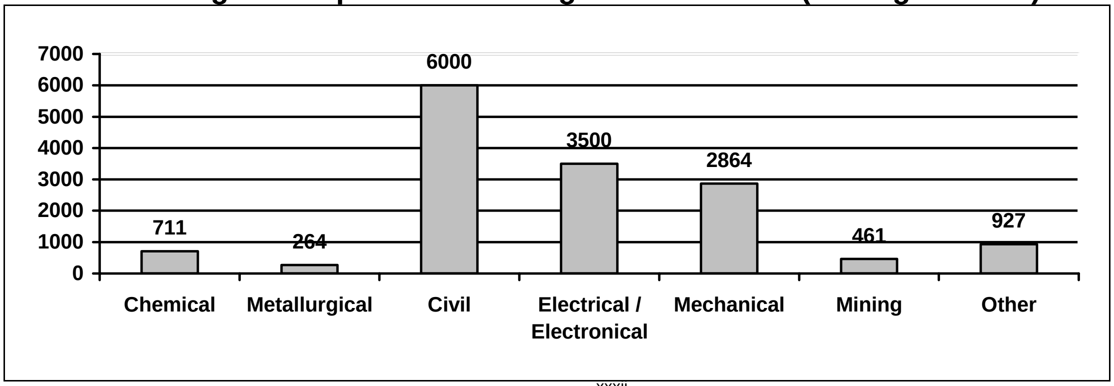
3.4.5 *Engineering and engineering Technology*

Engineering and Engineering Technology includes all the engineering fields, as well as Chemical Engineering and Technology that is discussed separately above.

There were 14 727 professional engineers (Prof B Degree), 2 944 Technologists (B Tech), 3 099 Technicians (Diploma) registered at ECSA on 31 August 2007. Registration is however not compulsory yet.[xxxii]

The breakdown in registered professional engineers is shown in Chart 3.18:

Chart 3.18: Registered professional engineers at ECSA (31 August 2007)



Source: Personal communication, ECSA, April 2007 [xxxii]

Several of these engineering disciplines are regarded as scarce in the chemical sector, especially for identified expansion projects[15]. These disciplines include civil, electrical and instrumentation, and mechanical engineers. An analysis was therefore made on the supply data of these engineers for NQF levels 5 and 6. There was no mention on shortages for NQF levels 7 or 8 and these supply numbers were therefore excluded. Due to these disciplines not being directly related to the chemical sector, gender and racial distributions were also not done.

3.4.6 *Civil engineering*

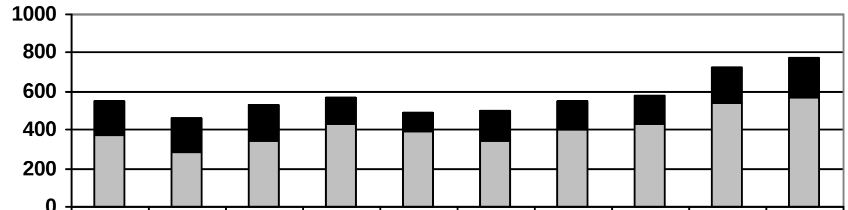
The average number of civil engineering graduates between 2004 and 2005 amounted to 931 p.a. as can be seen in Charts 3.19 and 3.20, while the demand according the vacancies in the Sunday Times Newspaper[xxxi] amounted to 1 120 for April 2006 to March 2007, which was an increase from 688 in the year before that. Although it seems as if enough civil engineers are supplied on average, the large number of capital projects currently running and the increase in demand for civil engineers in SA might cause a supply deficit in the near future.[10]

a) NQF level 5 civil engineering graduates

There is a general increase in civil engineering graduates over the last few years of analysis.

[15] Refer to Chapter 6 for more information on future capital investments.

Chart 3.19: NQF level 5 civil engineering



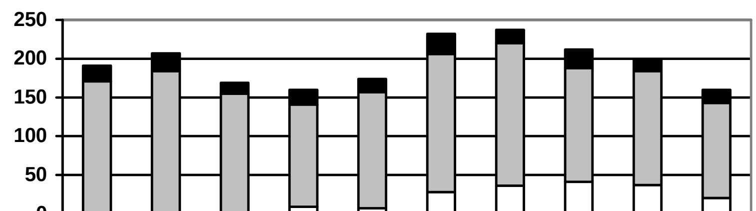
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
B Tech	182	179	187	135	94	148	151	139	186	209
National Diploma	371	285	341	429	396	348	397	435	542	566
Certificate/Diploma	0	0	0	2	0	0	3	1	1	0

Source: Personal communication, DoE, April 2007 [xxiv]

b) NQF level 6 civil engineering graduates

There was a decline in NQF level 6 civil engineering graduates. This is a cause for concern, especially with the number of construction products in SA at the moment.[10]

Chart 3.20: NQF level 6 civil engineering graduates



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
PG Certicate/Diploma	20	23	14	19	17	26	17	24	14	17
Prof B Degree	171	184	155	132	150	178	184	147	147	123
B Degree	0	0	0	9	7	28	36	41	37	20

Source: Personal communication, DoE, April 2007 [xxiv]

3.4.7 *Instrumentation engineering*

There was almost no instrumentation engineering graduates from the data made available by the DoE. These engineers could be listed under other engineering professions such as electrical engineering, but could not be verified.

3.4.8 *Electrical engineering*

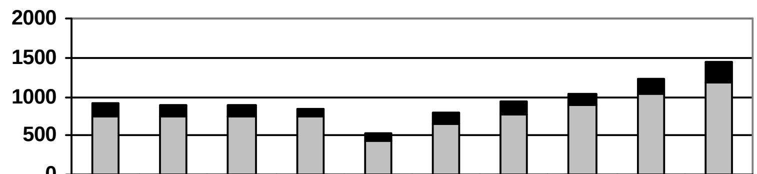
The demand for electrical engineers from vacancies in the Sunday Times Newspaper[xxxi] was 243 for April 2005 to March 2006, and almost doubled to

430 in the following year. Based on the supply data in Charts 3.21 and 3.22, there still seems to be ample electrical engineers graduating.

a) NQF level 5 electrical engineering graduates

There is a gradual increase in NQF level 5 electrical engineering graduates.

Chart 3.21: NQF level 5 electrical engineering



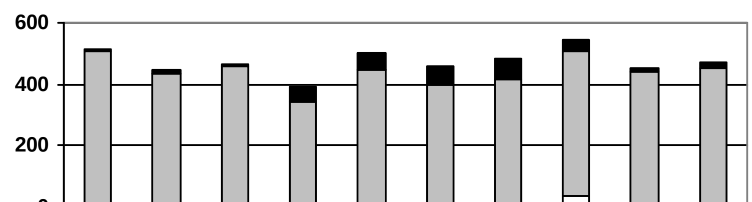
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
B Tech	169	139	139	95	90	135	159	155	207	264
National Diploma	742	745	754	740	439	644	777	890	1028	1179
Certificate/Diploma	0	0	0	1	2	6	3	2	0	0

Source: Personal communication, DoE, April 2007 [xxiv]

b) NQF level 6 electrical engineering graduates

The number of electrical engineering graduates went up and down over the period of analysis, with decreases in 2004 and 2005.

Chart 3.22: NQF level 6 electrical engineering graduates



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
PG Certicate/Diploma	7	11	6	50	55	61	67	35	10	21
Prof B Degree	501	433	456	328	442	386	412	472	431	447
B Degree	5	4	5	12	4	11	4	39	10	6

Source: Personal communication, DoE, April 2007 [xxiv]

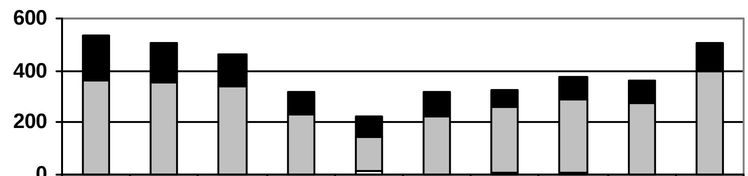
3.4.9 *Mechanical engineering*

The demand for mechanical engineers from the vacancies in the Sunday Times Newspaper[xxxi] was 415 from April 2005 to March 2006, and jumped to 592 in the year after that. These vacancies included industrial and production engineers, which might fall under other engineering professions than mechanical. Based on the supply data shown in Charts 3.23 and 3.24, the mechanical engineer supplies still seem to meet the demand.

a) NQF level 5 mechanical engineering graduates

There was a large dip on mechanical engineering graduates on NQF level 5 towards 2000, but it started picking up again.

Chart 3.23: NQF level 5 mechanical engineering graduates



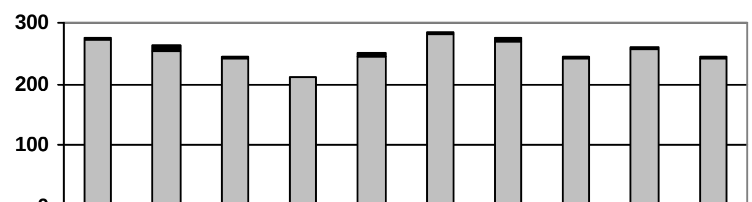
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
B Tech	170	147	123	92	79	98	69	89	83	105
National Diploma	362	355	337	227	129	222	250	281	278	397
Certificate/Diploma	0	2	2	1	17	1	7	7	0	1

Source: Personal communication, DoE, April 2007 [xxiv]

b) NQF level 6 mechanical engineering graduates

Mechanical engineers on NQF level 6 went up and down in numbers over the period of analysis.

Chart 3.24: NQF level 6 mechanical engineering graduates



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
PG Certicate/Diploma	4	9	3	1	5	2	5	2	4	4
Prof B Degree	271	252	242	210	246	283	268	241	256	241
B Degree	1	2	1	1	0	0	1	2	1	0

Source: Personal communication, DoE, April 2007 [xxiv]

3.4.10 *Other qualifications*

Other areas of study might be linked indirectly to the chemical sector, e.g. that certain levels of subjects might be needed to complete a degree such as chemical engineering, but the qualifications as such have not been identified as needed or scarce from either this study of from the CHIETA's latest data on scarce and critical skills in day-to-day running of operations[xxix]. These qualifications were therefore not analysed for this report, which include mathematical sciences, physics, and biological sciences.

3.5 Sectoral Education & Training Authority (SETA) training

3.5.1 *Background*

Both the CHIETA and MERSETA service the chemical sector in SA. The CHIETA covers the first nine sub-sectors and the MERSETA plastic and rubber conversion.[4]

Training data of the member companies are provided through annual training reports and Workplace Skills Plans (WSPs) to the SETAs. WSPs were not made available from either of the SETAs for analysis.

3.5.2 *CHIETA*

The CHIETA currently has 64 registered learnerships in place, as well as a large number of other learnerships available through Memorandums of Understanding with other SETAs.

The CHIETA did not make their learnership data available (i.e. how many learners enrolled and completed their training). There has been no response from them regarding this after several attempts to obtain this information. No respondents were available and did not return any calls either. The Chairperson of the CHIETA Board and also the Executive Director of CAIA, Dr. Laurraine Lotter[xxxiv], complained about research fatigue in the chemical sector questioned why this information should be made available, and subsequently did not make it available.

The available learnerships from the CHIETA for the chemical sector (therefore exclude the glass related learnerships that are also available from the CHIETA) are as follows[xxxv]:

- Chemical Fitter [NQF 2-4]
- Chemical Boilermakers [NQF 2-4]
- Chemical Rigger [NQF 2-4]
- Chemical Turner [NQF 2-4]
- Chemical Electrician [NQF 2-4]
- Chemical Instrument Mechanic [NQF 2-4]
- Chemical Welder [NQF 2-4]
- Medical Sales Representative [NQF 5]
- Chemical Adult Basic Education and Training (ABET) [NQF 1]
- Technician: Analytical Chemistry [NQF 6]
- Chemical Engineer [NQF 6]
- Chemical Operator [NQF 1]
- Chemical Equipment Operator [NQF 2]
- Chemical Systems Operator [NQF 3]

- Technician: Electrical Engineering [NQF 6]
- Technologist: Electrical Engineering [NQF 7]
- Engineer: Electrical Engineering [NQF 8]
- Technician: Mechanical Engineering [NQF 6]
- Engineer: Mechanical Engineering [NQF 8]
- Bachelor of Technology: Pharmaceutical Science [NQF 7]
- Master of Technology: Pharmaceutical Science [NQF 8]
- Chemical Process Operator [NQF 4]
- Technologist: Chemical Engineering [NQF 7]
- Research Technologist: Chemical Engineering [NQF 8]
- Chemical Operator: Chemical Liquid, Gas Storage and Transfer [NQF 2]
- Explosives Plant Operator [NQF 2]
- Explosives Manufacturing Plant Operator [NQF 3]
- Manufacturing Assembly Operations Supervisor [NQF 4]
- Batch Mixing (National Certificate)
- Technologist: Mechanical Engineering [NQF 7]
- Technician: Industrial Engineering [NQF 6]
- Technologist: Industrial Engineering [NQF 7]
- Engineer: Industrial Engineering [NQF 8]
- Technician: Polymer Technology (Surface Coating) [NQF 6]
- Engineer: Polymer Technology (Surface Coating) [NQF 7]
- Technologist: Chemistry [NQF 7]
- Technologist: Research and Development: Chemistry [NQF 8]
- Operation of Mobile Explosives Manufacturing Units (National Certificate)
- Automated Packaging [NQF 3]
- Manufacturing Operations Household and Personal care [NQF 3]
- Laboratory Analyst (FET Certificate)
- Chemical Manufacturing Operations [NQF 2]
- Technician: Engineering Technology [NQF 6]
- Technologist: Engineering Technology [NQF 7]
- National Certificate: Manufacturing of Surface Coatings [NQF 3]

Training providers for NQF levels 5 to 8 include various universities and universities of technology, while ABET training is covered by institutions such as FET colleges. The CHIETA also has additional accredited training providers that are not available to the public for viewing unless released by the CHIETA themselves.

A summary of the CHIETA training providers in the chemical sector are as follows:
- Full qualifications: 26 manufacturing sites in the chemical sector (mostly the larger operations); 9 training and other organisations
- Unit standards: 9 manufacturing sites in the chemical sector; 14 training and other organisations
- Accredited with other Education and Training Authorities (ETQAs): 16 training or other organisations

3.5.3 *MERSETA*

Registered learnerships specifically related to the plastic and rubber conversion sub-sectors at the MERSETA can be seen in Table 3.1. for 1 April 2007 to 31 March 2008. Historical information was not made available by the MERSETA.

The following learnerships had no registrations in this period: Mechanical Engineering (Machining) (Plastic Mould Maker) Level 2; Polymer Composite Fabrication Levels 3 and 4; Thermoplastic Fabrication Levels 3 and 4; Plastics Manufacturing Level 5; Industrial Rubber Manufacturing (Mixing or Extruding or Moulding or Calendaring) Level 3, 4 and 5; Quality Assuror of Tyre Manufacturing Processes Level 4; Quality Checker and Finisher of Manufactured Tyres Level 2; Quality Checker of Tyres and Tyre Components Level 3; Tyre Builder Level 3; Tyre and Tyre Component Manufacturer Level 3 and 4.

Table 3.1: Registered MERSETA learnerships related to the chemical sector (1 April 2007 – 31 March 2008)

Qualification Title	Total	Regis-tered Status	Qualification Obtained	Withdrawn
Polymer Composite Fabrication Level 2	251	27	195	29
Thermoplastic Fabrication Level 2	22	22		
Plastics Manufacturing Level 2	245	37	139	69
Plastics Manufacturing Level 2 (reviewed)	109	109		
Plastics Manufacturing Level 3	17	11	6	
Plastics Manufacturing Level 3 (reviewed)	21	4	13	4
Plastics Manufacturing Level 4 (reviewed)	5	5		
Industrial Rubber Manufacturing (Mixing or Extruding or Moulding or Calendaring) Level 2	56	56		
Rubber Technologist Manufacturing Level 5	19		8	11
Tyre and Tyre Component Manufacturer Level 2	1	1		

Source: MERSETA, Personal Communication, September 2007. South Africa. [xxxvi]

The largest number of learnerships therefore obtained through the MERSETA in the relevant chemical sub-sector in this period, was in polymer composite fabrication Level 2 and Plastics Manufacturing Level 2. This is positive, especially with the Chemical Sector Development Strategy[iv] prioritising increased plastic products production in SA as one of its key action programmes for downstream development.

3.6 Artisan training initiatives

A major artisan training initiative in the chemical sector is the Shutdown Network Forum Employment and Skills Development Lead Employer.[10]

Other identified artisan training projects across the SA economy for 2010 are as follows:[xxx]

- Coega Industrial Development Zone (IDZ): 4 000
- MERSETA: 4 000
- Steel and Industries Federation of South Africa (SEIFSA): 6 000 metal engineering artisans over and above own-employer need
- State Owned Enterprise (SOEs): 4 000

An investigation is currently underway by the Coega Development Corporation (CDC) to determine the feasibility of establishing a chemical cluster development at the Coega IDZ[xxxvii]. The CDC is also adjudicating expressions of interest for the construction of a new refinery in its IDZ of which the two bidders are PetroSA and the Port Elizabeth-based project development firm Bidco[xxxviii].

Duncan Grenfell[xxxix], a Project Manager at Coega Human Capital Solution, said that the Coega IDZ is in partnership with the MERSETA, CHIETA and the Energy SETA, which have donated R22 million towards training artisans over three years. By the end of October 2007, they would have had 1 000 artisans in training. The trainees start at NQF level 2 and progress to NQF level 4, which is in theory equal to a trade test. The main artisans being trained are boilermakers, welders, fitters, machinists and electricians.

Once trained, these artisans will be used during the construction process at Coega, and will also be used by the CDC as well as their customers that will be sited at Coega. Once the construction has been completed, the trained personnel will have to find alternative suitable employment. Some may be able to find employment within the investigated chemical hub for maintenance teams.

Government-funded artisan training was set to accelerate with a R300 million allocation as reported in September 2007 from the DoL to train 20 000 people. The funds would be provided to companies willing to train unemployed people in the 22 scarce artisan fields as listed in section 3.3 of this report.

The DoE is also working on increasing SA's artisan complement, and is updating training programmes for the 22 prioritised artisans by the end of 2008. It has R600 million for bursaries for FET students between 2007 and 2010 as well as a recapitalisation programme of R1.9 billion for FET colleges.

The DoL is also aiming to have registered the first batch of the Employment Skills Development Agencies (ESDA) across the economy by February 2008. The ESDAs will be organisations or companies that, through a written agreement with employers, employ trainees and manage their placement with host employers for on-the-job training. Trainees will also be sent to formal institutions for training. This initiative involves artisan training.[xl]

3.7 Engineering training initiatives

Some of SA's universities are working with the Joint Initiative for Priority Skills Acquisition (Jipsa) on increasing the yield of professional engineering graduates by about 1 000 per year, by addressing the issues that influence the current pass rates of entrants. This number was derived from consultations with institutions that produce engineering and related skills as well as professional councils that register these skills.[xli]

There are several challenges to increase this yield such as the educational quality of entrants and their understanding of engineering, student attitudes and their social conditions, academic and social demands, training resources, funding, amongst others.[xli]

There are several other investments in the chemical sector to promote the training of engineers, of which one of the largest is Sasol[2].

Other operations in the chemical sector that have also been identified from an Internet research exercise to offer bursaries (not only to engineers) are shown below. There might be other operations that provide bursaries too in the chemical sector that have not been identified.[xxvii]

- Liquid fuels: Caltex, PetroSA and Sapref
- Primary polymers and rubbers: Safripol
- Commodity inorganics: Afrox
- Pure functional and speciality chemicals: Chemserve, Clariant, Formalchem, Henkel, Stoncor and Vivendi Water Systems
- Bulk formulated chemicals: AEL, Omnia and Somchem
- Pharmaceuticals: Adcock Ingram, Aspen Pharmacare, Johnson & Johnson and Sandoz
- Consumer chemicals: Amka Product and Unilever
- Plastic products: Aberdare SA, African Cables, Astrapak, ATC, Marconi and Multotech

3.8 Entrepreneurial training for downstream development

There are three chemical incubators that are aimed at downstream development projects in the chemical sector of SA, namely Chemin, ChemCity and Sedichem. Chemin is specifically involved in some entrepreneurial training initiatives.[1]

3.9 Research and development training funds

The Department of Science and Technology (DST) has increased its investment in research from 0.6% of GDP in 1997 to a planned 1% of GDP for 2008. The DoE has however decreased investment in higher education from 0.87% of GDP in 1987 to 0.6% of GDP in 2006. This had meant a flat line in staff appointments at a time when student numbers increased, which meant that SA's academics were teaching more and researching less.[xlii]

The National Research Fund (NRF) put R1.5 billion into research in 2006 and planned to grow this investment to R3.1 billion by 2008, with the aim to increase the number of Black researchers and young people. It has also started sponsoring university chairs and centres of excellence.

Government is also planning to create a public funding agency, to be known as the Technology Innovation Agency, which will fall under the DST. Partnerships with industry will be critical for this agency to be successful. Innovation is however also very dependant on Government incentives when international models of success is evaluated such as Norway, Finland, India, Pakistan and others.[xlii] The Treasury has already introduced an R&D tax incentive in 2006 that allows companies to claim a 150% rebate in their research activities.[xliii]

CHAPTER 4: FUTURE CAPITAL INVESTMENTS

O_3bc has developed a data base on capital investments in the SA chemical sector from the year 2000 onwards that includes future planned investments. The data was obtained from publications such as the Business Day, Engineering News, as well as from an Internet desk research exercise. This chapter lists identified planned investments in the chemical sector, which determined some of the operations chosen for the case studies in Chapter 5.

Table 4.1 provides a summary of future planned investments in the chemical sector. Transnet Pipelines' new 24-inch pipeline from Durban to Gauteng was excluded as they are part of the Transport SETA.

Table 4.1: Future Investments in the SA chemical sector

Sub-Sector	Operation/s	Planned Investment	Estimated Value of Investment (R Billion)
Liquid Fuels	Crude oil refineries (Chevron, Enref, Natref and Sapref)	Cleaner fuels – refinery upgrades by 2010.	9
Liquid Fuels, Commodity Organics and Inorganics	Sasol*	Various projects over the next three years.[2]	25
Commodity Organics	Isegen*	Plant upgrade.	0.002
Primary Polymers and Rubbers	Hosaf Fibres*	Double production of PET (startup in 2009)	0.1
Commodity Inorganics	Afrox*	Six new gas producing facilities around the country at Scaw Metals, Mondi, Xstrata, Sasolburg, Pietermaritzburg and Kuils River, and an upgrade of its entire Afrox Gases operation centre.	not available
	NCP Chlorchem*	Expansion in 3 stages over the next 5-10 years: Phase 1 - complete by 2008 - increase production by 35%. Phase 2 – 2-3 years later – increase production by another 25%. Phase 3 – further 5 years - 95% increase in production capacity.	0.75
	NECSA in partnership with Metorex*	Busy with a feasibility study to build a hydrofluoric acid plant in Richards Bay.	0.45
Pure Functional and Speciality Chemicals	Chemserve	20 000 tons per annum (tpa) carbon disulphide plant in Sasolburg by the last quarter in 2008, for the expansion of xanthates production for exports.	0.23
		Guar/carboxymethylcellulose plant and further expansions.	0.104
Bulk Formulated Chemicals	Chemical Initiatives*	Plant nutrient sulphur plant in Umbogintwini.	0.018
	Foskor*	Investigating the viability of building an on-site raw water purification plant and also looking at diversifying into other	not available

Table 4.1: Future Investments in the SA chemical sector			
Sub-Sector	**Operation/s**	**Planned Investment**	**Estimated Value of Investment (R Billion)**
		products such as food-grade acid.	
	Omnia*	A multimillion rand project to reduce the emission of nitrous oxide emissions by 98% at their fertiliser plant in Sasolburg. Also plans to build a shock tube assembly plant and to extend another plant.	not available
Pharma-ceuticals	Aspen Pharmacare*	Two new production lines and upgrading of equipment between 2003 and 2008.	hundreds of millions
	Ranbaxy*	Small production development facility by February 2010.	not available
Plastic Conversion	Astrapak	Replacement and capital expansions.	millions
	Smith Plastics*	No details available.	0.07
	Venture*	Robotic lines for painting car bumpers in Uitenhage and might also expand this to Durban.	not available

Source: Publications such as the Business Day, Engineering News, as well as Internet desk research exercises.[xxii] Personal Communication (September 2007) South Africa*.

As can be seen in Table 4.1, Sasol and the refinery upgrades contribute to more than 90% of the value of the future planned investments in the chemical sector.

The Biofuels Industrial Strategy[vii] was developed by the DME to create job opportunities, alleviate poverty and establish developing farmers. Renewable fuels is one of the areas identified for accelerated economic growth within the AsgiSA initiative. The strategy currently excludes crops such as maize, sorghum and wheat due to food security concerns, but this is still being debated by Government and the relevant industry role-players based on articles in the Business Day Newspaper in December 2007.

Identified potential biofuels projects that awaited the approval of the Biofuels Industrial Strategy are shown in Table 4.2. These developments are dependant on incentives offered by Government in order to make them viable.

Table 4.2: Potential biofuels projects			
Operation	**Crop**	**Biofuel**	**Estimated Value of Investment**
Biodiesel SA*	Jatropha Curcas	Biodiesel	under investigation
dti projects*	Canola	Biodiesel	Farming component: R1 billion per plant Capital cost: R700 million per plant
Ethanol Africa*	Maize	Bioethanol	R1 billion per plant
Evergreen Biofuels	Soya	Biodiesel	not available
Industrial Development Corporation	Cassava, Maize, Sugar Beet, Sugar Cane and Sweet Sorghum	Bioethanol	not available
Invest North West*	Under investigation	Biodiesel	under investigation
Sasol*, the Central	Soya	100 000 tpa	R800 million to R1

Table 4.2: Potential biofuels projects			
Operation	**Crop**	**Biofuel**	**Estimated Value of Investment**
Energy Fund (CEF) and Siyanda Biodiesel		biodiesel	billion
Tongaat Hulett*	not provided	Bioethanol	not provided

Source: Publications such as the Business Day, Engineering News, as well as Internet desk research exercises.[xxii] Personal communication (September 2007)*.

André Kudlinski[xliv], the Director of Geographic Projects at the dti said that the average rural farm in the Eastern Cape is about 2 hectares, and can potentially produce 2 tons of Canola seed per hectare. To produce 100 000 tons biodiesel p.a., about 250 000 tpa seed would required which would provide employment to about 35 000 families. The refinery would only employ about 60 workers and most of these would be on the machine operator level and 5-7 laboratory technicians. Only 3-4 highly trained technical staff and engineers would be required.

Apart from the identified published projects in each of the sub-sectors, Government also hopes to attract an additional investment of up to R13 billion in the chemical sector, which could create 5 000 skilled jobs by 2014. This plan is part of the dti's broader industrial policy framework, set out in the Chemical Sector Development Strategy. The key action programmes include the following:

- the promotion of greater production in local pharmaceutical products
- the promotion of downstream plastic products production
- titanium beneficiation initiative (still under a investigation)
- fluorochemical expansion initiative (still under a feasibility investigation)

CHAPTER 5: CASE STUDIES

5.1 Introduction

Due to the low production growth rate of 2% p.a. of the chemical sector as well it being stagnant in terms of job creation, skills development should be directed towards areas of active investment, as well as further downstream development in identified feasible sub-sectors.

Based on this direction, the case studies firstly include large identified capital investment areas in the chemical sector, namely:

- Sasol - the largest identified historical and future investor in the chemical sector;
- Sasol's Project Turbo - the largest identified capital investment in the chemical sector between 2000 and 2006 – for the purpose of identifying typical skills required in large capital projects;
- The Shutdown Network Forum - an initiative to counter skills constraints in active investments and maintenance projects such as refinery upgrades.

In downstream development, operations within sub-sectors in the dti's key action programmes of the Chemical Sector Development Strategy were chosen, namely:

- Adcock Ingram – a pharmaceutical manufacturer;
- The Plastics Federation of South Africa – an umbrella organisation in the local plastics industry.

SA has three incubators that promote downstream development in the chemical sector, and therefore one of these incubators, Chemin, was also included as a case study.

Renewable fuels from agricultural sources is one of the areas identified for accelerated economic growth within the AsgiSA initiative and therefore Grain SA was also included as a case study for their role in developing this industry from an agricultural point of view.

5.2 Sasol Case Study

Sources: Sasol Annual Review 2007[xlv]; Otto Pepler, Project Talentgro Project Director through personal communication with Monique van Wyk, a Change Management Consultant working for Project TalentGro (January 2008) South Africa[xxi]; Mike Macrae: Manager of the Oil, Gas & Chemical Manufacturing Companies Artisan Skills Training Project[10]; Herman Berry, Business Development Manager of Chemcity, Personal Communication (September 2007)[xlvi]; Engineering News (7 September 2007) *SA casts new skills development die amid acute shortages*. South Africa[xlvii]; Sasol website (www.sasol.com) (January 2008)[xlviii]; O_3bc/CMCS data base.[ii]

Sasol is an integrated oil and gas company with significant chemical interests that was formed in 1950 and started production in 1955. Sasol mines coal in SA and produces natural gas in Mozambique, converting these into synthetic fuels and chemicals through world-renowned, proprietary technology. Natural gas is also delivered as an energy source through a 2000-kilometre pipeline network to 550 industrial and commercial customers in Gauteng, Mpumalanga, the Free State and KZN.

Sasol supplies an estimated 37% of SA's fuel needs through Sasol Synfuels at Secunda and their share in the Natref Refinery at Sasolburg [a JV with Total SA]. Sasol Synfuels is the world's only commercial coal-based synthetic fuels manufacturing facility. Products include petrol, diesel, jet fuel, paraffin, liquefied petroleum gas, lubricants, pipeline gas, and other speciality products.

Sasol has chemical manufacturing and marketing operations worldwide and is the largest upstream chemical manufacturer in SA with mostly capital intensive processes. The Synfuels operations at Secunda are integrated plants, producing a range of fuel products, petrochemicals, polymers and other by-products. The original Sasol I operation in Sasolburg has stopped fuel production, and is now a primary chemical production site.

Sasol's local chemical manufacturing operations cover all the upstream chemical sub-sectors except fine chemicals. Products produced within these sub-sectors by its various divisions include:

- Commodity organics: ethylene and propylene produced by Sasol Polymers; a wide range of solvents produced by Sasol Solvents; alpha olefins produced by Sasol Olefins & Surfactants; phenols and cresols produced by Merisol (a JV with Merichem USA); and waxes produced by Sasol Wax.
- Primary polymers: polyethylenes, polypropylene, and polyvinyl chloride produced by Sasol Polymers
- Commodity Inorganics: chlor-alkali's produced by Sasol Polymers; and ammonia, nitric acid and sulphuric acid produced by Sasol Nitro.
- Bulk formulated chemicals such as explosives and fertilisers produced by Sasol Nitro.
- Pure functional chemicals: mining reagents produced by Sasol Polymers

Sasol is one of SA's largest investors in capital projects, skills development and R&D. Historical investments in the SA chemical sector from 2000 to 2006 amounted to around R40 billion[xxii], of which Sasol accounted for more than R25 billion (i.e. more than 60%). Sasol's Project Turbo[16] accounted for more than R16 billion of this R25 billion.

Capital projects of about R50 billion is planned at Sasol over the next three financial years, 50% of which is expected to be spent by the SA energy businesses. This accounts for almost 70% of identified future investments in the local chemical sector.[xxii]

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[16] Refer to the Project Turbo Case Study for more information.

Sasol is expanding its power generation capacity to free up capacity on the national grid, and over the next nine years they will increase liquid fuels production by 20% at Secunda or with 30 000 bbl/d to current production volumes. Three-quarters of this additional capacity will use natural gas feedstock, and the rest will be from fine coal.

Sasol is currently working closely with the SA Government on a potential new inland synthetic fuels refinery, called Project Mafutha. At this stage 80 000 bbl/d is envisaged. If feasible, the plant will increase the alternative fuel supply to the SA economy, helping to secure greater self-reliance in the supply of SA's future energy requirements. The project will also involve the creation of a new town. Sasol estimates that the plant, the residential area, and all its supporting utilities will add about one percent to the country's GDP and create thousands of new jobs. Three geographical sites with abundant coal reserves are being considered, including in the Free State, Mpumalanga, and Limpopo provinces.

Cleaner fuel along with the growing concern about the security of crude oil supply is becoming a global issue. As a consequence, GTL and CTL alternatives are expected to feature prominently in the energy mix of the future. The opportunities for Sasol to commercialise CTL technology both in SA and globally are considerable. China, India and the USA have large populations and are rich in coal and deficient in oil and gas, and therefore show a lot of potential. Sasol's involvement in developing the world's first GTL projects is also allowing gas-rich countries to monetise gas reserves and therefore unlocks economic value.

Sasol's key R&D facilities are based in SA, which is the largest team of research scientists in industry in Africa, including some 200 Doctors of Philosophy (Ph.D.s). Their leadership in developing and commercialising technology is a major competitive advantage, but is dependant on continuously developing their skills base. One of their most important group initiatives is a wide-reaching culture change programme that aims to embed a values-driven leadership style across the group.

Sasol has not escaped the global skills shortages that have put pressure on the schedule and budgetary expectations of capital projects worldwide. This is particularly high in SA in part due to the skills required to deliver the country's extensive infrastructure development programme[10]. With skills development of particular importance to SA in achieving higher growth rates, Sasol has increased learnership and apprentice training twofold since 2004.

Sasol's operations require a wide range of skills, from highly proficient scientists and engineers to lawyers, financial specialists and artisans. In order to ensure ongoing talent development and to provide sufficient skilled resources for its current and future needs, Sasol has initiated Project TalentGro. This project focuses on internal and external talent development through a multi-pronged approach that is aimed at the following:

1) improving internal skills development capacity for current and future skills needs

2) contributing to external skills development initiatives expanding Sasol's operations support in order to grow key talent pools; furthermore it endeavours to influence the external skills development environment by participating in other initiatives and engaging industry leaders, in partnership with Government and other organisations

3) in 2007 a new division to manage recruitment and training requirements associated with the accelerated roll-out of expansion projects have been started; amongst others this involves the establishment of a pool of approximately 1 000 new employees to be assigned to various new projects (including foreign operations) for startup purposes. 430 appointments have already been made; this pool of people will consist of about 43% artisans and process controllers, and 11% engineers and technicians (mechanical, electrical, chemical, process, and instrumental). The rest of the pool will be made up of planners, resource consultants, trainers, managers, and others.

Some of the external skills development initiatives are as follows:

- An allocation of R140 million to an industry-wide artisan training scheme that will enable 830 entry-level learners to qualify as artisans over three years that forms part of the Shutdown Network Forum.[10] This is in addition to Sasol's normal training allocation.

- A National Business Initiative (NBI) initiative in which a partnership was formed between Sasol, Eskom, Transnet, Arcelor Mittal, Gold Fields, and Anglo Platinum called the Technical Skills Business Partnership, which aims to deal with the national skills shortage to train 50 000 artisans by 2010 and 1 000 additional engineers p.a. The benefit to business is that a larger skills pool would reduce the competition for skilled trades people that is currently experienced. These companies will make significant investments in training facilities and educators and will also act as anchor companies in their sectors to involve other relevant companies. Consultation work is also being done with the various SETAs and the National Skills Fund (NSF) to obtain some funding.

Sasol invested in excess of R84 million in training and development in 2006/2007, with more than 25 000 employees undergoing some form of training over the period. This investment includes in-house technical training and self-learning centres. An additional R26 million was invested in 2006/2007 in 427 undergraduates and 89 postgraduate bursaries, with the emphasis on developing scientific, engineering and technological skills. R34 million has been budgeted for bursaries for the next academic year. In addition, Sasol will be investing almost R250 million over the next eight years into teaching and research capacity in chemistry and chemical engineering at selected SA universities, in order to establish world-class teaching and research capacity to ensure that Sasol has adequate access to highly skilled chemists and chemical engineers to employ in R&D. Sasol will also continue to channel considerable resources into the teaching of maths and science at school level.

Sasol is also involved in downstream development projects in SA through ChemCity, a chemical incubator that is wholly owned by Sasol. With the assistance of Sasol's resources at ChemCity's disposal and by partnering with other business incubators, ChemCity focuses on incubating sound business propositions into viable enterprises throughout SA. In the past 2.5 years, ChemCity has successfully established 30 new businesses that include biofuels, consumer chemicals (e.g. cosmetics), plastic conversion, effluent to fertiliser production, and waste management.

Sasol has donated three hectares of land to the Vaal University of Technology in 2005/2006 for the construction of an Institute of Chemical- and Biotechnology on the Sasol ChemCity premises in Sasolburg. The Institute of Chemical- and Biotechnology would have coordinated the research, training and expertise of the departments of technology, chemical engineering, analytical chemistry, food technology and biotechnology at the university. The Vaal University of Technology, with the assistance of Sasol, has successfully negotiated partnerships and the support of the petrochemical and related industries in the Vaal Triangle to supply feedstocks for further research and product development that may initiate entrepreneurial projects in downstream chemical manufacturing.

In September 2007 Sasol announced their first terms for a Black Economic Empowerment (BEE) ownership transaction. Sasol also gives equal weight to the other pillars of Broad Based BEE in increasing management diversity, improvement of employment equity, increased support for preferential procurement and the drive for the development of BEE enterprises.

5.3 **Project Turbo Case Study**

Sources: Sasol Investor Insight – December 2006[xlix]; Sasol Annual Review 2007[xlv]; Mike Macrae: Manager of the Oil, Gas & Chemical Manufacturing Companies Artisan Skills Training Project, Personal Communication (September 2007)[xxx], chemicals-technology.com *Sasol Polypropylene Plant - Catalytic Cracker*, South Africa[l]; O_3bc/CMCS data base[li].

Project Turbo, at a cost of more than R16 billion, was Sasol's largest capital project in South Africa since their main synthetic fuels plants were built in the late 1970s and early 1980s. It is also the largest single investment in the chemical sector between 2000 and 2005, accounting for about 40% of all identified investments[xxii] in the chemical sector over this period.

Project Turbo involved the upgrading and building of new capacity to meet the SA Government targets for introducing lead-free petrol and low-sulphur diesel. In addition to meeting SA's new requirements for cleaner fuels, which came to effect in 2006, Project Turbo is also expected to address most changes in fuel specifications expected in the years ahead.

The new capacity included ethylene and propylene output from a selective catalytic cracker located in Secunda. The cracker converts low-octane into high octane components to meet more stringent Government fuel regulations.

The new capacity also included a 220 000 tpa low-density polyethylene (LDPE) plant located in Sasolburg and a 300 000 tpa polypropylene plant, located in Secunda. The LDPE plant is also known as Poly 3 and is Sasol's third polyethylene plant located in Sasolburg.

Engineering firms were awarded contracts for the design and construction of the different parts of the expansions, including Kellogg Brown & Root, Japan's Mitsui Engineering & Shipbuilding, Uhde SA, Exxon Mobil Chemical Company, and the France-based Technip. The electrical and instrumentation portion of the LDPE project was awarded to Kentz Engineering & Constructors, while the switchgears were awarded to ABB in Elandsfontein.

Project Turbo was running behind schedule mainly due to construction facilities limitations and limited human resources. There has been a high demand in construction work in the global oil and gas sector, which led to these limitations. Sasol also needed to import around 800 maintenance workers through labour brokers from Thailand in 2006 due to shortages experienced for their shut-down, which included welders, riggers, crane operators, and boilermakers. A large portion of the skills were for coded welders, authorised to weld on statutory equipment.

Mike Macrae, the Manager of the Oil, Gas & Chemical Manufacturing Companies Artisan Skills Training Project, said that the shortage of specific artisan skills for peak refinery maintenance events and periods of peak construction activity in the SA industry has risen due to significant capital investment programmes in numerous industries such as the petrochemical, transport and infrastructure sectors. The refineries schedule shut-downs so that they do not coincide and many of the maintenance shutdown maintenance crew migrate from one shutdown to another on short term contracts. The same resources are however often contracted into longer term capital construction activities and may be lost to the migrant shutdown pool for a year or more.

The total manpower required on the construction of Project Turbo is shown in Table 5.1. This excludes the engineering companies who would have used their own internal staff. The supervisors included some mechanical and electrical engineers, while the foreman included some artisans with managerial skills.

Table 5.1: Project turbo manpower requirements

	Total Local	Total South Africa	Total Inter-national	Sasol burg Total		Total Local	Total South Africa	Total Inter-national	Secunda Total	Combined Total
Skill Description										
Supervisors	42	55	0	97		60	139	12	211	308
Foreman	44	65	0	109		106	258	20	384	493

Table 5.1: Project turbo manpower requirements										
	Total Local	Total South Africa	Total Inter-national	Sasol burg Total		Total Local	Total South Africa	Total Inter-national	Secunda Total	Combined Total
Boiler Maker	52	44	0	96		72	39	0	111	207
Rigger	17	12	0	29		54	78	21	153	182
Mechanical Fitter	40	26	0	66		69	86	0	155	221
Pipe Fitter	74	68	0	142		152	439	0	591	733
Pipe Welder	59	50	0	109		70	110	31	211	320
Electrician	15	14	0	29		39	25	0	64	93
Instrument Technician	0	6	0	6		5	3	0	8	14
Total				683					1 888	2 571

Source: Project Turbo Management Team as obtained by Mike Macrae [Error! Bookmark not defined.]

5.4 Shutdown Network Forum Case Study

Sources: Sasol Annual Review 2007[xlv]; Mike Macrae: Manager of the Oil, Gas & Chemical Manufacturing Companies Artisan Skills Training Project[xxx].

In 2004 some of the major oil refiners in SA (known as the Oil, Gas and Chemical Manufacturing Companies or OG & CM) set up a training arm of their joint Shutdown Network Forum (SNF) to address the problem of artisan shortages in SA in collaboration with the CHIETA. This was known as the Shutdown Network Forum Employment and Skills Development Lead Employer (SNF ESDLE). The SNF ESDLE's prime task was to manage and co-ordinate training across the SA petrochemical industry, while the CHIETA provided some funding for training. The project kicked off in 2004 and 665 learners had been trained up to NQF level 2 by July 2007, out of an intake of 1 037 learners.

Additional funding was requested from the CHIETA for more training, but only some of it could be obtained. This led to industry supporting the shortfall. The participating OG & CM companies also started to employ and train unemployed candidates by making use of tax breaks. In September 2007 there were just over 700 learners in training under this new structure, known as the OG & CM Artisan Skills Training Project (OG & CM ASTP).

Sasol, who is one of the OG & CM companies, has trained artisans and process operators to the value of 100 million p.a. for the past decade and has trained more than 700 artisans between 2004 and 2006. They are currently investing R140 million from 2007 in the funding of the OG & CM ASTP, scheduled to run until early 2010. The programme has additionally received R60 million from the CHIETA and the NSF. The funding will enable 1400 artisans to be trained up to an NQF level 4 qualification by 2010.

The objective of this investment is to close the gap in the national pool of skilled labour that is available for rotation to the OG & CM companies during shut-downs and large capital projects. Applicants will be trained as boiler makers, electricians, fitters, instrument mechanics, riggers and welders, which are the specific trades needed for these projects. In addition, if a welder is required to work on statutory equipment such as that associated with high pressures, hazardous chemicals and other specialised applications he or she is required by legislation to pass a coding test.

The artisans will be trained through learnership programmes. Three consecutive learnerships are required to become a qualified artisan, which will take between 24-30 months. The entry requirement for this programme is a grade 12 qualification with maths, science, and English. The intakes are staggered, and a number of learners are already scheduled to qualify early in 2008. 89% of the intake of learners by September 2007 was previously disadvantaged individuals.

Due to the training initiatives taking place by the OG & CM ASTP, less artisan skills will need to be imported from 2007 onwards for maintenance projects. These trained artisans will largely be adequate for the 2010 refinery upgrades, provided they are not absorbed into other sectors of the SA environment or the international labour market.

One of the challenges that the above programme faces is funding. Although medium-term funding has been secured, it is imperative that additional funding be secured from the second half of 2008 to ensure sustainability. The anticipated funding requirement is R80 million per year in order to train 500 artisans each year. Funding from the CHIETA and the NSF also needs to be streamlined as there are concerns that the approval and allocation of funding takes too long (on one occasion, in excess of one year from application).

Jipsa has set a target to train 50 000 artisans from 2007 to 2010. Mike Macrae, the Manager of the Oil, Gas & Chemical Manufacturing Companies Artisan Skills Training Project, agrees with this estimate of 50 000 artisans are needed for large capital projects in SA as published by September 2006 These projects are shown in Table 5.2 below.

These artisans are however mostly needed already as most of the projects need to be completed by 2010. The listed projects exclude mining and other civil projects that do not require significant numbers of artisans, as well as possible new projects such as the Saldanha and Cape Town oil rig refurbishing yards, a second Koeberg nuclear power station and Sasol's Mafutha.[2]

As can be seen from Table 5.2 none of the listed projects are linked to the chemical manufacturing sector and should the chemical sector planned investments as shown in Chapter 4 go ahead within the same timeframe of the these projects, additional artisans should be required.

Table 5.2: Other capital projects in SA

Sector	Project	Area	Date
Electricity	Braamhoek Pumped Storage Scheme	Orange Free State /KZN border	2007
	Independent Power Producer Investment Project	Eastern Cape and KZN	2008

Table 5.2: Other capital projects in SA			
Sector	**Project**	**Area**	**Date**
	Eskom's Open Cycle Gas-turbine Power Plant	Mossel Bay and Atlantis	2007
	Pebble-bed Modular Reactor	Pelindaba and Koeberg	2013
	Eskom's Return to Service Project	Mpumalanga	2006-2014
Industrial	Coega IDZ	Eastern Cape	ongoing
	East London IDZ	East London	ongoing
	Coega Aluminium Smelter Project	Eastern Cape	2012
	Mittal Steel South Africa	SA	2010
	PPC Cement Capacity Expansion Project	North West	2008/9
	Sappi Saiccor Expansion	KZN	2009
Gas Exploration	South Coast Gas Development	Southern Cape	2007
Transport	Gautrain Rapid-rail Link	Johannesburg	2010
	Port of Saldanha Bulk Iron-ore Handling	Western Cape	2012
	Sishen-Saldanha Iron-ore Export Line	Western Cape	2010
	Spoornet Recapitalisation Programme	SA	2011
Water	Berg Water Project	Western Cape	2012
	Olifants River Water Resource Development Project	Limpopo/Mpumalanga	2010
	Vaal River Eastern Subsystem Augmentation Project	Secunda/Mpumalanga	2007
Ferrochrome	Buffelsfontein Mine and Smelting Plant	North West	2007
	Lion Ferrochrome Project	Mpumalanga	2007
Iron Ore	Sishen Expansion Project	Northern Cape	2007
Mineral sands	Corridor Sands	Mozambique	2007
	Rustenburg UG2 phase 2	North West	2008
	Twickenham Project	Limpopo	2009
	Two Rivers Platinum	Mpumalanga	2006

Source: Mike Macrae, Manager of the Oil, Gas & Chemical Manufacturing Companies Artisan Skills Training Project, Personal Communication, September 2007. Error! Bookmark not defined.

Mr. Macrae is of the opinion that training and infrastructure present problems and there is expected to be a scarcity of suitable equipped training facilities, trainers, assessors and moderators to reach the 50 000 trained artisans as estimated by Jipsa. Another concern is host employers to place lower-level artisans for experiential workplace training, as they currently need qualified artisans and do not necessarily have the time for training.

Mr. Macrae also commented that recruiting learners is a challenge. One of the reasons is that being an artisan is perceived as an unglamorous career choice. Advertisements in the papers also do not reach the target market for potential applicants. Short-term posters and pamphlets are therefore distributed in the relevant geographical areas where artisans might be needed in the future.

5.5 **Adcock Ingram Case Study**

Sources: Bradley Parson and Michael Radebe: Managers of R&D at Adcock Ingram, Personal Communication (September 2007) South Africa[li]; Adcock Ingram website (www.adcock.co.za) (January 2008)[lii]; Department of Trade and Industry (August 2007) *Implementation of Government's National Industrial Policy Framework: Industrial Policy Action Plan*. South Africa[v].

Adcock Ingram is a market leader in SA's private pharmaceuticals market and the second largest local producer of generic medicines. It is the longest standing pharmaceutical company in SA that started as a small pharmacy in Krugersdorp more than 100 years ago. The company currently employs about 2 300 people.

The vision of Adcock Ingram is to be recognised as a leading world class branded Healthcare Company and its mission is to add value to life. It supported a number of programmes in the past that ranged from health education initiatives through to sponsorships of capital projects such as the construction or refurbishment of homes for HIV-positive babies.

Through its corporate social investment initiative, Unite 4 Health, it aims to support efforts to improve healthcare for disadvantaged South Africans. Unite 4 Health projects financed in 2006 and 2007 were: A R4 million donation to the Red Cross War Memorial Children's Hospital in Cape Town to go towards a new modern theatre complex; the heart of Soweto Project in which over 15 000 Soweto residents will take part that aims to track the incidence of cardiovascular disease in a developing-world scenario; a R1 million donation to the Women's Ward for the new Soweto Hospice; a R500 000 donation towards renovating the clinic which services the Pimville area in Soweto.

Adcock Ingram has an extensive range of prescription, generic and over-the-counter (OTC) products. Products are mainly produced through formulation type processes.

Adcock Ingram Critical Care is SA's largest supplier of hospital and critical care products, blood systems and accessories as well as products used for renal dialysis and transplant medication. Key relationships with innovators such as Baxter International afford Adcock Ingram the advantage of quality products for a growing market.

To complement a full range of generics and prescription medicines across all therapeutic classes, Adcock Ingram also recently launched a range of generic Antiretrovirals (ARVs). These were developed in-house by a team of senior researchers at Adcock Ingram's World Health Organisation approved Research site in Aeroton.

Michael Radebe, a Senior Manager of R&D at Adcock Ingram however commented that the pharmaceutical industry is struggling to get sufficiently well qualified people for R&D work. The resources required are qualified pharmacists with a strong background in chemistry, as it is essential for the researcher to understand the chemical reactions involved. This would normally require someone with a Master of Science (M.Sc.) in Pharmacy. Adcock Ingram normally has a full complement of six researchers but at present they only have four. They have to take in Bachelor of Science (B.Sc.) graduates and put them through an internship, which involves rotating through all the departments. At present they have two of these graduates in training.

Mr. Radebe further added that currently, because of the shortage of these skills, all work is being concentrated on ARVs. There is plenty of work and new ideas for development but no staff to spare. This is particularly so for development of generic drugs and new forms of delivery of drugs to patients (e.g. Elastoplast type patches that are wet and then get stuck on - these are a safer form of taking the medicine, rather than by mouth and already well advanced in overseas). Currently the technology and background for generics are bought in from overseas but in effect could be done here if staff were available.[17]

The promotion of greater production in local pharmaceutical products, especially generics, was added as one of the key action programmes prioritised for implementation in the Chemical Sector Development Strategy, which forms part of the dti's broader industrial policy framework.

Apart from assisting the pharmaceutical sector in addressing the above-mentioned skills shortages, the SA Government could improve the sustainability of further local investments in generic medicines manufacturing through[xv]:

- The promotion of a better local access to global information and know-how
- The improvement of regional market (e.g. SADC countries) intelligence
- The promotion of a local spatial cluster for the pharmaceutical industry (i.e. an integrated upstream and downstream manufacturing cluster in a specific geographic area e.g. East London, together with supporting industries such as maintenance support)
- Implementing a more investors friendly and efficient regulatory environment as well as health policy (i.e. related to the purchasing policies for public sector medicines) – this includes speeding up compliance and product approval procedures via the MCC
- Improving its sourcing through COMED, a central purchasing organising of Government, to purchase medicines to favour more the local industry
- Implementation of a better incentive scheme to make investment more attractive

Bradley Parson, an R&D Manager at Adcock Ingram, said that there needs to be an elevation of the status of the pharmaceutical industry, so that more students obtain a pharmaceutical qualification. He is of the opinion that the SA

[17] The communications department at Aspen Pharmacare, the largest generics medicines manufacturer in SA, confirmed that the amount of R&D done in the SA pharmaceutical industry is small and that there is potential for developing generics for local production.

Government should incentivise companies to give internships of bursaries to fill the identified skills gap.

5.6 **Plastics Federation of South Africa Case Study**

Sources: David Hughes: Executive Director of the Plastics Federation of South Africa, Personal Communication (September 2007)[liii]; Plastics Federation website (www.plasticsinfo.co.za) (January 2008)[liv].

The Plastics Federation of South Africa (PFSA) is a non-profit umbrella organisation for the local plastics industry.

The vision of the PFSA is to be fully representative of the industry, to be the spokes body of the industry, to have a competent and skilled sector, for plastics to be environmentally acceptable materials, to be the information custodian of the plastics industry, and to promote and market the benefits of plastics.

The mission of the PFSA is to coordinate, develop and promote the interests of the SA plastics industry. Its overall aim is to ensure an efficient and effective plastics industry and long term growth of the industry. This is achieved through the two-way communication of information, advice and skills to and from all its members, Government and industry observers, education facilities, customers of the plastics industry, and the public at large.

Constituent members of the PFSA are:

- Raw material (primary polymer) suppliers: Safripol, Sasol Polymers, and the South African Polymer Importers Association
- The Plastics Converters Association whose members are the downstream converters (i.e. plastic products manufacturers)
- Other Associations: The Association of Rotational Moulders of SA, the Plastics Institute of SA, the SA Plastic Pipe Manufacturers Association, the Expanded Polystyrene Association of SA, the Polystyrene Packaging Council, the SA Plastics Recyclers Organisation, and SAMPLAS being the association representing the industry machinery supplies in SA.

In the case of the environmental issues, the PFSA works with a number of affiliated organisations and associations. There are also other associations representing interest groups allied to the industry such as the Institute of Materials.

The PFSA's purpose is to:

- Be the 'Gateway to' and 'the Voice of' the SA Plastics Industry, supporting the industry and gathering, sorting and disseminating information relating to the industry
- Provide a forum for, and assistance and services to, the Plastics Industry Associations
- Promote plastics as a material of choice and promote the SA plastics industry

- Provide education and training services to the industry, creating an awareness of career opportunities
- Facilitate and drive the environmental initiative of the plastics industry

The PFSA is well positioned to make a difference to the industry by providing industry specific training both at any of its three well-equipped branches and in-house at factories. The PFSA is formally accredited by the MERSETA to offer national certificates in plastics manufacturing, polymer composite manufacturing and thermoplastic fabrication for NQF levels 2 to 5.

In addition to these NQF qualifications covering manufacturing/process principles, the PFSA offers a variety of courses covering workplace safety and quality, AIDS/HIV awareness, written and oral communication, workplace maths and financial principals, conflict resolution, supervisory management, time management and basic knowledge about plastics.

The courses offered are of a high standard and the qualifications are exam based. Those that pass are awarded a national certificate as relevant. Some qualifications are time controlled such as welding techniques that are only valid for one year and that have to be re-examined.

PFSA's 2008 courses include:

- Plastics Materials & Processes: For anyone who needs to know more about plastics and understand the terminology used in the SA Plastics Industry – especially new entrants to the industry, non-technical individuals who need basic technical knowledge, production planners, and sales- and marketing representatives.
- Basic Injection Moulding: For injection moulding operators and setters.
- Supervisory Management: For first line managers and supervisors.
- Quality Awareness: Operators and packers involved in production or printing. The course is generic and not process specific but works better on an in-house basis.

There are some dishonest operators who have stolen the PFSA's teaching material and offer similar courses, but they are not accredited. There are also companies that offer courses in e.g. supervisory training but these are general in nature and not specific to the plastics industry.

A particular problem that the PFSA experiences is that they have course places booked and then because the employers suddenly realise that they cannot afford to give the staff time off to attend, there is a no show.

David Huges, the Executive Director of the PFSA, is of the opinion that tertiary training is somewhat limited in SA. A new graduate with a chemical or chemical engineering degree that wants to know more about plastics before embarking on their career could attend the relevant PFSA NQF course, which would give them some insight into plastics technology. The Pretoria Technikon used to offer a Diploma in Plastics Technology but they are struggling to sustain the department as the demand is not high enough.

Generally there is a skills shortage but Mr. Hughes said that one has to be careful how it is defined, as although there are shortages there are solutions available. There are insufficient numbers available for the types of skills that are short. The mentorship level is low in the industry.

Mr. Hughes further added that in many instances the smaller plastic converters are owner managed businesses that make a reasonable living but employ just enough staff to get the job done. This does not allow for sending staff out for training or to bring someone in for training. They are generally not prepared to take a look at the bigger picture and seem not to fully realise that letting process workers and supervisors go on training could be beneficial as it then releases more time for the owner to concentrate on the business and management side of things. Much improvement could come from training people to think especially in the fields of production, quality and supervisory management. There is also a huge 'salary-based grasshopper' problem in that skilled people are constantly changing jobs once they have been trained, which to some extent acts as a disincentive to in-house training.

Mr. Hughes further commented that in the 'old days' the mines, Eskom, Iscor (now Mittal), the AECI and others used to have proper training centres where people were taken through their apprenticeships. The demise of that scheme has led to large shortages of artisans. He is of the opinion that the learnerships are probably not as good as the former apprenticeships and are not producing sufficient numbers as it is the responsibility of industry now and resources are limited.

The PFSA is involved in setting up learnerships in the plastics industry, with about 60 unemployed and about 60 employed learnerships in place so far. This is not an easy process and requires a lot of persuading to get young people placed in industry. Somehow the industry needs to be persuaded to train staff, but do need to get paid to train staff.

Mr. Hughes said that in time gone past the MERSETA was not functioning well, but there has been a significant improvement over the last year since the new Chief Executive Officer was appointed. Internal governance and processes are working more smoothly now, although there are still issues to resolve.

Growth in the plastics industry will typically remain around GDP growth, at present in the region of 4-6%. Cheap imports from China have had some affect on this growth through displacement of local manufacturing, but not in the engineering plastics field where standards, tolerances and requirements are very strict (e.g. car parts).

The latest problem of power supply cuts has however created new fears that the plastics industry will suffer both now and in the future. Investment will be curtailed and financial losses may be severe enough to put some companies out of business.

Mr. Hughes however said that the plastics industry is robust and it will survive, supported by the PFSA in training the workforce as relevant.

5.7 Chemin Case Study

Sources: Sam Matlala: Director of Chemin, Personal Communication (September 2007) South Africa[lv]; Chemin website (www.chemin.co.za) (January 2008)[lvi]

Chemin in Port Elizabeth is a catalyst in the establishment of an entrepreneurial culture leading to the development of a successful downstream chemical industry in SA, also known as a chemical incubator. The only other two chemical incubators in SA are ChemCity[2], which is Sasol's enterprise development initiative and also a wholly owned subsidiary of Sasol, and Sedichem[18] in Vanderbijlpark.

Chemin is a section 21 company, and has the following members among others: CSIR Biochemtek (a division of one of the leading scientific and technology research, development and implementation organisations in Africa), CMCS (a specialist consultant in the chemical sector), Sasol (the largest upstream chemical manufacturer in the SA chemical sector), Sterling Waterford (a company involved in the carbon credits and biofuels markets) and the Small Enterprise Development Agency or SEDA (the dti's agency for supporting small business in SA).

Chemin's mission is to:

- Stimulate, launch and grow globally competitive and sustainable small and medium enterprise (SME) chemical manufacturing start-ups, as well as project development within established SMEs in SA
- Identify skills gaps within targeted SMEs and provide business, technology and entrepreneurial training, nurturing and skills development
- Provide access to infrastructure and services for appropriate technology and business incubation e.g. office space and equipment, laboratory space and equipment, telecommunication facilities, internet and e-mail facilities, and information technology equipment and software
- Facilitate and significantly increase BEE within the chemical industry
- Establish networks linking global and local companies for investment, technology transfer and market opportunities

In collaboration with a wide network of service providers, Chemin can provide a range of technology incubation services, including feasibility evaluation, forecasting, audits, environmental health and safety regulatory compliance, product registration, analytical services, process and product development

[18] SediChem is a business and chemical technology incubator, which also offers entrepreneurs the opportunity for commercialisation of chemical products and services. Sedichem's focus is on the provision of infrastructural, commercial, strategic and legal support with the purpose of developing sustainable SME's in the Gauteng Province.

and optimisation, process scale-up and plant design, technical and economic evaluations, and toll manufacture for product testing.

Chemin can also provide business incubation and business nurturing services to clients, including market research, mentoring facilitation, partnering and network assistance, accounting and financial management support, financial modelling, tax assistance, sourcing of developmental funding, and sourcing of venture-, equity-, or asset finance.

Chemin's focus for the development of the downstream chemicals manufacturing industry in SA is aimed mainly at the fine and performance chemicals markets, but does not exclude the production of other downstream chemicals. Within the dti's classification performance chemicals include consumer chemicals such as household cleaning products and cosmetics and toiletries, pharmaceutical products, and pure functional and speciality chemicals. The fine chemicals that Chemin focuses on are mainly plant extracts that are also classified by them as agricultural processing. Chemin had 33 running projects in September 2007.

Chemin is looking to the following groups for entrepreneurial opportunities in chemical manufacturing to incubate:

- SMEs operating in a wide range of end markets such as food and feeds, personal care, natural products, water treatment, and other that are seeking or have identified opportunities in technologies or technology upgrades, new product developments, etc.
- Chemical producers with under utilised or unutilised facilities, a need to back- or forward-integrate, or a need to improve their competitive edge
- Allied industries with chemical entrepreneurial opportunities resulting from their own activities e.g. waste beneficiation, specialist products, etc.
- Higher education institutions wanting to commercially exploit opportunities arising from research results
- Science councils looking to commercialise potential technologies or products
- Other technology incubators in need of specific chemical technologies
- Individual entrepreneurs who require a supporting infrastructure to launch a new business

Chemin will guide a client within the pre-incubation stage to a better definition of the potential opportunity and determine whether there is sufficient information to motivate moving the proposed project to the incubation stage. For the pre-incubation process to commence the client will be required to sign a Memorandum of Understanding with Chemin that defines actions to be taken by each party towards reaching a decision as to whether or not the proposed project has sufficient merit to proceed. To qualify for pre-incubation, the project must pass the following criteria:

- The transformation of chemicals must be a fundamental part of the business
- The product marketed by the business could be matter (e.g. a water treatment chemical) and/or information (e.g. a validated analytical chemistry datum)

- The technology of the process and/or product must have at least been proven at laboratory scale - incubation input could therefore be provided anywhere along the value chain from prototyping through pilot plant to full-scale commercialisation
- Market potential must be demonstrated
- The business must be an SME as defined by the dti, a group of partners or a single entrepreneur

Upon entry into the incubation stage the client must agree to sign a Memorandum of Agreement with Chemin and be willing to submit to a skills analyses which will assist in identifying any training requirements of the client.

In collaboration with a selected network of training service providers, Chemin provides a comprehensive range of training courses to incubator clients to fill the identified skills gaps, such as:

- Entrepreneurial skills e.g. How Business Works
- Leadership e.g. Conflict Management
- Inter / Intrapersonal skills e.g. Emotional Intelligence
- Personal management skills e.g. Time, Health & Stress Management
- General business skills e.g. Business planning, implementation and review
- Financial management e.g. Budgeting, cash flow forecasts
- Marketing management e.g. Market Penetration
- Human resource management e.g. Basic Conditions of Employment
- Legal management e.g. Legal Risk and Liability
- Venture capital funding negotiation (identified as a critical skill)

The project will then be managed and the client must be willing to adhere to the pre-negotiated milestone criteria. At the initial Incubation Kick-off Meeting, clients together with Chemin staff, draw up a project schedule, detailing the first milestone to be met. Roles and responsibilities are then determined as well as costs and time lines agreed upon.

Although milestones are project specific, in general, most projects proceed through six incubation stages with a milestone and exit criteria at the end of each stage namely – investigation, feasibility, planning, introduction, full scale production, and maturity.

The irony of the extend of the skills gap is that even though one of Chemin's missions is to bridge this skills gap, Chemin also suffers from lack of skills when it comes to training of their clients. Chemin therefore has to rely on external service providers, but an ideal situation would be for Chemin to have these skills in-house.

5.8 **Grain SA Case Study**

Sources: Nico Vermaak, Manager of Corporate Services at Grain SA, and Jane McPherson, Programme Manager of Developing Agriculture at Grain SA, Personal Communication (September 2007 and January 2008) South

Africa[lvii]; Department of Minerals and Energy (October 2007) *Biofuels Industrial Strategy*. South Africa[vii]; Grain SA website (www.grainsa.co.za) (January 2008)[lviii]

Grain SA was established in June 1999 and was formed out of: the National Maize Producers Organisation (NAMPO); the National Oil Producers Organisation (NOPO) that covered soya beans, sunflower and groundnuts; the Winter Grain Producers Organisation (WPO) that covered wheat, barley and oats; and the Sorghum Producers Organisation (SPO) that covered grain sorghum.

Grain SA is recognized nationally and internationally by key role-players as the commercial grain producers' only and official representative. It is the leading provider of industry strategic services to the SA grain producer, in order to promote sustainable production and profitability.

Products and services offered include: strategic bargaining, strategic information, market information, production information, production environment information, external information, input product information, marketing information, macro environment information, lobbying/influencing, strategic commodity research coordinating, extension of strategic information, and technology transfer.

Grain SA has a Developing Producer Programme for which they get support from the Maize, Wheat, Oilseeds and Sorghum Trusts. The mission of the Developing Producer Programme is to empower developing grain producers to sustainable, self-supporting commercial production and to promote the principles of Agricultural BEE amongst Grain SA members.

The focus is on commercial production rather than support for household food security. It is quite often the case that a person starts to produce food for own use and this starts the process towards commercial production, although not every person who talks about farming will not eventually become a commercial producer.

Currently Grain SA has personnel in the North West, Free State, Gauteng, Mpumalanga and the Eastern Cape, as well as management personnel based in Bothaville. The programme is made up of various sub-programmes that each address a certain aspect of agricultural development – or a certain group of individuals who are at a particular stage of development towards commercialisation.

Various courses are provided over SA in Afrikaans, English, Isixhosa, Isizulu, Sesotho, and Setswana. Typical courses include:

- Introduction to Maize Production
- Introduction to Sunflower Production
- Introduction to Sorghum Production
- Advanced Maize Production and Marketing
- Tractor and Farm Implement Maintenance Course
- Course for Agricultural Contractors

- Business Management Course for Advanced Farmers
- Basic Engine Repair Course
- Wheat Production in the Summer Rainfall Regions

The Biofuels Industrial Development Strategy[vii] entails the creation of agricultural jobs in under-developed areas, such as the former homelands. Grain SA can play an integral part in the development of such new farmers, especially for crops such as sunflowers (which are already included in the Development Producer Programme), and soy beans (a difficult crop for developing farmers).

Developing farmers lack certain basic skills according to Nico Vermaak and Jane McPherson at Grain SA, which include the following:

- Many are illiterate
- Many are not numerate to a level which enables them to do arithmetic calculations
- The level of maths and science of school leavers is not very high and true commercial farming requires considerable ability
- Many have no practical experience in farming – farming is difficult and there are many enterprises that all have their own 'tricks' – some examples include:
  - Knowledge and skills relating to crop production
  - Knowledge about mechanical maintenance
  - Business management at a practical level
  - Practical knowledge about the calibration of planters and sprayers

Possible reasons for the lack of skills are as follows:

- Many current farmers have had no training in agriculture
- In many cases, particularly in the communal areas, the farmers are not exposed to good agricultural practices i.e. there are no good commercial farmers in the area from whom they can learn
- The extension support from the Departments of Agriculture is inadequate

Children leaving school do not view agriculture as a viable career choice either and therefore most of the current farmers are elderly.

There are also other problems that developing farmers face, such as:

- Until this season during which the grain prices have increased dramatically, the biggest problem was the non-profitability of grain production. The inputs exceeded the output which means that some of the farmers might be facing bankruptcy.
- Secure access to land in the communal areas
- Lack of tractors and farm implements - many have tractors and implements that are in a very poor condition and cannot work
- Lime to correct the acidity of the soil - this is an expensive operation for the farmers and does not always yield immediate results; however it is very necessary in many areas
- Fencing around the lands to keep the livestock from eating the crops
- Soil sampling so that the farmers know the status of their soil

- The phosphate levels of the soil are very low - this too is a long term investment which most farmers cannot afford
- Support and guidance from the extension officers[19] who themselves are not good at practical farming - they have no practical experience
- The roads in many areas are in a terrible condition and grain cannot be transported easily to the markets
- In the wetter areas, like in the Eastern Cape, there is a need for grain driers and grain storage facilities
- Access to production loans
- The lands are not measured and their sizes are unknown – this is necessary for the purpose of calibrations etc.
- Often, the quality of the grain that they produce is of a poor quality and there is no market for it

Possible solutions to these problems are that current commodity organisations could be used to train farmers and extension officers and mentoring should be done by people with honourable intentions to take the farmers by the hand during the peak season.

Possible support that could be forthcoming from the Government include financing for training courses provided by the commodity organisations, commitment from the extension services to cooperate with the commodity organisations, financing for the application of lime and phosphates on the arable land, and access to finance with a special dispensation to developing for farmers, e.g. low interest rates etc.

Official public/private partnerships should also be formed e.g. some of the departments of agriculture in many of the provinces give groups of farmers tractors and implements – the groups have no management structure to manage the implements, they are not taught to calibrate the machinery, and they do not understand the maintenance requirements of tractors and machinery. These donations should be done in collaboration with a commodity organisation that is supporting the farmers so that the farmers can be assisted to manage the assets before it is too late and the equipment is damaged.

[19] An extension officer should communicate agricultural information to farmers and ensure that they not only understand the information but that they use it to obtain the best production results.

CHAPTER 6: RESEARCH AND DEVELOPMENT

Sasol is the only operation in SA that has comparable R&D levels with the rest of the world with their proprietary CTL and GTL technologies in synthetic liquid fuels production.[2]

The rest of the SA chemical sector's R&D levels are low compared to the rest of the world, and this is not likely to change in the future. The relative cost of R&D versus the expected outcome is too high to make it feasible. SA competes with large multi-nationals with much higher turnovers than local operations' (e.g. 1% of a multi-national's turnover for R&D could be a couple of billion Rand; while in SA it might only be a couple of million Rand). R&D costs are however the same anywhere in the world, and it would therefore be a much higher expense for an SA firm to do R&D than for a multi-national. For this reason technology is mostly rather licensed in and modified for the local market conditions where needed.[xv]

The only identified sub-sector where low R&D levels were identified as a specific skills constraint for future developments was in pharmaceuticals.[14]

It is also recommended that the plastic conversion sub-sector strengthen its product design in order to focus on broader growth opportunities in the African and export markets.

For potential new developments in biofuels, the South African National Energy Research Institute (SANERI), a subsidiary of the CEF, has awarded three chairs of energy research in an initiative to boost the development of SA's research base. This has resulted in the establishment of the Biofuels Research Programme (BPR). Under the BPR, postgraduate training and research in biofuels and clean alternative fuels will be driven at both Stellenbosch and Cape Town Universities to ensure local skills development in these fields for the development of commercial biofuels production technologies.[lix]

CHAPTER 7: ADDITIONAL SKILLS CONTRAINTS IDENTIFIED

7.1 Introduction

Apart from the case studies, discussions were also held with other respondent operations that have future planned investments in the chemical sector. This chapter only provides information on additional skills constraints identified in these active investments and not on the additional staff requirements in general. Where skills constraints are similar to the ones already identified in the case studies, e.g. artisans, they are not shown in this chapter again. Some additional opinions on artisans are however discussed in this chapter. The operations that provided this additional input and their respondents are shown in table 6.1.

Table 6.1: Other respondents regarding skills constraints

Operation	Activities or Sub-sector	Respondent	Position
Afrox	Industrial Gases (Inorganic Commodities)	Simon Muller[lx]	Communications Manager
Chemical Initiatives	Commodity Inorganics	Leon Kearny [lxi]	Manager
dti	Biofuels development.	André Kudlinski[xliv]	Director of Geographic Projects
ECSA	Registration of professional engineers.	Johan Pienaar [xxxii]	Registration Manager
Lurgi	Contract engineering company in the chemical sector.	Peter Dewar [xxxiii]	Engineering Manager
NCP Chlorchem	Commodity Inorganics	Corrie Botha [xx]	Business Development Leader
SA Tyre Recyclers	Rubber Conversion	Ron Khan [lxii]	Chief Executive Officer
Sasol Project TalentGro[2]	Skills development project within Sasol.	Otto Pepler [xxi]	Project Director
Sasol Wax	Commodity Organics	Paddy Padyachee [lxiii]	Business Track Leader
Unilever SA	Consumer Chemicals	Mike Ngidi [lxiv]	Human Resources Director

The South African Petroleum Industries Association (SAPIA) has not supplied their latest scarce and critical skills list to the CHIETA yet by the time of releasing their SSP Plan Update[xxix], and therefore this association's comments are also included in this chapter. Althea Banda-Hansmann[lxv], the Human Resource Development Project Leader at SAPIA, was responsive.

7.2 Engineering skills

Engineering skills for expansion and/or construction projects are mostly provided by contract engineering companies such as Fluor, Uhde, Lurgi, Foster Wheeler and others. [Sources: Afrox, Lurgi, Sasol's Project Turbo, NCP Chlorchem and Sasol Wax]

NCP Chlorchem would put a new project out to tender and the company who wins the tender would be responsible for supplying the engineering staff in respect of the following engineering disciplines: Mechanical, Civil, Electrical, Instrumentation and Chemical.

There is a shortage of the above mentioned engineering skills according to Mr. Botha at NCP Chlorchem. In the past when a project was put out for tender at least five or six of the big companies would tender; now maybe only one or two tender. The other effect this skills shortage has had is to increase costs enormously. Labour costs of skilled personnel have gone up about 10-15% above normal cost of living increases over the past year, and the large companies have no compunction about charging R600-700 per hour for a Chemical Engineer. Mr. Padyachee at Sasol Wax agreed that engineering contractors' prices are higher as demand currently outstrips supply. Projects Managers was also mentioned by him as an additional constraint to the above engineering disciplines.

Mr. Dewar at Lurgi, is also of the opinion that all types of engineers are scarce for new construction projects, especially civil engineers with the worldwide construction boom going on. Mechanical, chemical or process engineers with experience, instrumental and control engineers are also regarded as scarce by him.

Chemical engineers with experience are sourced from operations that have already provided them with the relevant experience. The problem is not the number of graduates but the ones with experience. Vacancies for chemical and materials engineers and technologists on NQF level 5 from the Sunday Times Newspaper[xxxi] amounted to almost 697 between April 2004 to March 2007, which confirms this statement, as 1 311 qualified on NQF levels 5 and 6 between 2004 and 2005 who could have filled these positions.

Otto Pepler at Sasol's Project TalentGro agreed that the shortage in chemical engineering graduates is less critical than of chemical engineers with experience. With all the development taking place, the time to train new engineers is very limited, and inexperienced engineers need to be supervised on a chemical site. Sasol has a graduate development programme that places trainee engineers on an 18-month rotation programme to acquire work experience before they qualify as engineers.

Both Mr. Dewar at Lurgi and Mr. Botha at NCP Chlorchem mentioned that Black engineers are moving around fast. These engineers are high in demand and therefore earn very high salaries. Some will remain for a year where they go through a training period and as soon as that is done they are poached by other companies.

Mr. Dewar further added that the shortage of engineers is not only a SA phenomenon, but that it is a worldwide problem. In the late 1990's Uhde started using India for bulk engineering designs, as the cost was lower. At that stage India had no shortage in engineers. Young graduates however started to leave India and it caused a gap in middle management. Currently engineers cannot be sourced from India anymore as they also have a shortage of resources now. Some engineers can still be sourced from the Philippines but their resources are also drying up. According to him there is a worldwide engineering boom, especially in the search for alternative fuels with the shortage of oil such as CTL technology, and some SA engineers go to places like the Middle East and Khazakhstan. Salaries are therefore becoming very high for engineers, which mean that they can be poached easily.

Mr. Dewar provided the following estimates on the number of engineers required as a fraction of a total construction effort:

- 10% on a large capital projects such as Project Turbo[16]
- 20-30% on a smaller projects (R100 million or less)

Johan Pienaar[xxxii] at ECSA is concerned in the SA industry that due to the high artisan shortage in the country, technicians are used to do artisans' work, technologists are used to do technicians' work, and professional engineers are used to do technologists' work. Therefore, there might seem to be a shortage of engineers, but it is however possible that they might be used for the wrong purposes. Although this is not necessarily the case for chemical engineers, it is relevant to the other engineers needed in construction projects.

7.3 Additional opinions on the artisans shortage

Several of the respondents agreed with a comment made by David Hughes[liii] of the PFSA[8] that learnerships are probably not as good as the former apprenticeships. These include: Mike Ngidi at Unilever SA; Corrie Botha at NCP Chlorchem; and Leon Kearny at Chemical Initiatives.

According to Mr. Kearny, Transnet, Eskom, Iscor (now Mittal) and the mines all used to have training centres with very high standards. The trainees they were exposed to supervised plant work during their training and the company was responsible for sending the apprentice to technical colleges for formal learning. Currently the onus is on the learner and the initiative and finance is not always there - resulting in far fewer going to college. In addition the whole process involving the SETAs with the necessary facilitators and WSPs has become too complicated and long winded according to Mr. Kearny. If the process was simplified and training incentives were easier to recover e.g. through tax rebates, then the numbers in training might start to rise again.

Chemical Initiatives recently completed a full turn around of the sulphuric acid plant. For this they had to hire 100 extra artisans, which were mainly fitters and boilermakers. The standard of workmanship produced by these artisans was well below expectations. The first year apprentices of Chemical Initiatives (with only seven months on plant experience) were sent behind these hired artisans to check for and rectify the mistakes that had been made. Whilst it is only hearsay, during informal discussions between the extra artisans hired and the permanent staff, it came to Mr. Kearny's attention that some artisans paid a fee and attended a two week course, qualifying with their trade papers.

In view of the technical nature of a chemical plant and the potentially serious implications for personnel and environmental safety this is considered to be a serious problem. Mr. Botha at NCP Chlorchem confirmed this by saying that too often after attending a very short course of a couple of weeks, it is possible to get papers qualifying artisans in a trade.

Mr. Padyachee at Sasol Wax is of the opinion that the whole concept of multi-skilling is not working in SA. According to him there are a lot of people that are jack of all trades, but masters of none, and that artisans should go back to old training methods, i.e. FET training and then practical training.

7.4 **Rubber conversion**

Ron Khan, the Chief Executive Officer of SA Tyre Recyclers, is of the opinion that there is an acute shortage of skilled personnel in the country that have an electrical cum engineering background cum computer knowledge and with experience in the rubber industry. Mr. Khan is of the opinion that there are people around who say they can do the work, but in actual fact cannot, which is due partially to lack of proper on-the-job training. The lack of skills will impact negatively on all possible expansions in the tyre recycling and rubber processing according to him.

7.5 **Other scarce and critical skills**

SAPIA members are busy compiling a list of scarce and critical skills which is expected to be released in April 2008. The SAPIA members include BP, Chevron, Engen, Shell, and Total. Ms. Althea Banda-Hansmann, the Human Resource Development Project Leader at SAPIA, said that one of the important emerging requirements to close scarce and critical skills amongst their member companies is the development and implementation of petroleum industry specific learning programmes across the industry value chain. However, member companies will review the final scarce and critical skills report to inform the way forward to bridge industry skills gaps.

CHAPTER 8: OTHER GROWTH CONTRAINING FACTORS

8.1 Introduction

Apart from SA having a small local market, there are also other overlapping growth constraining factors across the sub-sectors of the chemical sector such as transportation, regulatory constraints, international competition and feedstock constraints that are discussed below.[vi]

Apart from these constraints, energy supply security is a serious issue that could lead to large capital investments being held back as well as reduce the level of foreign investment in SA.

8.2 Transportation

SA has significant disadvantages in terms of the inland location of most operations, high transportation costs (road, railway and harbours for exports) as well as lack of access to large regional markets. Other disadvantages include the lack of container handling facilities in ports such as Richards Bay and a shortage of rail line capacity and failing services in these.

Processing of documents by customs is regarded as too slow. This includes rules on refusal to accept last minute discrepancies/changes to shipping documents (e.g. overfilling/under filling of a container caused by production variances). Customs clearance also takes too long.

The congestion at ports is causing problems in both costs and deliveries. The inefficiency extends to the release of bills of loading, as these are only released days after the ship has left port. These have to be at the port of destination by the time the ship docks or they are unable to off-load the cargo. Shipping lines have also added an additional congestion charge. This significantly affects their price and competitiveness of some products.

There is therefore a strong feeling that SA's transport system is not geared up to provide export advantage.

Fine chemicals often require sophisticated methods of transportation, which is not readily available, while what makes transportation critical for the explosives category of bulk formulated chemicals, are the rules and regulations of the Explosives Act. To some extent SA is more lenient than other countries, which means that SA is at a disadvantage as it is easy for other countries to export into SA. In many countries the ammonium nitrate does not have a differentiation between fertiliser and explosive grades and is hence easier to move about.

Distribution logistics into the pharmaceuticals market is complex and costly, and this impacts negatively on this sub-sector. Theft of medicines during transportation and storage is also high. For consumer chemicals, the logistical requirement to supply a large product range into the retail distribution network has a negative impact on this sub-sector, in particular on SMMEs.

The major transport issue in the plastic conversion sub-sector is the logistical requirement to supply a large product range to many customers. This aspect has a negative impact in particular for SMME operations. Another negative aspect is that the bulky, light nature of plastic products often leads to less than optimal space utilisation, especially for exports in containers.

8.3 Regulatory constraints

Regulatory constraints in the chemical sector include the following:

- Slow reactions to Environmental Impact Assessment applications for new projects or expansions
- Assistance for new investors in dealing efficiently with regulatory requirements for new plants
- Difficulty to obtain work permits; there is a lot of red tape involved according to Peter Dewar[xxxiii], the Engineering Manager at Lurgi, and in some cases staff are rather seconded from international branches
- High real interest rates lead to high hurdle rates for capital expenditure; in addition they also add significantly to operational costs compared to competitors with low rates such as the USA, European Community and Japan

All pharmaceutical products have to be registered with the MCC and all manufacturing operations have to be approved by them too. The regulatory environment in SA is regarded as slow and not conducive to the competitiveness and sustainability of local manufacturing. In addition, the Government as custodian of the regulatory framework is also the largest customer of the industry. The DoH sets the overall health policy, including issues such as generic substitution.

Trade permits for fuel products is a regulatory constraint in the liquid fuels sub-sector.

8.4 International competition and feedstock constraints

The high value of the Rand has decreased SA’s competitiveness against Dollar-based producers of commodity organic chemicals producers such as Brazil and the USA. International competition, particularly cheap dumped products from China are also playing an increasing role in preventing the growth of the home market.

Producers in the Middle and Far East are significant threats to local producers of primary polymers and rubbers. In the Middle East, producers have access to low cost crude oil and natural gas supplies, and in the Far East the production costs are low due to cheap labour and low starting-up costs.

In inorganic chemical categories such as metal salts where scrap metal and silicates are globally available, labour costs become the major determining factor for export competitiveness, and countries such as China, Turkey, and India are regarded as too competitive for SA to be viable. Other disadvantages include a poor feedstock position in salt, potassium, alumina and sulphur. Labour costs in speciality chemicals relative to skills also appear expensive relative to China and other Asian competitors.

For bulk formulated chemicals, SA has a poor feedstock position in urea, ammonia, sulphur and potassium, as well as relative poor position in natural gas as feedstock for ammonia and urea production. The previous Competitions Board [now the Competition Commission] did not to allow the Sasol takeover of AECI to go ahead, mainly due to the perceived reduction in downstream fertiliser and explosives markets. AECI's two ammonia plants and their urea production facility have since been closed down and this has lead to significant imports of basic fertiliser feedstock, especially urea.

For pharmaceuticals, increasing market competition from imports and pressure on public sector prices has put pressure on operating margins, and it has become necessary for companies to control labour costs more carefully.

SA has little advantages in consumer chemicals as far as raw materials are concerned. Most raw materials are being imported, and locally sourced raw materials are generally sold at import parity pricing.

Main challenges facing for the plastic packaging category are: the strength of the rand that influences exports; imports of food-stuffs that influences the market for plastic packaging; imports of plastic products such as flexible packaging that is easy to transport, especially finished goods from the Far East.

The rubber conversion sub-sector is influenced by low-cost imports, and it has become necessary for companies to control all costs more carefully, inclusive of salaries and wages. Sub-standard imported products are however carefully monitored by end users such as automotive manufacturers. Certain quality specification marks laid down by authorities in other countries such as the United Kingdom, Canada and the USA are difficult to obtain in rubber products other than tyres, and appear to be set in order to protect their local industries. The lack of customs control allowing illegal imports of sub-standard tyres is a serious disadvantage in SA. Most of the major raw materials are imported.

There is a concern that there is an inability or unwillingness of the dti to protect the local industry, whilst the EU and other international markets are increasingly working to protect their domestic industries, e.g. the implementation of anti-dumping laws.

CHAPTER 9: ANALYSIS AND RECOMMENDATIONS

9.1 Historical and future outlook of the SA chemical sector

Growth in the consumption of chemicals have always been similar to manufacturing GDP as it touches every part of the economy such as agriculture, mining, etc. where chemical products are used.[ii] The manufacturing GDP was 4% on average between 2004 and 2007. Apart from a handful of individual enterprises such as Sasol, the production growth rate in the chemical sector was however lower than this, at an estimated 2% per annum between 2004 and 2006.[i]

The reason for this is that there is a world tendency that high manufacturing volumes tend to be in countries with competitive feedstock advantages, e.g. crude oil and other raw materials and SA is at a competitive disadvantage with many feedstocks that need to be imported.[ii]

The chemical sector is also stagnant in terms of job creation[iii], due to efficiency improvement as well as a general trend towards automation and capital intensiveness, especially in the upstream chemical sector.[ii]

In terms of R&D, Sasol[2] is also the only operation in SA that has comparable R&D levels with the rest of the world with their proprietary CTL and GTL technologies in synthetic liquid fuels production. The rest of the SA chemical sector's R&D levels are low compared to the rest of the world, and this is not likely to change in the future.[vi] The relative cost of R&D versus the expected outcome is too high to make it feasible as SA competes with large multi-nationals with much higher turnovers than local operations. For this reason technology is mostly rather licensed in and modified for the local market conditions where needed.[xv] The only identified sub-sector where low R&D levels were however identified as a specific skills constraint for future developments was in pharmaceuticals.[14]

This highlights the need for future skills development to be directed towards areas of active investment, as well as further downstream development in sub-sectors that have proven to be feasible from the Chemical Sector Development Strategy.

9.2 Constraints and opportunities in the current chemical sector

9.2.1 *Introduction*

There are various overlapping growth constraining factors in the SA chemical sector in which the Government can play an active role in finding solutions, such as transportation constraints, regulatory constraints, as well as energy supply security.[20]

[20] Refer to Chapter 8 for more information on general growth constraining factors.

Energy supply security in particular is a serious issue that could lead to large capital investments being held back as well as reduce the level of foreign investment in SA, and therefore ultimately influence Asgisa's target growth rates.

Other constraints in which Government could also play a role include aspects like a small local market as well as international competition and feedstock constraints. The level of these constraints are however different in each of the sub-sectors of the chemical sector with different approaches needed, if at all, to address them.

The strategic classification of the SA chemical sector is based on 11 sub-sectors that were developed as part of a Customised Sector Programme[vi] of the dti. There is also the SIC classification that is mostly used for statistical purposes. For this section, the dti's strategic classification is used, and the sub-sectors are further categorised within the upstream and downstream chemical sectors.

9.2.2 *Upstream chemical sector*

Upstream chemical operations are capital intensive and have chemical synthesis production processes that are controlled by automated process control. The sub-sectors that are part of the upstream chemical sector are liquid fuels, commodity organics, primary polymers and rubbers, commodity inorganics, and fine chemicals. All the sub-sectors of the upstream chemical sector are well developed in SA except for fine chemicals.[ii]

Fine chemical products change to fast internationally (such as ARVs) to set up a sustainable local production base, and R&D would also not be feasible competing with large multi-nationals.[xv] This sub-sector's outlook is therefore not expected to change in the near future.

Although the liquid fuels sub-sector is well established in SA, demand is currently outstripping supply with the deficit being imported. There are several plans to counter this trade deficit in the future such as Sasol's increased production of synthetic fuels and their investigation into a new CTL inland refinery called Project Mafutha on which Sasol[2] is having talks with Government. There are also other investigations underway by PetroSA and Bidco for possible new developments. With the finalisation of the Biofuels Industrial Strategy[vii], there might also be some future developments in renewable fuels production in the future.

Commodity organics is the best established sub-sector in upstream chemicals manufacturing in SA and a growing exporter of products.[viii]

For primary polymers and rubbers SA is well established in certain product categories, but do however still need to import others such as polystyrene, which leads to a trade deficit.[viii] Some of these products could offer local manufacturing opportunities but the import figures are too low from an economies of scale perspective, and therefore the export market should also be targeted. Exports would generally not be viable unless substantial protection is offered for inland sales by Government.[vi]

Lack of specific feedstocks drives large imports in the commodity inorganics sub-sector. There are however investment opportunities in areas where SA has feedstock advantages, such as titanium beneficiation, which is under feasibility investigation by both Government and other role-players.[vi]

9.2.3 *Downstream chemical sector*

Downstream chemical operations are typically labour intensive and generally consist of formulation production processes as well plastic and rubber conversion. Pure functional chemicals could also have synthesis reactions, but these are on a smaller scale than in the upstream sub-sectors.

The sub-sectors that form part of the downstream chemical sector include pure functional and formulated speciality chemicals, bulk formulated chemicals, pharmaceuticals, consumer formulated chemicals, as well as plastic and rubber products.

All these sub-sectors are well established in SA, especially bulk formulated chemicals that had a positive trade balance in 2006.[viii]

Lack of specific feedstocks however drive large imports in pure functional, speciality and consumer chemicals sub-sectors. There is also a worldwide trend that these types of chemicals are tailor-made for their specific country and not for the export market, which SA follows. Increased R&D for new product development would be too expensive as it would be in competition with large multi-nationals. The R&D is therefore focused on local conditions rather on new products.[xv] This situation is not expected to change.

The rubber conversion sub-sector was previously regarded as uncompetitive, mainly due to old equipment, and small production runs. This situation has been addressed by the multinational tyre companies, focusing on investment of new equipment, rationalisation of product lines and export development.[vi] The rubber products sub-sector is more labour intensive than the plastic products sub-sector in terms of the number of people per plant.[ii/iii] It is therefore recommended that this sub-sector is investigated for further development in South Africa.

Both pharmaceutical products and plastic products had a trade deficit in 2006.[viii] The promotion of the greater production in local pharmaceutical products and downstream plastic products production are however two key action programmes in the Chemical Sector Development Strategy[iv] that forms part of the dti's broader industrial policy framework that could address these trade deficits in the future. These two sectors therefore form the focal area in the downstream chemical development arena.

9.3 **Current employment levels in the SA chemical sector**

9.3.1 *Introduction*

The SA chemical sector employs between 120 000 and 130 000 people.[ii/iii] Although the upstream chemical sector is better developed in SA than the downstream chemical sector, the downstream chemical sector contributes to about 80% of all employees being more labour intensive, with plastic products the biggest contributor at 25% of the total number of employees.

Core functions such as manufacturing, sales, and administration are generally fulltime in the chemical sector, while services such as information technology, catering, cleaning services, security, as well as logistics are often outsourced on a contract basis.[vi]

9.3.2 *Gender distribution*

Male employment dominates at 80% or more in most of the positions in the chemical sector, except in clerical and sales positions where females account for about 60% of employees. Most downstream chemical operations employ a bit less males at around 70%, but this excludes the rubber sub-sector where males are dominant at more than 80%. The gender distribution has not changed much between 1996 and 2005 based on data from the Household and Labour Force Surveys done by StatsSA.[xix] There has however been a general increase in the contribution of female graduates in fields such as chemistry, chemical engineering and pharmaceutical science over this period that could increase the female contribution to the chemical sector in the future.[xxiv]

9.3.2 *Skills levels and racial distribution*

Higher level positions such as managers, professionals and technicians are dominated by White employees, while the lower positions such as artisans, operators and elementary positions are dominated by Black people.[xix] Skills levels are higher in upstream chemicals than in downstream chemicals manufacturing.[iii] It also seems as if more Black people are employed in the downstream chemical sector than in the upstream chemical sector, but the accuracy of this data is questioned.[xix]

The average skills level distribution remained similar over the period of analysis for all the sub-sectors, except for coke and refined petroleum products. Skilled workers increased with 14% for coke and petroleum products if 1995 is compared to 2005, due to a similar decrease in semi- or unskilled workers.[iii] This could be due to a rise in qualification requirements in the chemical sector that used to require an NQF level 2 qualification that was increased to NQF level 4.[xx]

There has also been a general increase in the contribution of African graduates in fields such as chemistry, chemical engineering and pharmaceutical science over the period of analysis[xxiv] that could mean a higher level of African employees in the future chemical sector.

9.4 Areas of active investment and identified scarce skills

9.4.1 *Introduction*

Sasol's future projects and the refinery upgrades for cleaner fuels by 2010 account for more than 90% of identified capital investments (in value) in the chemical sector.[xxii] There is also an investigation towards a possible new CTL refinery for Sasol[2], a chemical cluster and refinery at Coega, and potential new biofuel plants with the finalisation of the Biofuels Industrial Strategy[vii].

Identified scarce skills for active investments include artisans and engineers for the construction of these new or improved operations. There are no identified constraints in terms of operating these new plants, but there is however a concern about the low pass rates of African matriculants in subjects like maths and science that are required as operators in the chemical sector.

9.4.2 *Artisans*

Identified scarce artisans for chemical sector developments include boilermakers, coded welders, mechanical and pipe fitters, electricians, riggers, and instrument mechanics.

The shortage of these artisan skills for peak refinery maintenance events and periods of peak construction activity in the SA industry has raised due to significant capital investment programmes in numerous industries such as the petrochemical, transport and infrastructure sectors.

The refineries do however schedule shut-downs so that they do not coincide, but the same resources are often contracted into longer term capital construction activities and may be lost to the migrant shutdown pool.

Jipsa has set a target to train 50 000 artisans from 2007 to 2010. Some of these artisans are however required already and these estimates also do not include any identified investments in the chemical sector.

Identified projects however running currently in the chemical sector to fill this skills gap include the Shutdown Network Forum (SNF) as well as Sasol's Project TalentGro. There are also additional artisan training projects running across the economy, including the Technical Skills Business Partnership (that Sasol is also involved in), as well as at Coega, the MERSETA, SEIFSA and State Owned Enterprises.

Funding is one of the challenges that the SNF is facing. Funding from the CHIETA and the NSF also needs to be streamlined as there are concerns that the approval and allocation of funding sometimes takes too long.

There is also expected to be a scarcity of suitable equipped training facilities, trainers, assessors and moderators. Another concern is host employers to place lower-level artisans for experiential workplace training, as they currently need qualified artisans and do not necessarily have the time for training.

Recruiting learners is also a challenge. Advertisements in the papers do not always reach the target market for potential applicants and short-term posters and pamphlets are therefore distributed in the relevant geographical areas where artisans might be needed in the future.

Project Turbo provides an example of the number of artisans required on a large capital project. Project Turbo however involved sophisticated technology, and therefore the number of artisans required on other projects might differ slightly.

Several of the respondents [David Hughes at the PFSA, Mike Ngidi at Unilever SA, Corrie Botha at NCP Chlorchem, Leon Kearney at Chemical Initiatives] commented that learnerships are probably not as good as the former apprenticeships. Transnet, Eskom, Iscor (now Mittal) and the mines all used to have training centres with very high standards. The trainees they were exposed to supervised plant work during their training and the company was responsible for sending the apprentice to technical colleges for formal learning. Currently the onus is on the learner and the initiative and finance is not always there - resulting in far fewer going to college.

9.4.3 *Engineers*

Engineering skills for expansion and/or construction projects are mostly provided by contract engineering companies. Engineers used in these contracts are regarded as scarce, including civil, electrical and instrumentation, mechanical, and chemical engineers. The scarcity of these engineers has also increased the cost of construction.

The shortage of these engineers is not only a SA phenomenon, but is regarded as a worldwide problem, especially in the search for alternative fuels with the shortage of oil with some of SA's engineers going to places like the Middle East and Khazakhstan. Salaries are therefore becoming very high, which also means that they can be poached easily.

Chemical engineers with experience are sourced from operations that have already provided them with the relevant experience. The problem is therefore not the number of graduates but the ones with experience. Vacancies for chemical and materials engineers and technologists engineers on NQF level 5 from the Sunday Times Newspaper[xxi] amounted to almost 697 in total between April 2004 to March 2007, which confirms this statement, as 1 311 qualified on NQF levels 5 and 6 between 2004 and 2005[xxiv] who could have filled these positions. The time to train new engineers is very limited, and inexperienced engineers need to be supervised on a chemical site.

Black engineers are also moving around fast in SA. These engineers are high in demand and therefore earn very high salaries. Some will remain for a year where they go through a training period and as soon as that is done they are poached by other companies.

The average number of civil engineering graduates on NQF levels 5 and 6 between 2004 and 2005 amounted to 931 p.a. [xxiv] while the demand according the vacancies in the Sunday Times Newspaper[xxxi] amounted to 1 120 for April 2006 to March 2007, which was an increase from 688 in the year before that. The large number of capital projects currently running and the increase in the demand for civil engineers in SA might cause a larger supply deficit in the near future. There was also a decline in NQF level 6 civil engineering graduates between 2002 and 2005, which is a cause for concern.

The demand for electrical engineers from vacancies in the Sunday Times Newspaper[xxxi] was 243 for April 2005 to March 2006, and almost doubled to 430 in the following year. Based on the supply data from HET institutions[xxiv] there still seems to be ample electrical engineers graduating at an annual average of 1 664 on NQF levels 5 and 6 between 2004 and 2005.

The demand for mechanical engineers from the vacancies in the Sunday Times Newspaper[xxxi] was 415 from April 2005 to March 2006, and jumped to 592 in the year after that. These vacancies included industrial and production engineers, which might fall under other engineering professions than mechanical. Based on the supply data[xxiv] mechanical engineers from HET institutions still seem to meet the demand at an annual average of 587 between 2004 and 2005 on NQF levels 5 and 6.

The fact that there seems to be enough electrical and mechanical engineers speaks to the concern[xxxii] that due to the high artisan shortage in SA, technicians are used to do artisans' work, technologists are used to do technicians' work, and professional engineers are used to do technologists' work, especially in the construction engineering disciplines.

Identified initiatives to increase the number of engineers include: Sasol's Project TalentGro and investment in universities; the Technical Skills Business Partnership (which Sasol is also involved in); and Universities aiming to train 1 000 more engineers per annum by addressing issues that influence the current pass rates of entrants.

9.4.3 *Synergies and strategies required*

The future of active investments in the chemical sector and the SA economy as a whole will depend on the level of commitment of all the entities involved to develop the skills required such as artisans and engineers. Various initiatives are underway to address this problem, but better coordination between these initiatives is required to improve the synergy that would strengthen these efforts. Strategies to ensure the outcome of these projects should also be put into place.

9.5 Downstream development and relevant skill constraints

9.5.1 *Introduction*

The sub-sectors prioritised in the Chemical Sector Development Strategy[iv] for downstream development include pharmaceuticals and plastic conversion,

9.5.2 *Pharmaceuticals*

Major growth exists is the generic pharmaceuticals market and to increase local formulation capacity. This market however requires access to low-cost raw materials and large markets in order to be viable for manufacturing. A harmonised regulatory regime for SADC countries would give SA based manufacturers easy access to a market of nearly 200 million people.[xv]

The pharmaceutical industry is also struggling to get sufficiently well qualified people for R&D work. The resources required are qualified pharmacists with a strong background in chemistry, as it is essential for the researcher to understand the chemical reactions involved. This would normally require someone with an M.Sc. in Pharmacy.[14]

Because of the shortage of these skills, all work is currently being concentrated on ARVs. There is plenty of work and new ideas for development but no staff to spare. This is particularly so for development of generic drugs and new forms of delivery of drugs to patients. Currently the technology and background for generics are bought in from overseas but in effect could be done here if staff were available. [14]

NQF level 6 pharmaceutical science graduates have stayed fairly constant between 1996 and 2003, with a sharp increase in 2004, and a decrease to the average levels again in 2005. The average number of pharmaceutical science graduates produced on NQF level 6 between 2003 and 2005 were 283 p.a.[xxiv] The average number of vacancies for pharmacists as identified from the Sunday Times Newspaper[xxxi] between April 2004 and March 2007 was however 636 p.a., which shows that the average annual supply of pharmacists currently does not meet the demand.

Masters students however increased between 1996 and 2005, with 128 qualifying in 2005.[xxiv] This number sounds enough for what the local pharmaceutical sector requires, but these graduates have most probably been absorbed into other sectors of the economy such as healthcare, or they do not have the necessary required chemistry background leading to the identified shortage in supply.

Apart from assisting the pharmaceutical sector in addressing the above-mentioned skills shortages, the SA Government could improve the sustainability of further local investments in generic medicines manufacturing through:[xv]

- The promotion of a better local access to global information and know-how
- The improvement of regional market (e.g. SADC countries) intelligence
- The promotion of a local spatial cluster for the pharmaceutical industry
- Implementing a more investors friendly and efficient regulatory environment as well as health policy
- Improving its sourcing through COMED, a central purchasing organising of Government, to purchase medicines to favour more the local industry
- Implementation of a better incentive scheme to make investment more attractive

9.5.2 *Plastic products*

Opportunities exist in to increase local beneficiation of plastic products, in particular for automotive and packaging applications. It is also recommended that the plastic conversion sub-sector strengthen its product design in order to focus on broader growth opportunities in the African and export markets.

Low mentorship levels were identified as a critical skill constraint in the plastic conversion sub-sector. There are also low levels of training by smaller operations and a 'salary-based grasshopper' problem in that skilled people are constantly changing jobs once they have been trained, which to some extent acts as a disincentive to in-house training.[8]

It is also not an easy process to get young people placed in the plastics industry. Somehow the industry needs to be persuaded to train staff. A particular problem that the PFSA experiences is that they have course places booked and then because the employers suddenly realise that they cannot afford to give the staff time off to attend, there is a no show.

Cheap imports from China have also had some affect on this growth through displacement of local manufacturing.

9.5.3 *Chemical incubators*

SA has three chemical incubators that are involved in developing the downstream chemical sector in SA.

ChemCity that is wholly owned by Sasol[2], and focuses on incubating sound business propositions into viable enterprises throughout SA. In the past 2.5 years, Chemcity has successfully established 30 new businesses that include biofuels, consumer chemicals, plastic conversion, effluent to fertiliser production, and waste management.

Chemin[1] is a catalyst in the establishment of an entrepreneurial culture leading to the development of a successful downstream chemical industry in SA. Chemin has a focus on developing entrepreneurial skills amongst other aspects. Chemin had 33 running projects in 2007 in consumer chemicals, pharmaceutical products, and pure functional and speciality chemicals. The fine chemicals that Chemin focuses on are mainly plant extracts.

SediChem is a business and chemical technology incubator, which offers entrepreneurs the opportunity for commercialisation of chemical products and services. Sedichem's focus is on the provision of infrastructural, commercial, strategic and legal support with the purpose of developing sustainable SME's in the Gauteng Province.

9.5.4 *Biofuels development*

Apart from the skills constraints already identified in the construction of new chemical plants, namely artisans and engineers, the development of the biofuels industry faces significant constraints in terms of new upcoming farmers.[21]

Skills constraints identified include: illiteracy, innumeracy, low maths and science results, and no practical experience in farming.

Other constraints include: non-profitability, no secure access to land, lack of equipment, lack of processing materials, no fencing to protect lands, bad farm roads, no access to loans, and poor quality products.

Current commodity organisations could be used to train farmers and extension officers and mentoring should be done by people with honourable intentions to take the farmers by the hand during the peak season. The extension support from the Department of Agriculture might not be sufficient currently.

Possible support from Government could include financing for training courses provided by commodity organisations, commitment from the extension services to cooperate with the commodity organisations, and access to finance with a special dispensation to developing for farmers, e.g. low interest rates etc.

Official public/private partnerships should also be formed e.g. some of the departments of agriculture in many of the provinces give groups of farmers tractors and implements. These donations should be done in collaboration with a commodity organisation that is supporting the farmers so that the farmers can be assisted to manage these assets.

[21] Refer to the Grain SA Case Study for more information

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