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Sector Report for HSRC

PROJECTED SKILLS DEMAND AND SUPPLY FOR THE ELECTRICAL ENERGY SECTOR

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The Learning Event

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Chapter One

Profile of the SA Electrical Energy Sector

This research report provides a review of the current and future skills demand and supply situation for the South African energy sector specifically in the generation, transmission and distribution of electrical energy. The report also contains a synthesis of these findings and a selection of case studies and identifies critical skills shortages, likely blockages to skills development and potential opportunities for job creation.

AIMS AND METHODS

The research aims to:

- Provide support for government's AsgiSA initiative with a particular focus on skills development and job creation;
- Contribute to the better alignment between skills development policies with industrial or sector initiatives/policies;
- Develop a sectoral and enterprise focus in the debate about skills development in South Africa; and
- Make a contribution to the SETA community by providing an up-to-date analysis of the critical inter-relationships between industrial policy, sector (or economic) growth and skills development.

This report presents the result of the research, covering :

- A high-level overview of the sector, drawing on available secondary sources;
- An assessment of current and projected demand for skills, based mainly on sector trends and occupational data;
- A review of case studies of selected organizations, covering skills demand-supply variables;
- A review of the current and projected supply of skills from educational and training institutions, as well as enterprise training initiatives, based mainly on educational data; and
- A concluding assessment to identify possible bottlenecks and barriers affecting the supply of skills, consider policy issues and make recommendations.

The research methods applied included perusal of primary and secondary literature, access to a variety of databases made available by the HSRC, recent news items, website scans, interviews and case studies.

SECTOR SCOPE

This review focuses on the sector concerned with the generation, transmission and distribution of electrical energy in South Africa. This includes all forms of generation ranging from non-renewable to renewable sources. The review excludes biofuels and natural gases, except where they are utilized to produce electrical energy.

This review cover a number of key electricity-related sub-sectors, notably electricity production, collection and distribution, the manufacture and maintenance of electric motors, generators and transformers, distribution and control apparatus, insulated wire and cable. These sub-sectors will be reviewed to identify any growth or changes in these sectors associated with the expansion of energy generation and distribution and consider the implications for skills requirements.

The report will examine not only formal employment trends relating to the electricity sector and related sub-sectors, but will also consider patterns in informal employment and unemployment, to identify possibly opportunities for promoting growth in informal economic activities and reducing unemployment.

The time frame for the review will cover trends in historical statistical data for the period 1996 to 2005. As far as future strategic projections are concerned, the report will mainly review implications for skills demand and supply up to 2012. Beyond that, a limited assessment will be offered for the future to 2025, given that this timeframe features in some scenario planning.

This high-level overview of the sector assesses the status of electrical energy sector in South Africa, current and projected growth of the sector, alternative sources of supply, power conservation and demand management, changing market size, the role of small and medium sized enterprises, opportunities and barriers to entry, sector performance and key statistics.

The overview sets the background and context for assessing current and future skills requirements pertaining to key occupations, as well as broad barriers and enablers affecting the supply of skills and the job creation potential of the sector.

The primary skills considered are professional and technical electrical engineers and artisans, although a broad focus will also be placed on the National Qualifications Framework (NQF) levels in relation to formal and informal sector skills requirements and availability.

NOTE ON DATA SOURCES

The information presented in this report has been largely dependent on:

- The available employment and educational data obtained from the HSRC; and
- The availability of data requested from other organizations, mainly for case study purposes.

The databases supplied by the HSRC which have been extensively used include :

- the Department of Education’s Higher Education Management Information System (HEMIS- DoE 2007a);

- The DOE’s Further Education and Training (FET) output for 1996 to 2005 (DoE, 2007b);
- StatsSA’s October Household Survey (OHS) for 1996-1999 (Quantec 2007); and
- StatsSA’s Labour Force Survey (LFS) for 2000-2005 (Quantec, 2007).

The case study profiles were drawn up using mainly website information, published sources (such as annual reports) and interviews and correspondence with organization representatives. A number of companies in the sector approached for skills-related information did not supply the requested information within the available time period.

THE SKILLS DEBATE

The so-called skills shortage has been dominating news headlines in South Africa for the past few years. Recently, the annual International Business Report Survey from Grant Thornton, found that a shortage of skilled workers was regarded as the main impediment to business expansion by 58 percent of 200 respondents in medium-to-large businesses (Business Day, 16 July 2007).

The skills debate has not been without controversy. The Commissioner for Employment Equity (CEE), for example has been on record that the “shortage” is artificial and due to the unwillingness of many employers to hire black people. By contrast, the trade union Solidarity has claimed that affirmative action contributes to the skills shortage by failing to recruit or retain skilled white people (Business Day, 8 July 2007).

Many independent commentators and business leaders believe that there is indeed a skill shortage (see comments by Ann Bernstein of the Center for Development Enterprise and Wiseman Nkuhlu in the Sunday Times, 10 June 2007). The legacy of “Bantu Education” is recognized by many as having stunted the development of skills in the country.

For government, acknowledgement of this legacy led to the drafting of the Skills Development Act and Employment Equity Act (among others), with a view to promoting the training, development and advancement of previously disadvantaged people. More recently, government has launched the Accelerated and Shared Growth Initiative for South Africa (AsgiSA, 2006), and the Joint Initiative on Priority Skills Acquisition (JIPSA, 2006), which reflect its twin concerns about skills and job creation, particularly the shortage of professional engineers and artisans.

The demand for skills, especially intermediate and high-level engineering and artisan skills, appears to be intensifying. According to the Department of Labour’s (DoL) most recent report on the “State of Skills in SA” (2005), there has been a shift towards capital-intensive production calling for more skilled labour associated with an export-led economy. The DoL report quoted SASOL’S claim in 2003 that the country was already short of at least 20 000 artisans.

A number of current developments can be identified which could be placing pressure on the supply of skills. A major drive is underway to boost the transport infrastructure across South Africa, focusing mainly on upgrading Transnet's railways and ports, which needs engineers and technicians.

For the next few years at least, the infrastructural work on the Gautrain and the 2010 world cup soccer is also drawing away seemingly limited engineering and technical skills.

Furthermore, a global commodities boom has been taking skilled artisans and engineers away from South African mining operations to other countries, including parts of Africa and Australia.

Government's JIPSA anticipates that the number of engineers produced each year will need to be almost doubled from 1400 to 2400, whereas artisans will need to more than double from 5000 to 12500 every year over the next four years.

Within the electrical energy sector, there has also been a reported lack of skills and jobs. For example, the "Engineering News" periodical has made frequent reference to these challenges in their energy-related headline stories during 2006/7 :

Table 1.1

Headline Energy Topics in Engineering News : 2006 - mid 2007

Headline Topic Category	**No. reports**
New generation capacity *	13
Renewables and environment **	7
Energy planning	6
Skills shortages, job creation and development	5
Contracts and agreements	3
Pricing	2
Distribution restructuring	1
Independent power producers	1

* Includes coal-fired, nuclear and gas

** Includes biofuels, landfill, wind, co-generation, solar

This range of topics reflects not only the skills/jobs issue but also the planned expansion of the energy sector and the debate around renewable energy sources (see Annexure One for more detail on these new items).

The main aim of the present research will be to establish, through the use of available supply and demand information, the extent to which the electrical energy sector can be described as experiencing a current and future skills shortage.

The related question of job creation and unemployment will also be considered, given government's concern about the abundance of marginalized youth in the unskilled, semi-skilled and small business sectors, including the "informal sector" :

"Sufficient employment creation remains the most crucial and most difficult of the ASGISA objectives" (AsgiSA Annual Report 2006)

This paper is informed by the perspective that skills development in South Africa cannot be tackled separately from job creation and poverty alleviation.

CONTEXTUAL OVERVIEW

Eskom has dominated the energy sector as the main supplier and distributor of electricity since early in the last century, producing 96 percent of the total.

As of mid-2007, Eskom operated 24 power stations across the country :

Table 1.2
Provincial Distribution and Type of Eskom Power Stations

Province/Type of Generation	Coal-fired	Hydro-electric	Gas Turbine	Pumped Storage	Nuclear	TOTAL
Mpumalanga	11					11
Eastern Cape		5 *	1			6
Western Cape			1	1	1	3
Northern Cape		1				1
Limpopo	1					1
KwaZulu Natal				1		1
Free State	1					1
TOTAL	**13**	**6**	**2**	**2**	**1**	**24**

* Includes 4 smaller hydro-electric units forming part of the Distribution infrastructure
Source : www.eskom.co.za

Table 1 indicates that power generation is concentrated in the Mpumalanga province, which has extensive coal fields in the north-eastern highveld region of South Africa.

Ten of South Africa's coal-fired stations provide base load power for the national grid, with three additional "mothballed" stations currently being returned to service (several stations were "mothballed" or shut down during the 1980s as a result of the slowdown in economic growth during the apartheid sanctions era).

The hydro-electric, pumped storage and gas turbine stations are "peak load" stations which can bring additional power to the grid within a relatively short time period to meet peak demand (pumped storage stations transfer water from lower to upper dams when there is sufficient electricity available, and store the water until the station needs to generate electricity again).

One of Mpumalanga's stations (Kendal) is reported by Eskom to be the largest fossil-fuel station in the world, with a generation output of 4116 MW. Matimba power station in Limpopo is also the largest dry cooling station worldwide (3990 MW). The rest of South Africa's coal-burning stations are mainly water-cooled

(Eskom annually consumes 1,5 percent of the country's total water consumption in the production of electricity).

As far as interconnections across national borders are concerned, South Africa supplies more than half of the electricity used on the African continent. It supplies power directly to Lesotho, Swaziland, Botswana, Namibia and Zimbabwe (although these services have been affected by the utility's "load-shedding" practices in recent times).

South Africa also imports around 2000MW from Cabora Bassa in Mozambique and there are plans in future to import power from Namibia (mainly from the Kudu gas field). There have, however, been recent problems of supply from Cabora Bassa due mainly to poor weather conditions in Mozambique.

As power leaves each station, the electricity is boosted by step-up transformer to higher voltages (132 kV, 400 kV or 765 kV) for conveying through the transmission infrastructure of overhead lines. When the electricity reaches a substation near a load centre (such as Gauteng, Western Cape or KwaZulu Natal), it is stepped down to lower voltages for distribution to customers via the distribution network.

As of March 2007, South Africa had a total of 27 770 km of high voltage transmission lines and 325 000 km of distribution lines. The distribution in urban areas is shared between Eskom and Municipal councils. Municipalities are by law entitled to sell and distribute power and in their demarcated areas (there is no legal role or responsibility for the provinces in respect of electricity supply).

Municipalities provide new connections and maintenance for domestic (residential) consumers, whereas Eskom provides electricity and maintenance services directly to "bulk" customers, such as mines and industries. **(Jeff is this right?)**

In 1994, the inaugural year of South Africa's new democracy, the average level of electrification countrywide was 36 percent. By 2004, this had risen dramatically to 72% (Eskom, 2007). During that time, the number of rural households electrified countrywide rose from 12% in 1994 to 52% by 2005. While this is a significant historical achievement, close to half of the rural population still does not enjoy access to grid-based electricity, partly due to the size of the country and long distance between towns.

Rural households comprise the majority of poor homes and are characterized by "energy poverty", which is exacerbated by the increasing scarcity of fuel-wood. The cost of providing an extended national grid to rural areas becomes increasing expensive, given that small consumption by the end-user makes the investment in power lines not economically viable. In these areas, alternate sources of (renewable) energy become more attractive.

In 2004, industry consumed the lion's share (38 percent) of electrical energy, followed by mining (15,9 percent) and the domestic residential market (16,8 percent – NERSA, 2004). Most household energy is obtained from fuel wood

(50 percent of net household energy), primarily in rural areas, with the remainder from coal (18 percent), illuminating paraffin (7 percent) and a small amount from liquid petroleum gas (South Africa Yearbook 2005/6).

STAKEHOLDERS AND LINKAGES

The electricity sector falls under the responsibility of the Department of Minerals and Energy (DME). The DME's Energy Policy, as set out on its website, is based on the following key objectives:

- Attaining universal access to energy by 2014;
- Accessible, affordable and reliable energy, especially for the poor;
- Diversifying primary energy sources and reducing dependency on coal;
- Good governance and the promotion of private-sector investments in the energy sector; and
- Environmentally responsible energy provision**.**

At the center of the electricity market are those entities involved in the generation, transmission and distribution of electrical power, starting with the national supplier Eskom as a state-owned enterprise. Partly because of the large start-up capital costs associated with generation capacity and transmission infrastructure, there are few independent power producers (IPP) in the country.

However, one or two IPPs have emerged in recent times, such as the German company IFE, which has signed an agreement with the state-owned Central Energy Fund (CEF) to establish a new company (Johanna Solar) in a bid to help commercialise solar technology in South Africa.

Overseeing the role of Eskom and the IPPs is the National Electricity Regulator (NERSA), which together with the DME, strives mainly to ensure that electricity tariffs and capital expansion plans are aligned with national policy and development objectives.

The linkages within the energy sector are characterised by both the supply side to the sector and demand side from the sector, each of which has numerous stakeholders.

The upstream **supply side** includes the many coal mining companies supplying fossil fuel to power stations, water supply (mainly for cooling), sugar mills (for bagasse), finance, transport, labour market, goods and services and gas exploration. The electrical energy industry is also broadly supplied by the major producers of steel and petroleum products, international and local equipment manufacturers, construction companies, research and technology institutions, professional engineering and local government associations, universities and colleges (ESETA, 2005).

The downstream **demand side** includes market demand, goods and services, the industry's own generation, transport, the environment, municipal distribution entities and effectively the entire country, including a significant contribution to GDP growth.

By far the least involved stakeholders are those in the informal sector and small, medium and micro enterprises (SMME) which may have entrepreneurial, intermediate and low level technical skills and could contribute more effectively to supporting the production and distribution of energy, as well as for job creation. As will be shown in the report, however, the informal sector in the electrical energy sector is poorly developed.

EMPLOYMENT SCOPE

According to the latest Department of Minerals and Energy web site and policy report, energy comprised about 15 percent of South Africa's gross domestic product (GDP) in 2003, creating employment directly and indirectly for about 250 000 people.

The delineation of the electrical energy sector depends in large part on the boundaries set to include or exclude the demand and supply-sided institutions listed above. For example, the coal-mining workforce which supplies fossil fuel to coal-fired power stations, could be viewed as enjoying indirect employment in the energy sector. However, from the perspective of this research, the mining industry is understood to represent a separate national sector. Similarly, whereas the construction industry may be (temporarily) engaged in the erection of energy installations, employment numbers in this sector are also excluded from this analysis.

In an effort to adequately delineate and quantify the size of the electrical energy sector and determine its specific skills requirements, sectoral occupational data was consulted (drawn from the Stats SA household and labour force surveys).

The following key sub-sectors were identified in the data :

- At the core of the sector are those formal organizations directly involved in the production, collection and distribution of electrical energy, which by 2005 employed 70 206 people; of these, 29 697 were employed within Eskom and 12 359 within the municipalities;
- A supporting formal sub-sector can also be identified which employed 44 520 people in 2005 and provides electrical equipment and other services to the core, including the manufacture of motors and transformers, wires and cables, distribution and control apparati, as well as some related research services;
- A small informal sector can also be identified which in 2005 employed 1115 people in electricity production, distribution and research.

Within these boundaries, at least 115 000 persons can be described as being employed, formally and informally in the South African electrical energy sector in 2005 (the latest year for which data was available).

Apart from the 12 359 municipal personnel involved in the distribution of electrical energy to commercial and residential end-users, roughly half of Eskom's workforce (14 778) is also involved in distribution, bringing the total number of people as a distribution sub-sector to 27 137 (ESETA 2005, p.20).

The electricity distribution industry has been characterized by some duplication. For example, ESKOM maintenance personnel look after substations and lines in a metropolitan area, while skilled municipal workers are doing the same in residential suburbs. The planned formation of Regional Electricity Distributors (REDs) which involve a merger of Eskom distribution with that of the municipalities, is expected to partly address these overlaps, but to date the six planned REDs for the country have not yet been implemented, mainly due to policy uncertainty and lack of capacity.

For purposes of this research, the available quantitative data on the numbers of personnel directly involved in the production, collection and distribution of electrical energy, as well as the supply of electrical components and equipment, will be the core focus, covering both the formal and informal sectors.

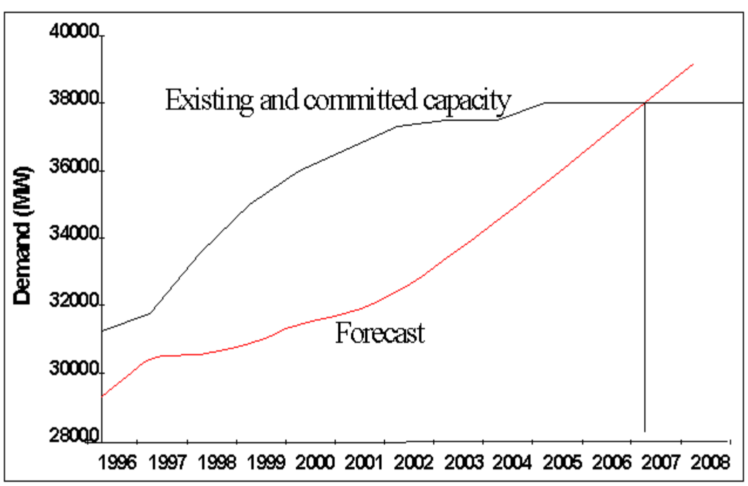
ELECTRICAL POWER DEMAND AND SUPPLY

For decades, electrical energy in South Africa has been among the cheapest in the world. However, as the economy has expanded, power demand has been increasing, hitting a record high of 35 479 MW in the winter of 2007, as a severe cold front cut through the country, causing the mercury to plummet (Engineering News, 22 May 07). The record was 672 MW above last year's record of 34 807 MW, set on June 29.

The total electricity sales by Eskom in 2006 grew to 208 316 Gigawatt-hour (GWh – see Annexure Two for detailed sales and performance of the Eskom utility).

The frequency of power blackouts and load-shedding and the prospects of increased prices for electrical energy in future, has become a matter of national concern. It is clear that Eskom's current installed capacity will be insufficient to meet forecasted demand, as Figure 1.1 shows :

Figure 1.1
Eskom Capacity Status and Maximum Demand Forecast



(Source : ESETA Sector Skills Plan 2005-2010)

Why has South Africa's electricity supply become inadequate for current and future needs? Many have argued that the demand for energy has grown because of unexpectedly higher economic growth rates. However, Anton Eberhard of the UCT Graduate School of Business and an acknowledged expert on energy policy, has recently pointed out that annual peak demand for electricity has grown on average by just over 3,6 percent per annum since 2000, and current peak demand is actually lower than that predicted in Eskom's strategic planning (Eberhard, 2007a).

Eberhard lists four main reasons for recent supply failures. First, policy uncertainty has slowed investment. In 2001, Eskom was prohibited by government from building new generation capacity (partly to encourage independent power producers to take up the challenge).

Second, poor co-ordination has caused further setbacks. There have been licensing delays and delays in finalizing bids for private independent power plants, due in part to poor co-ordination between Eskom, the regulator (NERSA), the Departments of Minerals and Energy (DME) and Public Enterprises (DPE).

Third, some planning assumptions have been wrong. Estimates for generation plant availability were too optimistic and reserve margins were set too low (the national reserve margin has decreased from 25 percent in 2001 to 6 percent in 2006 – Eberhard, 2007b).

Fourth, inadequate maintenance and negligence has played a role. The regulator concluded that the Western Cape outages were due to negligence on the part of Eskom personnel, and procedures were inadequate (although Eskom has disagreed with these findings).

Whatever the causes, Eberhard notes that *"the primary constraint is time"* and that there will be further outages, higher demand growth, delays and an ongoing scarcity of skills in future.

In his address to the Africa Energy Forum in Hamburg on 27 June 2007, Eberhard warned that

"Electricity supply security is threatened not only by inadequate generation capacity, but also by distribution failures caused by inadequate investment in human and physical capital (which is) caused by policy uncertainty and lack of progress in establishing REDs" (Eberhard 2007b).

For its part, the Energy Resource Center (ERC) takes a broad view of South Africa's energy priorities. The Center's recent report on "Energy Policies for Sustainable Development in South Africa" stresses the need to reduce overall demand, improve efficiencies, improve design of buildings for energy efficiency, make more efficient use of energy in the residential sector, apply alternative supply-side measures such as gas, hydro and renewables, stimulate bio-diesel production, levy a tax on coal and achieve emission reductions (Winkler, 2006).

The ERC report did not comment directly on the skills requirements for the sector, which are implied in its listed priorities.

To address the challenge, Eskom is embarking on a programme to establish new generation capacity over the next five years, at a cost of R97 billion. Beyond 2012, with an average expected growth in demand of 4 percent, roughly 2000 MW will be added every year to 2025, to eventually double existing capacity by that date (Eskom Annual Report for 2006).

From a skills point of view, it is clear that while skills shortages have played a part, they do not appear to be the primary cause of the country's electricity supply problems, which can be traced mainly to policy uncertainty, poor planning and co-ordination.

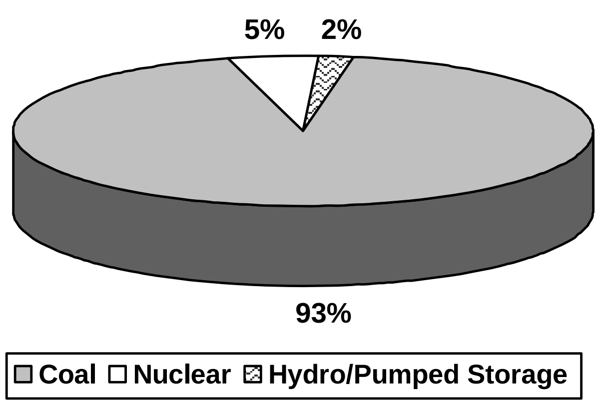
Going forward, however, projections of skills requirements will be affected by the fact that rapid planning has now had to be done on a large scale to remedy the challenges. There could well be a lag in the development and deployment of skills to support the rapid expansion of the sector over the next 5 to 10 years and beyond, which will be considered later in this analysis.

ALTERNATIVE ENERGY SOURCES

Electricity generation in South Africa has for long been dominated by coal, which makes up 93 percent of the total :

Figure 1.2

Energy Sources for Electricity Generation in South Africa (2001)



(Source : NERSA 2004, Electricity Supply Statistics)

Nuclear energy makes up 5 percent, but the Minister of Trade and Industry announced that Eskom could consider an additional 5000MW of nuclear energy by 2023 to add to the generation mix (Eng News 27 Oct 2006).

Renewables currently make up a negligible part of the total supply. Eskom has some pumped storage and hydro generation. There are co-generation, wind, solar, landfill gas, bagasse and other projects which are experimental, planned or in use. The low cost to date of electricity produced through burning fossil fuels (and the fact that external environmental, social and economic costs are not built into the price), has mitigated against the use of renewables to date, which can only become more attractive as the price rises in response to reduced supply or increased demand.

Renewable resources currently in use include :

- *Biomass:* Supply of wood from natural woodlands in communal rural areas is estimated at 12mt.
- *Wind:* Approximately 300 000 windmills are being used for watering livestock and supplying communities with water. In 2003 the first wind-energy farm was established.
- *Solar:* There is more than 2 500 hours of sunshine per year and average daily solar radiation levels range between 4,5 and 6,5 kWh/square meter in one day. The country's solar equipment industry is developing. Annual photovoltaic panel assembly capacity totals 5MW and a number of companies in South Africa manufacture solar water-heaters. Current capacity installed includes domestic 330000 square meter and swimming pools 327 00 square metre, commerce and industry 45 000 square metre and agriculture 400 square metre**.**
- *Hydro:* The current installation is 2 061 MW, with potential of 3 500 MW (ESETA, 2005, p.25).

The present wind energy projects include research and development as a major component. These include ESKOM Klipheuwel Wind Turbine Test Centre, Darling National Demonstration Project, Darling Visitor, Training and Education Centre, the South African Wind Energy Project, DME/NER/CSIR/SHELL Wind Hybrid Mini-grid Systems and Kestrel Wind Charger (ESETA 2005).

Research and trials have also been conducted into the use of energy-saving methods (such as CFL globes) at community level, notably the Kuyasa-Khalitsha clean development mechanism initiative (City of Cape Town), and geyser insulation work in Cape Town suburbs.

Looking to the future, the DME in 2003 set a target of 10 000 GWh of renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro (DME, 2003).

In summary, this contextual overview of the electrical energy sector in South Africa has revealed the following :

- Approximately 115 000 persons are employed in the production, collection and distribution of electrical energy in South Africa, together with the provision of electrical equipment and related services;
- Electrical energy has been dominated historically by Eskom as the key state-owned electricity utility, and there are currently few independent power producers (IPP) in the sector;
- The production of electrical energy has been characterized by the burning of fossil fuels, with a negligible contribution to date of renewable sources;
- Due to supply problems arising from policy uncertainty and poor co-ordination, the sector is embarking on a major expansion programme over the next 15 years, mainly through the further use of fossil fuels for

generation, but also with some consideration for a "mix" of nuclear and renewable options; and

- These expansion plans, together with the preferred energy mix, present a special challenge to the development and deployment of skilled human resources to support the planned growth of the sector over the next 5 to 10 years and beyond.

Accordingly, the current and projected demand for skills in the context of these changes in electricity supply, will be considered in the next chapter.

Chapter Two

The Demand for Skills in the Electrical Energy Sector

The electrical energy sector in South Africa is currently embarking on a capital expansion plan to extend installed generation capacity. At the same time, the sector is starting to shift away from fossil fuels to consider a range of alternative (renewable) sources, partly in response to environmental concerns.

Will the electricity labour market have the necessary skills to support this expansion? To address this question, this chapter will first look at trends in employment and occupational data in the electricity supply industry, to determine the current skills mix of the industry.

This will be followed by an assessment of the industry's expansion plans and a projection will be made of the likely scope for job creation in the sector.

Finally, the future skills requirements will be considered.

TRENDS IN ELECTRICITY-RELATED EMPLOYMENT AND OCCUPATIONS

To assist in forecasting the likely demand for skills, a review was conducted of trends in employment in the electricity sector and related sub-sectors between 1996 and 2005.

Overall, employment levels in the formal electricity sector underwent a slow decline to 2000, gradually increasing thereafter :

Figure 2.1

Formal Employment Levels in the Electrical Energy Sector 1996-2005

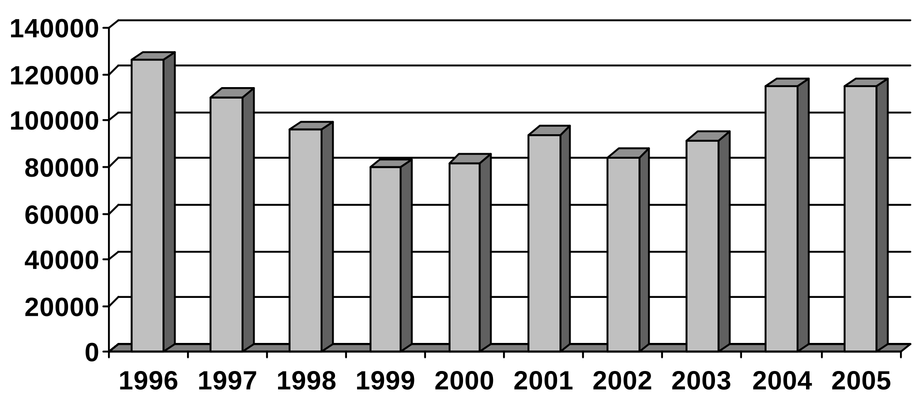


Figure 2.1 – Base Data	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	125972	110092	96149	79684	81700	93824	84311	91590	114813	114727
Source : Quantec, 2007 (StatsSA OHS Data for 1996-1999; StatsSA LFS Data for 2000-2005)										

The upward trend after 2000 can be attributed mainly to the national electrification programme. As noted in the previous chapter, electrification in South Africa rose from 36 percent in 1994 to 72% in 2004. To achieve this dramatic increase, employment grew across the sector after 2000 to implement the programme.

The main increase appear to have taken place in the core sub-sector involved with the production, collection and distribution of electrical energy, as indicated in Figure 2.2 :

Figure 2.2

Formal Employment Levels in Electricity-related Sub-Sectors 1996-2005

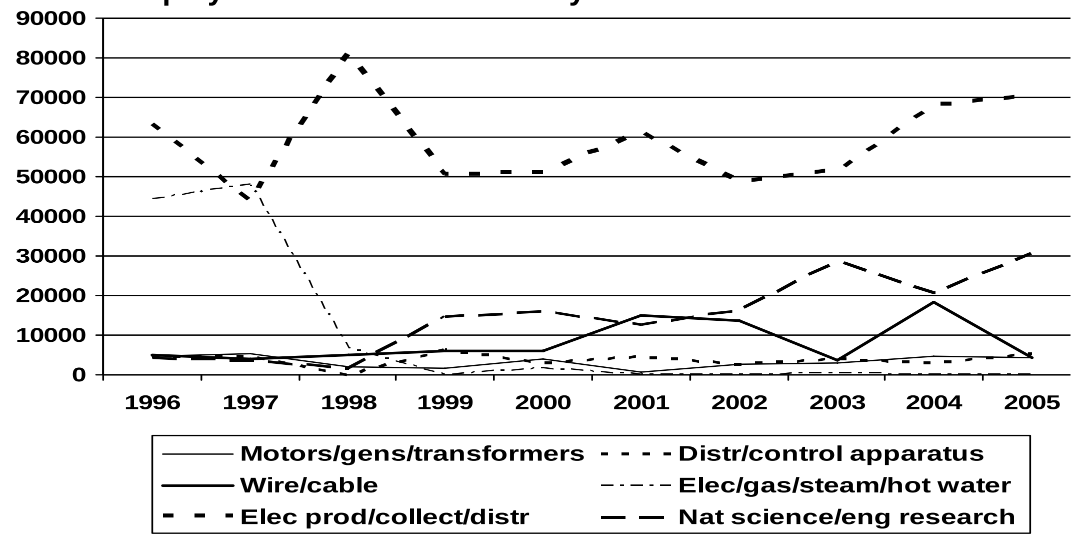


Figure 2.2 – Base Data	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Electricity production, collection and distribution	63307	44087	81004	50701	51040	61432	48704	51705	68142	70206
Distribution & Control Apparatus	4672	4538	0	6390	2923	4548	2665	4077	2900	5245
Motors, Generators & Transformers	4832	5447	1935	1645	4136	563	2756	3148	4720	4438
Insulated wire and Cable	4949	4144	4930	6152	5951	14712	13825	3529	18429	4313
Electricity, Gas, Steam and Hot Water	44196	48053	6607	110	1765	0	0	433	0	0
Natural Science and Engineering Research	4421	3823	1673	14683	15881	12567	16361	28697	20767	30524
Source : Quantec, 2007 (StatsSA OHS Data for 1996-1999; StatsSA LFS Data for 2000-2005)										

Figure 2.2 indicates that :

- Electricity production, collection and distribution dominates the sector, and has been gradually increasing in size over the past few years, formally employing 70206 people by 2005, mainly in Eskom and the municipalities;

- In addition, by 2005 a total of 44520 people were active in the formal sub-sectors of electricity supply, manufacturing distribution and control apparati, motors, generators and transformers, wire and cabling;
- From 2001 in particular, there was some growth in the manufacture of insulated wire and cabling, associated with the growing emphasis on extending electrical distribution and connections; and
- From 1999 onwards, the formal employment of people in natural sciences and engineering research has been gradually increasing, some of which could be attributed to intensified energy planning from that time.

The informal electricity sector went on a different growth path, escalating in the late-1990's, but then tailing off after 2000, as Figure 2.3 shows :

Figure 2.3

Informal and Self-Employment in the Electricity Industry : 1996-2005

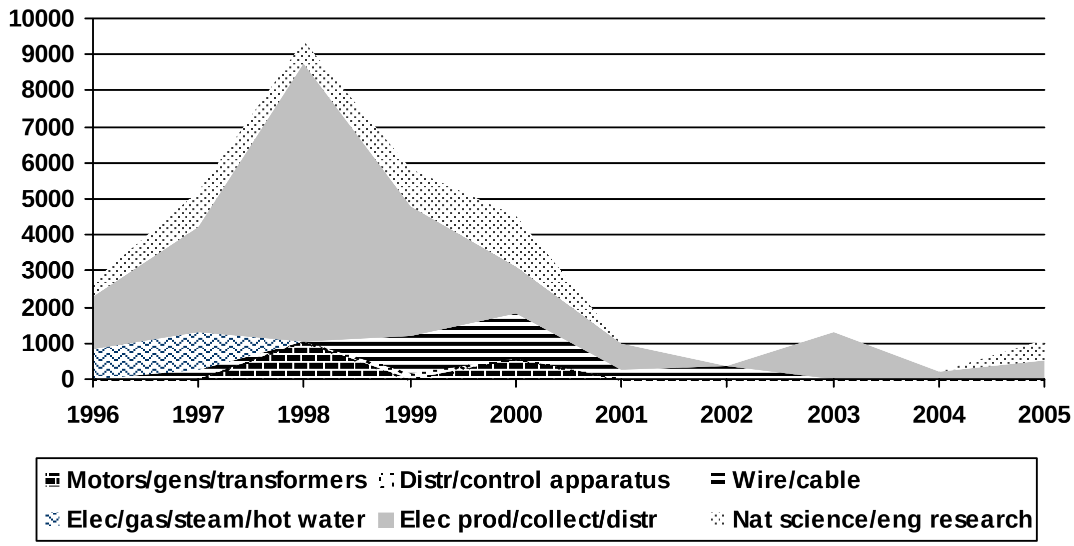


Figure 2.3 – Base Data	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Electricity production, collection and distribution	1481	2945	7706	3621	1306	696		1290	220	509
Distribution & Control Apparatus				134						
Motors, Generators & Transformers			1058		580					
Wire and Cable		239		1049	1240	275	368			
Electricity, Gas, Steam and Hot Water	828	1050								
Natural Science and Engineering Research	381	950	618	1034	1404					606
Source : Quantec, 2007 (StatsSA OHS Data for 1996-1999; StatsSA LFS Data for 2000-2005)										

Figure 2.3 indicates that the informal and self-employment of people in the production and distribution of electrical energy reached a peak in 1998-2000,

together with some simultaneous growth in the supply of motors, transformers and wire cabling. This growth spurt may also have been stimulated by Eskom's electrification programme. A feature of this process naturally involves a greater demand for insulated wire and cabling and related services.

However, the apparent initial impact of the electrification programme on the informal sector does not appear to have been sustained, as evidenced by the fall-off in informal and self-employment across most of the electricity-related sub-sectors from 2001 onwards. By 2005, only 1115 people were recorded in the StatsSA Labour Force Survey as being active in the informal electricity sector.

It is possible that some informal service providers were taken up into formal employment as the electrification programme drew on available resources, but this take-up cannot easily be quantified.

The available data on the informal sector in South Africa must be accepted as being incomplete and less reliable than data obtained from formal sources. At best, the data suggest that informal employment in the electricity supply sector is weak and undeveloped in South Africa. The implications of this feature of the sector for skills requirements will be considered again later.

The next step in this assessment involves an analysis of trends in occupational data, in an effort to identify specific occupational shifts over time which are associated with the delivery of electrical energy, and which can be applied to make projections of likely future demand for specific occupational skills.

Figure 2.4

Trends in Formal Occupations in the Electrical Energy Sector : 1996-2005

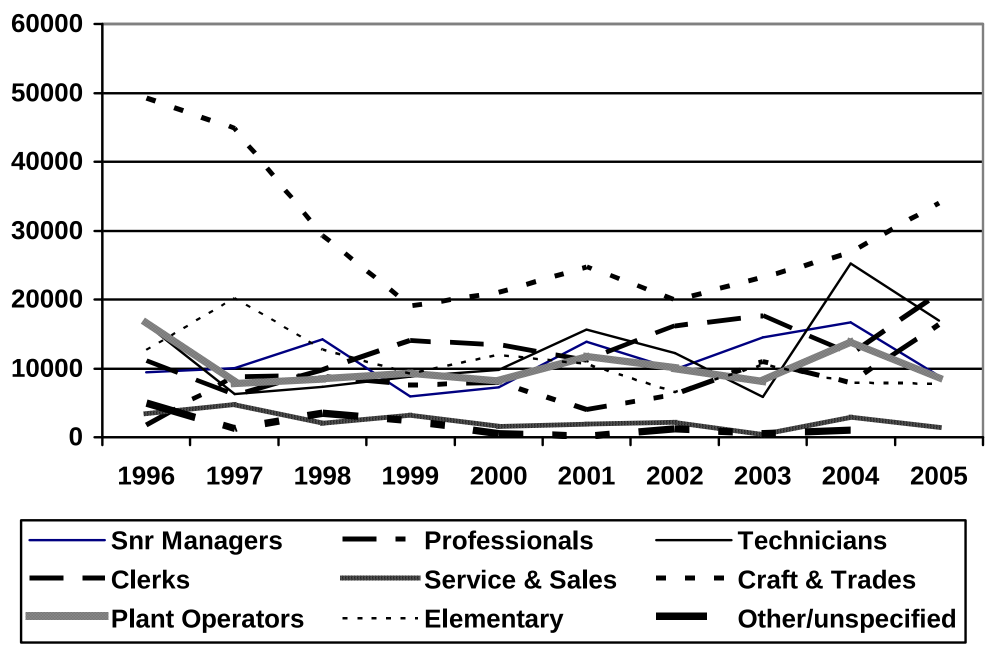


Figure 2.4 – Base Data	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Snr Managers	9475	10042	14199	5963	7281	13860	9903	14486	16721	8941
Professionals	1726	8851	8881	7634	7949	3978	6162	10969	7945	16355
Technicians	16439	6274	7333	8794	9760	15591	12223	5822	25262	16906
Clerks	11093	6086	9811	14023	13462	11177	16139	17673	12067	20912
Service & Sales	3396	4831	2023	3201	1529	1940	2195	318	2989	1413
Craft & Trades	49264	44822	29258	19022	21064	24680	19871	23235	26841	34013
Plant Operators	16919	7766	8479	9364	8135	11793	10022	8036	13997	8380
Elementary	12677	20179	12711	9250	12001	10629	6587	10535	7904	7807
Other/unspecified	4983	1241	3454	2433	519	176	1209	516	1087	0
Source : Quantec, 2007 (StatsSA OHS Data for 1996-1999; StatsSA LFS Data for 2000-2005)										

Figure 2.4 above indicates that :

- The largest occupational category formally employed in the production and distribution of electricity has been that of craft and related trades workers (as defined in the SIC database), which has been increasing year-on-year for the past five years to reach 34013 by 2005;
- The second-largest occupational category has been that of clerks, which has grown strongly in recent years to reach an all-time high of 20912 by 2005;
- The third-largest category are technicians and associate professionals, which have shown a modest increase in recent years (16906 in 2005);
- By contrast, most other occupational categories have remained largely unchanged in size over the past ten years, or shown small and sometimes erratic increases, notably among senior officials and managers, plant operators and service workers.

These trends in occupational employment can also largely be accounted for in terms of Eskom's electrification programme, which typically requires tradesmen and technicians to make the connections, and clerical employees to administer the new accounts.

As far as informal sector occupations is concerned, the year-to-year data is incomplete, but the following Figure highlights the main categories :

Figure 2.5

Informal Occupational Trends in the Electricity Sector : 1997-2005

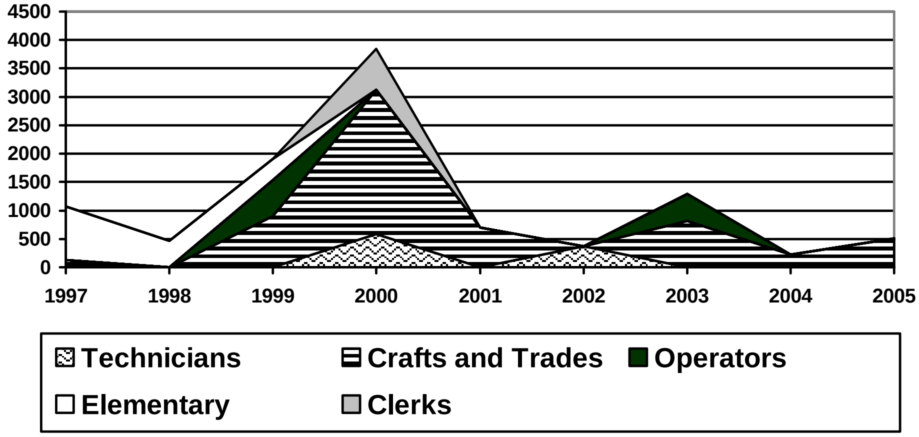


Figure 2.5 – Base Data	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Technicians					580		368			
Crafts & Trades		124		902	2546	696		814	220	509
Operators				629				476		
Elementary		948	467	372						
Clerks					717					
Source : Quantec, 2007 (StatsSA OHS Data for 1996-1999; StatsSA LFS Data for 2000-2005)										

Figure 2.5 indicates that some informal sector occupations were stimulated in the period 1999 to 2001. People in crafts and trades and elementary occupations possibly became more involved in electricity production and distribution and related services associated with further electrification. Thereafter, informal sector craftsmen and tradesmen enjoyed a diminished but ongoing role in electrical production and distribution over the next few years.

Once again, it is clear that despite gaps in the data, informal occupations in the South African electricity sector seem to be poorly developed and that the initial impact of electrification on informal employment has to date not been sustained.

In summary, the main implications of these changing occupational profiles in the electricity energy sector are that :

- The formal demand for craft and tradesmen, technicians and clerical employees in particular will continue to increase, mainly to support new connections; and
- Unless special efforts are made to stimulate informal sector occupations and SMMEs, the impact of future growth in the industry on the informal sector can be expected to remain erratic and underdeveloped.

These findings are based on occupational trends during a period in the electricity sector when many new connections were being made to advance electrification in South Africa, but when there was little expansion in generation capacity.

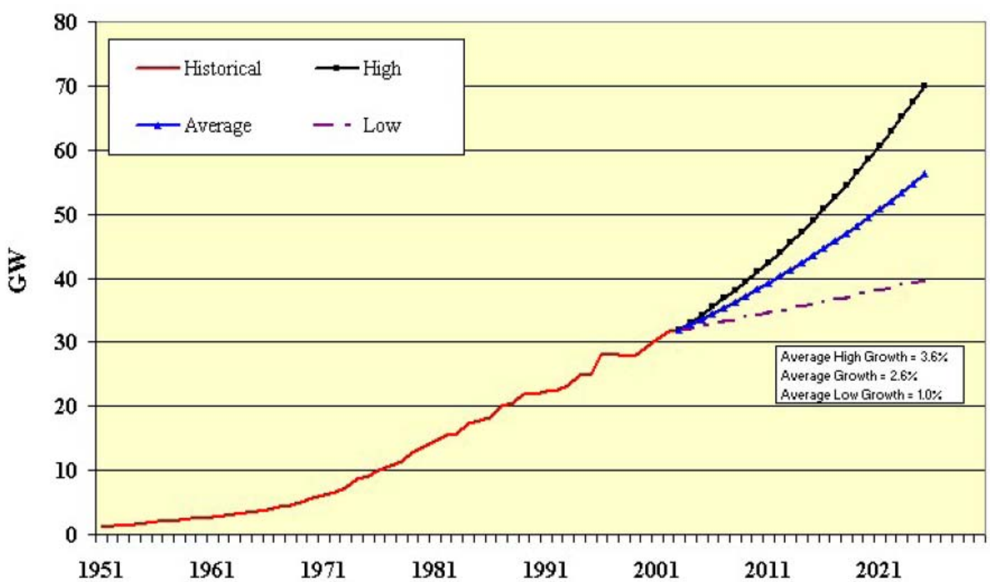
Whereas these occupational trends can be expected to continue, additional demands will be placed on the sector in respect of Eskom's capital expansion programme.

EXPANSION PLANS

Figure 2.6 below shows the maximum energy demand to 2030, based on different growth rate assumptions :

Figure 2.6

Projected Maximum Energy Demand : 1950 to 2030



(Source : NERSA)

Which of the growth curves in Figure 2.6 are being considered in planning?

Statistics SA has established that in 2007 South Africa's power generation increased by 3% in April 2007 to 20 587 GWh, when compared with 2006, suggesting that the "average growth" curve of 2,6 percent should be considered (Eng News, 31 May 2007).

However, in its 2006 Annual Report, Eskom indicated that it has revised its original expansion programme (originally based on 3 percent growth in demand), in the light of the government's drive to boost economic growth to 6 percent by 2010. Eskom has estimated that this will result in an average growth in electricity demand of 4 percent per annum, requiring approximately 47 252MW of new capacity by 2025 – more than double the total existing capacity.

From this point of view, the “average high growth” curve of 3,6 percent in Figure 2.6 is now being applied by Eskom.

Accordingly, in the Eskom Director’s Report for 2006, the organization committed itself to achieving an installed generation capacity of 85000 MW by 2024.

Eskom’s current installed generation capacity stands at 38 000 MW, with a peak demand to date of 36 513MW. The national reserve margin has declined from 25 percent in 2001 to 6 percent in 2006 (Eberhard, 2007b). This reserve margin is regarded as being too close to current capacity, and the utility plans to extend its reserve margin to 15 percent.

Generation plans

Eskom’s planning includes the return-to-service of three “mothballed” coal stations, the commissioning of two open cycle gas turbine stations (OCGT), namely Ankerlig and Gourikwa (opened in October 2007 by the Minister for Trade and Industry), the construction of a new coal-fired station at Medupi (scheduled for completion by 2015) and the greater use of renewables such as wind, hydro, pumped storage, solar and bagasse.

A target has been set by government for 10 000 GWh of renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. At the time the DME drafted its White Paper, renewable energy sources were expected to make up 4 percent (1667 MW) of the (then) projected electricity demand for 2013 (41539 MW). This was equivalent to replacing two units of Eskom’s combined coal-fired power stations (DME White paper, 2003).

The DME estimates that 20 000 new jobs could be created in the field of renewables alone (DME White Paper, 2003). The skills required for people in these jobs can be expected to be mainly at intermediate and high-level for the design and build stage and moving more to artisan and semiskilled levels once in operation.

Transmission

The transmission grid is being expanded and these investments costs are also substantial (up to R50 billion). The need for skills will also increase, specifically in temporary construction work. Geographical locations far from the coalfields will either pay more for their electricity or have to be subsidized by other customers, or invest in local sources of generation.

The Inga 111 project in the Democratic Republic of Congo (DRC) is expected to be commissioned in 2010 (ESETA 2005). This is a hydropower project funded by South Africa's electricity utility ESKOM, Botswana Power Corporation, Empresa national de Electricidade of Angola, NamPower of Namibia and SNEL of the DRC. This will see the construction of a transmission network of 500kv to supply power to all five countries that are funding the Inga 111 project. This has been identified as a NEPAD project and feasibility study and construction is likely to be implemented for this project form 2004 to 2010. Some local skills may be drawn (temporarily) to foreign countries in the course of carrying out this work.

Distribution

For AsgiSA, the restructuring of electricity distribution is a priority for 2007 and beyond. The economic costs of worsening power interruptions and inefficiencies is estimated to cost between R2,9 and R8,6 billion (AsgiSA Annual Report for 2006).

EDI Holdings CEO Phindile Nzimande recently reported that some R5-billion in maintenance backlog has amassed over the last ten years (Engineering News 11 May 2007). Additional challenges include inequitable treatment of consumers across the country and a noteworthy disparity in average tariffs by distributors.

There has been a delay of at least ten years in the implementation of the proposed Regional Electricity Distributors (REDs), a combination of Eskom and Municipal distributors. Municipalities can use income from electricity to subsidize other municipal functions. This firstly increases the price for customers and secondly encourages management to reduce investment and maintenance costs. Unfortunately, this has resulted in power blackouts in the major cities, Johannesburg being a prime example. The networks are generally in a poor state and will need substantial investment to upgrade and expand, together with the related skills requirements, especially as networks reach their full capacity and become older (see City of Johannesburg case study later).

FORECASTING GROWTH IN JOBS TO 2012

This report is aimed at assessing the jobs and skills requirements of the electrical energy sector over the next five years, i.e. to 2012. This time frame has been selected because the growth parameters can be more reliably estimated than a longer-term projection, and accordingly the requirements over the next five years can be more realistically determined.

To determine the projected increase in jobs to 2012 more precisely, the MW contribution of specific generation projects likely to come on-line by that time need to be combined, namely :

- The re-commissioning of three previously “mothballed” coal-fired power stations at Camden, Grootvlei and Komati (3800MW);
- The construction of two open-cycle gas turbines (OCGT) at Ankerlig and Gourikwa (1050MW);
- Commissioning an additional pumped storage facility at Ingula, to be operational by 2012 (1322 MW);
- The upgrading of the Arnot and Gariep power stations (380MW);
- Achieving the current DME target for renewable energy sources (1667 MW by 2013);
- Provision for independent power producers (IPP) to contribute some additional power (1000MW); and

- Some progress in power delivery from the new Medupi coal-fired power station (est. 1000MW by 2012).

As far as the latter is concerned, the Medupi station is expected to eventually generate between 4200 and 4500MW by January 2015.

All the above generation projects can be expected to contribute an estimated additional 10909 MW to the national grid by 2012/3. This figure must be regarded as an estimate, given that some projects may be delayed, and new projects may be commissioned over the next few years.

At the same time, Eskom is also involved in a demand-side management programme to encourage users to reduce their electricity consumption by a targeted 3500MW over the next five years (Engineering News, 25 June 2007). However, it is unlikely that progress in reducing demand will slow down or cut back the scope of Eskom's planned expansion programme over that period.

Three alternative scenarios will be presented here for forecasting the projected growth of jobs in the electrical energy sector over the next five years.

The first scenario comprises a simple ***arithmetic projection***, calculated by applying the current ratio of MW per employee to the projected MW growth target for 2012.

In 2005, the electrical energy sector formally employed 114727 employees (as indicated earlier in Figure 2.1), a figure which includes both the Eskom utility, as well as the many other smaller organizations providing electricity-related materials and services.

The electricity energy sector can be broken down into two sub-sectors, namely the core sub-sector of electricity production, collection and distribution, and a supporting sub-sector employed in the manufacture of transformers, cables and distribution apparati, and other related services.

In 2005, the core directly employed 70 206 employees in electricity production, collection and distribution (as indicated earlier in Figure 2.1). Given an installed capacity at that time of 38 000 MW, a current ratio of 1,85 jobs per MW can be derived for the core.

If that ratio is applied to the projected additional capacity to 2012 of 10909 MW, then an additional 20182 jobs could be created within the core formal electricity production, collection and distribution sector by then. Given that Eskom employees currently make up 42,3 percent of the total formal jobs in the sector, at least 8537 jobs could be created within the Eskom utility by 2012.

As far as the supporting sub-sector is concerned, an additional 44 520 people were employed in 2005. Expressed as a ratio against the current installed capacity of 38000MW, 1,17 people per MW were active in these "spin-off" industries in 2005. Accordingly, the 10909 MW increase in generation could also stimulate the creation of an additional 12 775 formal jobs in the supporting sub-sector.

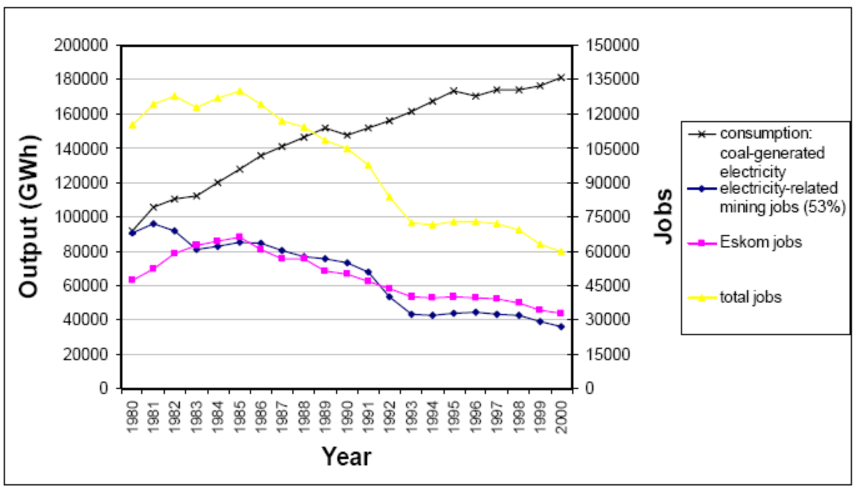
As noted earlier, some informal employment could also be identified in the sector (Figure 2.3). A low ratio of 0,03 informal jobs per MW can be derived which suggests that at best 327 informal new jobs would be created by 2012 under present conditions (an active programme to stimulate informal employment may result in bigger gains).

In terms of Scenario One then, the estimated 10909MW of planned expansion in electricity generation to 2012 could stimulate the creation *in toto* of an additional 33284 jobs in the formal and informal sectors of the electricity sector as a whole.

The second scenario can be termed an ***efficiency projection***, and is based on the assumption that over time, efficiency improvements in the utilization of human resources can and should be achieved in the sector.

Employment levels in coal-based electrical generation have been declining by an average of 5,4 percent per annum, mainly due to increased efficiency in production. Employment levels have halved over the past two decades while electricity production has doubled :

Figure 2.8
Employment in Coal-Based Electricity Generation in South Africa



(Source : AGAMA, 2003 : p.iii)

To reflect the likely efficiency measures that may be applied over time with respect to increased employment levels, the arithmetic projection developed above for Scenario One has been reduced by 5,4 percent per annum. This was done by identifying the annual step-up needed to eventually reach the arithmetic projection of 33284 jobs by 2012, then subjecting each annual year-on-year total to a 5 percent efficiency reduction.

By applying this efficiency correction measure, the net number of new formal and informal jobs which may be created under Scenario Two in the electrical energy sector by 2012 is estimated at 29 879. Of these, at least 7709 jobs would be created in Eskom itself (given that formal jobs represent 61 percent of the total sector and Eskom jobs make up 42,3 percent of formal jobs).

The third scenario is based on the Eskom utility's own forecasted growth in jobs to support its capital expansion programme. Eskom's Human Resources division supplied the authors with an estimate of future resource requirements. By 2012, the utility estimates that 9594 new jobs would be created within Eskom, to be achieved through the addition of at least 1000 jobs per annum over the five years to 2012.

This figure is somewhat in excess of what would be expected in terms of an efficiency projection, as developed for Scenario Two (namely 7709 Eskom jobs). Eskom's higher jobs target to 2012 suggests that the utility plans to achieve an earlier build–up of staffing levels so that the necessary skills and competencies can be developed over time and be in a position to adequately support the longer-term expansion programme in subsequent years.

From this point of view, Scenario Three can be termed a ***proactive growth*** scenario, in that it reflects the utility's plan to rapidly grow it's human resources capacity over the next few years, with a view to supporting its longer-term objectives.

Given that the proactive growth scenario represents an internal staffing strategy for the utility, it is unlikely to have any additional knock-on effect on job creation on the electrical energy sector as a whole, other than that implied by the growth in demand for equipment and services to support the expansion programme.

In terms of Scenario Three then, the total number of jobs created in the sector can be calculated by combining Eskom's own projected 9594 new jobs, together with the balance of an estimated 22170 jobs for the rest of the sector (based on the efficiency projection), i.e. an estimated 31 764 jobs in all.

In identifying the type of skills required to support this jobs expansion, a distinction must be drawn between capital expansion requirements, on the one hand, and operations and maintenance on the other, each of which calls for different types of skills.

Firstly, the skills required for expanding the capital infrastructure can partly be met with existing engineering resources deployed to facilitate the expansion on a project management basis (particularly within Eskom). A substantial amount of work will also be sub-contracted or outsourced, mainly through the use of construction companies for the new build, and also to support Black Economic Empowerment objectives.

The construction of power generation plant is a short-term process because once built, only the operations and maintenance staff are required. If large power stations are built in sequence, the project management and construction skills move from project to project and the number of jobs created cannot easily be related to the number of total MW planned.

Secondly, additional skills will be required for operation and maintenance of the expanded installed capacity and to carry out connections to new customers. This skills profile can be expected to be roughly similar to that currently in place, with the main emphasis on craft and trades people, technicians and clerical employees, as indicated earlier in Figure 2.4.

The current (2005) ratios of these formal occupations as a proportion of the total number of employees in the sector provide a baseline indication of the numbers likely to be required to 2012 in each occupational category.

The following table provides the current ratios for different occupations and then projects the likely demand in jobs to 2012, based on the total number of jobs projected under Scenario Three :

Table 2.1

Occupational Ratios in NQF Levels and Projected Skills Demand for the Electrical Energy Sector to 2012

NQF Level	Occupations	No. Employed (2005)	Occupational Ratio (prop. of total)	Projected No. of New Jobs
Low-level (pre-matric) 1-3	- Elementary - Operators	16187	0,14	4447
Intermediate (matric/post-school) 4-5	- Crafts and Trades - Clerks - Technicians - Service workers	73244	0,64	20329
High-level (degree equivalent) 6-8	- Senior Managers - Professionals	25 296	0,22	6988
TOTAL		**114727**	**1,0**	**31 764**

These figures apply mainly to occupations relating to the generation of electrical power through current technologies, i.e. mainly burning of fossil fuels. The specific occupational requirements associated with the greater use of renewable sources of energy call for a separate assessment, one for which no adequate baseline skills profile exists in the current energy mix.

To summarise : the projected estimated increase in installed energy capacity to 2012 of 10909MW can be expected to stimulate the creation of 9594 new jobs within the Eskom utility, together with an additional estimated 22170 jobs in the rest of the electrical energy sector (formal and informal support services). The skills requirements for the sector as a whole (including Eskom) are estimated at 20329 intermediate-level tradesmen, technicians and clerical employees, 6988 high-level managers and engineers and 4447 plant operatives and elementary workers.

FUTURE SKILLS DEMAND FOR RENEWABLE ENERGY

South Africa's vulnerability to both dollar-denominated imported fuels and global climate change measures, has prompted government to encourage diversity of energy supply, with the focus on developing renewable energy sources.

In its White Paper on Renewable Energy, released in 2003 by the Department of Minerals and Energy (DME), a target was set for 667 MW of renewable energy contribution to final energy consumption by 2013 (4 percent of the total).

One of the main benefits of renewable energy sources is the fact that renewable energy can be deployed in rural communities far from the national grid. The use of decentralized mini-grids and hybrid systems in rural areas is also expected to promote the development of small medium and micro enterprises (SMMEs). Already, solar photovoltaic systems are being introduced in rural areas to replace candles, paraffin and diesel. In time, the poor will also run out of fuelwood unless something is done.

The turnkey costs for alternative renewable technologies reviewed by the DME reflected the higher investment burden of solar PV and solar thermal sources, compared for example to biomass, geothermal and wind sources, as Table 2.2 indicates :

Table 2.2
International Cost Data for Renewable Energy Technologies

Technology for electricity generation	*Operating capacity, end 1998*	*Capacity factor*		*Turnkey investment costs*		*energy cost of new systems (2000)*		*Potential future energy cost*	
	GWe	*%*		*(US$ per kW)*		*US c/kWh*		*US c/kWh*	
		Low	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*
Biomass	40	25	80	900	3 000	5	15	4	10
Wind	10	20	30	1 100	1 700	5	13	3	10
Solar PV	0.5	8	20	5 000	10 000	25	125	5	25
Solar thermal	0.4	20	35	3 000	4 000	12	18	4	10
Small hydro	23	20	70	1 200	3 000	4	10	3	10
Geothermal	8	45	90	800	3 000	2	10	1	8
Tidal	0.3	20	30	1 700	2 500	8	15	8	15

(Source : DME White paper, 2003)

An in-depth study of the employment potential of renewable energy conducted by a private agency, described the White Paper's target as "exceedingly modest" and called for a higher target, mainly to derive the maximum employment benefits (AGAMA, 2003).

The employment potential of bio-diesel and solar water heating was seen to be highest of all the renewable technologies. Should government agree to setting a higher target of 15 percent for the development of renewable electricity generating energy technologies (RET) by 2020 (a target suggested by the

Energy and Development Research Centre of the University of Cape Town), at least 36 400 net, direct jobs in renewables would be created in the South African economy.

For the renewable energy sector as a whole, the total number of direct and indirect jobs which could be created by 2020 would be much larger, in the opinion of the AGAMA researchers. Their report offered a higher (somewhat optimistic) estimate, namely 500 000 direct jobs and nearly 700 00 indirect jobs (mostly in bio-fuels, solar water heating and wind, where the key skills requirements would be located).

The types of skills or occupations required to support the expansion of the renewable energy sector are indicated as follows (based on a summary of the AGAMA proposals) :

General : Engineering, environmental, planning, financial, legal, mechanical and electrical technicians, civil engineering and construction, consultants, academics, policy analysts, economic managers

Wind : Meteorology, surveying, structural engineers, metalworkers, mechanics, computer operators, fitters and welders, underwater marine engineering

Solar PV : Glass and steel manufacturing, electrical and plumbing contracting, architecture and system design, battery and electrical equipment manufacture

Biofuels : Mainly semi-skilled and unskilled, contract and seasonal labour, small-scale farming

Solar water heating : Artisans, “bakkie and ladder” people.

In making their assessment of job creation and skills requirements, the AGAMA report operated on the assumption of a particular “mix” of renewable energy technologies, with wind contributing 50 percent, biomass 30 percent and solar 10 percent. In the government White Paper, no specific policy projections were made of the appropriate mix for renewables. Instead, *g*overnment would go for a “least-cost and employment maximizing supply model” in reaching the target (DME, 2003 : xiii).

In a later (2004) report on ”Capacity Building in Energy Efficiency and Renewable Energy”, the DME made a financial assessment of the implications of applying different RE technologies, and examined the potential energy contribution of different RE technologies :

Table 2.3
Energy Contribution of RE Technologies

RE Technology	Potential GWh Contribution	Percentage
Biomass pulp and paper	110	0.1%
Sugar bagasse	5,848	6.9
Landfill Gas	598	0.7%
Hydro	9, 245	10.3%
Solar Water Heating: commercial	2,026	2.0%
Solar water heating: residential	4,914	6%
Wind	64,102	74%
TOTAL	86,843	100%

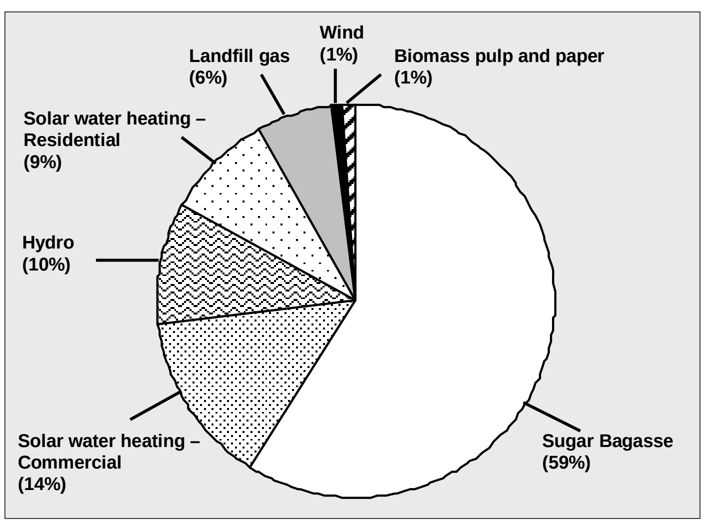
(Source : DME, 2004)

Table 2.3 indicates for example that the potential GWh contribution of wind far outstrips other RE technologies, whereas as its job-creation potential may not be as high as other forms.

In weighing up the macro-economic benefits of different approaches, the DME report concluded that because of the high capital intensity of RE technology and the relatively limited gains which would flow from subsidizing job-rich technologies, "least-cost principles should guide the selection of RE technologies". It also concluded that it was "probably not advisable for government to use RE as a tool for creating jobs" (DME, 2004).

The 2004 DME report concluded that the future RE energy mix should ideally be based on least-cost technologies, as follows :

Figure 2.9
Least-Cost Combination of the 10 000 GWh RE Target



(Source : DME, 2004)

The DME's model suggest that sugar bagasse, solar water heating and hydro would dominate the RE market, although this RE "mix" was implied rather than adopted as a formal policy target. The report recommended that further research on RE resource availability, costs and alternatives be conducted.

In conclusion, the specific skills requirements required to support renewable energy are dependent on whether government will eventually adopt a least-cost approach or a hybrid model supporting job creation.

Given the intensifying global debate on climate change, shifts in policy remain possible and could even extend to embracing higher targets for renewable energy. In the 2003 White Paper, the DME committed itself to re-evaluating its RE targets and objectives after five years to determine whether the policy direction remained appropriate, i.e. that review can be expected in 2008. The preferred mix of renewable energy technologies and related job and skills requirements can then be determined with greater confidence.

Chapter Three

Sector Case Studies

The foregoing chapter has examined the changing demand for skills in the electrical energy sector. To explore further the specific skills needs in various practical contexts, a number of organizational case studies will be reviewed.

By focusing on the micro or enterprise level, it becomes possible to identify specific skills needs, challenges and solutions on the ground.

The selection of case studies for the electrical energy sector is informed by the overall structure of the sector in South Africa, together with the key developments taking place in the sector.

The electrical energy sector in South Africa is characterized by four distinct segments, namely :

- the formal sector dominated by Eskom;
- the informal and SMME sector;
- the municipal distribution sector; and
- the emerging renewables market.

Firstly, the Eskom utility will be reviewed as a case study, given that it currently dominates the formal electrical energy sector and makes use of the great majority of the skills available in the sector. The current and future needs of this state-owned utility and its own efforts to promote skills development are therefore of special importance.

Secondly, one SMME providing technical services in the electricity sector will be profiled, to identify the challenges and opportunities in promoting the role of SMMEs in future.

Thirdly, the distribution business is key to the delivery of electrical energy to customers large and small, and may need to upgrade skills to reduce power outage time periods and generally provide a quality service to greater and greater numbers of South Africans. Two case studies will be reviewed here, namely City Power in Johannesburg and City of Cape Town.

Finally, renewable energy sources are now enjoying greater attention than previously, in the context of global climate change and increasing direct and indirect costs associated with fossil fuels. The skills requirements for this sector are in their infancy and clearly deserve vigorous attention going forward.

The case study covered here (Darling wind farm) is a typical example of a “least-cost” renewable intervention, high on energy output but low on job creation.

THE ESKOM STATE-OWNED UTILITY

In 2006, Eskom employed 29697 people in 2006, broken down into 11919 in Generation, 3000 in Transmission and 14 778 in Distribution. By August 2007, total workforce size had increased to 31 217 employees, reflecting the fact that the utility was moving into a growth period and was expected to reach 40811 by 2012.

Generation

Eskom initial plans to expand generation capacity involve the return to service of three mothballed stations, namely Camden in Ermelo, Grootvlei in Balfour, and Komati in Middelburg.

Eskom is also embarking on a programme to establish new generation capacity over the next five years, at a cost of R97 billion. The immediate actions include the recent commissioning of two open-cycle gas-turbine (OCGT) stations at Ankerlig and Gourikwa.

Beyond 2010, with an average expected growth in demand of 4 percent, roughly 2000 MW will need to be added every year to 2025, to eventually double existing capacity (Eskom Annual Report for 2006).

Accordingly, Eskom is seeking approval to proceed with arrangements to procure generating units for the construction of a coal-fired power station, consisting of three 636-MW generating units. A further four large coal plants are also included in the plan, with a total of 25 636-MW coal units, to be commissioned between 2010 and 2024 (Engineering News, 18 May 2007).

The construction of three pumped-storage stations is also planned, which will have a total capacity of 3 326 MW, with the first unit being commissioned in 2013. Discussions have taken place regarding the option of building nuclear power plants as a possible alternative to a coal-fired plant.

Transmission and Distribution

In the Transmission sub-sector, the numbers employed have been stable since 1991, at just under 3000 Eskom employees.

How will the expansion in Generation affect Transmission?

Eskom's five-year-plan includes new capacity refurbishment and network improvement, to the value of R50 billion. Adding more high voltage power lines, for example to reinforce the Cape network will not significantly increase jobs after construction. The deployment of staff at manned sites remote from big cities is set by response times and not work load. Manned sites have people who focus mainly on scheduled maintenance, unless there is a power outage. They need to be within an hour or so of travel time from the point where the line or substation has failed. Technical and management staff will not be greatly affected since they are centralized at the control centre or deployed at office sites around the country.

Transmission (and distribution) power lines and substations should run with little interference other than minimum maintenance periods. When these systems get old they fail more and then more staff are required to maintain them, until there is reinvestment in new equipment, for example, a municipal system like the City of JHB (see case study ahead). Once again these skills are often used by the international manufacturers outside of SA. The biggest need would be for artisan training to maintain and operate switchgear, transformers and line hardware.

Enterprise skills requirements and training

Eskom notes in its Annual Report for 2006 that *"it is critical to the success of the capital expansion programme to ensure that Eskom has sufficient human resources with proven skills and abilities to fill the jobs created by the project"* (Eskom 2006, p.60).

The priority skills listed include project managers, engineers, artisans, technicians, supply-chain managers, finance, management and leadership, maintenance, fossil and nuclear plant operators, technologists, chartered accountants and buyers.

Currently (2007), the utility has 1550 engineers in employment, and 142 vacant engineering posts, 6508 artisans on the payroll and 48 artisan vacancies.

Looking forward, Eskom is seeking to employ the following additional skills :

- Electrical (general) : 276
- Electrical engineering : 144
- Construction project managers : 57
- Civil engineers : 13
- Accountants (general) : 13
- Electrical engineering draft-persons : 13.

Eskom reports that it has committed R748 million to training in 2006/7, or 8,6 percent of its annual payroll, which is double that reported for selected companies surveyed by the NBI (see chapter four ahead for details).

The technical training being planned for internally includes maintenance and on-job engineering (power plant-related), operating process control, lines and servitudes practical training programme (NQF Levels 2 and 3), high voltage plant practical training programme (NQF Levels 2 and 3), live line specialised training programmes and a range of others.

In 2006 Eskom indentured 595 learnerships with the Energy Sector Education and Training Authority (ESETA) and in that year had 2163 bursary-holders and trainees.

Eskom also has a relationship with various learning institutions providing Eseta-accredited in-house technical and non-technical training. During 2006, over 61 000 training days were logged, of which roughly half were technical learnerships at NQF levels 2 and 3 in respect of measurement – control and instrumentation, electrical, and mechanical and fabrication.

The utility anticipates that 60 percent of its projected demand for artisans can be met through in-house or other training, compared to 50 percent of its engineers. In other words, Eskom will be able to meet a large part of its skills requirements on an in-house basis, although it will still depend on the external skills market for its entry-level learners and skilled tradespeople and professionals.

Eskom's Human Resources division lists various challenges with respect to meeting its future skills requirements, including the HIV/AIDS epidemic, the large number of major capital expansion projects taking place, an ageing workforce, long development periods, the poor quality of graduates coming out of the school system and the low availability of equity candidates with experience in the external labour market, especially women.

The remedial actions planned or implemented include fast-track training in core, critical and scarce skills, increased learner intakes, international recruitment drives focusing on skilled SA exiles and recruitment initiatives in its generation division "catchment" areas.

Eskom's Human Resources Shared Services Manager, Elsie Pule, reports that the utility is mainly concerned with the training of artisans and technicians for new plant, and that the shortage of engineers is "less scary". Eskom initially supplied Denel with 100 apprentices (formerly SANDF employees who lacked funding), but are now actively recruiting learners and forwarding them to Denel for training, which has "lots of capacity" (up to Level 4).

Pule also reported that Eskom is represented on the JIPSA "Technical Skills for Business" project which also involves mining, metal industries and Transnet. The purpose is to collaborate in producing artisans, technicians and engineers. The project team has established that the subject matter being taught in the FET colleges is "too traditional" and that the colleges must be engaged to customize their courses to produce better quality diplomates (for example, training operators to develop competencies in minor maintenance tasks).

As far as the ESETA is concerned, Pule reports that the relationship between Eskom and the ESETA did "lose its strength", but that they now had monthly meetings. One outcome to date has been the recognition of the need for plumbing skills to install solar water heating.

With respect to SMMEs, Pule stated that Eskom had "lots of intentions" which have yet to bear fruit, but the utility has started partnering with smaller companies to give them exposure and provide training for their apprentices, particularly those which have service contracts with Eskom (for example, ABB PowerTech which manufactures bag filters for power stations).

UKUBONA ELECTRICAL

Ukubona is a 14-year old small electrical manufacturer based in the Johannesburg area. The company installs and maintains low and medium voltage switchgear and reticulation works and was recently nominated as the Business Partners' Entrepeneur of the Year award.

Its clients include ACSA, Rand Refinery and ABB PowerTech. The latter has inter alia sub-contracted Ukubona for work on Eskom's Camden power station.

Two of the four business owners of Ukubona Holdings (Pty) Ltd are black and the firm has a current permanent workforce of 40 employees, with plans to expand to 150 over the next five years. The company's spokesperson Michael Faber reports that there is a lack of commissioning electrical engineers. There are also three vacant artisan posts (compared to 7 in employment).

The company spends 5 percent of its payroll on training and plans to meet most of its skills needs on an in-house basis. The main reason is that Ukubona cannot afford to send its staff on training workshops that run over two weeks. IN Faber's view; training programmes are also somewhat generic and lack specialization, and Ukubona has implemented its own training programmes on health and safety and quality management. The firm has also seen the need to partner young professionals with retired pensioners as mentors.

Ukubona has agreements with its international partners in Malaysia and China, the latter according to Faber having "unbelievable" training programmes. Accordingly, the firm has arranged for key staff members to attend these programmes.

Ukubona also believes that one way to address the skills shortage is to support SMMEs as local partners by assisting with the creation of smaller companies (Ukubona, 2007).

CITY POWER - JOHANNESBURG

City Power (Pty) Ltd is the electricity distribution utility for the greater Johannesburg area (excluding Soweto and Sandton). It is solely owned by the City of Johannesburg and governed by a service delivery agreement. City Power is supported by Kelvin Power station, a privately owned company supplying the city with electrical energy through a Power Purchase Agreement.

City Power has allocated R876 million capex for 2007/8 and R726 million for 2009/10, for bulk infrastructure refurbishment, outages and public lighting. An additional R15m has been allocated by DME for new electrification connections.

The specific expansion and maintenance plans are as follows :

- Two major transmission substations are to be commissioned within the next five years and capacity at Delta is currently being increased from 250MVA to 500MVA;
- Kelvin Power station is to be restored to full capacity of 600MW (doubling present capacity) and diesel gas turbines are being re-instated;
- 27 existing substations are being upgraded and 15 new substations are planned;
- Transformers are being refurbished and medium voltage cable is being replaced;
- Public lighting infrastructures are being extended to eventually provide for 95% of formal areas and 60% of informal settlements;
- Solar street lighting is being implemented to reach 10%;
- The City plans to eventually distribute electricity to 95% of formal households and roll out pre-paid meters to selected areas.

There is currently (2007) a total staff complement of 1948 (of which 79 percent are african men and women). Despite the scope of the expansions listed above, City Power does not anticipate that there will be much growth in staff numbers. There will however be more focus on skills development and job creation through the Expanded Public Works Programme (EPWP).

The skills development element aims to address shortages in critical skills which affect response times after black-outs, “because the staff on duty cannot always deal sufficiently with the problem at hand” (City of Johannesburg 2007 a and b).

CITY OF CAPE TOWN

In 2005, the City of Cape Town signed a service delivery agreement with a Regional Electricity Distributor (RED) as a separate company, for the provision of electricity services. However, the implementation of this agreement has been slowed, and Eskom Distribution continues to provide electricity services to customers in the region on behalf of the City (Although the City itself provides power directly to certain areas).

With the recommissioning of Reactor 1 at Koeberg Nuclear Power Station the acute shortage of electricity during peak periods has been addressed and the Western Cape is operating normally once again. The successfully energy savings programme led by Eskom resulted in blackouts being far fewer than would have been the case otherwise.

Organizational structures are undergoing change and no approved City structure is yet in place. The current workforce of the City of Cape Town is 1908. There are 18 engineers on the establishment and no reported vacancies.

However, there is a reported shortage of artisans - of the 227 artisan posts, only half (115) are filled. There are also over 600 other posts which have been vacant for some time, mainly for infrastructure management.

The City does not anticipate any expansion of the network, but is not able to carry out network optimization exercises due to skills shortages and asset maintenance remains a challenge.

The skills shortage can be traced in the view of Leeuwendal, the Head of Electricity Services Business Information, to the lack of suitably qualified trainers and lack of support for on-the-job training. Less than 1 percent of the payroll is spent on training. A total of 58 artisans are currently in training at various levels, which is expected to eventually cover half the existing vacancies.

There should be more support for learnership and skills training. In future, the apprenticeships may be run in parallel with current learnership programmes. It is also hoped that AsgiSA will assist in addressing skills shortages (www.capetown.gov.za).

DARLING WIND FARM

The Darling Wind Farm (DWF) is a partnership between the Central Energy Fund, the Development Bank of Southern Africa, the private sector, Darling Independent Power Producer and the South African and Danish Governments, to establish South Africa's first commercial wind farm (a R70 million project).

An expected annual 13.2 GigaWatt hours of Green Electricity from DWF will be generated by 4X1.3 MW wind turbines near Darling and injected onto the national grid managed by Eskom. From there it will be "wheeled" through the national grid to a substation at Atlantis where it will be introduced onto the City's electrical network and then sold onward to "willing buyers" (DME, 2005).

This Green Electricity will replace electricity normally generated by Eskom's power stations. The DWF project will contribute towards the Government's target of 10 000 GWh/year renewable energy consumption by 2013 and towards the City of Cape Town's target of sourcing 10% of its energy from renewable sources by 2020.

Environmental Impact Analyses (EIA) have been conducted. During the lifetime of the project, the wind farm will not produce the pollutants normally emitted by conventional electricity generation, and will also save 60 million litres of water.

In 2006, a Power Purchase Agreement (PPA) was signed with Cape Town Metropolitan Council to purchase "clean" energy from DWF. The Council will pay a premium for the purchase of renewable energy as part of its commitment to reach the renewable target. In February 2007, the City's project manager took part in a sod-turning ceremony to give the project the go-ahead, after six years of legal wrangling (including securing approval from Swartland Municipality for "change in use" of the farm for power-generation purposes).

The director, Herman Oelsner reported that Darling Wind Farm planned to later add another six wind turbines to the farm, followed by another 10 in the longer term. Global demand for the wind turbines was so high that the earliest additional wind turbines would be available only by 2008.

There is no indication that any skills shortages have affected the project to date. Instead, the main obstacles encountered have been legal and procedural.

IMPLICATIONS

This brief review of four case studies has highlighted the following themes :

- Eskom's capital expansion programme may create some challenges for the utility in terms of future skills requirements, but there is internal commitment to an accredited training and development programme and a large part of the required skills are being developed internally or through other organizations;
- Companies on the ground feel that available training programmes are too generic and lack specialization and subject matter flexibility, highlighting the need for FETs and other training providers to provide better quality training materials;
- At city and municipal distribution level, the main skills challenges concern the need to handle power outages and ensure adequate maintenance of infrastructure;
- The main obstacles to the development of wind-based renewable energy have to date been mainly legal and procedural, rather than skills-based.

Chapter Four

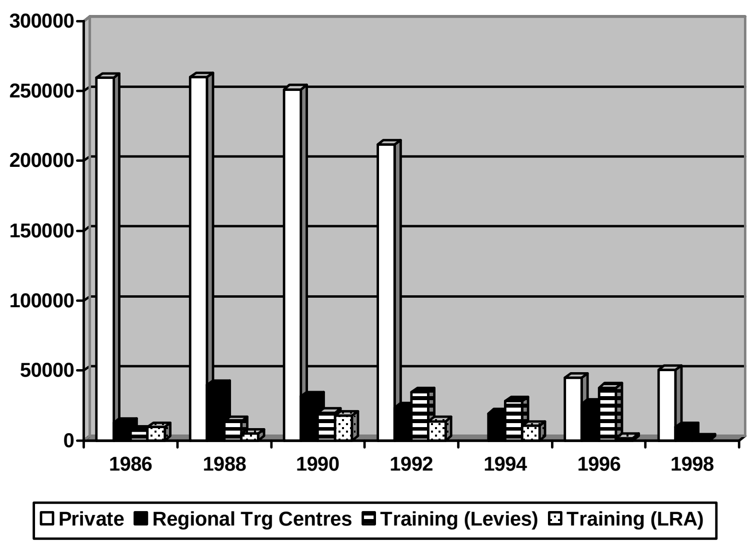
The Supply of Skills for the Electrical Energy Sector

ENTERPRISE TRAINING IN SOUTH AFRICA

The Human Resource Development Review conducted by the HSRC and published in 2003 revealed that there had been a significant decline in private enterprise training in South Africa during the late eighties and nineties :

Figure 4.1

Enterprise Training in South Africa : 1986 to 1998



(Source : HSRC HRD Review 2003)

At the same time, the training of apprentices in terms of the “structured apprenticeship model” declined from 10 758 in 1991 to 3129 in 1999 (Kraak 2007).

Mainly in response to this decline in training investment, the new democratically elected government passed legislation to promote skills training and development, notably the Skills Development Levy Act and the Employment Equity Act. The 23 Sector Education and Training Authorities (SETA) were also brought into being to establish a single national regulatory framework.

The combined impact of these legislative and structural initiatives has been a rapid rise in learnerships. The Department of Labour’s 2005 survey found that there had been an “exponential” improvement in the output of the National Skills Development Strategy (NSDS), with a four-fold increase in the number of learners achieving NQF 1 (from 111 367 in 2002/3 to 433 437 in 2003/4).

Enrolment in structured training also increased and the number of registered learnerships increased almost three times to 69 308 in 2003/4. This number fell just short of the 72 908 targeted by the Growth and Development Summit (Daniels, 2007).

The training efforts made by industry have also been recognized by the Department of Labour, which in its 2005 State of Skills survey reported that private sector training had improved. Of 1222 employers surveyed for employment equity purposes, 70 percent had introduced some form of training and development.

In the Department of Labour's earlier (2003) skills survey, it was noted that South Africa's training rate now compared favourably with that of OECD countries, namely 1 in 4 employees in training per year.

However, in a recent review conducted by the University of Cape Town's Development Policy Research Unit (DPRU), South African business was described as still lagging behind international norms. SA businesses trained 45 percent of their skilled workers in 2006, compared to 77 percent for Brazilian firms (Daniels, 2007).

An independent survey of 82 participating companies conducted by the National Business Initiative (NBI) early in 2007 reported that training expenditure had been on average close to 4 percent of salary budgets, over and above the 1 percent skills levy. During 2006, 28 percent of employees benefited from training in these companies. Two-thirds of the companies were accredited skills training centres, although the "vast majority of programmes are not directly related to SETA initiatives" (NBI, 2007 : p.84).

Although substantial progress has clearly been made, Kraak has noted that many learnerships have been in non-technical fields and the skills levels have been lower than that required for artisanal work, as per the National Qualifications Framework (NQF – Kraak, 2007). Training rates in South Africa have also varied greatly across the SETAS, from a high of 61% to a low of 9% (proportion of the labour force receiving training per annum – DOL State of Skills, 2003).

Government's JIPSA strategy recognizes that skilled engineers will need to be imported in the short-to-medium term for major infrastructural projects and predicts in the long-term that the country faces a critical shortage of engineers. As far as artisans are concerned, the Joint Task Team has set a target to train 50 000 artisans over the next four years.

On balance, it is clear that substantial progress has been made in reversing the historical decline in enterprise training in South Africa over the past decade or so, but it is also clear that much work remains to be done.

SUPPLY OF GRADUATES FROM TERTIARY INSTITUTIONS

There has been a dramatic upsurge in enrolments from the Further Education and Training (FET) colleges since 1990, as well as from the universities.

The DOL, in its assessment of the State of Skills in South Africa, observes that the technikons have been producing more engineering, science and business graduates than the universities, where most students enroll for humanities and the social sciences.

Of direct relevance to the electrical energy sector being reviewed in this report, is the question of the supply of qualified electrical engineers, diplomates and tradesmen from the various training and educational institutions.

Accordingly, trends in graduate output from Further Educational Training (FET) and Higher Education (HET) institutions will be reviewed here, focusing on output for low-level, intermediate and high NQF levels, respectively. All the figures supplied below are drawn from the Department of Education's Higher Education (HEMIS) and Further Education (FET) databases (DoE 2007a and 2007b).

In the course of the analysis, the output of diplomates from FET colleges and graduates from HET institutions will be compared against the corresponding NQF Levels, as follows :

Table 4.1

Comparison of FET, High School and HET Output with NQF Levels

FET College National Certificate	High School Grade	NQF Level
-	Grade 8	-
N1	G9	1
N2	G10	2
N3	G11	3
N4	G12 Matric	4
N5	Post-school	5
N6	Post-school	5
	Bachelors Degree (HET)	6
	Masters (HET)	7
	Doctorate (HET)	8

FURTHER EDUCATION AND TRAINING OF ENGINEERS AND TRADESMEN

Between 1996 and 2005, the pre-matric output (NQF Level 1-3) of Engineering Studies from FET colleges underwent a steady increase, although the proportion of output relating to electrical trades, power station science and theory in particular made up only 15 percent of the total output for 2005 (21 212 of 136 975).

In that year, 40 percent of pre-matric output was in engineering sciences, followed by industrial electronics (22 percent) and engineering drawing (16 percent). Figure 4.2 also shows that electrical trade theory as a subject has been increasing somewhat in popularity since 2000 :

Figure 4.2

N1-N3 Pre-Matric Engineering Studies Output from Further Education and Training (FET) Colleges : 1996 to 2005

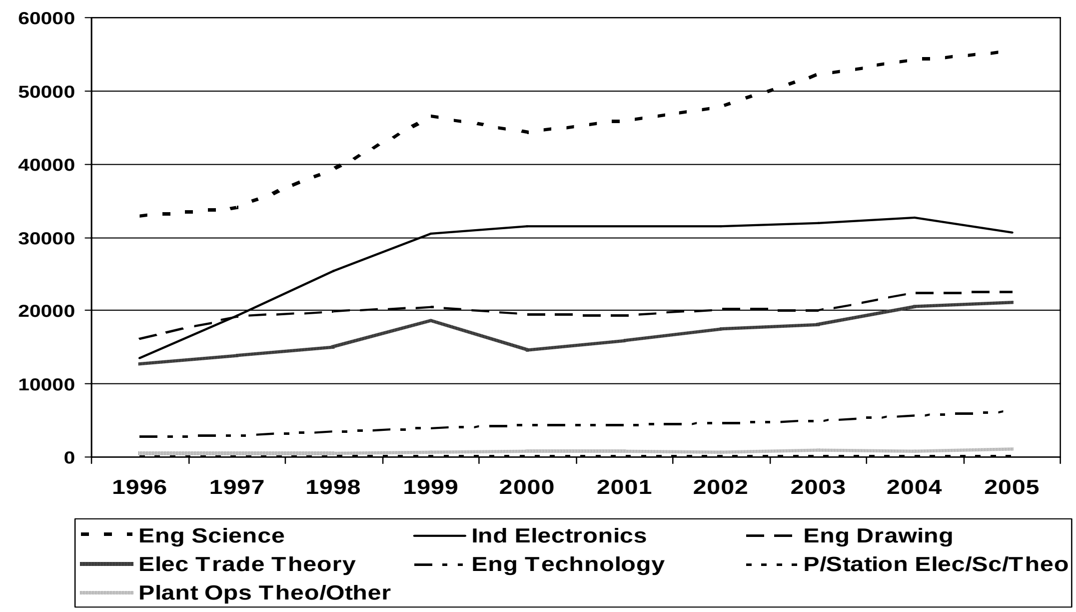


Figure 4.2 – Base Data	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Engineering Science	32792	34040	39278	46439	44381	45849	47811	52105	54190	55373
Industrial Electronics	13507	19269	25486	30548	31490	31475	31512	31914	32755	30689
Engineering Drawing	16066	19124	19885	20539	19483	19326	20257	20079	22424	22452
Electrical Trade Theory	12688	13776	14964	18573	14489	15902	17448	18087	20519	21097
Engineering Technology	2801	2914	3558	3945	4322	4430	4659	4911	5728	6247
Power station electricity, P/Station Science and P/Station Theory	260	145	169	140	96	166	161	203	118	115
Plant Operation Theory/Other	454	507	463	509	684	773	621	931	735	1002
Source : DoE 2007b, FET Output										

Most of the output of electrical trade theory was at N1 and N2 Level, with N3 Level output being small and in decline, as Figure 4.3 indicates :

Figure 4.3

Changing Levels of Electrical Trades Theory Output from Further Education and Training (FET) Colleges : 1996 to 2005

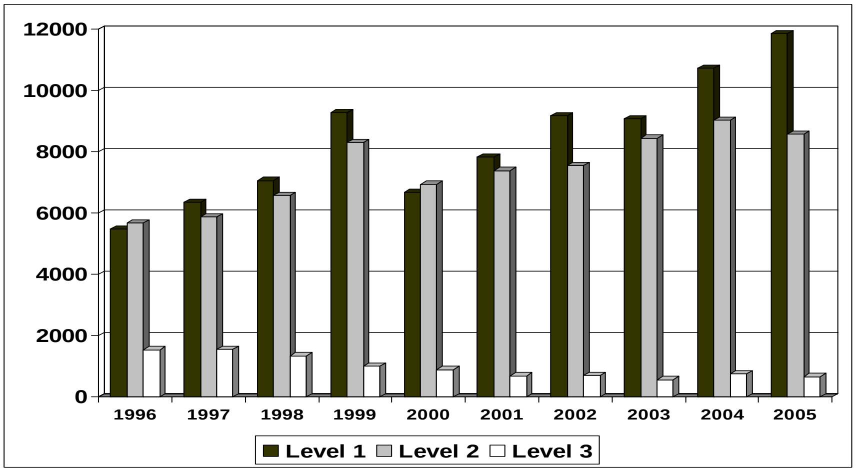


Figure 4.3 – Base Data	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
N 1 Level	5472	6351	7061	9273	6669	7830	9184	9086	10734	11854
N 2 Level	5680	5882	6569	8305	6937	7389	7558	8439	9034	8585
N 3 Level	1536	1543	1334	995	883	683	706	562	751	658
Source : DoE 2007b, FET Output										

The likely reasons for this progressive drop in Level 3 output are not known, but they could range from problems in the quality of prior schooling to the movement of more ambitious students into other study and employment opportunities in the economy (such as tourism).

As far as intermediate matric/post-school qualifications were concerned (NQF Levels 4-5), most of the FET output of engineering studies over time has been dominated by industrial electronics and engineering science (Figure 4.4 below) :

Figure 4.4

N4-N5 Matric/Post-School Engineering Studies Output from Further Education and Training (FET) Colleges : 1996 to 2005

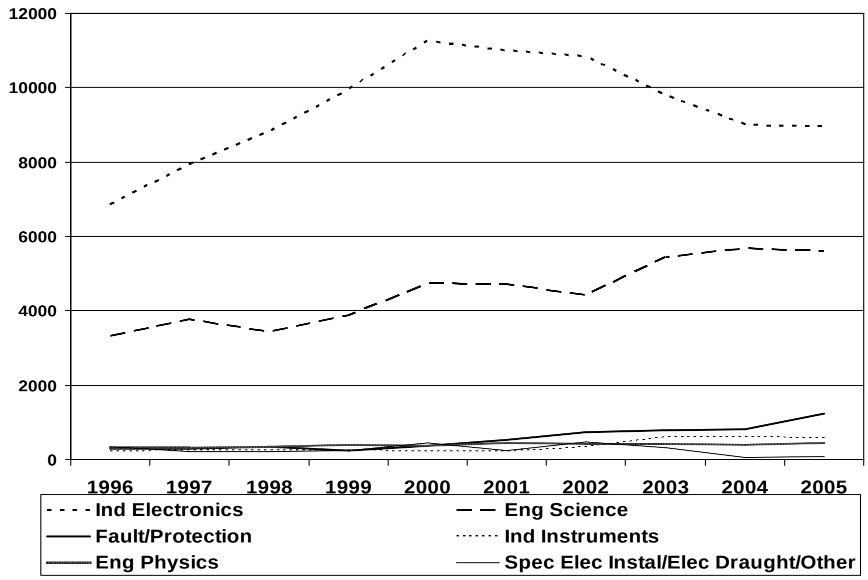


Figure 4.4 – Base Data	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Industrial Electronics	6859	7936	8828	9963	11279	10995	10855	9809	9004	8952
Engineering Science	3329	3779	3439	3887	4745	4713	4432	5453	5691	5615
Fault Finding and Protective Devices	277	292	342	230	372	526	745	774	823	1228
Industrial Instruments	215	241	247	242	214	213	332	591	597	583
Engineering Physics	315	306	329	390	365	434	414	422	402	450
Specialised Electrical Installations/Electrical Draughting/Other	351	200	214	228	451	237	475	305	51	74
Source : DoE 2007b, FET Output										

Industrial electronics also dominated FET output at the N6 level (NQF 5), as the following Figure shows :

Figure 4.5

N6 Output in Engineering Studies from Further Education and Training (FET) Colleges : 1996 to 2005

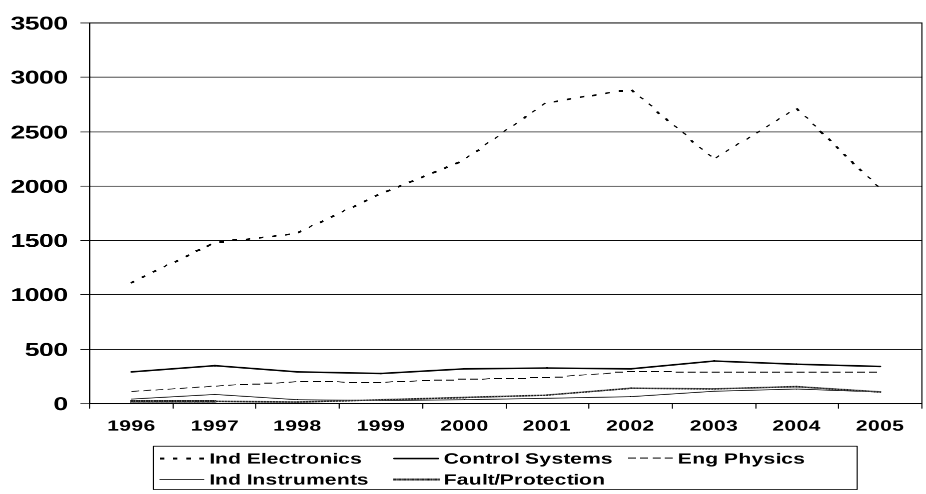


Figure 4.5 – Base Data	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Industrial Electronics	1110	1478	1568	1925	2239	2770	2888	2244	2709	1972
Control Systems	292	351	290	276	323	327	321	390	366	338
Engineering Physics	110	156	199	194	218	234	294	282	285	286
Industrial Instruments	43	85	36	25	38	48	66	111	137	109
Fault Finding and Protective Devices	18	23	16	39	58	75	145	133	153	110
Source : DoE 2007b, FET Output										

Jeff, Andre wants to know how industrial electronics is different from electrical engineering and why it is rising and falling in Figs 4.4 and 4.5? Do these people work in the electrical sector? Can you put in a comment here?

HIGHER EDUCATIONAL OUTPUT IN ELECTRICAL ENGINEERING AND TECHNOLOGY

Graduate output of electrical engineers and technologists from the higher educational institutions (NQF Levels 6-8) has show an encouraging upward trend since 2001, particularly the National Diploma qualification, which in 2005 boasted 1179 graduates (Figure 4.6) :

Figure 4.6

Electrical Engineering and Technology Graduates from Higher Education Institutions : 1996 to 2005

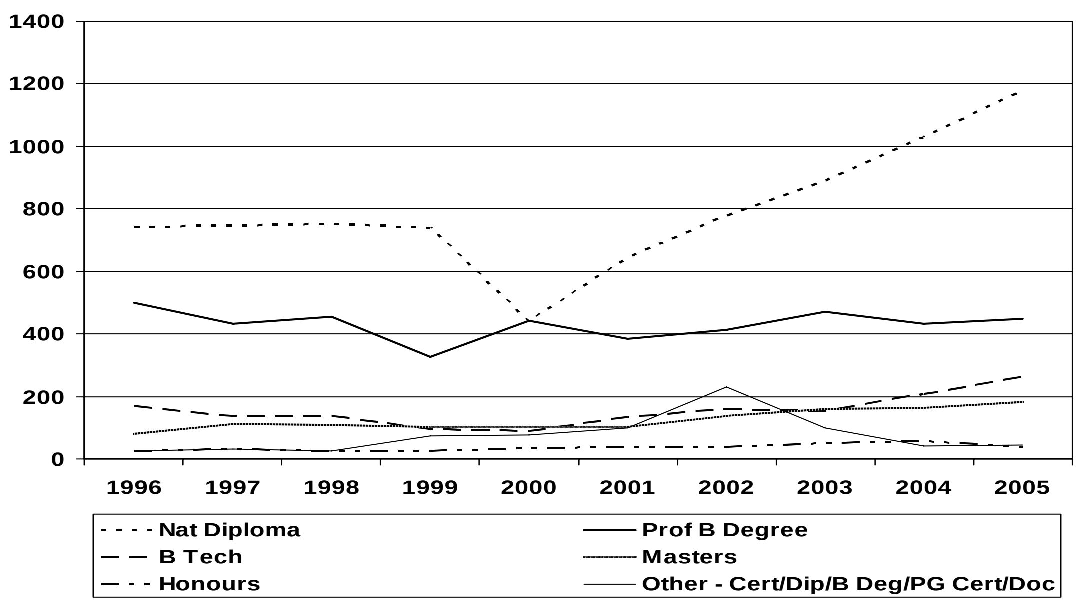


Figure 4.6 – Base Data	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
National Diploma	742	745	754	740	439	644	777	890	1028	1179
Professional B Degree	501	433	456	328	442	386	412	472	431	447
B Tech	169	139	139	95	90	135	159	155	207	264
Masters	80	111	108	103	101	104	138	160	164	182
Honours	25	31	26	26	34	38	39	51	57	39

Other - Cert/Dip/B Deg/PG Cert/Doctorate	27	33	25	75	76	98	231	98	42	45
Source : DoE 2007a, HEMIS Output										

Figure 4.6 also shows that a steady increase has taken place since 2001 in respect of the B.Tech degree (264 graduates in 2005) and the Masters (182 graduates in 2005).

As far as the demographic make-up of the National Diplomates are concerned, there has been a dramatic upswing in african graduates, and a reduction and flattening out of white graduates, especially from 2001 onwards. By 2005, over 65 percent of N.Dip graduates in Electrical Engineering and Technology were african :

Figure 4.7

Demographic Profile of National Diplomates in Electrical Engineering and Technology from Higher Educational Institutions : 1996 to 2005

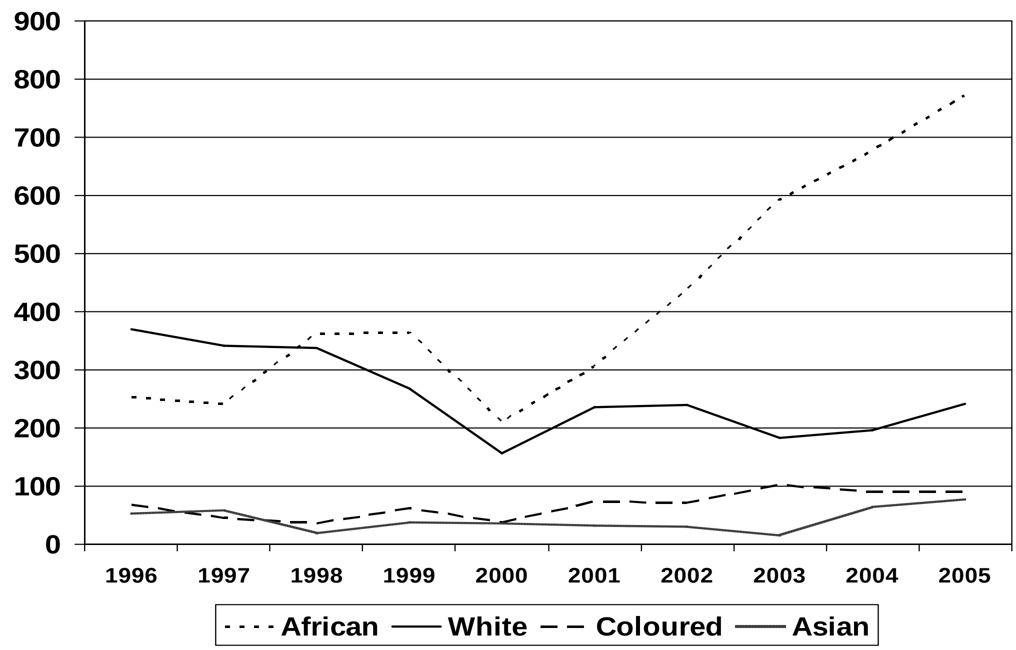


Figure 4.7 – Base Data	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
African	253	241	363	365	209	305	438	592	677	772
White	369	341	337	267	157	235	239	183	197	241
Coloured	68	45	35	63	37	74	71	101	91	90
Asian	53	58	19	38	36	32	30	16	64	77
Source : DoE 2007a, HEMIS Output										

Apart from the National Diploma, the second most popular electrical engineering and technology degree has been the Professional B Degree (447 graduates in 2005). Whereas africans made up only 11 percent of Prof B Degree graduates in 1996, that proportion had more than doubled by 2005 to

27 percent, while the proportion of white graduates, while still high had gradually flattened out (see Figure 4.8 below) :

Figure 4.8

Demographic Profile of Prof B Degree Graduates in Electrical Engineering and Technology from Higher Educational Institutions : 1996 to 2005

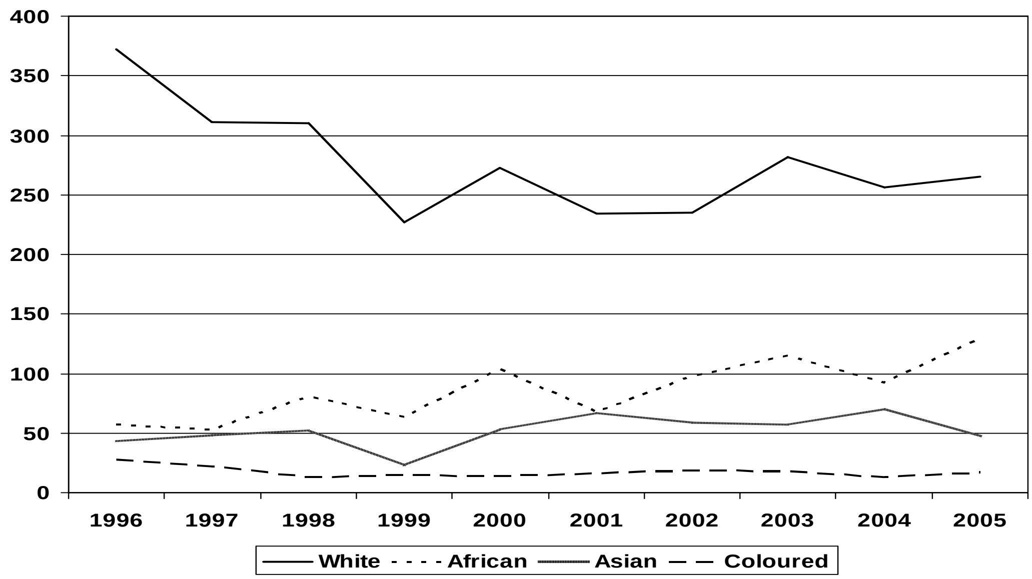


Figure 4.8 – Base Data	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
White	372	311	310	227	273	234	235	282	256	265
African	57	53	81	64	104	68	98	115	92	129
Asian	43	48	52	23	53	67	59	57	70	47
Coloured	28	22	13	15	14	16	19	18	13	17
Source : DoE 2007a, HEMIS Output										

The same trend was observed in respect of the third most popular degree, the B.Tech. Whereas africans made up 14 percent of B Tech graduates in 1996, that proportion had risen to 52 percent by 2005.

The year-on-year number of post-graduate masters and doctoral qualifications in electrical engineering and technology has traditionally been low, and mostly composed of white graduates. However, the annual combined output of post-graduates in electrical engineering has increased from 118 in 1996 to 239 in 2005, of which 32 percent in 2005 were black :

Figure 4.9

Demographic Profile of Post-Graduates in Electrical Engineering and Technology from Higher Educational Institutions : 1996 to 2005

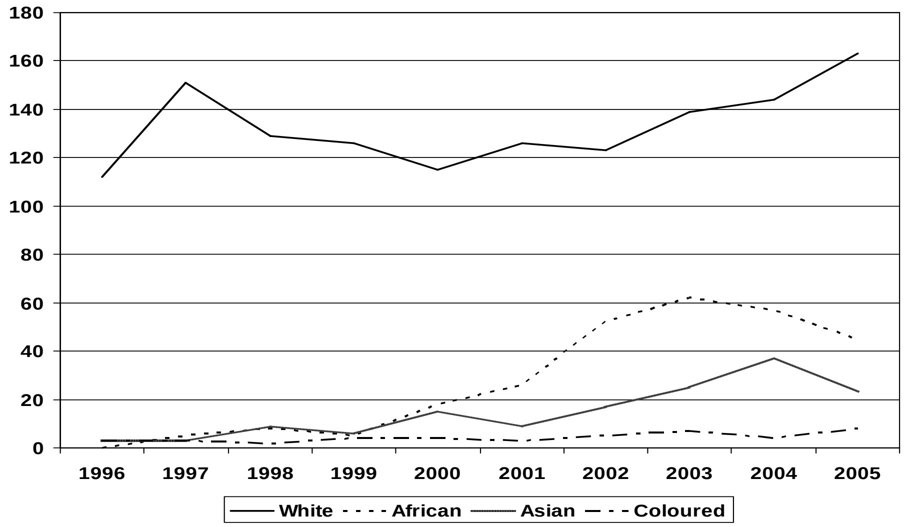


Figure 4.9 – Base Data	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
White	112	151	129	126	115	126	123	139	144	163
African	0	5	8	5	18	26	52	62	57	45
Asian	3	3	9	6	15	9	17	25	37	23
Coloured	3	3	2	4	4	3	5	7	4	8
Source : DoE 2007a, HEMIS Output										

The proportion of female graduates has also improved over time. For example, the proportion of women graduating with the popular National Diploma in Electrical Energy and Technology had improved from 5 percent in 1996 to 19 percent in 2005 :

Figure 4.10

Gender of National Diploma Graduates in Electrical Engineering and Technology From Higher Educational Institutions : 1996 to 2005

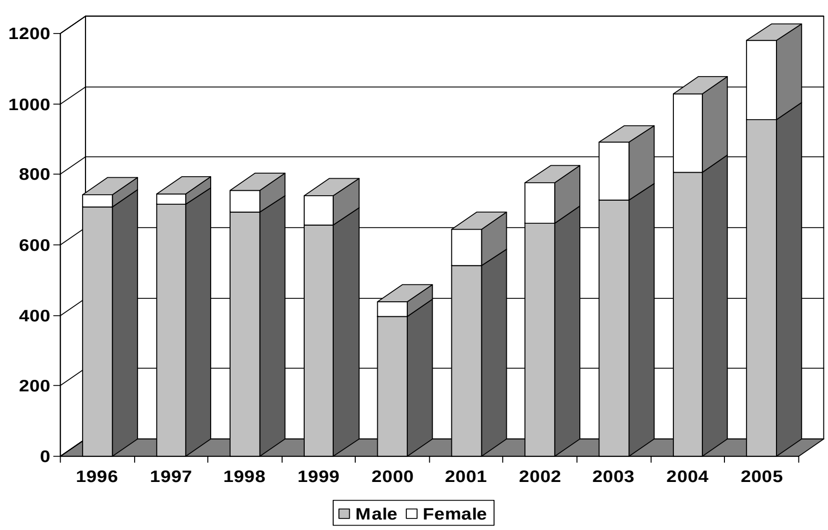


Figure 4.10 – Base Data	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Male	707	714	692	656	396	540	662	726	805	955
Female	35	31	62	84	43	104	115	164	223	224
Source : DoE 2007a, HEMIS Output										

One final point needs to be made concerning the provision of skills for nuclear energy options. Already, South Africa is seriously considering the nuclear option, which has become more attractive as an alternative to burning fossil fuels, which have the disadvantage of contributing further to global warming.

Given that nuclear power is expected to contribute at least 5000MW by 2023, it is discouraging to note that not one single diplomate or graduate has been recorded in the DoE's HEMIS database between 1996 and 2005 in the field of nuclear engineering and technology.

HIGHER EDUCATIONAL OUTPUT FOR RENEWABLE ENERGY

Whereas the output of graduates in conventional qualifications for electrical energy is established and growing, output form HET to support the introduction of renewable energy sources is very low. In 2005, only 80 candidates graduated with the National Diploma in Renewable Energy, only 75 with the professional B Degree and only 52 with the B Tech, although a strong upward trend has taken place since 2003 :

Figure 4.11

Renewable Energy Resources Graduates from Higher Education Institutions : 1996 to 2005

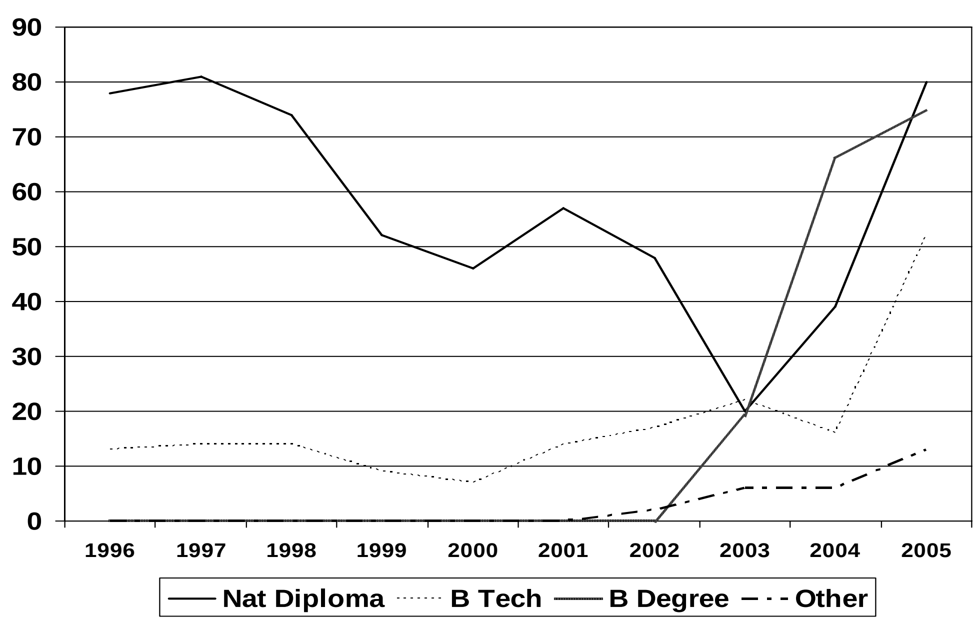


Figure 4.11 – Base Data	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
National Diploma	78	81	74	52	46	57	48	20	39	80
B Tech	13	14	14	9	7	14	17	22	16	52
B Degree	0	0	0	0	0	0	0	19	66	75
Other	0	0	0	0	0	0	2	6	6	13
Source : DoE 2007a, HEMIS Output										

IMPLICATIONS

The implications of these supply trends in the output of graduates from FET and HET institutions over the past ten years are as follows :

- The greatest bulk of engineering output from FET colleges is at the pre-matric NQF skills level 1 and 2, suggesting that further upskilling will be needed in the work environment before these students can perform effectively;
- The relatively small number of N3 FET diplomates in the electricity trades implies that there may be greater difficulty in developing a suitable feedstock of lower level electrical skills in future;
- Most of the intermediate matric/post-school (NQF 4-5) FET output has been dominated by industrial electronics and to a lesser extent, engineering science, suggesting that the electricity sector will need to look for skilled resources at this level from these disciplines;
- There has been a substantial improvement over the past five years in the supply of electrical engineering diplomates from higher educational institutions, particularly among africans and more recently, women; there has also been a modest improvement in post-graduates of all races; and
- The supply of higher education graduates to support nuclear and renewable energy alternatives is poor, but the fact that the current target for renewables is so low may mean that the small growth in renewable energy graduates could meet that demand; however, if the demand for renewable energy sources escalates rapidly in response to growing awareness of environmental issues, the available skills output will probably not be sufficient to meet such an escalation.

At face value, trends in FET and HET output suggest that the electricity industry should be assured of a reasonable supply of diplomates and graduates in the electrical engineering profession in future, although the supply of graduates in the renewables field could be inadequate if (and when) this sector takes off.

From a planning point of view, however, it is necessary to determine more precisely the extent to which the supply of skilled personnel is likely to meet the anticipated demand in specific occupational categories. For this to happen, a matching exercise will be conducted, drawing together the findings from Chapter Two in respect of occupational demand data, with the results of the present chapter dealing with the supply of output from educational institutions.

MATCHING SUPPLY AND DEMAND IN THE ELECTRICAL ENERGY SECTOR

It has been estimated in Chapter Two of this report that an additional 10909MW could be generated by 2012, and that this expansion could stimulate the creation of 9594 new jobs within the Eskom utility, together with an additional 22170 jobs in the rest of the electrical energy sector (formal and informal support services).

In the preceding chapter, the skills requirements for the electricity sector as a whole were estimated at 20329 intermediate-level tradesmen, technicians and clerical employees, 6988 high-level managers and engineers and 4447 operatives and elementary workers.

It is important to note that in the assessment to be conducted below the skills requirements of the electrical energy sector as a whole will be considered, covering both the formal and informal sectors and ranging from Eskom as the dominant entity to other organizations providing supporting electrical services. From this perspective, most of the people acquiring electricity-related qualifications from educational institutions can be expected to seek and find work in the sector as a whole.

Table 4.2 below provides a comparison between :

- the projected demand for jobs in the electrical energy sector, broken down into NQF skills levels, as determined in Table 2.1 of the report; and
- the projected supply of skills likely to be available from FET and HET institutions in respect of these skills levels, as outlined in the chapter dealing with the supply of skills :

Table 4.2

Comparison and Assessment of Skills Demand and Supply to 2012 in the Electrical Energy Sector

NQF Levels	Demand : Est. No. New Jobs	Supply : Annual Output from FET/HET	Assessment
Low-level (pre-matric) 1-3	4447	• Less than 1000 qualify annually with NQF Level 3 • Close to 20000 qualify annually with NQF Levels 1 and 2	• Poor supply of NQF Level 3 graduates • However, Eskom has an established learnership programme for Levels 2 and 3
Intermediate (matric/post-school) 4-5	20329	• Over 20000 people qualify annually in electrical trades, power station science and theory from FETs	• Supply likely to meet demand • However, the quality of output and relevance of training materials is a concern, and is partly being addressed through JIPSA working groups

High-level (degree equivalent) 6-8	6988	• Over 1000 people qualify annually with the National Diploma in Electrical Energy from HET • Over 400 graduates qualify annually with the professional B degree in electrical engineering, over half of whom are African • Over 200 graduate annually with the B Tech • There are over 200 electrical engineering post-graduates per annum from HET • There are up to 21 000 unemployed graduates in engineering and manufacturing • Less than 100 graduates qualify annually with the National Diploma in Renewable Energy, professional B Degree and the B Tech, respectively • There have been no recorded graduates in Nuclear Engineering and Technology since 1996	• For conventional electrical technology, there will be an initial shortage of high-level skills, given the rapid expansion of the sector to address electricity supply problems • The cumulative year-on-year supply of graduates should approach demand by 2012 or later • In respect of skills for renewables and nuclear options, there is a poor match which may not be sufficient to meet (increased) demand

Table 4.2 indicates that :

- the supply of NQF level 3 low-level skills may not meet demand and will need to be boosted through in-house training;
- the quantity of supply of output from FET and HET institutions will be more than adequate to meet the intermediate skills needs of the electrical energy sector over the next five years;
- there will be a shortage of high-level professional and managerial skills in the first few years of the expansion programme, but this situation can be expected to improve over time; and
- in respect of renewable and nuclear options, a shortage of skills can be expected as these options come to enjoy increasing attention in future energy policy.

From a skills supply point of view, three priority areas should enjoy special attention in future workplace skills plans (WSP) for the ESETA. They include :

- the need for further in-house training at Level 3 within the sector;
- the need to ensure that FET course materials are made more relevant to practical on-the-job requirements; and
- the need to promote careers in renewable and nuclear technologies.

In addition, the alignment of supply and demand for skills in the energy sector is not just a question of matching numbers, but is also dependent on effective governance in the labour market to "join up" learners and graduates with jobs.

LINKAGES IN THE LABOUR MARKET

The South African labour market is characterized by the paradox of a widely claimed skills shortage, together with high levels of unemployment among skilled and semi-skilled workseekers.

The DoL's 2003 Report on the "State of Skills", noted that at least 1,3 million unemployed people had Grade 12/matric or equivalent qualification, mainly in the age group 15-34. The same point was made in its 2005 Review – matriculants made up 34% of the pool of registered unemployed, and 21 000 unemployed people were qualified in the manufacturing-engineering-technology field alone.

The HSRC has also established that only 34 percent of all FET graduates have found employment after graduation (Kraak, 2007). Tertiary graduates made up 2,6 percent of the unemployed and most unemployed graduates (85 percent) were African. Of the 134 223 learnerships registered between 2001 and 2005, 66 percent were unemployed (Kraak, 2007).

Kraak ascribes this state of affairs to the absence of an effective "structured pathway into employment". Formerly, many students were sponsored by employers and had access to shop floor training. Today, however, most students study full-time without sponsorships, and then move into the vast, unstructured labour market to find work.

To remedy this "dysfunctionality", Kraak argues that there is a need for better co-ordination between DOL and DOE, together with improved alignment between the SETAS, local and provincial government and employers. One solution in his view could be the promotion of localized structured labour markets.

The DPRU review observed in this respect that the SETAs provided a (potentially) coherent framework for linking training across national, sectoral and enterprise levels, mainly through workplace skills plans (WSP), and argued that this was an "under-valued" aspect of SETA functioning (Daniels, 2007). The DPRU report also called for improved co-ordination between DOL and DOE, together with partnerships between government, FET colleges and industries to resolve the problem.

The problem of co-ordination has also been acknowledged in the National Industrial Policy Framework, released by the DTI in 2007. In the section dealing with skills (S10), the need for greater co-ordination between the development and implementation of sector strategies and the corresponding SETAS was emphasized.

As far as the labour market for electrical energy is concerned, the sector is dominated by one major entity, namely Eskom. Compared to other sectors, co-ordination between the utility, the ESETA, the FETs, universities and government should not pose too great a challenge.

However, one cause for concern is the fact that the energy SETA as a whole had among the lowest training rates of all the SETAS. Only 13 percent of workers in the energy sector underwent training in 2002/3 (the average is 24%; the mining SETA ranks highest at 59 percent, see McGrath and Paterson, 2007). Furthermore, only 28% of companies in ESETA claimed training grants in 2002/3, which was also below the national average of 41%. There were also comparatively fewer companies with workplace skills plans in the ESETA (DoL, 2003).

It should be noted that the energy SETA differs from the electrical energy sector being reviewed here, in that gas and water supplies, sanitation and services are included in the ESETA.

According to the ESETA's Energy Sector Skills Plan for 2005-2010, the electricity, gas, steam and hot water supply industry was expected to grow at 3,2 percent per annum (the plan did not consider the need for increasing generation capacity in its scope). The sector was expected to need computer skills, renewable and nuclear expertise. Renewable energy in particular was expected to call on engineers, environmentalists and technicians, among others.

The eventual establishment of Regional Electricity Distributors (REDs) was also expected to require a range of skills, including (among others) governance, technology management and measurement in the short term, load research, business development and pricing in the medium term and maintenance planning, contracting and legal trading in the long-term.

A wide range of skills were described in the ESETA plan as critical or scarce, including project management, financial management and information technology, artisans, fitters, computer operators and others, together with the "softer" skills of leadership, change management and HIV/AIDS awareness, among others.

The ESETA report also noted that renewable energy offered greatest opportunities for electricity-related ventures involving small business and enterpeneurial opportunities, especially in the rural context.

In summary, it is apparent that more needs to done with respect to building closer working relationships between the different stakeholders in the South African electrical energy sector, so that defined linkages can be established to ensure the effective linking up of learners, diplomates and graduates with job opportunities for mutual benefit.

Chapter Five

Conclusions

This conclusion will consider :

- The overall skills outlook for the sector, now and in future; and
- Key blockages and constraints affecting skills development in the sector, together with some proposed remedies for addressing them.

OVERALL SKILLS OUTLOOK FOR THE ELECTRICAL ENERGY SECTOR

The most outstanding feature of the electrical energy sector is the planned rapid expansion of the sector to meet the country's growing energy requirements.

The country's premier utility Eskom is embarking on a capital investment programme to boost generation capacity by at least 10909MW by 2012 and to eventually double current generation capacity by 2025.

At the same time, government plans are to ensure that at least 4 percent of the projected MW target for 2013 is sourced from renewable forms of energy. Thereafter, renewable targets could be extended to represent a more substantial part of the new capacity planned for 2025.

A two-fold skills challenge is therefore presented, on the one hand to support conventional generation expansion and on the other, to make the first significant shift towards new technologies for harnessing renewable energy.

This research has found that in the case of low-level skills, there will be insufficient Level 3 trainee output from FET colleges, which will need to be remedied with workplace learnerships and on-the-job training.

In the case of intermediate skills requirements for crafts, trades and technical skills, the quantity of supply from educational institutions is likely to meet demand over the next five years, although the quality of the training received may vary and would result in the need for further shopfloor upskilling for upgrading of competencies.

In the case of high-level skills, an initial shortage of graduate managers and professionals can be expected as the sector undergoes rapid expansion over the next five years. Over time, however, the year-on-year supply of high-level managers and professionals should start approaching demand towards 2012 or later.

The research has also established that there will be a significant shortage of skills to support the increased use of renewable energy in the foreseeable future. The same can be said for nuclear options.

BOTTLENECKS AND REMEDIES AFFECTING SUPPLY OF SKILLS

The following key bottlenecks have been identified with respect to the provision of skills for the electrical energy sector. These bottlenecks relate to three key themes, namely :

- The development of the informal electricity sector and SMMEs;
- Co-ordination between stakeholders and market linkages; and
- Skills for renewables and nuclear energy.

The informal sector and SMMEs

This research has found that informal and self-employment sector in the South African electricity industry is poorly developed and the initial impact of the electrification process on informal employment has not been sustained.

Going forward, it is vital that the informal sector becomes directly engaged in providing appropriate services to support the industry's capital expansion programme. Any failure to ensure growth in informal employment in the context of the expansion of the industry will represent a crucial loss of opportunity for job creation in the country.

To address this blockage, a start should be made by obtaining more reliable information on the informal energy sector, on the one hand, and SMMEs on the other.

There is very little information available on the number and type of SMMEs in the electricity sector, covering products and services, skills bases, challenges and opportunities. In the course of surveying SMMEs, the linkages between them and a wider network of informal suppliers and smaller businesses can be tracked, with a view to improving knowledge of the informal sector in general and identifying the skills and services which are on offer and which can be boosted and incorporated in the formal economy.

Apart form the need for further research on this aspect, ways also need to be found for the informal sector and SMMEs to link up to more directly with the formal sector in identifying new opportunities and services in the context of expanding electrical energy supplies. These opportunities can be identified in both the conventional and renewable energy supply markets, including the supply and maintenance of insulated wire and cable, motors and transformers, and distribution apparatus on the one hand, and solar PV, SWH and biofuels on the other.

Co-ordination

Up to now, co-ordination between stakeholders in the electrical energy sector has reportedly been poor. As the sector embarks on a massive expansion programme, there is a clear need for closer alignment and co-ordination between government, the Eskom utility, the ESETA, independent power producers, SMMEs, colleges and universities.

From this perspective, it is heartening that Eskom and the ESETA have developed a closer working relationship in recent times, but also clear that that more needs to be done to :

- pool resources for training;
- collaborate to ensure a better quality of output from educational institutions,
- establish more partnerships with SMMEs with a view to assisting in extending skills training and development through the sector; and
- develop more effective linkages for connecting up learners, diplomates and graduates with available job opportunities.

Skills for renewables and nuclear energy

This research has found that there are insufficient diplomates and graduates from FETs and HETs respectively, with qualifications relevant to renewable energy.

It is clear that interest in the field of renewable and nuclear energy has yet to take root among prospective students, with the result that skill shortages can be expected in these areas as alternative sources of energy become more widely developed and applied.

One barrier in this respect is the lack of clarity of the future direction which the country should take in respect of renewables and nuclear energy for that matter. The current target for renewable energy development is widely accepted as being too modest, and pressure is likely to grow for setting higher targets for renewables in the context of global warming.

Government will need to commit soon to a firm policy on the desired target, together with a vision and objectives for nuclear energy.

It is recommended that in the course of conducting its scheduled follow-up review in 2008 of the renewable energy target, the DME should be requested to propose a firm “mix” of renewable energies, so that the specific skills requirements can be identified and planned for by the sector, within the relevant workplace skills plans and the overall skills plan for the sector.

Until that happens, the specific skills requirements cannot easily be determined and renewables will not be viewed as a recognized career and field of study among potential students.

A campaign can then be mounted by DME in collaboration with the ESETA and Eskom, to promote student enrolments in the field of renewable and nuclear energy across FET and HET institutions.

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LIST OF INTERVIEWS AND CONTACTS

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Annexure One

Headline Stories in Engineering News 2006-2007

✓	All systems go for R66bn coal-fired power station build, SA's first in two decades
✓	Clinton, Jo'burg and other cities unveil buildings energy plan
✓	DME to unveil energy master plan in June, to pass electricity efficiency laws
✓	Eskom is to launch its pilot cogeneration project next month as it moves towards achieving at least 900 MW from cogeneration by 2011
✓	Eskom kicks off environmental process for 4 000-MW nuclear plant
✓	Eskom to launch pilot cogeneration plant in April
✓	German group to invest R100m in SA boiler-manufacturing capacity
✓	Ipsa plans February start-up for KZN cogeneration plant
✓	Portfolio committee to hear Eskom, Nersa submissions on price hike
✓	R323m budgeted to tackle 'critical' skills shortage in science, engineering
✓	SA gears up for far-reaching electricity-distribution restructuring
✓	SA power demand hits record high
✓	Salga, EDI Holdings to hold workshops on power-distribution restructuring plans
✓	SA mulls creative ways to boost fledgling biofuels industry
✓	Eskom commissions pilot coal-to-gas project State-owned power utility Eskom flared the first gas from the underground coal gasification (UCG) pilot project at Majuba power station near Volksrust, in Mpumalanga
✓	French Industry Minister heads to SA for talks on energy cooperation, skills development Work under way to double Western Cape gas-turbine capacity Advanced preparatory work is under way for the doubling up of Eskom's 1 050-MW open-cycle gas turbine (OCGT) capacity in the Western Cape to around 2 100 MW by the winter of 2008
✓	The eThekwini Municipality and the World Bank on Tuesday launched the Durban Landfill Gas to Electricity Clean Development Mechanism (CDM) project, which was the first Kyoto Protocol CDM project of its kind in Africa.
✓	Reducing by half the amount of imports required for Transnet's and Eskom's capital expansion programmes would have a substantial multiplier effect on the growth of the South African economy, and on job creation, says Department of Public Enterprises sector specialist Edwin Ritchken.
✓	Government aims to spend some R75-billion in capital infrastructure in key sectors in the 06/7 financial year, and this will move up to R91-billion by 2008/9, bringing expenditure in key sectors over the three-year budget period to R252-billion. Of this, R18-billion alone will be spent on Eskom and municipal electricity projects in this financial year.
✓	SA eyes new energy sources to meet GDP goal South Africa will need an extra 25 000 MW of energy between 2010 and 2024 should the economy reach the government's targeted 6% annual growth rate, the energy minister said on Friday.
✓	Eskom approves 1 000 MW base-load plant, revising plans to 6% growth The board at beleaguered State-owned electricity utility Eskom has sanctioned the first of what is expected to be a slew of new base-load power-generation projects
✓	Mittal progresses power-plant plans South Africa's largest steel producer is progressing plans to become one of the country's first large-scale independent power producers.
✓	Eskom targets SA expats at UK jobs fair Power utility Eskom is sending a team of 12 recruitment specialists to the UK over the weekend to participate in a 'jobs fair' arranged specifically for South Africans and those keen to work in South Africa.
✓	ABB signs $25m Eskom supply agreement Power and automation technology group ABB on Tuesday said that it had signed a frame agreement worth $25-million with State-owned enterprise Eskom to supply medium-voltage switchgear and protection units for two 1 200MW power plants.
✓	Joburg unveils R14bn capex plan, power and water dominate The City of Johannesburg has earmarked some R14-billion to be spent on capital projects over the next five years, of which R3,2-billion will be spent this year, mainly by City Power and Johannesburg Water.
✓	Cape Town wind-farm project backed by city Independent power producer Darling Wind Power is to enter into a 20-year contract with the City of Cape Town for the supply of wind-generated electricity, the city said on Wednesday.
✓	Southern African nations study of $7bn power plan Five Southern African countries will conduct feasibility studies into the development of a $7-billion power project in the region, where demand for electricity is expected to increase by a quarter by 2010.
✓	Eskom places $62m order with ABB for transmission systems Power and automation group ABB has won a $62-million order from South African utility Eskom to strengthen one of the region's most important cross-border power transmission systems, it said on Thursday.
✓	Eskom to boost E Cape supply as industrial investments near With three multibillion-rand investments pending at Coega, as well as other developments in the Eastern Cape
✓	DME turns to building sector to achieve energy efficiency targets In a bid to achieve its energy efficiency target of 12% by 2015 and renewable energy target of 10 000 GWh by 2013
✓	Nersa study to get to grips with SA's electricity resale market
✓	Eskom now budgeting some R70bn capex for Lephalale project
✓	SA, Brazil and India back nuclear as key energy source
✓	POWER GENERATION Renewable-energy equipment market to benefit from power crunch Although the South African renewable energy equipment market is still small, it is poised for “spectacular” growth

✓	Solidarity calls for Eskom skills audit
✓	Big guns put weight behind SA solar-energy initiative The State-owned Central Energy Fund (CEF) has signed an agreement with a German company, IFE, to establish a new company, Johanna Solar Technology (JST), in a bid to commercialise solar technology in South Africa.
✓	SA mulls cost and benefits of mega solar project It's 35 ?x2DA;C in the shade. Often. In Upington, a town in the arid, ironed-flat expanse of the Northern Cape, the extreme and persistent heat may cause some to become hot and bothered, but to Eskom it's good news - because this is where the utility is considering building its electricity-from-the-sun project.

Annexure Two

Eskom Electricity Sales, Output and Performance 2003-2006

	2006	2005[1] (15 months)	2004	2003
Sales				
Total sold, GWh[2]	**208 316**	256 959	206 799	196 980[3]
Growth in GWh sales, %[3]	**18,9**[4]	30,5	5,0	4,8
Electricity output				
Total electricity for Eskom system (Eskom stations and purchased), GWh[6]	**232 295**	285 601	229 970	218 412
Total produced by Eskom stations, GWh (net)	**221 216**	273 404	220 152	210 218
Coal-fired stations, GWh (net)	**205 837**	251 914	202 171	194 046
Hydroelectric stations, GWh (net)	**1 141**	903	720	777
Pumped storage stations, GWh (net)	**2 867**	3 675	2 981	2 732
Gas turbine stations, GWh (net)	**78**	–	–	–
Nuclear power station, GWh (net)	**11 293**	16 912	14 280	12 663
Total purchased for Eskom system, GWh	**10 310**	12 197	9 818	8 194
Total consumed by Eskom, GWh[7]	**3 814**	5 043	4 040	3 664
Total available for distribution, GWh[2]	**228 480**	280 557	225 929	214 748
Plant performance indicators				
Total power station nominal capacity, MW	**42 011**	42 011	42 011	42 011
Total power station net maximum capacity, MW[8]	**39 810**	39 810	39 810	39 810
Peak demand on integrated Eskom system, MW	**33 461**	34 195	34 195	31 928
Average energy availability – EAF (UCF), %[9, 10]	**87,4 (88,7)**	89,5 (89,9)[11]	89,5 (90,0)	87,5 (88,7)
Generation load factor, %[10, 12]	**69,7**	69,0	69,2	66,3
Integrated Eskom system load factor, %	**79,8**	78,0	77,4	76,8