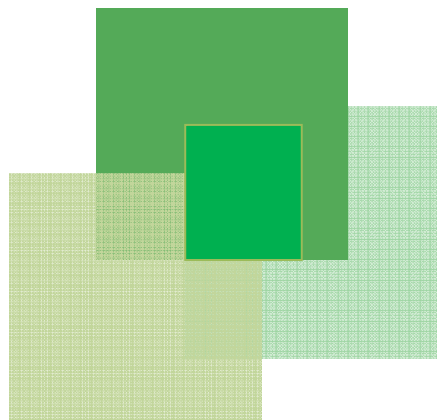




International
Labour
Office
Geneva



Skills for green jobs in South Africa

Unedited background country study

OneWorld Sustainable Investments (OneWorld)

ILO Skills and
Employability
Department

2010

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Foreword

The world finds itself in a slow recovery after the deepest recession since the Great Depression. The world is also coping with a host of environmental problems and the urgent need to reduce carbon emissions. A greener future also promises an enormous potential in a much needed employment growth. However, without suitable skills, this potential cannot be realized. Today, skills gaps are already recognized as a major bottleneck in a number of sectors, such as renewable energy, energy and resource efficiency, green building and retrofitting, environmental services, and green manufacturing. Training response measures are successful where they are coherent across policy domains, systemic and systematic, and targeted at disadvantaged groups. These training measures can only be effective if based on timely identification of skills needs. Effectiveness of training measures is decisive not only for the economic recovery but also for a longer-term sustainability agenda.

This report was produced in the framework of the project, ‘Skills for green jobs’. The project was implemented in cooperation between the International Labour Organization (ILO) and the European Centre for the Development of Vocational Training (Cedefop). The project identifies skills needed for greener economies with respect to structural shifts, and new, emerging and changing occupational profiles. The ‘Skills for green jobs’ study is embedded in the Green Jobs Initiative, a joint initiative of the United Nations Environment Programme (UNEP), the ILO, the International Employers Organization (IOE) and the International Trade Union Confederation (ITUC), to assess, analyze and promote the creation of decent jobs as a consequence of the needed environmental policies. The global study was jointly funded by the Skills and Employability Department of the ILO and the Green Jobs Initiative.

The following countries have been included in the study: the ILO covered Australia, Bangladesh, Brazil, China, Costa Rica, Egypt, India, Indonesia, the Republic of Korea, Mali, the Philippines, South Africa, Thailand, Uganda and the United States. In addition, Cedefop covered six European Union (EU) member States: Denmark, Estonia, France, Germany, Spain and the United Kingdom. The ILO global synthesis report,¹ which analyzes the situation in all 21 countries involved in the study, and the European synthesis report,² which covers the six EU countries, as well as all individual country reports, are available at: http://www.ilo.org/skills/what/projects/lang-en/WCMS_115959/index.htm (the ILO website) and <http://www.cedefop.europa.eu> (Cedefop website; look under *Skills Needs* theme). The unedited background country studies have been published in the electronic form in order to make them available quickly. The summaries are published as part of the synthesis reports.

The global project in the ILO was coordinated by the Skills and Employability Department and, in particular, benefited from comments and technical guidance by the team under the leadership of Olga Strietska-Ilina, Christine Hofmann, Mercedes Duran and Shinyoung Jeon. The ILO coordinating team would like to express great thanks to OneWorld Sustainable Investments (OneWorld) for their background country research which contributed to the global study. Special thanks also go to the ILO regional and country field offices for the project support and the ILO colleagues who assisted research at national level.

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¹ Strietska-Ilina, O.; Hofmann, C.; Duran Haro, M.; Jeon, S. (forthcoming 2010). *Skills for green jobs: A global view. Synthesis report based on 21 countries* (Geneva, ILO Skills and Employability Department).

² Cedefop. (forthcoming 2010). *Skills for green jobs: European synthesis report* (Luxembourg, Publications Office of the European Union).

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Abstract

This report examines the current issues in South Africa pertaining to greening the economy with special attention to skills requirements now and in the future. Current policy is found to be inconsistent and market forces have tended to be more effective in driving change. However, going forward there is potential for policy to direct significant structural changes. There is currently a significant skills gap across all sectors and the development of a low carbon economy will undoubtedly be hampered by this. Skill development structures are well developed but are led by market demand, which may lead to green skills requirements either being overlooked, or being provided outside of this framework. This in turn could be detrimental to national training programmes. It is recommended that a cohesive approach is taken to green skills anticipation at a national level which will ensure correct identification of needs, and strong implementation of the pre-existing skills framework.

OneWorld Sustainable Investments (OneWorld)

Executive summary

South Africa is a young democracy which has experienced strong growth over the past decade. Since the end of apartheid rule in 1994 it has made positive strides in many areas of development including standard of living, infrastructure expansion, educational achievement, healthcare and housing provision, foreign investment, and access to basic services.

However, because of the need to redress previous imbalances, South Africa has not to date made greening of the economy a priority—in fact it has hardly featured at all in policy until recently – although various environmental policies are in place (see Section 2). South African governments since 1994 have focused on redressing historical imbalances through various interventions. Strategic goals have been poverty-reduction and increased growth and development through, for example, land restitution, improved spatial planning, and improved equitable service delivery in terms of housing, health, water, electricity, sanitation and education. South Africa's history of skewed economic and political opportunity has however left a legacy of disparities. Many of these remain despite the removal or replacement of discriminatory legislation and practices. Some of the effects of apartheid are continuing inequality, high poverty and unemployment rates and inequitable land ownership and use. Despite significant achievements, the historical background of segregation, spatial constraints (such as densely populated peri-urban informal settlements), lack of skills, poverty and inequality continue to provide significant challenges. These challenges coupled with South Africa's dependence on abundant, cheap coal for energy have kept South Africa from focusing on low carbon ("green") development pathways and green skills.

As outlined above and explained in detail in this report, South Africa in 2010 is only at the outset of identifying the economic possibilities presented by greening the economy and moving towards a low carbon pathway of development. Most of the responses have been very recent, particularly in terms of policy. No policies exist as of March 2010 that specifically and exclusively address green jobs and green skills. References to greening and green jobs have recently begun to emerge as a small aspect of general policy framework development (for example IPAP2, Department of Trade & Industry, Feb. 2010, and the Medium Term Strategic Framework, July 2009). However, these policies and initiatives take a narrow view of the greening possibilities (for example, focusing largely on Solar Water Heating (SWH), or as in the Expanded Public Works Programme (EPWP), the green aspects are seen as a by-product of the main objective, which is employment creation). These draft policies are mostly in development in 2009 and 2010. They are either not yet finalized, have not yet become law, or are yet to be translated into implementation plans that will include skills identification and training frameworks and planning.

The information in this report reflects the lack of coordination in training and development. Whilst an effort has been made to gather information about green jobs, green skills and training programmes, this can only be done where such programmes exist, and in many cases, as will be seen, they do not.

South Africa is almost entirely dependent on coal for energy, which is partially the reason why the country has become amongst the highest emitters of CO₂ on earth. However, during 2007/8, South Africa experienced a severe power disruption, with more than 20 per cent of South Africa's electricity-generating capacity out of commission (Center for Development and Enterprise, 2008). Extreme blackouts had a devastating effect on the entire economy and gold and platinum mines had to shut down operations for five days (see Section 2.1 below). The Department of Minerals and

Energy (DME) and Eskom, South Africa's generation and distribution utility, released a policy document titled "National response to South Africa's electricity shortage" in late January 2008. Amongst other initiatives such as the Demand Side Management Programme (DSMP), the document focuses on the need for investment in generation from Independent Power Producers (IPPs). An immediate response in this regard is the fast tracking of cogeneration³ projects in private industry whereby the IPP would supply power to the national grid. However, a lack of cohesion has still not resulted in finalization of tariffs for feed-in and so progress has been slow (as at March 2003).

Electricity tariff increases are also a factor in driving the transition to a low carbon economy. Tariff increases were requested to allow for the recovery of additional primary energy costs (required for new power plants), and to address the need for demand-side management to reduce electricity consumption. However, these tariff increases have been viewed by trade unions and industry alike as having a negative impact on the economy, especially against the backdrop of the global recession, also impacting South Africa. *The tariff increases have not as yet been marketed to the public as part of a necessary move to a greener economy.*

The challenge of transitioning the economy onto a low carbon path is a formidable one and until recently developments have been almost exclusively driven by the market rather than policy. However encouraging signs are beginning to emerge. At the international climate change negotiations held in Copenhagen in December 2009 (the UNFCCC Conference of the Parties (COP-15), South Africa's President Zuma announced South Africa's commitment to a reduction in emissions of 34 per cent below "business as usual" levels by 2020, and 42 per cent by 2025⁴. This indicates South Africa's commitment to greening the economy. However, the challenge will be around implementing the necessary policy to achieve the reduction in emissions. This implies a degree of political will to achieve the necessary economic restructuring. The future skills requirements underlying this target will then have to be assessed and incorporated into national skills planning.

South Africa's climate change response is still in development. It has a National Climate Change Strategy (2004) which it is in the process of developing into a long-term climate response. This process includes an underlying commitment to move to a low-carbon economy (LCE), and includes a focus on green jobs, however this has yet to be finalized and the implications for labour and skills detailed.

The government has well developed policies in national environmental management including acts governing air quality, waste management, biodiversity, and integrated coastal management. In addition the National Water Act defines water user groups and gives priority use to households and the environmental reserve before agricultural and industrial processes. However, these pieces of legislation have not been enforced as strictly as they could have been and if this were done correctly it could drive greening in many sectors.

The effects of the global economic crisis are felt strongly in the labour market in South Africa, with ongoing, significant job losses. The priority of the government's response package is to protect the poorest and most vulnerable members of society, whilst focussing on maintaining growth and development. This has led to a ZAR 2.4 billion National Jobs Fund to support temporary layoffs

³ For the purposes of this report, cogeneration is defined as source of electric power facilitated by, or in addition to, some other manufacturing process (KE Consulting, 2008). Cogeneration is considered 'green' as it makes use of waste energy (heat, gas or biomass) and reduces air pollution and CO2 emissions. Thus cogeneration can take a number of forms. In South Africa the primary sources or most potential is derived from the smelting, cement, sugar, timber (paper/pulp), oil refining and petro-chemical processing industries (Mbohwa, 2008).

⁴ Address by President of the Republic of South Africa, Dr Jacob Zuma, at the United Nations Climate Change conference, Copenhagen. South African Government Information website: <http://www.info.gov.za/speeches/2009/09121816151003.htm>. Accessed 26 Feb. 2010.

during the downturn, complemented by the long standing Expanded Public Works Programme (EPWP) which has created over 1,000,000 job opportunities since its inception and provided substantial training and education opportunities for every worker. Moreover it has a strong focus on environmental protection issues and has pioneered the use of a Payment for Ecosystems Services (PES) approach, as discussed in Section 3.1, Case study 1. *However, there is no specific budget allocation for green measures within this package. Skills development measures are embodied in relevant aspects of the specific programmes, for example, Working for Water (see Case Study 1 on page 44 and Appendix 2: Working for Water training matrix). Skills development per se is not however earmarked for budget.*

In an effort to move away from the inequalities of apartheid practices, South Africa has since 1994 restructured its skills development framework. This has resulted in a globally recognized skills development framework which has overseen the transformation of the economy. In practice there have been some problems along the way and the institutional arrangements have often been criticized for not being as effective as expected. For a number of years a vacuum existed in terms of skills training and development, as the previous structures were dismantled before the replacements came into force. As a result much training has continued to be undertaken in the private sector outside of the national framework and whilst this probably hasn't hampered green skills development to-date, in the future when greening becomes important across a large numbers of sectors and employees it will be essential to have coordinated national training responses in place.

Incentives are being developed for renewable energy technology adoption and these could represent a significant restructuring of the economy should they prove effective. Currently solar water heating technology is being used in specific areas both in low and middle income households and this is emerging as the first major employer of labour in a truly green sector. Skills requirements vary between product types but the labour market is well placed to satisfy demand in at least the low income segment.

Several sectors have potential for greening of existing occupations. Construction and architectural design have begun to develop the necessary skills at the higher levels (see Case Study 6); agriculture already includes certain elements of sustainability in working practices; and there is potential for biofuels to become a big employer of the future, although biofuels may not be an environmentally sustainable option for South Africa. Architects who undergo training so they can function as "green building advisors" (see Case Study 6) are an example of an occupation that will become greener in South Africa, as this occupation begins to take cognizance of green technology and development. Since South Africa is only on the horizon of greening its economy, examples of new green collar occupations are few and far between. However there is likely to be a strong demand for solar water heating technicians as a result of government's recent push towards this technology.

Generally speaking there is a lack of awareness of issues relating to energy efficiency and water conservation throughout the majority of the population. This is reflected in the energy intensity of the economy although businesses are now starting to take note. (The reasons for this are largely market-related, for example increasing energy tariffs and rising costs.) As South Africa is increasingly connected to global markets, those markets' demands for greener products are affecting South Africa's production methods. Increasing awareness and new legislation across the board would provide the opportunity to green a wide range of occupations and this is nowhere truer than in manual labour occupations. South Africa has over one million labourers who handle materials, water, and control waste processes every day. The impact of greening these occupations by providing basic education in energy and water efficiency could be significant. Furthermore, all sectors are required to develop energy efficiency strategies.

South Africa currently faces an enormous lack of skills in many sectors, which may not bode well for green skills, new green skills and for greening of existing skills. The shortages are clear in the Scarce Skills List (Dept. of Labour 2008), see Section 3. For example, the country is short of approximately 12,600 industrial and mechanical engineers and technologists; 5,000 electricians; 7,000 specialist managers (including environmental, arts and culture, office and quality managers); 6,000 agricultural and forestry scientists; 7,000 teachers for Grades 4 to 9; and 9,365 teachers in Grades 10 to 12 (including technical colleges), to mention a few. Another important factor may be the serious shortage of professionals in the training and development, and human resources sectors (approximately 13,000 people according to the 2008 Scarce Skills List, Dept of Labour, 2008). The shortage in Training and Development professionals appears to be one of the most severe shortages, with enormous consequences, at over 9,000.

Across all green occupations there exists a skills gap in skilled jobs including all engineering and technical roles. There are many factors which can explain this but the most critical is the lack of basic mathematical and scientific ability of school leavers. Every industry consulted during the writing of this report suggested that the government's priority should be on solving this problem if it wishes to provide skills of adequate quantity and quality for a low carbon economy. In addition, school children seem to lack careers guidance and awareness of options available to them.

All in all it can be said that South Africa is at the brink of embarking on the green curve and has yet to put together a cohesive action plan for transforming to a low carbon economy. Having skills in the right place at the right time is a critical success factor for South Africa's transition into a low carbon economy. Recent emissions targets will help spur this transitioning process, and if funding and technology transfer pledges from international climate change negotiations are forthcoming then skills development could boom. Events in the energy industry have already helped to drive some green measures and market forces will continue to play a large role.

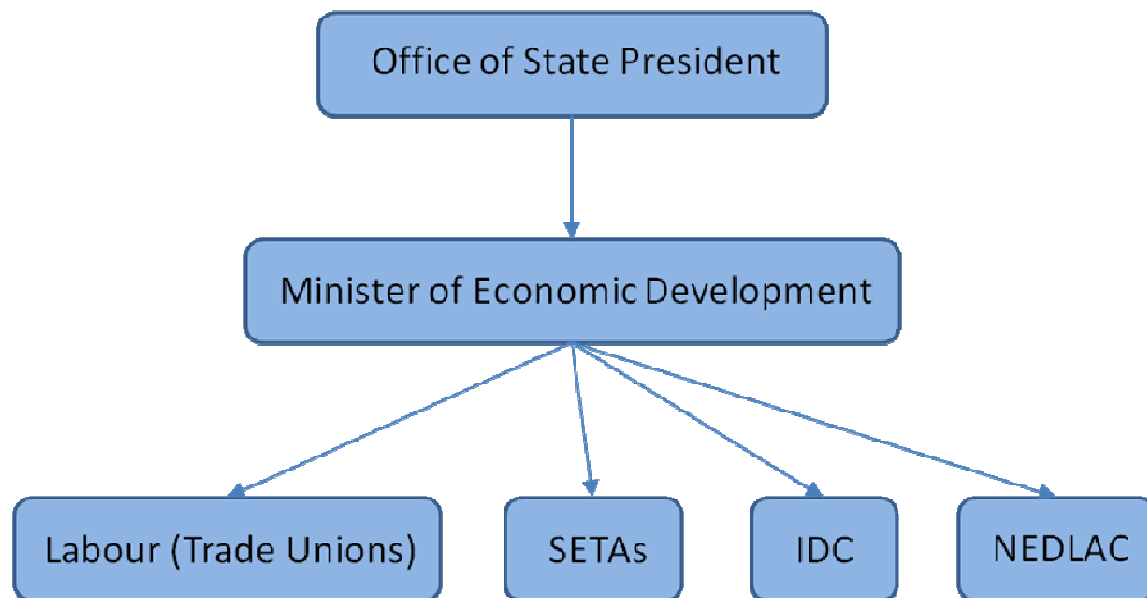
It is evident that a commitment to an LCE will stimulate the development of green skills. However, if those skills are not in place, this commitment cannot be achieved. A conference in South Africa between industry, government, labour (trade unions) and civil society is strongly recommended based on the outcomes of this important international study, with the objective of facilitating dialogue and stimulating action.

This report also recommends the creation of a National Low Carbon Economy Skills Forum which would oversee training and education in all sectors. At the same time this forum would model future changes in global and domestic green goods and services to ensure that South Africa is well placed to provide goods and services to drive the economy whilst reducing negative environmental impacts and simultaneously protecting itself from the adverse effects of climate change. It is recommended that this forum be driven from the highest political and government implementation level - the Ministry of Economic Development in the Office of the State President. Key players and partnerships would be the National Economic Development and Labour Council (NEDLAC), labour (trade unions), and the Industrial Development Corporation of South Africa (IDC) (a self-financing, state-owned national development finance institution that provides financing to entrepreneurs and businesses engaged in competitive industries).

In terms of training delivery mechanisms, public private partnership (PPPs) programmes are likely to be the only success scenario and as indicated, this requires coordination at the highest level. A proposed institutional structure is suggested in Figure 1. **As mentioned, this envisaged structure is driven from the Office of the State President (Ministry of Economic Development), and includes coordinating participation in policy development from all segments of the economy central to driving both skills AND low carbon economy policy implementation. The trade unions as well as business (with emphasis on certain key sectors such as labour intensive high energy users) and**

institutions that provide the country's skills development (via the SETAs) are therefore seen as key participants.

Figure 1: A PPP for green skills development in SA: Low Carbon Economy (LCE) Skills Forum



Abbreviations and acronyms

AES	Associated Energy Solutions
B-BBEE	Broad-Based Black Economic Empowerment
BEE	Black Economic Empowerment
BRT	Bus Rapid Transit Project
CDM	Clean Development Mechanism
CER	Certified Emissions Reductions
COP	Conference of the Parties
COSATU	Congress of South African Trade Unions
CPD	Continuing Professional Development
CSIR	Council for Scientific and Industrial Research
CSP	concentrating solar power
DEAT	Department of Environmental Affairs and Tourism
DEFRA	Department for Environment, Food and Rural Affairs
DEG	Deutsche Investitions und Entwicklungs-gesellschaft (German Development Bank)
DME	Department of Minerals and Energy
DNI	Direct Normal Insolation
DOL	Department of Labour
DSMP	Demand Side Management Programme
DST	Department of Science and Technology
DWAF	Department of Water Affairs and Forestry
EDD	Economic Development Department
EE	Environmental Education
EPWP	Expanded Public Works Programme
ESCOs	Energy Service Companies
ETQA	Education and Training Quality Assurers
FET	Further Education and Training
GCMs	Global Climate Models
GCX	Global Carbon Exchange
GDP	Gross Domestic Product
GHG	greenhouse gas
HET	Higher Education Institutions
IAPs	Invasive alien plants
IDC	Industrial Development Corporation of SA
IPAP	Industrial Policy Action Plan
IPCC	Intergovernmental Panel on Climate Change
IPPs	Independent Power Producers

IUCN	International Union for the Conservation of Nature (now World Conservation Union)
IWMP	Integrated Waste Management Plan
LCE	Low carbon economy
LTMS	Long-Term Mitigation Scenarios
MFMA	Municipal Finance Management Act
MTSF	Medium Term Strategic Framework
NEDLAC	National Economic Development and Labour Council
NEMA	National Environmental Management Act
NERSA	National Energy Regulator
NGO	non-governmental organizations
NQF	National Qualifications Framework
NSDS	National Skills Development Strategy
NSF	National Skills Fund
OFO	Organising Framework for Occupations
PES	Payment for Ecosystems Services
PPP	public private partnership
PV	photovoltaic
QCTO	Quality Council for Trades and Occupations
R&D	Research & Development
REFIT	Renewable Energy Feed-In Tariff
RSP	Regional Standards Program
SACAP	South African Council for the Architectural Profession
SADC	Southern African Development Community
SAQA	South African Qualifications Authority
SDL	Skills Development Levies
SETA	Sector Education and Training Authority
SGB	Standards Generating Bodies
SP	Strategic Priority
SPWP	Special Public Works Programmes
SSP	Sector Skills Plan
SWH	Solar Water Heating
THRIP	Technology and Human Resources for Industry Programme
UCT	University of Cape Town
UJ	University of Johannesburg
UNFCCC	United Nations Framework Convention on Climate Change
WESSA	Wildlife and Environment Society of South Africa
WfW	Working for Water: Programme of the Expanded Public Works Programme
WWF	World Wildlife Fund

1. Introduction

South Africa has experienced strong growth over the past decade and, since the end of apartheid rule in 1994, has made positive strides in many areas of development including standard of living, infrastructure expansion, educational attainment, healthcare provision, foreign investment, and access to basic services.

Development during this period has been supported by an electricity generation industry almost entirely dependent on coal as a source of fuel. South Africa enjoys vast reserves of this natural resource and because of the consequent ease of access to fuel and its relative cheapness, there has been little incentive to develop other methods of electricity generation that can exhibit similar low cost characteristics.

The resulting reliance on coal-fired power has caused a rapid increase in the country's greenhouse gas emissions to the point where South Africa is now one of the heaviest polluters in the world (13th by total CO₂ emitted (UNEP, 2009)) and certainly the biggest emitter on the African continent, although in comparison to other more developed countries, South Africa's emissions look slightly less severe. With factors such as the rapidly increasing demand for energy (approximately 5 per cent pa) and the fact that only 70 per cent of the population currently have access to the electricity grid, the likelihood is that emissions will continue to grow rapidly.

The challenge then for South Africa is to continue to develop in a way that can raise the standard of living across a population displaying high levels of poverty and income distribution inequality, whilst simultaneously reducing emissions and progressing along a low-carbon pathway. Crucially the government has recently committed to reducing emissions by 34 per cent between 2009 and 2020 and 42 per cent between 2009 and 2025 (DEAT, 2009) which represents the first major policy move towards lowering the country's carbon usage. *It is for this reason that this report interchanges 'green skills' with 'low carbon economy' skills.*⁵ However, this commitment to emissions reduction is as yet unsupported by specific implementation plans (including skills plans) that will allow the achievement of these targets.

The skills implications to achieve this target are considerable, varied, and encompass all sectors of the economy. Currently South Africa suffers from a chronic shortage of skilled and semi-skilled workers in many disciplines (without taking into account the development of a low-carbon economy), and this shortage holds back growth in several areas. This report examines various skills requirements in some of those sectors and looks at the approaches taken to identify gaps and future trends. Furthermore, it gives examples of current activities in the form of case studies that demonstrate where greening is taking place and where good practice has been followed.

Research was conducted through a combination of extensive consultation in the form of interviews and ideas sessions with stakeholders across many sectors of the economy including both the private and public sector. Existing literature and government statements and objectives were reviewed in conjunction with a quantitative analysis of labour statistics from Statistics South Africa.

⁵ The ILO has defined "green jobs" as "work in agriculture, industry, services and administration that contributes to preserving or restoring the quality of the environment." (UNEP et al. 2008).

2. Policy and market context

2.1 Key challenges and priorities for the green economy

South Africa has yet to examine and face the challenges involved in greening its economy. It currently relies on relatively cheap coal-based power generation and this, coupled with its high electricity consumption and its targets for growth, point towards the continued use of high emitting fossil fuels for power generation and resultant high emissions. South Africa has a so-called *dual economy* with high levels of unemployment (over 25 per cent) amongst the unskilled and semi-skilled, as well as poverty, and social inequality. Medium term goals for government include faster growth, job creation, and correction of social imbalances, however there is little if any focus on greening of the economy, despite a growing awareness of the need to respond to climate change and to reduce emissions. In the context of the economic crisis, and the urgent need to mitigate and adapt to climate change, these targets become considerably more difficult to attain. An additional factor is that to a certain extent—despite environmental legislation—low carbon, clean-energy development and environmental concerns are still viewed as a luxury. In addition, South Africa does not currently necessarily view the greening of the economy as an opportunity for job creation.

South Africa's development challenges and a transformation agenda

When South Africa's new democracy came to power in 1994, it faced formidable problems stemming from the structural (historical) inequalities and imbalances of the past, which characterized every area of the public and private sector, the economy and life in the country in general. The new government needed to prioritize measures to redress these imbalances and inequalities. Interventions included restructuring and transformation of many sectors from which most black people had been excluded in the past. Employment equity, access to and ownership of land, access to basic services and a decent education were and are priorities. Lack of investment employment opportunities in rural areas has led to rapid urbanization. This has put enormous pressure on underdeveloped peri-urban infrastructure. Needless to say, the above factors have created an enormous demand for service delivery in many sectors, for example education, transport, access to housing, water, sanitation, electricity and land. In addition, South Africa suffers from high unemployment, which was officially at 23.5 per cent in 2009, and at the same time the country suffers from a serious shortage of skills. The above, coupled with the exit of many white skilled professionals and semi-skilled employees from various sectors lead to a loss of skills in many sectors.

In addition, South Africa is one of the countries most affected by HIV. The estimated overall HIV prevalence rate is approximately 10.6 per cent and the total number of people living with HIV is estimated at approximately 5,21 million (Statistics SA, 2009)⁶. This also presents a considerable challenge to the developing state and tends to preempt other goals, such as greening of the economy.

Education and training in South Africa have undergone a total transformation in order to address the effects of the disastrous separate education system that disempowered black people in the past. This process has involved an extended process of revision of the school curriculum as well as restructuring of tertiary education institutions and occupational training processes, and this process is ongoing. The above factors have affected the availability of skilled labour and professionals in many sectors.

⁶ Statistics South Africa, 2009. *Mid-year population estimates 2009*.
<http://www.statssa.gov.za/PublicationsHTML/P03022009/html/P03022009.html>

With regards to Research and Development (R&D), South Africa has a relatively low spending on R&D to GDP ratio, at 0.92 per cent in 2007, as well as a low rate of R&D practitioners per 1,000 population (0.61). On the other hand, according to the National Research Council, South Africa has 73 “A-rated” researchers, who are considered to be world-class by peers in their fields, for example Animal and Veterinary Sciences, Engineering and Mathematics, Health Sciences, Physics, and Plant Sciences.

Sixteen years after its first democratic elections, South Africa has made strides towards addressing many of these problems, however the efforts and resources required to focus on this social and economic transformation has meant that aspects such as greening of the economy have taken a back seat. More recently, the growing global awareness of climate change impacts has led developing countries to consider the need to adopt low carbon pathways to development, and South Africa’s voluntary commitment to reducing emissions, discussed below, shows that South Africa has now made a commitment to developing a low carbon economy (LCE), if at this stage as yet unsupported by the necessary policy for implementation.

Progress is slow with regards to green skills development. The Department of Labour’s (2005) National Skills Development Strategy (NSDS) (2005-2010), for example, does not mention green skills. The following principles are listed, which indicate the country’s focus on poverty eradication and attempts to address past inequalities:

- *“Support economic growth for employment creation and poverty eradication*
- *Promote productive citizenship for all by aligning skills development with national strategies for growth and development*
- *Accelerate Broad-Based Black Economic Empowerment and Employment Equity. (85 per cent Black, 54 per cent women and 4 per cent people with disabilities, including youth in all categories). Learners with disabilities to be provided with reasonable accommodation such as assistive devices and access to learning and training material to enable them to have access to and participate in skills development*
- *Support, monitor and evaluate the delivery and quality assurance systems necessary for the implementation of the NSDS*
- *Advance the culture of excellence in skills development and lifelong learning”*

Skills shortages

A critical aspect of challenges for the green economy is the general lack of skills in many sectors in South Africa, and in particular the lack of engineers and technicians, as illustrated later in this report. Engineers and technicians (amongst others) will be essential in transitioning to a greener economy.

Furthermore, human resource professionals and training and development professionals who are at the interface of skills development and greening of the economy, are also in short supply. There is a national scarcity of human resource professionals (3,855, according to the National Scarce Skills List of 2008, Dept. of Labour) and of training and development professionals (9,260). This indicates that the human resources and skills development sectors are under-resourced themselves. The sector is therefore unlikely to be able to meet needs for planning, analysis, research, training and skills development required for skills development in general, let alone green skills.

A high carbon economy

South Africa will have to work hard to decarbonize its economy. Currently 13th in the list of global emissions, it produced 414 million tonnes of CO₂ in 2006. Emissions per capita are around 9 tonnes per year, putting South Africa 48th globally, although it should be noted that the vast majority of countries with higher emissions per capita are developed countries. (For example, whilst China and India are ranked 1st and 4th respectively in terms of total emissions, they lie 81st and 140th in per capita terms.) (UNEP, 2009). However, according to International Energy Agency figures, 2006, South Africa is ranked 8th globally in terms of per capital emissions.

Furthermore, South Africa currently does not view a renewable energy rollout in a positive light, as illustrated by the following example regarding concentrating solar power (CSP). The comments in the excerpts are based on discussions at a stakeholder workshop held in Cape Town, March 2009. CSP is discussed further in Section 3.1.1.

Attitudes to Concentrating Solar Power (CSP) rollout in South Africa

“There seems to be an educational and perception barrier, in that CSP rollout in South Africa has not yet been perceived as anything more than ‘a pilot’, which may have to do with Eskom’s position over their ‘test plant’. To redirect the national perception and support the large-scale rollout of CSP, Eskom could brand their development as ‘building an industry’ - the Solar Industry Development Programme. A national planning framework, possibly led by the Department of Trade and Industry, would have to be established to encourage the industry by coordinating with other government departments and interested industrial sectors. Holm et al. (2008) similarly identify ‘the most important constraint is not money, men, machines, materials or management, but the motivation, the inspired political will’ for the deployment of renewable energy in South Africa.” (Edkins et al. 2009)

http://www.erc.uct.ac.za/Research/publications/09Edkins-et-al-Rollout_of_CSP.pdf

Job creation in the renewable sector is discussed in more detail further in section 3.1.

Centralized, coal based energy economy

The country has very large reserves of coal, and because of this, coal provided 71.5 per cent of primary energy supply in 2006, with oil accounting for 12.4 per cent, and combined renewable and waste energy a further 10 per cent. More specifically, coal-fired power plants produced approximately 95 per cent of South African electricity in 2006 and as such, one of the priorities for government is to increase electricity supply from other sources such as gas, nuclear, and renewable energy. A Renewable Energy Feed-In Tariff structure (REFIT) was agreed in 2009 which aims to support the development of wind, hydro, landfill gas, and solar energy. Clear institutional arrangements, that is to say the enabling mechanisms and clarified roles and responsibilities, between the National Energy Regulator (NERSA), the national utility (Eskom), the Department of Energy and the Independent Power Producers (IPPs) of renewable energy that are needed in order to implement REFIT have not yet been finalized, delaying the introduction of the tariff structure in South Africa. One objective of REFIT is to stimulate the achievement of the annual electricity supply of 10,000 GWh from renewables by 2013, as laid out in the Renewable Energy White Paper, 2003. This represents approximately 4-5 per cent of generation output (see Section 3.1.1).

In addition, South Africa has an Energy Efficiency Strategy (Department of Minerals & Energy, 2005) with a target to achieve 10 per cent savings in energy consumption by 2025 through energy efficiency measures (see 2.2.1). The energy crisis experienced in South Africa in 2007-2008 gave impetus to

achievement of this target (see 2.2.2). Expert analysis and research has indicated that South Africa could achieve as much as a 25 per cent savings through effective energy efficiency measures in government and industry. Even higher savings could be realized with domestic measures.

Attitudes to greening

According to Earthlife and Oxfam (2009), “overcoming the omnipresence of Eskom and its preference for fossil fuels is largely considered to be the most compelling obstacle to developing a renewable energy market in South Africa.” (*ibid.*)

A water scarce economy

South Africa is a semi-arid country and lack of water is a limiting factor to development. Current demands for water are met by large scale infrastructure projects such as major dams (the most recent one having been built in the Western Cape, one of the most water scarce regions in South Africa) and irrigation schemes (such as the Orange River Project and the Vaal Harts scheme in the Northern Cape). However, agricultural activities (excluding forestry and soil-water abstraction) account for approximately 64 per cent of total water-use. As the effects of climate change begin to reduce water availability, the importance of increasing efficiency in this area, and developing methods of sustainable agriculture, will be paramount. Domestic uses account for 16 per cent of water demand. Adding further pressure to water availability are: (1) the expansion of basic supply infrastructure, and (2) the Free Basic Water policy, which allocates 6,000 litres of free water to 11.3 million households nationwide (or 86 per cent of all households), an increase of 4.2 million households since 1996.

Problems of water quality and availability are increasing due to five main reasons:

1. Changing land use patterns which affect water flows and availability in four main ways:
 - a. Urbanization and the associated increase in impervious ground surfaces affects the amount of recharge to groundwater as well as surface water.
 - b. Hydrological patterns (flow and volume) are affected by changes in infrastructure such as dams, canals etc.
 - c. Misuse of land, such as overgrazing, increases erosion leading to slow running sections of water becoming dammed where materials settle on the riverbed. This changes flow dynamics of waterways and degrades ecosystems through silting.
 - d. Alien vegetation holds more water than indigenous species and therefore can reduce water levels significantly.
2. Regulation of water resources has historically been characterized by a lack of funding resources and capacity within the regulating bodies themselves. A water-use licensing process is ongoing but enforcement and monitoring is key.
3. The impact of climate change and the associated increase in variability of rainfall will affect both surface water flows, and ground water recharge. Some areas will experience floods whilst others will suffer drought. Parts of the country could experience reductions in water availability whilst the potential for increased temperatures raises the water requirement for plants, thus further reducing water availability. Less water availability also reduces water quality, restricting its uses.
4. Pressures exerted by human activities affect water quality especially in heavy industry, mining and agriculture where waste water often contains harmful chemicals which recharge ground water resources.

5. Future water requirements are affected predominantly by population growth and economic growth. Contributing towards these factors are issues of migration, urbanization, and HIV and AIDS infection rates.

It is estimated that 10 per cent of birds and frogs, and 20 per cent of mammals in South Africa are now threatened (DEAT, 2006). These negative effects on biodiversity come from several factors including: habitat conversion such as urban development and afforestation; invasive species (both plant and animal) which threaten indigenous species; over-exploitation including abstraction from fresh water resources and destruction of woodlands by subsistence farmers; and climate change which reduces availability of suitable climatic conditions for certain indigenous species whilst simultaneously reducing water flows and quality. Furthermore, the industrial and power sectors require large quantities of water and due to these factors it is vitally important that an integrated approach is taken to the management of land and water uses.

2.2 The response strategy [to climate change and environmental degradation]

2.2.1 General environmental strategy

Climate change strategy

The South African National Climate Change Response Strategy was released in 2004 by the Department of Environmental Affairs and Tourism (DEAT). The government later established an Inter-Ministerial Committee on Climate Change to continue the formulation of a more specific and targeted national programme on climate change. In the interim, the government commissioned the Long-Term Mitigation Scenarios - LTMS (DEAT, 2007) which subsequently fed into this process by providing a picture of South Africa's long-term emissions scenarios and possible costed reduction scenarios (see below).

The Climate Change Summit (March 2009) was a multi-stakeholder process that established a framework for development of the climate change response strategy along with a discussion document drawn up by government. The conference statement notes that government's position is as "*required by science*" as outlined in the South Africa's Long Term Mitigation Scenarios (LTMS, outlined below) entailing a peak of emissions by 2020-2025 and a decline by 2030-2035. The climate response policy will be built on six pillars, or policy direction themes:

Theme 1: Greenhouse gas emission reductions and limits;

Theme 2: Build on, strengthen and/or scale up current initiatives;

Theme 3: Implementing the "Business Unusual" Call for Action;

Theme 4: Preparing for the future;

Theme 5: Vulnerability and Adaptation; and

Theme 6: Alignment, Coordination and Cooperation.

Prior to the Copenhagen discussions in 2009, the government made statements that although South Africa is committed to taking responsible action to reduce emissions, it was not prepared to agree to any targets that would "undermine our growth trajectory". Nonetheless, the South African President released a statement at the Copenhagen talks of 2009, stating: "*South Africa will undertake mitigation*

actions which will result in a deviation below the current emissions baseline of around 34 per cent by 2020 and by around 42 per cent by 2025”.

The above is clearly a big step forward for South Africa and will have serious implications for industry and skills requirements if the target is to be met. A national climate change programme requires a long-term planning strategy, which will enable long term effects on climate change to be taken into consideration across an appropriate timescale, rather than focusing on quick fixes which may lend themselves to furthering political agendas during government terms over just a few years.⁷

The next significant output of the climate change response strategy process is planned for 2010, during which the government will formulate and detail a climate change action plan with the aim to put those actions into legislation in 2011.

South Africa's Long-term Mitigation Scenarios (LTMS) and climate change policy

In the face of growing global awareness of climate change and of the impacts that it is likely to have on Southern Africa, in 2006 the cabinet commissioned a process to examine the country's greenhouse gas emissions and the potential for mitigation. The process resulted in a range of emissions reductions scenarios made up of groupings of costed mitigation actions. This led to cabinet's agreement to a strategic direction for national climate change policy. The LTMS set the foundation for the South African Climate Change Policy package, under six policy direction themes. The government has adopted the *Required by Science* scenario of the LTMS, which aims to limit global temperature increase to below 2 degrees C above pre-industrial levels.

In a 2008 document (DEAT⁸, 2008a), the process going forward from 2009-2012 was outlined as follows:

- National Climate Change Response Policy Development Summit (Feb. 2009) (Adopt Framework)
- Sectoral policy development work (Feb. - June 2009)
- Post-2012 negotiation positions (up to July 2009)
- UNFCCC post-2012 negotiations concluded (Copenhagen, Dec. 2009)
- National policy updated for implementation of international commitments (Mar. 2010)
- Green Paper published for public comment (Apr. 2010)
- Final National Climate Change Response Policy published (end 2010)
- Policy translated into legislative, regulatory and fiscal package (from now up to 2012)

To date, this process is on track, with a Climate Change Summit having been held in March, 2009. The Conference Statement (DEAT, 2009) indicates South Africa's commitment to reducing its emissions in line with the 2 degrees C below pre-industrial levels limit. This requires that Greenhouse Gas Emissions (GHGs) peak in 2020-2025 and begin declining in absolute terms (end of plateau) in 2030-2035.

Medium Term Strategic Framework (MTSF) (2009 – 2014), Vision 2025

The MTSF (with Vision 2025) outline government's main medium-term strategic plans. The government's 2009 Medium Term Strategic Framework (2009-2014) (Minister in the Presidency, 2009) addresses two

⁷ Interview with Gareth Morgan - Shadow Minister for Water and Environmental Affairs, Democratic Alliance.

⁸ Department of Environmental Affairs and Tourism

relevant strategic priorities relating to this report (see Appendix 3). Strategic Priority 4 relates to strengthening the skills and human resource base in general, and Strategic Priority 9 relates to sustainable resource management and use and makes a specific reference to green jobs. Relevant parts of these strategic priorities are appended to this report as Appendix 3.

Strategic Priority (SP) 9 addresses Sustainable Resource Management and use, focusing on various interventions including diversifying the energy mix through renewable energy alternatives and promotion of energy efficiency; waste reduction practices; enforcing a zero tolerance approach to illegal and unsustainable exploitation of resources; improving air and atmospheric quality; supporting local and sustainable food production; sustainable water use and preserving quality of drinking water and enhancing biodiversity and the preservation of natural habitats. SP9 also specifically addresses green jobs, which are one of the key programmes:

“To pursue and explore further the concept of green jobs including scaling up labour intensive natural resources management practices that contribute to decent work and livelihood opportunities. In particular projects and industries are being pursued in the fields of marine aquaculture development, wildlife management, waste services and ecosystems rehabilitation programmes.”

The newly established Economic Development Department (EDD) has identified green jobs and a lower carbon-emission economy as key for South Africa's development and viability. The Minister of Economic Development (23 March 2010), identified the importance of a lower carbon-emission economy and noted its "huge potential for employment creation in the energy, agriculture, manufacturing and services sectors, including eco-tourism". He said that the government would allocate R2 million for policy and coordination work on the green economy and green jobs. The minister went on to outline objectives of promoting employment and decent work opportunities

2010 developments

Recent policy: The Industrial Policy Action Plan (second version: IPAP2): Green and energy-saving industries

A recent piece of economic policy may likely prove a driver to greening of the economy. The Industrial Policy Action Plan 2010-2013 (Economic sectors and Employment Cluster, Department of Trade & Industry, Feb. 2010), identifies three key clusters or sectors on which the IPAP will focus. Cluster 1 relates to "Qualitatively new areas of focus" and includes Green and energy-saving industries. The preamble to this section notes the threats presented to South Africa by increasing 'eco-protectionism' from industrialized countries (resulting in measures such as carbon taxes and restrictive standards), and increasing energy costs in South Africa, which render South Africa's current energy-intensive path unviable. The plan then notes that this presents "significant opportunities to develop new 'green' and energy efficient industries and related services".

The main focus is on Solar Water Heating, where 40 per cent of the market was captured by importers in 2009. There are 700 people employed in the sector, with 200 on manufacturing and 44 working on installation and the rest in administration. These figures exclude independent installers for whom SWH is not a primary activity. Key opportunities are noted as improved economic efficiency, increased domestic investment, and long-run export savings. Constraints are noted as: high initial costs; ***insufficient installers to meet the Dept. of Energy's targets (noting that they can be trained over approximately a six-month period)***; and poor quality products. A key action programme is the rollout of national solar water heating programme and manufacturing and installation capacity, using a phased

approach to allow time to scale up. Benefits are seen as increased local manufacture, skills development and employment. The skills development component is not specifically mentioned, although this will likely fall under the following key milestone: "2010/11-2012/13 Leverage DTI [Department of Trade & Industry] incentives and IDC [Industrial Development Corporation of SA] industrial financing to support investment and increasing manufacturing and installation capacity in the SWH value chain." The lead departments will be DTI and EDD (Economic & Development Department).

Other sectors to be focussed on are: concentrated solar thermal; industrial energy efficiency; water efficiency; wind, biomass and waste management; and energy efficient vehicles. Sector strategies are to be developed for other green industries including wind, biomass and recycling.

Science and Technology Minister Naledi Pandor has also noted recently (March, 2010) that government's economic sectors and employment cluster, which has been mandated to grow the economy and create jobs, will finalize a 'green economy' plan and present it to Cabinet by July 2010. In a media statement Pandor said the following:

"Green jobs will grow both directly and indirectly in the transport, energy, building, manufacturing, agriculture and forestry sectors. There will be employment in the manufacture, installation and operation of clean energy for people like wind turbine engineers, insulation installers, recycling sorters and photovoltaic cell salespeople," says Pandor.

"Indirectly, there will be jobs in the greener-goods supply chain - from solar cell manufacturers to green building-materials retailers to wind farm maintenance firms to recycling haulers to energy auditors. And, most importantly, there will be battery manufacturers with distribution centres at home and on the road," she adds.

Government is reportedly already supporting clean energy research at universities, as well as investing in an electric car, and will soon launch the prototype of an ebike.

The media statement went on to say that a recent report by international research organization the Global Climate Network on the job potential of low-carbon technologies indicates that, directly, some 36 400 jobs and, indirectly, 109 100 jobs could be created in the renewable-energy sector in South Africa by 2020.

Source: <http://www.polity.org.za/article/sa-seeks-to-make-virtue-of-necessity-with-green-industries-plan-2010-03-12-1>. Retrieved on 2 Apr. 2010.

Likely adaptation measures

South Africa's climate change response strategy and action plan (that would include adaptation and mitigation measures) is still in preparation (as at March 2010). Furthermore, due to the country's economic situation and history, its institutional capacity to begin implementing a climate change programme is uncertain. Climate change is cross-cutting and therefore responses to climate change need to cut across several sectors. Thus, patience and proper institutional arrangements will be necessary. International science (as well as local science⁹) shows that South Africa as part of the

⁹ According to the State of the Environment Report (DEAT, 2006), expected climate change impacts include less rainfall, especially in the western parts of South Africa, and higher temperatures, particularly in the interior; and more variable rainfall in general. This will lead to changes in the distribution and availability of water causing changes in agriculture. Increased health threats include the spread of malaria. Incidence of floods and droughts is likely to increase. Climate change may exacerbate existing land degradation.

Southern Africa region will be strongly impacted by climate change, regardless of reductions in global emissions. (IPCC, 2007). This is because the world is locked into a certain amount of climate change, no matter what the international community achieves in emission reductions. Climate impacts for South Africa include general warming, disruption of rainfall patterns and an increase in the frequency of extreme weather events.

Adaptation measures that are foreseen in the water sector are monitoring of water reliance, water availability and sanitation, for example. However, strategies outlined in the National Water Resource Strategy are flexible enough to cope with expected changes. Improvements of meteorological and hydrological systems will also be necessary, especially for forecasting droughts and extreme weather.

Climate change could negatively affect the health of livestock, thus preventative measures for disease control will need to be applied. In terms of agriculture, farmers will need to be provided with climatic information, and incentives will be offered to those who utilize helpful practices. Other agricultural adaptation methods will probably include changing planting dates, row spacing, diversification of crops, increased efficiency in irrigation, alternative land use, and the introduction of new cultivars and crop types that are tolerant of higher temperatures and possible longer duration droughts. The reduction in pesticide use could also contribute to adaptation and mitigation by reducing greenhouse gas emissions while also reducing water pollution. Forestry practices should also be monitored due to both the positive effects that climate change could have on forests (such as higher levels of atmospheric carbon and higher rainfall leading to increased growth) as well as the negative (such as increased temperatures and higher probability of wildfires). Animal diversity should be similarly monitored and areas that are most susceptible to climate change will be highlighted to observe the affects for future adaptation measures.

Mitigation measures

The government's integrated energy planning at the national and sector levels (as discussed under the Medium Term Strategic Framework above) is likely to be applied by government at the national and local levels, resulting in use and distribution of technological approaches such as clean coal technologies and increased use of renewables, in the future. Other renewable energy sources are being investigated largely in the private sector; however economic growth and assistance are still needed for such investments as they are currently not seen as economically viable in some cases. The MTSF Strategic Priority 9 includes the following key programme:

*"Efforts to meet the **energy efficiency** target of 12 per cent by 2015 and **renewable energy** target of 10,000 GWh by 2013, will be enhanced by creating an enabling environment for renewable energy, through for example implementing the renewable energy feed-in tariff (REFIT) and building the local renewable energy manufacturing capacity." Whilst the proposed REFIT tariffs are encouragingly high thus bringing viability to many renewable energy projects, the related institutional structures have not yet been determined, rendering the REFIT, as it is now, an ineffective policy.*

As outlined above, the National Climate Change Response Strategy, due to be finalized by the end of 2010 will further outline energy policy in terms of emissions reductions and mitigation measures.

Energy Efficiency Strategy

There is huge scope for reducing emissions through increasing energy efficiency across all sectors. The DME's Energy Efficiency Strategy of 2005 lays out a three-phase pathway to increasing energy efficiency specifically aimed at four sectors, industry and mining, commercial and public buildings, residential, and transport. Phase I was designed to run from 2005-2008, Phase II 2008-2011, and Phase

III from 2011-2015. Specifically, the following implementation tools will be used (with skills implications):

- **Industry and mining sector:** norms and standards for horizontal technologies (industrial boilers, electric motors, thermal insulation); energy audit scheme; energy management best practice; technology information and research; promotion of Energy Service Companies (ESCOs); maximize the value of energy efficiency investments.
- **Commercial and public buildings sector:** energy efficiency standards for commercial and public buildings; mandatory energy audits for commercial buildings; energy management systems; technologies and thermal measures (HVAC).
- **Residential:** standard for housing; appliance labelling; awareness raising program; efficient lighting program; non-electric appliance standards; fuel standards.
- **Transport:** passenger transport management policy; establish local transport authorities; feebate; efficiency labels for motor vehicles; emission standards for vehicles; promote diesel vehicles; audits on vehicle fleet operators; awareness raising program; roadworthy test including emission test; advance appropriate mode freight logistics policy; exploration of renewable energy in the freight logistics sector; intelligent transportation system data management.

The transport sector accounted for 19 per cent of South Africa's greenhouse gas emissions in 2000 and significant emissions reductions could be seen in this sector, largely due to the production and use of synthetic fuels. Improvements in public transportation are necessary and provide an opportunity to incorporate greener technologies. The MTSF's Strategic Priority 2 (government's economic and social infrastructure programme) includes continuing a programme to revamp public transport infrastructure, including the Bus Rapid Transit (BRT) project to ensure it is accessible, efficient, reliable and affordable. Fuel switching could reduce emissions and proper public transportation could decrease the number of private cars. Non-motorized transport should also be encouraged. In the agricultural sector mitigation measures have included reduction of the frequency of fires, effective management of soil organic matter, adopting minimum tillage methods, optimization of herds, and exploring synergies of adaptation and mitigation initiatives. Finally, afforestation schemes are being implemented along with improved waste management efforts.

Clean Development Mechanism (CDM)

The Clean Development Mechanism allows the creation of a greenhouse gas mitigation plan that promotes sustainable development through use of the Clean Development Mechanism (CDM) by technology transfer, donor funding and capacity building opportunities. To date CDM activity has been relatively sluggish in South Africa, with only four projects having been issued with Certified Emissions Reductions (CER). There are, however, 133 projects in the pipeline, of which 104 are still at the ideas stage, and 29 have a detailed project design (Designated National Authority, 2009). In terms of potential to reduce emissions, fuel switching covers 73 per cent of all possible emissions reductions from projects which are currently in the CDM pipeline, with cogeneration the next largest with 10 per cent. This is hardly surprising considering the country's reliance on heavy industry and mining (see Case Study 2). Some barriers to implementation of CDM projects have been publicly noted as lack of project development financing, lack of project development capacity, and some provisions of the Municipal Finance Management Act (MFMA) which make accessing carbon credits difficult for local authorities (National Assembly, Oral Question (No.282) to Energy Minister, Oct. 2006).

Education and skills

In terms of skills, South Africa is seeing climate change response actions as potential opportunities for sustainable economic and social development, *specifically including the creation of much needed jobs*. The objective is to improve the level of education, training, and awareness of climate change, to further qualify the government and sectors of the economy.

National Environmental Management Programme

As part of the National Environmental Management Programme which was drawn up in 1998, South Africa has passed legislation in many areas of environmental protection including four acts:

- Biodiversity Act (2004) - provides a framework for conservation, sustainable use, and equitable sharing of all biological resources and instills an “ecosystems approach” to planning and management as it aims to mainstream biodiversity issues into sectoral policy and planning.
- Integrated Coastal Management Act (2008) - provides for coordinated management of coastal zones (within the NEMA - National Environmental Management Act - framework) and aims to protect, preserve, extend and enhance the status of coastal public property.
- Integrated Waste Management (2006) - aims to secure ecologically sustainable development while promoting justifiable economic and social development as well as minimizing natural resource consumption and generation of waste.
- Air Quality Act (2004) - acknowledges that many areas of South Africa do not provide a healthy environment for people and provides the basis for setting air quality and emissions standards along with the establishment of air quality monitoring stations.

All four of these (relatively new) acts will place additional burden on local governments, and private enterprises, to ensure they meet minimum standards in each area. For example, each national, provincial and municipal government department will be required to draw up an Integrated Waste Management Plan (IWMP) and report annually on its success. The IWMP gives a situational analysis of the types and reach of existing waste management practices in the area, and goes on to detail how each department (within its domain) will give effect to the objectives of the Integrated Waste Management Act.

Some local governments are already implementing the Air Quality Act provisions (for example, the Eden District Municipality in the George area), requiring an up skilling of air quality station management, maintenance, data collection and analysis.

In the main, the skills requirements for the implementation of these acts are currently unclear but it is highly likely that local government especially will need ambitious plans on how to attract the necessary skills. Given current capacity constraints across local governments in South Africa, this is a challenging prospect. The national Department of Water and Environmental Affairs is considerably understaffed due to the huge shortage of engineers in South Africa. For example, of the 305 posts that are open for civil engineers in the department, only 95 are filled (National Assembly, Oral Question (No.173) to Minister of Water and Environmental Affairs, Oct. 2009). On the other hand, the Department of Environmental Affairs (DEA) has recently approved the recruitment of a number of new posts, directly relating to climate change, covering a range of skills to include low carbon economy development (with a particular focus on energy), climate change policy and environmental economics. A number of these posts have been filled, indicating job market interest in these careers. Whilst there is a shortage of skills as discussed below, the DEA provides attractive job opportunities for environmental skills (science, policy, economics and to a lesser extent, engineering for those that want to be at the “cutting edge” of green policy development in this country. The Department has also had good

leadership (recently changed) in Martinus van Schalkwyk who became a leading figure in the international climate policy arena and who was able to lead important policies through South African Cabinet approval processes, such as the Long Term Mitigation Scenarios, and the less recent National Climate Change Strategy. Although the DEA has not, as yet filled all the posts, the aforementioned places the department in a position of being able to attract some of the country's more experienced and skilled people.

However, there is a noted, overall skills shortage in this 'new wave' of environmental engineering and economics job market, in academia, the private sector and the public sector. Illustrative examples of skills related to the environmental sector from the Scarce Skills List of 2008 (Department of Labour, 2008) are:

Table 1: Scarce skills in the environmental sector

Specialization / descriptor	Magnitude of scarcity
Specialist managers (includes environmental, arts and culture, office and quality managers)	6,955
Civil engineers and technologists and quantity surveyors	2,940
Agricultural and Forestry scientists	6,175
Environmental scientists	740
Geologists, geophysicists and earth science technologists (includes for example advising on ground water extraction)	335
Agricultural technicians (includes forestry technicians)	200
Civil engineering draftspersons and technicians	3,960

Source: Scarce Skills List 2008. (Dept. of Labour, 2008)

Moreover, there is often tension between the so-called old skills and the new. Experienced engineers for example tend to be resistant to adopting new pathways to achieving development goals, with a tendency to remain focused on infrastructure development at the expense of some of the "softer" adaptation responses needed.

Evidence is pointing more and more strongly to the need to re-skill some of South Africa's longer standing, traditional professions, highlighting that we cannot always solve today and tomorrow's problems with yesterday's science and technological approaches. Traditionally, engineers and trained planners have been central to developing South Africa's infrastructure and to making important, long term decisions about, for example, the country's water management and energy generation capacity. Obviously, this needs to continue but with adjustments that reflect the need to plan for a different economy. Post-1994 planning has seen much more social engineering in development planning processes. Similarly, a transition toward a low carbon economy that also meets South Africa's socio-economic development requirements will need to see a multi-disciplinary approach to infrastructure planning and technology choices. This should include engineering, environmental science and resource economics as well as socio-economic development and macroeconomic skills. For example, resource economists are critical for planning for resource-scarce environments (in South Africa's case, water is scarce), and also for resource-unfriendly environments (for example in the case of energy: coal). Previously, engineers and economists planned in environments that were seemingly resource abundant. Furthermore, engineers need to be retrained on new technologies, such as clean coal technologies. Some of the recent planning decisions regarding energy development that have been taken in South

Africa (for example, building the Medupi Coal Fired Power Plant along traditional technological lines) suggest that engineering skills need to include adapting existing technologies to cleaner environmental specifications.

National Water Act

The National Water Act was adopted in 1998 and is the principle legal document with respect to water resources. The Act is considered very progressive for its time and is underpinned by guiding principles that aim to address the inequalities of the past in relation to water distribution and increase the realization of the right of access to water. The Act bases the comprehensive protection of all water resources on the need to protect basic human and ecological needs. To this end, it creates an environmental reserve which encompasses both human needs (drinking, cooking, and hygiene) and those ecological needs which maintain and protect the aquatic ecosystems of the water resource. Therefore the water resource is prioritized for household consumption and ecological functioning. However, experience throughout the country has shown that industry and agriculture have tended to disregard this law and extraction of water for these purposes is threatening availability for prioritized areas. This presents an opportunity for South Africa to enforce policy that drives changes in industrial processes (such as increased use of irrigation technology) which could improve water conservation whilst reallocating water to those prioritized areas.

The employment opportunities and associated skills requirements that are necessary to comply with a national climate change strategy, the recent National Environmental Management Acts, and a stricter implementation of the National Water Act have not been formally assessed by the government. To-date, green skills training and related education have been driven by demand, mainly in the private sector, and there is a lack of a collective “house” under which green up-skilling can be targeted at a national level. There is also not likely to be a collective approach to low carbon economy up-skilling in the foreseeable future as policy emphasis and priority is currently largely elsewhere. However, the South African job market has a history of private sector and demand driven up-skilling - often successfully, in part evidenced by the international demand for South African skills across a range of sectors. Drivers already exist and are continuing to emerge and there is a range of legislation and policy coupled with international demands for a low carbon economy approach in many sectors already acting as green skilling drivers (see Case Study 7).

2.2.2 Market context

There are currently (Dec. 2009) very few policy drivers directly aimed at greening South Africa’s economy and almost no policy drivers for investing in green skills. The market, or macroeconomic forces, have played and continue to play an important overriding role in terms of greening and the development of related green skills. However, in many cases these forces are not underpinned by green imperatives or a concern for environmental sustainability on the supply side of the economy but rather reactions to crises and changes in consumer preferences. Although it would be incorrect to term it greening, in this way the market has dominated changes in the operations of a number of South Africa’s major economic pillars: mining, minerals and metals processing, heavy industry, manufacturing, agriculture and retail. To facilitate these changes, skills have been required and thus developed to a degree.

The common link between mining, minerals and metals processing, heavy industry, and manufacturing is highly intensive energy use. With South Africa’s heavy reliance on coal for electricity generation these sectors are extremely high emitters of greenhouse gases. To make matters worse, with South

Africa's historically low energy prices - used to incentivize investment in these sectors - energy has been used very inefficiently. However, the energy crises of 2007/8 changed much of that, as did the current economic crisis explained below. While not greening in the true sense of the term, the reactions of these sectors to energy related market conditions have benefited the environment.

Driven by poor plant investment planning on the part of Eskom, the country's primary generator and distributor, and the lack of investment from private sector generators - due to low prices - only a very low (almost zero) reserve margin kept South Africa's grid meeting demand. Then, on the back of coal shortages and plant breakdowns, in the third week of January 2008, more than 20 per cent of South Africa's electricity-generating capacity was out of commission (Center for Development and Enterprise, 2008). By the fourth week, a quarter of Eskom's capacity (8700MW) was unavailable (Eskom, 2008). Extreme blackouts ensued. This had a devastating effect on the entire economy but the above sectors were hit particularly hard. Gold and platinum mines had to shut down operations for five days, with 25 January 2008 being called 'Black Friday'.

The Department of Minerals and Energy (DME) and Eskom released a policy document titled "National response to South Africa's electricity shortage" in late January 2008. Amongst other initiatives such as the Demand Side Management Programme (DSMP), the document focuses on the need for investment in generation from Independent Power Producers (IPPs). An immediate response in this regard is the fast tracking of cogeneration¹⁰ projects in private industry whereby the IPPs would supply power to the national grid.

The crisis and the awareness raising of security of supply issues as well as cogeneration commercial possibilities has led to major investments into such initiatives - essentially a greening process but really supported by a want for secure energy supplies and cost reductions as well as profiteering. Approximately 5,000MW from cogeneration was proposed for injection into the grid by IPPs. These include confirmed classifications of 44 waste heat projects, 42 primary fuel projects¹¹ and 22 renewable fuel based projects (predominantly bagasse from sugar cane) (Mbohwa, 2008). However only a small fraction of this amount (approximately 150MW) has been contracted upon, with most IPPs being unable to agree on favourable terms with Eskom or unable to raise the capital to fund, build or retrofit plans. This has resulted in many independent power producers simply investing in cogeneration technology for private energy requirements, for use off the grid, amounting to around 540MW. Growth in these markets is projected to be between 30 per cent and 50 per cent over the next five to ten years in South Africa (Frost and Sullivan Consulting, 2008) with cogeneration having the ability to achieve 90 per cent efficiency, while the current generation in South Africa has less than 40 per cent efficiency.

In terms of the current (2008/2009/2010) economic crisis, efficiency has been key for energy intensive industry and mines if they are to cover their costs in the face of decreasing demand and difficulty in accessing credit. A coupled effect has also come into play whereby these industries are feeling a form

¹⁰ For the purposes of this report cogeneration is defined as source of electric power facilitated by, or in addition to, some other manufacturing process (KE Consulting, 2008). Cogeneration is considered 'green' as it makes use of waste energy (heat, gas or biomass) and reduces air pollution and CO₂ emissions. Thus Cogeneration can take on a number of forms. In South Africa the primary sources or most potential is derived from the smelting, cement, sugar, timber (paper/pulp), oil refining and petro-chemical processing industries derived from the smelting, cement, sugar, timber (paper/pulp), oil refining and petro-chemical processing industries (Mbohwa, 2008).

¹¹ Primary fuel-based generation projects are defined as those which produce, as a part of the core design, other usable energy in addition to electricity, for example process steam.

of double exposure as energy prices have increased as a result of the energy crises. In reaction, energy efficiency measures become a necessity.

Skills issues have been raised across a number of industries although more commonly in mining and smelting. The technologies required are often “cutting edge” and new to South Africa and thus even business modeling and legal contracting have been difficult due to skills shortages. More so, the engineering aspects of investments into cogeneration are extremely complex and the skills required for retrofitting different forms of machinery to generate power are lacking locally. Skills have been imported in many cases, usually in tandem with cogeneration equipment.

In a similar way up-skilling has been needed in other sectors dominated by changing market conditions: for example retail and agriculture. In these sectors this is more closely aligned with a greening process in the true sense of the word and it has been driven by changing consumer preferences and associated growth in certification schemes. Both business to business and retail consumers in developed world markets are having an effect on South Africa’s export industries. This is most notable in food agriculture and forestry. In addition, South Africa’s retail markets have to accommodate changing market conditions in the form of changes in local consumer preferences at the higher end of the market, towards environmental protection and benefits.

In terms of certification schemes, ‘aware’ consumers, with the disposable income to afford higher prices are demanding changes to foreign supply chains that will benefit the environment and socio-economic issues at every node. A way of communicating and regulating this demand is through certification schemes such as those used by the Forestry Stewardship Council, Fair Trade and GLOBALGAP. To become certified by these schemes - and thus retain a competitive edge and market share as an exporter - certain environmental and socio economic standards have to be met. To meet these standards many South African organizations have had to make changes to their operations and inputs, such as ruling out certain pesticides, becoming more water efficient, implementing stronger environmental impact assessments and corporate social responsibility initiatives, and ensuring fair and equitable labour conditions.

The above are examples of the way the market can force the process of greening and how in South Africa this is a stronger force than that of policy or environmental strategy. The market dictates reactionary greening and in some cases, such as the energy intensive sectors mentioned above, other issues force a restructuring towards greener processes without greening being the imperative. This means that green skills development is very often a reactionary process too. This will be dealt with in more detail below.

2.2.3 Green response to the current economic crisis

Since December 2008, South Africa has been feeling the effects of the global economic crisis throughout its labour market. In the six months leading up to June 2009, the economy shed over 250,000 jobs in formal non-agricultural industries. In the year to June 2009 job losses have been seen across the board in mining (-26,000), manufacturing (-82,000), construction (-23,000), wholesale and retail trade (-62,000) and finance and business services (-80,000).

South Africa’s official response to the economic crisis is given in the Framework for South Africa’s Response to the International Economic Crisis (2009), a collaborative effort by the Presidential Economic Joint Working Group and the National Economic Development and Labour Council (NEDLAC). The Framework presents approaches that will be acted upon by the government to protect South

Africans during this time of economic uncertainty. In terms of greening initiatives being made during this time, the Framework only provides the following:

“The parties recognize the opportunities in industries that combat the negative effects of climate change and believe that South Africa should develop strong capacity in these green technologies and industries. Accordingly it is agreed to develop incentives for investment in a programme to create large numbers of 'green jobs', namely employment in industries and facilities that are designed to mitigate the effects of climate change. Government will be asked to develop a proposal for consideration by the parties. This proposal will, where appropriate, build on current initiatives of greening existing manufacturing and service activities.”

Based on the Framework, its first priority is to the most vulnerable members of society who will feel the highest burden of the crisis, followed by growth and development which are to continue through specialized programmes. It is evident that greening initiatives are currently not a major priority, and are not likely to become a priority if South Africa continues to see “green skills” as an appendix rather than integral to the mainstream economy. However the South African government is already showing signs of being open to incorporating such initiatives in the future and there are several opportunities in which to do so. One such opportunity comes with the establishment of the National Jobs Fund as part of the response to the economic crisis (discussed in Section 2.3).

The Framework begins by discussing the importance of investing in public infrastructure. This will be executed through expanding and improving road and rail systems, water sanitation, dams, etc. South Africa’s public investments programme of R787bn over three financial years to March 2012, will also be maintained during this time, and the maintenance of current infrastructure will be applied through labour intensive approaches. While this section does not suggest the installation of green infrastructure, it implies the creation of significant numbers of employment opportunities, covered as part of the Expanded Public Works Programme (EPWP, discussed in Section 3.1.3), and which goes some way to constituting fair and decent work in the South African context. It is useful to consider this in the context of the international (often World Bank dominated) drive to “climate proof” infrastructure investments, the adoption of a risk-based approach to climate proofing development in general and the drive toward attaining Low Carbon Economies globally. President Zuma’s 2009 announcement of voluntary emission reduction targets of 42 per cent by 2025 in exchange for technology and adaptation finance investments by the developed world, not only presents an imperative for green skills to be integral to the South African job creation and skills development drive, but also a business case for aligning green skills development with socio-economic development imperatives in South Africa (assuming South Africa actually adopts a low carbon economic development approach).

The second section addresses macroeconomic policy responses and discusses the opportunities that have arisen with the depreciation of the rand. This includes an increase in employment-generating exports, with a decrease in imports of light consumer goods. These imports are in turn produced locally, stimulating local economic activity, while tending to the trade deficit and unemployment. Furthermore, it encourages local buying and selling, which is much greener than global trade.

The third section of the Framework discusses industrial and trade policy measures in which the framework discusses the urgency to avoid de-industrialization. It is in this section that the Framework recognizes the opportunity South Africa’s industrial sector has to reduce the negative effects of climate change. As previously quoted, the Framework suggests that incentives be developed to encourage investment in a programme designed to create “green jobs”, mainly in industries and facilities aimed at minimizing these negative effects. In addition, the Framework suggests that a

proposal be written by the government to encourage current initiatives. Finally, this section further emphasizes the benefits of buying local goods and services. The Framework especially calls for local consumerism during the Confederation Cup and 2010 FIFA World Cup.

The fourth section discusses employment measures, in which retention and increases in employment will be the central focus during the crisis. The main objective is to avoid the massive job losses many developed nations have experienced, through various programmes. The National Jobs Initiative is a R2.4bn project in which the government administers job programmes based on need and situation. The Expanded Public Works Programme (EPWP), another programme implemented by the government, will be revised and improved to meet the challenges of the crisis. The EPWP seeks long-term employment opportunities and aims to halve unemployment by 2014. In addition to these major programmes, public sector employment will be increased. The EPWP and the National Jobs Initiative provides an important platform for the aforementioned process of aligning low carbon economic development, green skills development and economic growth, thus stimulating the requisite focus on green skills (see Case Study 1).

The fifth section addresses social measures, in which the Framework discusses programmes such as Unemployment Insurance Funds and the Emergency Food Relief Programme. The government will also maintain social transfers and expenditures, such as increasing access to free electricity and water for the poor. In addition, there will be encouragement and support by the government for household food production in rural and peri-urban areas, in which the government will provide seeds, fertilizers and pesticides. This presents an opportunity for the government to green the agricultural practices of these households by controlling which fertilizers and pesticides are administered, although this is not specifically mentioned.

The sixth section states the importance of putting South Africa in a strong global position that will maximize developmental objectives. The Framework aims to have policy space for new industrial development with expanded employment opportunities in the local economy. It also calls on member-states to apply the Declaration on Social Justice of the ILO, for fair globalization.

The Framework concludes by stating the importance of social partnership and cooperation during the economic crisis. It addresses its commitment to protecting the most vulnerable members of society, and ensuring a smooth transition for South Africa. While social needs must take precedence to environmental needs at this time, there are several opportunities within the Framework to easily incorporate green initiatives. Such ideas should be given special consideration, since the entire country could benefit. Appropriate institutional arrangements however are critical, and a cross- sectoral approach to implementing low carbon economy development initiatives - evident in the institutional arrangements - is essential.

2.3 The skills development strategy in response to greening

2.3.1 Context

Currently South Africa has not yet developed a coherent national strategy/policy to meet the skill needs for greening the economy. There is currently no publicly available skills development strategy in response to greening, nor is reference being made to one. Recent economic policy documents do however refer to green jobs, but this is very recent (late 2009/early 2010). (For example the Industrial Policy Action Plan of 2010 discusses the development of green industries (particularly mentioning the Solar Water Heating industry as a potential growth employer.) It is

possible and even likely that a green skill development strategy is being considered, in the light of this emerging policy, and almost certainly this will be developed in future. Currently there is no mention made of such a strategy in the available policy documentation.

It is important to view and understand the "skills development strategy in response to greening" in South Africa in the broader context of South Africa's development. The country is still essentially in the process of transforming many of its sectors - including training and skills development - in the attempt to redress the inequalities of the past. Since 1994 onwards, the education, higher education and occupational skills training sectors have been undergoing a process of transformation and restructuring (outlined below) in an attempt to provide equal opportunities to all, and at the same time to put in place an education and training system that is benchmarked internationally. Further Education and Training (FET) Colleges were set up in 2006 (with revised/new curricula) to replace previously existing structures (such as training colleges and a system of apprenticeships) for occupational training. Whilst this process was both welcome and essential, the disruption caused by restructuring has inevitably affected the pace at which the sector has been able to deliver required skills for a fast-growing economy as and when they are needed.

In terms of the skills development framework outlined below, new skills and retraining needs for the greening sector should filter successfully through the 'demand and supply' process. However, research to date indicates that whilst there is a skills development focus and a greening focus, there is little articulated alignment between the two. Due to South Africa's relatively young democracy and new laws, alignment of policy is often primarily focused on achieving targets such as Broad-Based Black Economic Empowerment (B-BBEE) targets and employment equity, rather than, for example, greening objectives. Having said that, (and as previously discussed), greening objectives are not an 'instead of' but rather an integral component of economic development, job creation and skills development. This section therefore outlines the skills development strategy in general, with a section on greening at the end.

2.3.2 The South African skills development framework

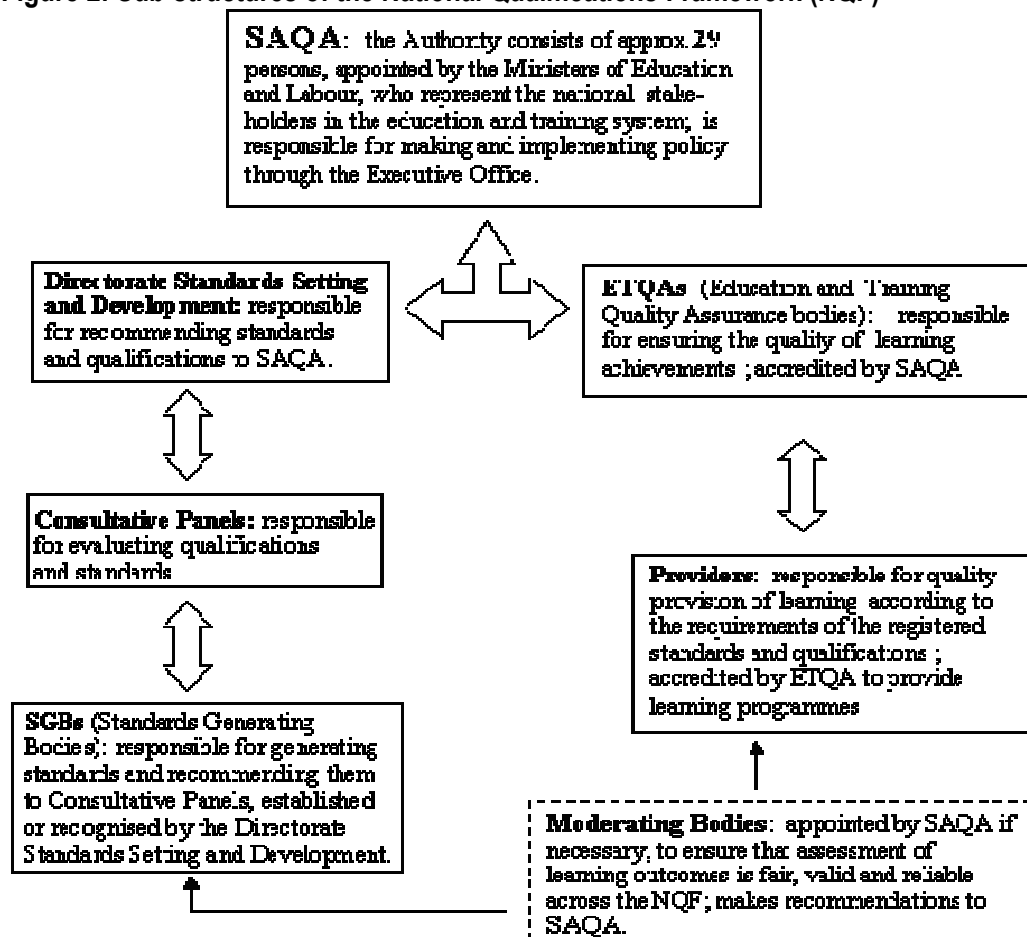
In order to understand the skills development framework in South Africa, it is important to understand the concept of outcomes based training and the governing bodies that have been implemented to assist in developing skills to remain competitive in the marketplace.

The national skills development framework is integral to a suite of complementary labour, equity and skills development policy and regulations that is of the most sophisticated in the world in terms of design. This suite drives ambitious strategies and targets and includes the Employment Equity Act (1998), the Labour Relations Act (1995) and the National Skills Development Strategy (Dept. of Labour, 2005). These pieces of legislation and frameworks are discussed in more detail below.

To create a coordinated and structured approach to training and development in South Africa, the National Training Board was established in 1994. This body developed a preliminary National Training Strategy which was published in 1994. Particular macro-factors taken into consideration at this stage included: population growth, low levels of education, unemployment, the supply and demand of labour, and technological acceleration. The objective of this discussion document was to identify training problems, emphasize the importance of training in the restructuring of South Africa and propose an integrated future approach to education and training.

In order to achieve these objectives a National Qualifications Framework (NQF) was developed and implemented in 1995. The aim of the NQF is to specify learning in terms of outputs that are recognized both nationally and internationally. A nationally recognized qualification would require many education and training facilities. In this way the NQF provides for the needs of the State, the community, the business sector, labour organizations and providers.

Figure 2: Sub-structures of the National Qualifications Framework (NQF)



The South African Qualifications Authority (SAQA) was created for the development and effective implementation of the NQF. SAQA's function is to set up structures, processes, standards and qualifications criteria for the National Qualifications Framework. The qualifications criteria are developed, approved, registered and published. This process ensures that education and training is of a high standard, and uniform in its set criteria. To assist SAQA to fulfil this role, the Education and Training Quality Assurers (ETQA) has been implemented. The ETQA is an accredited organization in terms of the SAQA Act, to monitor and audit learner achievements in terms of national standards or qualifications.

The Skills Development Strategy was established in 2001 to create an enabling environment for expanded strategic investment in skills development. This system is demand-orientated, flexible and decentralized and based on partnerships. Its main objectives are to increase the skills of the population through education and training linked via the NQF, to ensure the quantity and quality of intermediate

skills, incorporate more effective social and infrastructural delivery and to improve the cost effectiveness, quality and relevance of skills development throughout the country.

Sector Education and Training Authorities (SETAs)

The SETAs are industry bodies convened by the Minister of Labour with the mission to develop and implement a sector specific skills plan, register and promote learnerships and apply to SAQA for accreditation as an Education and Training Quality Assurance Body (ETQA) for qualifications in its sector. Learnerships are defined as the “new professional and vocational education and training programmes”. They are intended to combine theory and practice and result in a qualification that is registered on the National Qualifications Framework. Learnerships have a minimum duration of from thirty weeks to a minimum of one year. Employers enter into a Learnership Agreement with learners and providers. Generally employers provide the practical part of the learnership and the training, and an education provider offers the theoretical part of the programme. Some employers offer both aspects of the learnership. After completing a learnership, the learner has a qualification that “signals occupational competence”, which is recognized throughout the country.¹²

However, there is a dilemma or discrepancy between learnerships and accredited training providers, insofar as many registered learnerships do not yet have accredited training providers, and much training is provided on an *ad hoc* basis by industry sectors.

Each SETA develops and publishes a Sector Skills Plan (SSP) which describes in detail the 3-5 year skills development priorities for the SETA. This skills list is compiled after intensive consultation and research alongside industry to determine skills gaps and future demand for occupations. Scarce skills lists from each SETA are then amalgamated into the National Scarce Skills List (Dept of Labour, 2007 and 2008).¹³

SETAs effect much of their training through “learnerships”, which are planned and structured learning components created by the SETAs, based on the demand for a certain set of skills within each sector. This process is monitored by the submission of annual training reports submitted by industry participants. To date several SETAs, most notably the Agricultural SETA, have included aspects of green skills to unit standards (components of qualifications). However, there is a limited number of accredited training providers to disseminate learning, common throughout the SETAs.

The following excerpt from a 2007 review of skills shortages in South Africa illustrates that there has been general dissatisfaction with the performance of SETAs in provision of training.

¹² <http://www.saqa.org.za/show.asp?include=focus/learnerships.htm>

¹³ The National Scarce Skills List (2008) can be found on: <http://www.labour.gov.za/documents/useful-documents/skills-development/national-scarce-skills-list-2008/>

Table 4: Satisfaction with the Services of SETAs Rendered during 2002/03

Services	1	2	3	4	5*	Could not comment
	%	%	%	%	%	%
Advice and support (learnerships)	34.5	9.8	18.0	8.2	4.1	25.3
Easy submission procedures	30.9	7.2	21.6	7.7	3.6	28.9
Internet site and web pages	35.1	8.8	15.5	4.1	4.6	32.0
Promptness in paying grants	33.0	7.7	15.5	3.1	3.1	37.6
Providing information about courses, programmes and training	32.5	8.8	21.6	6.7	5.2	25.3
Providing information about grants	35.1	9.8	20.6	4.6	2.6	27.3
Providing Sector Skills Plans	40.2	9.8	14.4	3.6	2.6	29.4
Provision of free training not funded by employers	40.2	8.8	12.4	5.2	3.1	30.4
Response to queries	32.5	6.2	17.0	5.2	3.6	32.5

Source: Reproduced from DOL (2005a, 47).

* A score of 1 indicates that a respondent does not think the SETA did a good job at all, while 5 indicates the respondent thinks the SETA did do a good job to a large extent.

Source: Daniels (2007).

In an attempt to better coordinate this system, the government in 2009 established the Department of Higher Education and Training, in an attempt to address the fact that *"an integrated education and training system was hampered by the dispersal of administrative responsibility for the coordination of the education and training sub-systems across two national departments (Education and Labour), and nine provincial departments of education."* The document goes on to say that, *"With the establishment of DHET, all sub-systems of post-school education are now located within one department. This reform ..., has created new opportunities for the improved coordination of the entire post-school system, for improved interaction between sub-systems, and for the improved progression of learners from one sub-system to the next."* (DHET, Strategic Plan 2010-2015).

Introduction of the Quality Council for Trades and Occupations (QCTO)

A further and more recent change is the establishment of the Quality Council for Trades and Occupations (QCTO), launched in February 2010. This body will centralize occupational training into one organization as well as strengthening the aspect of occupational training. It will advise the Minister on matters of policy in terms of the Skills Development Act and the National Qualifications Framework Act. The QCTO's functions are: establishing and maintaining occupational standards and qualifications; quality assurance of learning in and for the workplace; designing and developing occupational standards and qualifications; liaising with the National Skills Authority on the suitability and adequacy of occupational standards and qualifications; liaising with the South African Qualifications Authority, other Quality Councils and professional bodies responsible for establishing standards and qualifications or the quality assurance of standards and qualifications.

Tertiary education system

South Africa's tertiary education system is well developed, with 16 universities and seven universities of technology. The largest is the University of South Africa (a distance education institution of 200,000 students), followed by the Tshwane University of Technology (60,000), the University of Pretoria (50,000), and the Universities of the North West and Johannesburg. Many courses are offered that

include a green aspect, and some of these are discussed elsewhere in this document and focused on in the case studies, for example under Case Study 7 (referencing greening in the agricultural sector).

Identification of scarce and critical skills

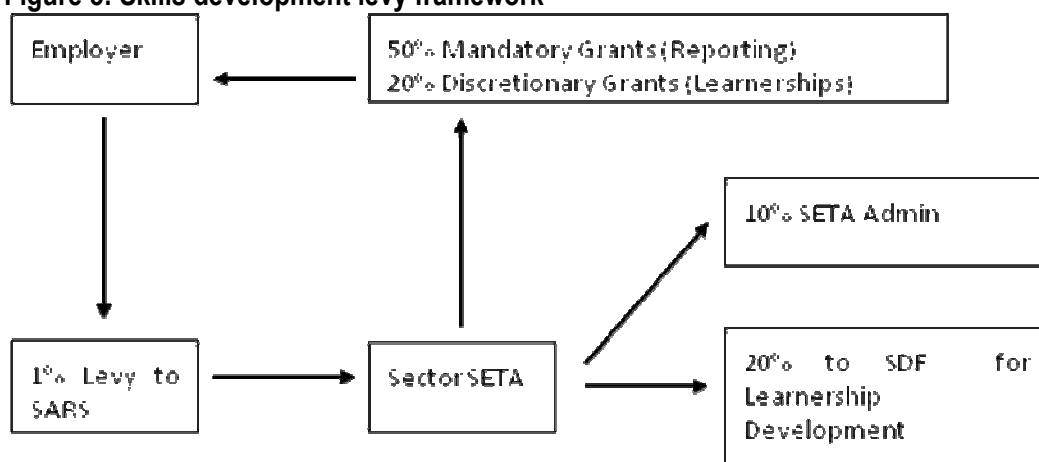
The Sector Education and Training Authority's (SETAs') annual training reports require participating organizations to identify the scarce and critical skills in their industry. These are defined as follows:

- **Scarce Skills:** refers to those occupations characterized by a scarcity of qualified and experienced people (current and anticipated) - in other words, occupations in which numerical imbalances exist in employment because of a difference between the demand for and the supply of skills.
- **Critical Skills:** refers to particular skills within an occupation, or the qualitative deficiencies that may exist or develop in the skills apparatus of the existing workforce.

By design, this process of demand drives the development of learner initiatives, primarily learnership programmes, which should respond to the sector skills requirements.

Funding for these initiatives comes from the National Skills Fund (NSF), which receives funding through payment of Skills Development Levies (SDL) by employers. Employers must pay SDL unless their annual payroll is R500,000 or less (applicable from 1 August 2005). The levy is calculated at 1 per cent of the company's total monthly salary bill and is payable by the employer. Employers in turn are incentivized to train their staff and to facilitate learnerships because they can claim back up to 70 per cent of their levy investment for training and development they have undertaken. This is illustrated in Figure 3.

Figure 3: Skills development levy framework



2.3.3 The role of Black Economic Empowerment (BEE) initiatives and legislation

South Africa has put a strong focus on Broad-Based Black Economic Empowerment (B-BBEE) targets as an employment and skill development strategy to redress inequalities. This focus on B-BBEE targets may also act as a factor that preempts and removes focus from other issues such as skilling for green jobs. It will be important that greening the economy is not perceived to potentially result in a reduction in skills required in general or in the need for green skills overtaking the need to transform the economy in a way that facilitates integration of black people into the economy. The intention of B-BBEE is to:

- transform South Africa's economy to allow meaningful participation by black people;
- substantially change the racial profile of companies' owners, managers and skilled professionals;
- increase the ownership and management of companies by black women, communities, workers, cooperatives and others, and help them access more economic opportunities;
- promote investment that leads to broad-based and meaningful participation in the economy by black people;
- help rural and local communities to access economic opportunities;
- promote access to finance for black economic empowerment.

B-BBEE legislation is housed in the Department of Trade and Industry under the Broad-Based Black Economic Empowerment Act No. 53 of 2003 and Codes of Good Practice gazetted by Parliament on 9 Feb. 2007 apply.

A BEE scorecard is used to measure companies over the following seven pillars:

- Ownership
- Management
- Employment Equity
- Skills Development
- Preferential Procurement
- Enterprise Development
- Socio-Economic Development

While BEE accreditation is not statutory, the advantages of being a strong BEE employer motivate organizations to invest in all of the above. BEE also plays a role in public sector procurement policies, and most government tenders have a strong BEE preferential procurement aspect. The skills development element focuses particularly on the training and development of Black (African, Indian, Coloured and Chinese) South Africans. Public opinion of the success of BEE varies greatly. Some believe it goes some way to redressing the inequalities of the past, whilst others argue that it has placed workers in jobs for which they are under qualified. In the long term, a more natural way to redress racial inequality in the workplace would be to ensure strong numeracy and literacy in all school leavers (as well as other essential key skills), an objective which South Africa currently struggles to achieve.

2.3.4 National Jobs Fund

A governing principle of the response to the economic crisis (see above) is to “strengthen the capacity of the economy to grow and create decent jobs”. As part of the response the National Jobs Fund has been established with a sum of ZAR 2.4 billion, funded by the National Skills Fund (NSF) and SETAs, for workers who would otherwise become unemployed.

Essentially the fund finances a training layoff scheme enabling employers to temporarily suspend workers so that they can pursue training opportunities. During this time employers and employees remain bound by the employment contract, but the employer only has to pay contributions to a basic social security package, and no longer pays a wage to its employees. Employees are given a training allowance during their period of training financed from the National Jobs Fund.

Throughout the scheme, SETAs will be responsible for facilitating the provision of training, funding training costs, applying to the NSF for training allowances and disbursing funds to employers. Because SETAs provide training that addresses the requirements of the Scarce and Critical Skills lists of each industry as part of a demand-led process, it is likely that training will only include greening aspects if they have been requested by industry.

The outcome of the scheme should be two-fold. Employers have the opportunity to be partly relieved of the payroll burden throughout the economic crisis. Employees on the other hand get the opportunity to train in work related areas, avoid retrenchment, and ideally come back to the workplace as better skilled workers with better prospects for decent work in the future.

The scheme targets those on low incomes (below R180,000 per annum) and ensures that training allowances are not more than 50 per cent of normal wage. It further stipulates that training should be NQF aligned, credit bearing training and should provide an opportunity for adult basic education and training courses, training on a basic ICT package and other generic skills that may further personal development. The scheme has been initially launched for three months with the first six weeks acting as a pilot phase, beyond which uptake, financial viability and success of the scheme will be reviewed and potentially extended (Dept. of Labour, 2009).

2.3.5 Greening

As recently as 2004, the National Climate Change Response Strategy (2004) for South Africa stated that awareness of climate change (and therefore the green economy) was limited throughout government. It also stated that *"Officials ... within all spheres of government, often do not see climate change as a priority and some even see it as working against national development priorities. They are concerned that South Africa has a huge backlog of service delivery where the performance of each department is measured by how effective and efficient it is on service delivery...Climate change is a relatively new issue in South Africa due to the prior isolation of this country from international events. Education, training and public awareness thus lag behind the requisite standards. Similarly, government has not got the necessary capacity to deal with climate change on an effective basis. Industry is better placed regarding technical skills. However, these skills are not usually specifically available for climate change related activities."* (DEAT, 2004)

However, as discussed above, the adoption of the "required by science" approach to mitigation as per the Long-Term Mitigation Scenarios process of 2007, and of a low-carbon economy as incorporated into the framework for the National Climate Change Response Strategy of 2009, will no doubt entail assessments regarding skills requirements, however, these are still in development.

Skills development is not yet specifically discussed in the National Framework for Sustainable Development (NFSD) currently in preparation by the Department of Water and Environmental Affairs (DWEA). However, consultations with the department, and the funder, the Department for Environment, Food and Rural Affairs (DEFRA) (UK) in this regard are under way (DEFRA OneWorld meeting, 17 Nov. 2009). The latest draft NFSD (Dec. 2009) includes recommendations for the inclusion of an "Introduction to Sustainability Thinking, and Application of Sustainability Criteria" component in capacity building and skills development programmes for workers in the public infrastructure sector. The November consultation workshop on the NFSD resulted in agreement to include a skills development analysis component which is likely to be seen in the next draft, expected in May 2010. Furthermore, the document makes the important point that skills development is essential in

government to ensure that policy is well informed, and that the demands of the green economy can be well catered for (DEAT, 2008).

The Economic Sectors and Employment Cluster's Feb. 2010 document, 2010/11 - 2012/13 Industrial Policy Action Plan, identifies "'Green" and energy-saving industries' as a focus within a targeted sector of the plan, however the implications for skills is yet to be outlined.

South Africa is obviously barely at the start of its learning curve with respect to the green economy. Government does not yet have sufficient capacity or fund allocations (due to prioritization of funds for other sources) to direct the green economy, or to provide the skills development programmes required on a national basis to implement green initiatives across the board. The 2004 Strategy recommended that climate change activities should be incorporated into all levels of education to increase public awareness of the issue, and also that industries should produce their own in-house training programmes which could then be shared through industries bodies and associations. This has happened in certain industries (see Case Study 5 on the Green Buildings Council of South Africa) but is by no means a widespread initiative throughout the country. The Strategy is somewhat vague about what kind of climate change activities should be encouraged. Since government is still in the process of identifying specifics of what needs to be done, policy is still in development and funds are not allocated to what is required.

3. Anticipation and provision of skills

As noted previously, South Africa is under-resourced in terms of human resource and training and development professionals (Department of Labour, 2008). According to the National Scarce Skills List, (2008), *the industry has a shortage of 9,260 training and development professionals*. This does not bode well for provision of skills. Furthermore, as mentioned elsewhere in this report, the higher education and training sector has been undergoing a series of changes since 1994, which have meant that the sector is not as well integrated as it could be with skills demands, skills needs identification and training provision although recent restructuring attempts to address this.

3.1 Green structural change and (re)training needs

Definitions of skills for green structural change and (re)training needs vs. New and changing skills needs

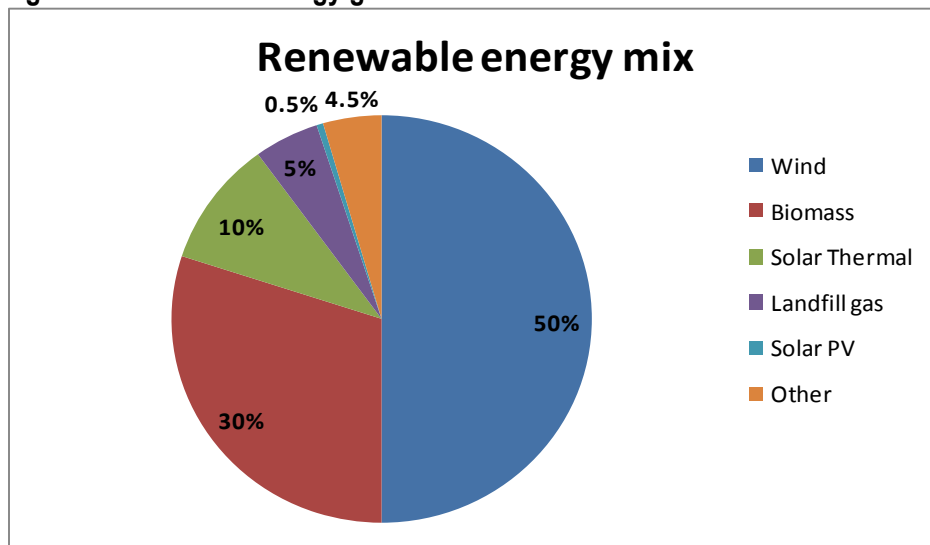
South Africa's labour market lacks significant numbers of workers for the expansion of the renewable energy industry due to green restructuring (as outlined below). However, these workers will be required in addition to and not instead of workers in coal-fired power stations, which will continue to be in short supply (as outlined below). A dilemma arises regarding where to place development of skills for renewable energy within this report's required definitions of sections 3.1 (green structural change and (re)training needs); and 3.2 (New and changing skills needs). With current plans for the extension of use of coal-fired power stations, it does not appear that those jobs will become obsolete. Some jobs/skills that are more related to retraining needs have been placed under 3.1.1 and those that may be called new green collar jobs, specifically appear under 3.2.

3.1.1 Green restructuring and its impact on the labour market

Despite South Africa's heavy reliance on fossil fuels for power generation and transport, there is significant potential for restructuring in the power industry to increase employment in the alternative energy sector due to the vast amount of untapped natural resources available within the country. These include wind, solar, and biomass energy using various technologies to harness and transform energy. Renewable energy is already playing a part in South Africa's energy mix but only to a limited extent. Energy demand is rising rapidly across the country at approximately 4.8 per cent of peak demand per year (equivalent to an additional requirement of 1,700MW of generation capacity per year) and creates an opportunity for renewable energy technology to provide employment additional to that which is required by coal-fired generation. Moreover, the recent power crisis (not resolved but now with fewer interruptions to power supply) provides an economic imperative for diversification of South Africa's currently highly centralized energy supply. More and more industries are looking to be less dependent on the grid with related, improved security of supply. This need is heightened by the recent increases in electricity tariffs, which Eskom plans to raise further over the next 2 years, effectively removing South Africa's status as being one of the cheapest providers of electricity in the world.

The government's renewable energy White Paper (DME, 2003) sets a target of 10,000GWh as the renewable energy contribution to final energy consumption in 2013, which represents approximately 4-5 per cent of generation output, with a technology breakdown illustrated in Figure 4.

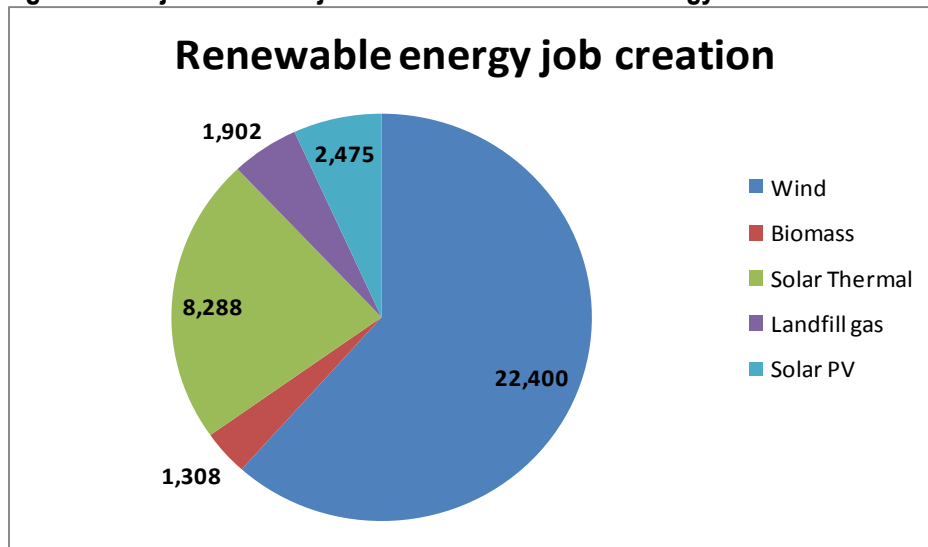
Figure 4: Renewable energy generation mix



Source: Agama (2003). [Wind: 50%; Biomass: 30%; Solar thermal: 10%; Landfill gas: 5%; Solar PV: 0.5%; Other: 4.5%]

Although considered a tame target by renewable energy pundits at the time of approval, the mid-term review indicates that so far, less than 1 per cent of this target has been achieved, with little confidence that even 30 per cent of this target will be reached by 2013. However, if capacity were to increase and continue to do so to 2020 so that alternative energy provides 15 per cent of electricity generation capacity, creation of direct jobs from the renewable energy sector could amount to 36,400. These jobs would be split between wind, solar energy (photovoltaic [PV] and thermal), biomass and landfill, as researched in a 2003 analysis shown in Figure 5 (Agama Energy, 2003). Some 110,000 indirect jobs could be created alongside this bringing total additional employment to almost 150,000 by 2020.

Figure 5: Projected direct job creation in renewable energy in 2020



Source: Agama (2003). [Wind: 22,400; Biomass: 1,308; Solar Thermal: 8,288; Landfill gas: 1,902; Solar PV: 2,475.]

Wind and solar PV industry

Using the current breakdown of occupations within the wind and solar (PV) sectors, it is possible to see in Table 2 jobs that would be in demand in the wind industry if this 15 per cent renewable energy target is met by 2020. South Africa currently faces shortages at all skills levels of employment, but especially in occupations such as technicians and craftsmen, as can be seen in Table 3. (Information for Table 3 was drawn from the Department of Labour's 2008 Scarce Skills List, adapted in Appendix 1 of this report. However, since the definitions of occupations are broad in the Agama study, and narrow in the Scarce Skills List, the information in Table 3 should be regarded as indicative only, i.e. it was not possible in the scope of this report to identify exactly which specializations were relevant to each requirement identified in the Agama study.) The renewable energy industry faces a formidable challenge to attract home grown talent into the industry. Demand competition for qualified and experienced artisans is intense across most industries and, with the added market influences of BBBEE, can often lead to rapidly escalating wage demands. Professional jobs such as accountants are also in short supply, to the figure of around 2,500 nationally (over half the estimated demand from the wind industry alone). (Dept. of Labour, Scarce Skills List, 2008)

Table 2: Future skills requirements of the South African wind industry

Occupation	Direct jobs
Managers	3,313
Professional	7,007
Technicians	4,529
Craftsmen	3,126
Semi-skilled	2,203
Commercial/admin	2,034
Trainees (graduates/apprentices)	205
Total	22,417

Source: Agama (2003).

Table 3: Scarce skills related to future requirements for the wind industry

Specialization	Magnitude of scarcity
Engineering Managers (engineering project managers)	2,770
Specialist managers: Contract, Programme and Project managers: special projects, programmes and support services)	2,860
Civil engineers and technologists and quantity surveyors	2,940
Electrical engineers and technologists	2,485
Specialist managers (includes environmental, arts & culture, office and quality managers)	6,955
Civil engineering draftspersons and technicians	3,960
Electrical engineering draftspersons and technicians	5,145
Mechanical engineering draftspersons and technicians	255
Safety inspectors	765
Metal fitters and machinists (including mechanics)	8,340
Engineering production systems workers	6,860

Source: National Scarce Skills List 2008 (Department of Labour, 2008)

The solar PV industry

The solar PV industry could be a considerable contributor to jobs in South Africa.

The skills requirements for the solar PV industry are slightly different from the wind industry and focus more on manufacturing and sales occupations, see Table 4.

Table 4: Future skills requirements of South African solar PV industry

Occupation	Direct jobs
Professional, technical and management	897
Clerical and sales	179
Service	7
Processing	268
Machine Trades	119
Bench work	361
Structural work	354
Miscellaneous	290
Total	2,475

Source: Agama (2003).

Table 5: Scarce skills (indicative) related to future requirements for the South African solar PV industry, not listed in Table 3

Specialization	Magnitude of scarcity
Metal fitters and machinists (including mechanics)	8,340
Structural steel and welding trades workers (including boilermakers and welders)	4,045
Precision metal trades workers (including instrument mechanics)	1,120
General clerks	5,625
Retail Supervisors	4,875
Sales representatives	360

Source: Scarce Skills List, 2008, Dept. of Labour.

Skills scarcity

The following discussion regarding scarcity of skills in the renewable energy generation industry is included in this section (3.2.1: Green structural change and (re)training needed) because this fits most closely with ILO's definitions. However, the author of this report felt that it could equally well and, perhaps, would better have been placed under section 3.2: New and changing skills needs, because although theoretically many of the skills required for renewable power generation could have been derived from retraining workers in the fossil fuel power sector, the significant existing lack of skills in that sector (outlined ...) means that these occupations will be trained directly as new occupations (i.e. as 'new green collar occupations') rather than upskilling/retraining existing occupations.

Generally speaking, across South Africa, awareness and knowledge of climate change and issues related to transitioning to a low carbon or green economy are low. As this knowledge begins to increase and filter through the economy, it is likely that numerous occupations relating specifically to greening will be created. (New occupations specifically will be discussed under section 3.2: New green collar occupations. This section deals with currently existing occupations that will require some retraining for

green restructuring.) South Africa is currently lagging behind, certainly in relation to more developed countries, with respect to building green industries. Having been isolated from the international community for so long prior to the end of apartheid in 1994, change has been slow and focus has been aimed at addressing the large inequalities that exist across all social groups. Moreover, South Africa has a huge informal economy estimated to represent 22.3 per cent of total employment (Davies and Thurlow, 2009). This employs a large portion of the labour force and is for the most part outside of the control and monitoring ability of government departments. That said, opportunities for new occupations have begun to emerge across different industries.

South Africa could see significant employment in the renewable energy sector (36,400 direct jobs by 2020) (Agama Energy, 2003) across a range of occupations, through greening existing occupations, and retraining needs due to restructuring. Renewable energy generation is currently small and the potential for future employment will be decided largely by the pace of technological advances and the resulting increases in economic viability of renewables. The success of the government's recent introduction of feed-in tariffs on renewable energy generated electricity will also determine the level of investment in these new technologies and therefore future employment.

The biofuels industry - Green or not?

Growing biofuels for use in transport fuels (as a result of the growing emphasis on reducing carbon emissions, but directly as a of government's objective to creation of jobs in rural areas) has the potential to create 350,000 direct jobs and the same number of indirect jobs by 2020 (Agama Energy, 2003). This is based upon a notional target of meeting 15 per cent of daily diesel demand with biodiesel, and then also substituting 15 per cent of petrol with bio-ethanol.

However, in an industrialized, developing economy like South Africa, which has limited arable land, ***fuel crops have significant potential to impact on food prices*** because food and fuel production compete (Petrie, 2008). Also, where land use is not limited to food production, competition between food and fuel sources could be based on access to labour. In addition, the environmental issues relating to biofuels are significant. Areas of South Africa's economy that rely on agriculture-driven livelihoods are already increasingly vulnerable to climate variability through droughts and floods. South Africa is a water scarce economy, with much non-commercial agriculture being rain-fed, and many water resources being already stretched. Producing reliable feedstock may thus be a challenge this country cannot meet, as most biofuel crops are heavy on water requirements. Evidence suggests that the international drive for biofuels is serving only to create new poverty traps and deepen existing ones. Their environmental impact may thus be intolerable, rendering biofuel skills in fact "non-green". However, South Africa may pursue the opportunities provided by this industry. The National Biofuels Industrial Strategy (Department of Minerals & Energy, 2007) states as an objective that it is driven "predominantly by the need to address issues of poverty and economic development" (whilst low-carbon development takes a lesser place).

The job requirements in the biofuels industry are somewhat different to other renewable energy technologies. The two main areas of labour are growing crops (where the new occupation is a biofuel farmer), and operating and maintaining the distillery and distribution processes with skills implications for operation of a biofuel distillery. These processes, although not unlike other distillation processes familiar to South Africa such as synthetic fuels refining (done by Sasol) or alcohol distillation are new to South Africa and as such require skills development and retraining throughout the plant lifecycle. Processing biofuels from plant material such as sugar beet (Eastern Cape project financed by the IDC) or soya requires adaptations to plant and technology processes and therefore equally to design, construction, maintenance and deconstruction skills. Retraining is often the necessity with not many

experienced engineers in this country being prepared to embrace new or adapted technologies and processes, potentially hindering the development of these initiatives.

The majority of direct jobs in biodiesel are in agricultural work (32 jobs per GWh), with considerably less in the operations of the distillery (1 per GWh). Bioethanol production creates slightly fewer jobs in agricultural work (5 per GWh) and the same in operations (1 per GWh). When compared to other renewable energy technologies, biofuel production is particularly labour intensive, which certainly fits into the South African policy context which aims to bring down unemployment as rapidly as possible. Generic skills are required in the construction, operation, and maintenance of the distillery as an industrial process. There will also be the need for specific knowledge of biofuel machinery and, as there is currently little biofuel activity in the country, this is likely to be a large skills gap.

Biofuel farmers require knowledge of crops and of efficient growing methods that would ideally incorporate principles of sustainable farming, water conservation, and low-carbon production. It is likely that normal agricultural workers would migrate to biofuel farming and existing qualifications could be adapted to suit various crops. Due to the current minimal activity on biofuels in the country there are currently no publically available courses in biofuel production (i.e. through the SETAs). As has been seen in other industries, it is likely that the private sector would provide the impetus for any training necessary for these new jobs.

Assuming the environmental and sustainability challenges can be overcome, biofuels are well suited to create employment in rural areas as there is generally little advantage to be gained from economies of scale when compared to other technologies. This means that a decentralized approach can be taken when building the industry as even small scale distilleries can be economically viable. The industry can be spread out across suitable agricultural areas and preferably will be closer to market and closer to workers' residences which could help to curb migration to urban areas whilst simultaneously reducing transport times of goods to market and associated emissions.

Skills in demand and scarce skills

The type of occupation in most demand across almost all renewable technologies will be technicians (Scarce Skills List, 2008, Dept of Labour. This is a trend across most sectors in the economy and has been identified in the National Scarce Skills List. *This is explained in detail in section 3.1.2.* Currently, without the additional impact of greening and the potential growth of the renewable energy sector, South Africa is short of technicians in the areas shown in Table 6. *Reasons for this shortage are explained elsewhere.*

The following table outlines skills shortages that are identified as being relevant to greening the economy in South Africa. That is, these skills are required for, for example solar water heating, and solar photovoltaic (PV).

Table 6: National skills shortages

Occupation	Magnitude of scarcity
Architectural, Building and Surveying Technicians	210
Civil Engineering Draftspersons and Technicians	5,360
Electrical Engineering Draftspersons and Technicians	855
Mechanical Engineering Draftspersons and Technicians	2,285
Safety Inspectors	925
ICT Support Technicians	3,230
Manufacturing Technicians	280
Sheetmetal Trades Workers	130
Structural Steel and Welding Trades Workers (including Boilermakers and Welders)	15,705
Metal Fitters and Machinists (including Mechanics)	3,730
Precision Metal Trades Workers (including Instrument Mechanics)	1,180
Toolmakers and Engineering Patternmakers (including Moulders and Tool, Jig and Die Makers)	325
Electricians (including Armature Winders)	3,585
Electrical Distribution Trades Workers	655
Chemical, Gas, Petroleum, Power Generation Plant Operators	2,120
Total	42,850

Source: Department of Labour (2007).

Generic skills from the power sector will be required for several jobs in renewable energy and it is evident from Table 6 above that operators of power generation plant machinery are already in short supply to the level of over 2,000 workers. Perhaps even more urgently with regard to construction of renewable energy plant, structural steel and welding tradesmen are in serious shortage of approximately 16,000 workers.

Effects of green restructuring on employment in the fossil fuel energy sector

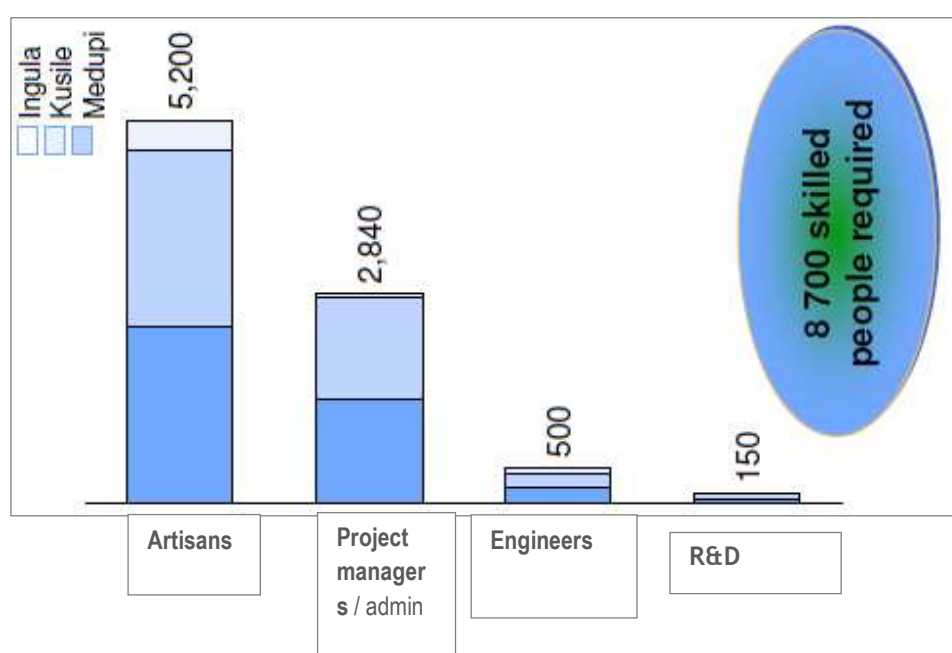
Although the energy sector could undergo considerable restructuring, this is *unlikely to negatively affect current employment in fossil fuel generation*, owing to South Africa's rapidly growing demand for energy, rising electricity prices and the construction of coal fired power stations. (Electricity price increases are likely to average +30 per cent per year for the next 3-4 years and possibly beyond). Eskom has embarked on an R385-billion (\$51-billion) new power generation expansion programme, which is set to span the next five years. This plan includes the building of new power stations and the rehabilitation of older existing ones that had previously been mothballed.

Two new power stations are currently under construction. The Medupi power plant which is currently under construction in Lephalale, in the Limpopo province, will be a coal fired 4,800MW power plant, made up of six 800MW units. Once completed, the Medupi plant will be the fourth largest coal plant in the world, as well as the biggest dry-cooled power station. The second power station is the Kusile coal-fired power plant, which is expected to be operational in 2017. Kusile will be the first power station in South Africa to have the sophisticated flue gas desulphurisation technology that will enable the utility

to produce cleaner gases, which will decrease environmental damage. Figure 6 below represents skills requirements for Eskom's three power station projects. Kusile requires approximately 2,500 artisans; 1,500 project managers/administration; 250 engineers and about 75 R&D, however it is unclear as to whether any of these skills can be classified as new skills. (Eskom, 2009)

Medupi is planning to upskill the local workforce (for example through the local training facility of the joint venture of engineering companies that won the building contract), targeting 3,000 workers in multiple skills categories. They also plan to reskill/upskill Eskom employees with on-the-job training for 500 people. (ibid)

Figure 6: Skills requirements for Eskom's three new power stations: Medupi, Kusile and Ingula



Source: Eskom (2009).

Abram Masango, Kusile project manager, was quoted in Engineering News (May 2009) as saying that it was a challenge to attract the labour required for such a large project. He also said that plans were in place to establish training centres in local communities to assist in skills development.

In addition to building power plants, Eskom is committed to renovating and re-opening three power stations that had been closed down. The three coal-fired power plants are Camden, situated near Ermelo in Mpumalanga, with an output ability of 1,600MW; Grootvlei power station in Pretoria which produces 1,200MW, and the Komati power station in Komatipoort, Mpumalanga, which produces 1,000MW. The three power stations will operate again after almost 20 years since they last actively produced electricity. Thus we can see that South Africa's main focus in the power generation sector will remain on coal.

Nuclear

Eskom are actively researching the building of a very large nuclear power station (20 GW) with completion scheduled for 2020, in the south west of the country. This region is connected to the coal-

fields generated power by 1,500 km of power lines. Eskom has also been actively supporting the research and development of a pebble bed modular reactor system which could supply power through 1,000 MW modular units. Research and development is ongoing but the recent economic crisis has slowed down progress and the viability of the system is in question.

Concentrating solar thermal plant

Eskom have also investigated the development of a *concentrating solar thermal plant* in the north-west of the country (near Upington) where Direct Normal Insolation (DNI) level of solar radiation is approximately 2900 kWh/m² per year. A large field of heliostats concentrating sunlight on a central tower would produce about 100 MW continuously (including night-time). This project has been put on hold because of the global economic crisis, the current South African focus on coal generated power and Eskom's funding shortfall.

According to Edkins et al. (2009), and a concentrating solar power (CSP) stakeholder workshop, job creation through rollout of CSP could be significant. According to the authors, "... the growth of a solar industry development programme could lead to large-scale job creation and possible foreign earnings through the export of the technology, especially if South Africa were to become a market leader in the less-developed central receiver and Linear Fresnel technologies. It was further noted that South Africa's well-established auto industry could possibly evolve to supply the CSP industry If 5.9 jobs are expected for each MW of CSP generation capacity constructed (Agama Energy 2003) then the large-scale rollout of CSP may result in creating over 600,000 jobs." (Edkins et al. 2009)

However attitudes to concentrating solar power in South Africa are still not supportive. See Box 1.

Box 1: Attitudes to Concentrating Solar Power rollout in South Africa

Edkins et al. (2009) in the same report commented on attitudes to CSP in South Africa, saying "There seems to be an educational and perception barrier, in that CSP rollout in South Africa has not yet been perceived as anything more than 'a pilot', which may have to do with Eskom's position over their 'test plant'. To redirect the national perception and support the large-scale rollout of CSP, Eskom could brand their development as 'building an industry' - the Solar Industry Development Programme. A national planning framework, possibly led by the Department of Trade and Industry, would have to be established to encourage the industry by coordinating with other government departments and interested industrial sectors. Holm et al. (2008) similarly identify 'the most important constraint is not money, men, machines, materials or management, but the motivation, the inspired political will' for the deployment of renewable energy in South Africa." (Edkins et al. 2009)

http://www.erc.uct.ac.za/Research/publications/09Edkins-et-al-Rollout_of_CSP.pdf

Energy security constraints, impacts and opportunities

Employment in the mining and quarrying sector, although still significant, has decreased over the past year from 532,000 in September 2008 to 494,000 in June 2009. Whilst the global economic crisis can be blamed for a portion of this decline, there are other longer term factors affecting the industry. One key issue is energy security. In 2008 a lack of reliable electricity supplies forced the three biggest mining companies in the country to halt all production for five days. Since then firms have been forced to operate at sub-maximum electricity supply which has reduced production and therefore the labour requirement for the industry. Escalating energy costs have added to the problem and the reduction in credit availability as a result of the global economic crisis has forced businesses to become more streamlined, forcing further job losses.

Expansion of other industrial processes such as aluminium smelting is also being halted. Despite securing electricity supply contracts with Eskom at favourable rates, companies are worried that they will face periods without supply of reasonable quantities of energy.

South Africa's power constraints affect Foreign Direct Investment (FDI), job creation and economic development

In early 2008, aluminium producer Rio Tinto Alcan delayed its Coega-based (Eastern Cape Industrial Development Zone) aluminium smelter to now only come on line in 2012. The company's CEO stated that the reason for the suspension of this important project for jobs and industrial development to the South African economy was South Africa's power constraints. He further stated that the project's engineers had been redeployed to Canada, where the power situation has improved, and Rio Tinto Alcan was looking into leveraging an "aluminium hub".

The company, which inherited the \$2,7-billion project when it bought Canadian aluminium producer Alcan, originally planned to bring the new smelter online in two phases, between 2010 and 2014. However, electricity capacity constraints in South Africa have forced it to review the timing of the project. The smelter was placed in an 'interim' phase, until the discussions, between the company, the government, the Coega Development Corporation, and state-owned utility Eskom, on the timing of the project had been concluded.

In the same year, the South African Government was forced to call for a review of all energy-intensive projects "in line with the country's strategic needs". This was a forced contradiction to South Africa's policy of attracting Foreign Direct Investment (FDI) as being a critical component of South Africa's Growth and Development Strategy.

The negative impacts on industry outlined above are driven by market forces rather than policy (and sometimes even contradicting policy) (see Section 2.2.2, Market Context) and this provides an opportunity for greening of industrial processes and developing low carbon economies. All industries have been set targets by government for improvements in energy efficiency and these could come from a variety of options including cogeneration. Many of the skills required for operating cogeneration machinery are transferable from the mining sector and more generally from most industrial processes working with large capital plant. Occupations such as machine operators, material handlers, industrial technicians, drivers, and process managers could all be taken from declining industries and used effectively, with minimal (but not insignificant) training (see Case Study 2).

Construction sector and Solar Water Heating (SWH)

The construction sector currently accounts for 27 per cent of national emissions and employs more than 500,000 people across a range of occupations. This number is expected to grow to 700,000 over the next five years (BMI Building Research Strategy Consulting Unit CC, 2006). The implications for future employment growth as a result of greening are unclear as the majority of skills requirements fit into existing jobs, and green buildings can be constructed using the existing skills base. Implementation of minimum building efficiency standards will go some way to making all construction greener, rather than creating a specific green construction sector.

The most immediate challenge in the construction sector in terms of skills is likely to come from the solar water heating industry which will require significant labour investment in order to meet the government's target of 1,000,000 installed units over the next five years. The manufacturing and installation of SWH sector is, as it stands today, under-capacitated to produce and install against this target, with current capacity able to manage less than 20 per cent of the government target. Green

architecture is beginning to emerge (see Case Study 5), but is by no means in the mainstream yet. Up-skilling is required in order to green the construction process, with implications for training in less skilled occupations, such as the 150,000 building labourers currently working in South Africa, where both building and waste materials are handled.

Conclusion

South Africa, as a developing economy with high unemployment, internationally low labour rates, and a strong need for increased energy efficiency, has the opportunity to create and grow green sectors without necessarily imposing detrimental impacts onto existing sectors. However, the extent to which green sectors can grow without “stealing” labour from other industries is restricted by the availability of skilled and semi-skilled labour throughout the country. Most of the unemployed population are considered unskilled and therefore it is a necessity to up-skill these people in order to increase the pool of skills available to facilitate the creation of the green economy.

3.1.2 Identification of (re)training needs

South Africa has a diverse and solid skills base, supported by relatively good education and training institutions. In addition, the government has, through its focus on learnerships and skills development, focused strategies on developing portable skills, meaning empowering the employed population to be able to transfer their skills across industries and sectors, thus spreading the job risk and reducing the unemployment problem. This approach, combined with South Africa’s robust skills base, creates an enabling platform for re-training. The global economic crisis combined with the power supply crisis has recently accelerated the need for portable skills because the most affected sectors (for example mining and manufacturing) have been shedding jobs at significant rates.

The National Scarce Skills List, Department of Labour

One of the main ways of identifying skills needs in South Africa is the National Scarce Skills List. The Department of Labour is responsible for publishing the National Master Scarce Skills List in South Africa. The list gives an idea of the extent to which economic growth and development are constrained by the country’s limited human resource capital. The list helps one identify those skills which are most needed in the economy.

When designing the processes through which the scarce skills list was developed, the Department of Labour ensured that robust definitions of “scarce” and “critical” were the basis of the analysis. These definitions were written after consultation with the Sector Education Training Authorities (SETAs). Following this the department developed the Organising Framework of Occupations (OFO) through which the SETAs write their 5-Year Sector Skills Plans, and the annual Sector Skills Plan Updates. The Framework essentially creates a structure through which each economic sector identifies and forecasts skills shortages. The department also noted the difference between “absolute” and “relative” scarcity of skills with the following definitions:

- Absolute scarcity - refers to suitably skilled people who are not available in the labour market.
- Relative scarcity - refers, for example, to the context where suitably skilled people are in fact available in the labour market but they do not exhibit other employment criteria.

The scarce skills list is developed by the Department of Labour based on data from the SETAs’ Sector Skills Plans as well as information from other government departments. Scarcity is identified by analyzing these data as well as annual training reports submitted by employers during sector and stakeholder consultation.

The purpose of the list is to indicate trends in the labour market across sectors rather than exact manpower deficits, and therefore figures are given as aggregate estimates and are rounded figures. It is noted that this magnitude of scarcity does necessarily correlate with the associated negative impact on growth as there are other factors unique to each sector affecting this.

The purpose of the list is given as follows:

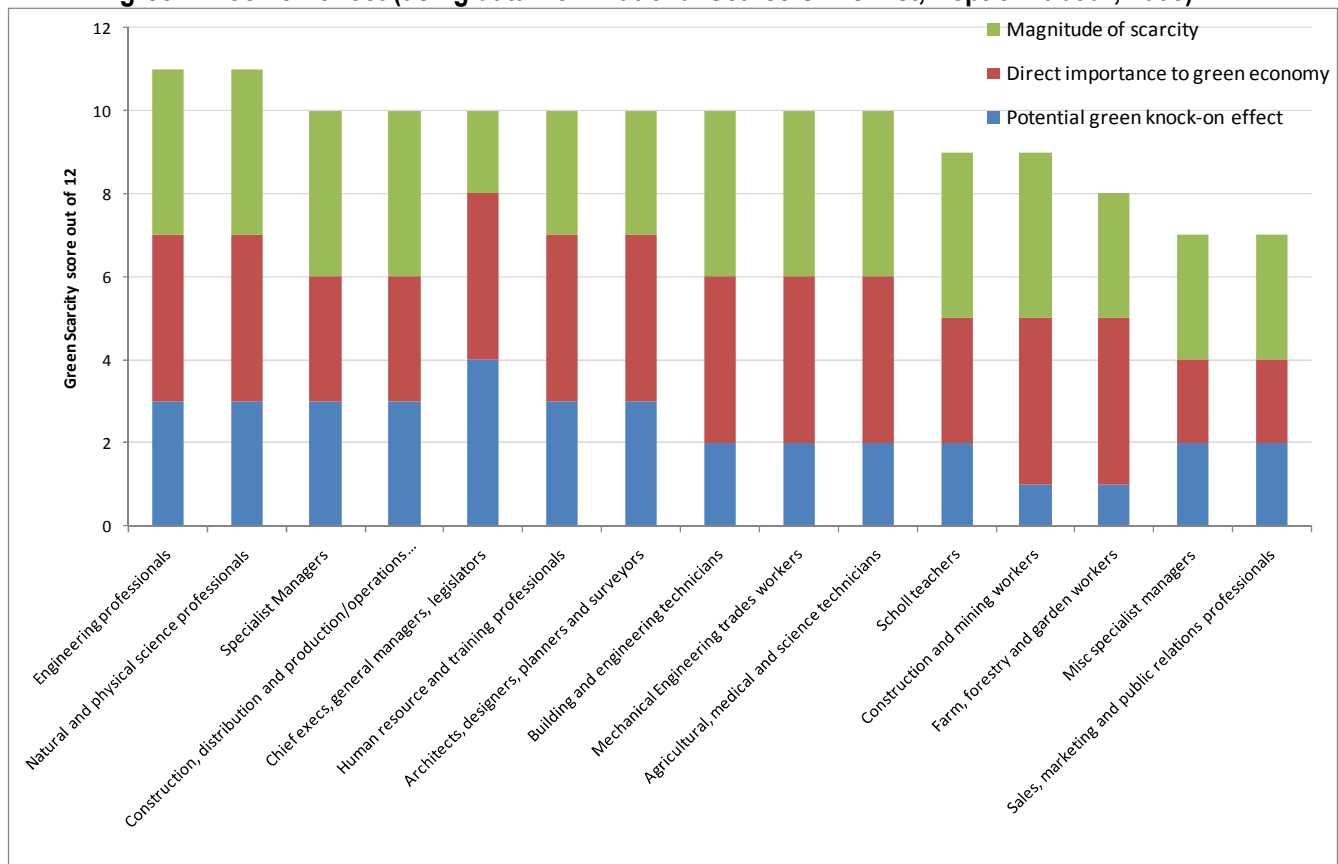
1. For the Department of Labour and its statutory skills development intermediaries, the national list provides a set of indicators for skills development interventions.
2. For the Department of Education and public education and training institutions, the national list provides a set of indicators for course development and career guidance that should be provided to learners and communities, including schools, Further Education and Training (FET) colleges, universities, universities of technology and learners across these institutions.
3. For the department of home affairs, the national list provides a basis for establishing the work permit quota list and for evaluating employer-sponsored applications for work permits.
4. For the national government and national initiatives such as Joint Initiative on Priority Skills Acquisition (JIPSA), the national list provides a platform for targeted interventions and the development of mechanisms to monitor and evaluate both the success and impact of measures aimed at redressing particular scarcities.

The figures in the 2008 list cover the period 2008-2010.

Whilst the Scarce Skills List can be used to measure scarcity of occupations across the economy, it can also be used as a gauge to determine those occupations that should be priority targets for training, education, and restructuring policies with respect to the green economy of the future. The following chart (developed from the Scarce Skills List for this report) shows those occupations that can be considered the most urgent when scoring the occupation groups in the Scarce Skills List based on three factors:

1. **Direct importance to the green economy (score out of 4)** - this indicates to what extent the roles of each occupation group are directly linked to the greening the economy (e.g. agricultural scientists score 4 / 4 because they advise farmers on techniques for increasing productivity in the face of a changing climate, while a general clerical worker scores 1 / 4 because, although they will be required in the green economy, the occupation group is not specific to it).
2. **Magnitude of scarcity (score out of 4)** - this indicates the level of scarcity indicated in the Scarce Skills List where:
 - a. 1 = Low = less than 1,000
 - b. 2 = Medium = between 1,000-3,000
 - c. 3 = High = between 3,001-10,000
 - d. 4 = Very high = above 10,000
3. **Knock-on greening effect (score out of 4)** - this indicates the potential for each occupation grouping to act as a catalyst for further greening in the economy. This is based on both the assumed knowledge of the grouping, as well as their seniority level which acts as a proxy for potential for influence other workers, companies, industries to green their processes (e.g. a CEO scores 4 / 4 because the potential to influence processes within a company is high so they have a high potential to change working practices of others, not just themselves, whilst a construction labourer, although very relevant to the green economy in a direct sense, does not hold the same standing within an organization and therefore we assume a lower potential to change working practices).

Figure 7: Scarce skills in South Africa related to importance to the green economy and potential green knock-on effect (using data from National Scarce Skills List, Dept of Labour, 2008)



Source: OneWorld Sustainable Investments, based on figures from the National Scarce Skills List, Department of Labour, 2008

If we interpret the index so that the highest scoring occupations represent those which should be priority targets when preparing the South African labour force for greening, we see that the top two occupation groups are engineering professionals, and natural and physical science professionals. With respect to the green economy, these would include occupations such as:

- Engineering professionals:
 - o Chemical engineers - design, construct, and operate commercial-scale chemical and industrial process plants. In addition they test and develop new materials and chemical engineering technologies.
 - o Civil engineers - design, construct, assess all types of infrastructure and apply knowledge of factors such as environmental impact and application of new technologies.
 - o Electrical engineers - design, develop and supervise systems for generation, distribution, utilization and control of electrical power and apply knowledge of new engineering technologies.
 - o Industrial and mechanical engineers - design, organize and supervise construction and operation of mechanical and process plant and ensure resource efficiency and appropriate technology application.
- Natural and physical science professionals:

- o Agricultural and forestry scientists - advise farmers and governments on developing techniques for increasing productivity as well as policies for effective forest management.
- o Environmental scientists - study and advise on policies and plans for protecting the environment and other natural resources.

More generally, the highest scoring occupations tend to include aspects of construction, agriculture, engineering, and high level management.

There are some important occupations (such as power plant technicians) which are found lower down the overall score chart despite having a high score for *direct importance to green economy*. This is largely due to a low score for *magnitude of scarcity*, indicating that, according to the Scarce Skills List data, the occupation group is not amongst the scarcest in the economy (although there is still a shortage).

Those occupations that have a high score for *knock-on greening effects* also feature highly on the overall score ranking. This shows that perhaps there is a shortage of higher level managers and directors in the economy who will be able to drive changes towards greening.

Several occupations such as sales assistants, and sales support workers, have a high score for *magnitude of scarcity* but feature very far down the overall list. This is due to both their relatively junior ranking within a typical firm (and therefore a lesser ability to drive green change) as well as the non-green specific nature of the job role.

Of course these scores are somewhat biased to reflect the knowledge and opinion of the analyst attributing the scores for *direct importance to green economy* and *knock-on greening effect*. Nevertheless the analysis links overall scarcity with labour requirements of the green economy in a way that can be rationally explained by common sense.

Retrenchment and retraining

This means that a growing pool of skilled, semi skilled and unskilled labour is in the market which requires a focus on re-training - for emerging jobs. Here the challenge lies not so much in the actual process of re-training because the political will, institutional arrangements and funding streams are in place. The challenge lies more in

- (1) better coordination of the bodies involved in training; and
- (2) the identification of the most realistic and appropriate sectors and jobs for which to re-train this labour pool.

A proactive approach is required, drawing on public, private and civil society sector initiatives - and partnership. For example better alignment is required between:

- (1) government policy (such as the stated target by South Africa's Energy Minister of installing 1,000,000 SWHs over the next five years);
- (2) private sector response in building up the capacity to respond to this target; and
- (3) the SETAs responsible for ensuring appropriate skills development.

This alignment is to some extent in place (see case study 3) but the missing dimension is that of the industry shedding jobs.

Re-skilling opportunities when retrenching

Section 189 of South Africa's Labour Relations Act deals with termination of employment resulting from operational requirements (i.e. retrenchments and redundancies). This section specifically stipulates that businesses and affected employees engage in "a meaningful joint consensus-seeking process and attempt to reach consensus on -

(a) appropriate measures:

- (i) to avoid the dismissals;
- (ii) to minimize the number of dismissals;
- (iii) to change the timing of the dismissals; and
- (iv) to mitigate the adverse effects of the dismissals"

As a result of this requirement, formal Outplacement Programmes are not uncommon when bigger organizations restructure. These programmes typically result from consultation and negotiation between the business, Unions and workers and include elements of:

- Personal Counseling
- Financial Counseling
- Job Search Counseling
- Further Studies
- Entrepreneurial Development

In the same way as the National Job Fund, this is another ideal opportunity to promote re-skilling opportunities in green skills.

Coordination between outgoing skill users and emerging skill markets would ensure a proactive, coordinated response and an opportunity to ensure, in a coordinated way, that South Africa does not walk down the low carbon economy and green skills path without the requisite skills to support it - thus potentially destroying any such initiative.

In the case of the government's SWH target, the companies retrenching artisans (such as the manufacturing and mining sectors) could for example be prevailed upon by the negotiating trade unions, to cooperate with the relevant incoming SETAs (and their emerging employers, such as the SWH manufacturers and installers) to fund and coordinate training programmes for artisans to equip them for new jobs in the SWH sector.

Trade unions are an important role player in the identification of retraining needs. They are often the only common denominator between outgoing and incoming industries and therefore are well placed to play a role in coordinated skills development and re-training. They are also well linked into government policy making and target setting processes that impact on the country's jobs. COSATU, South Africa's main trade union federation, is a robust, effective, well funded umbrella federation of a range of trade unions that represent most sectors in South Africa. It was established in 1985 as a part of the Tri-partite Alliance with the African National Congress and the South African Communist Party. Trade unions can play the linking role between labour, SETAs, economically declining industries and emerging industries. However, COSATU has expressed opposition to the aspect of privatization playing a role in the electricity generating sector, through the participation of independent power producers and an independent system operator. COSATU's response to President Jacob Zuma's State of the National

Address, dated 12 Feb. 2010, states: “COSATU is totally opposed to the suggestion that privatization has a role to play in the electricity generating sector, through the participation of independent power producers and an independent system operator. COSATU remains convinced that moves towards privatization will ultimately wreck a crucial public national service and we shall continue to campaign vigorously to prevent the sell-off of a vital public asset.” (Source: <http://www.cosatu.org.za/>)

The Education and the Science and Technology public sector departments are also an important role player in the task of redirecting skills in this country. The Department of Science and Technology (DST) for example has the job of stimulating interest in careers and therefore studies in science and technology, which is not currently the most popular choice of career among South Africa’s learners. By keeping abreast of the opportunities emerging from a low carbon and green skills economy in South Africa, the DST can stimulate interest in specific fields (such as climate science for example - see Case study 6). This is however often difficult as the education environment is not producing enough learners with appropriate subjects or with appropriate levels of learning in those subjects - particularly in the fields of science and mathematics. Educational institutions (from schools to training institutions and universities) need to become much more responsive to emerging skills needs and to ensure that curricula (and standards) are appropriately structured.

The above requires coordination as well. This is a role for the Office of the State President through the Economic Sectors and Employment Cluster under the Government’s Programme of Action, 2009. This cluster considers topics such as “Speeding up growth and transforming the economy to create decent work and sustainable livelihood”, “...maintaining a stable pro-employment macroeconomic environment”, “Develop proposals on various developmental path options available to SA to maximize impact on employment creation and poverty alleviation” and “Strengthen social dialogue and the Nedlac processes on economic development challenges and building a common vision and develop policy capacity within social partners” for example, all of which are appropriate focus areas to facilitate the coordination required. (See also the outline of the Cluster’s Industrial Policy Action Plan on p. 8).

3.1.3 Skills response

The path of skills development through South African central policy has had little explicit focus on the green sector. Currently most training and qualifications frameworks developed are demand-driven by private industry. The large skills shortages in South Africa mean that businesses and training bodies have struggled to examine what the economy will require in the long-term regarding skills development.

Importantly, one of the areas with the most acute skills shortages is in the education and training sector. Specifically, the country is short of over 9,000 training and development professionals. In the wider education sector there is a shortage of 6,000 pre-primary teachers; 4,200 foundation phase school teachers; 7,000 intermediate phase school teachers; 9,000 further education and training teachers and lecturers; 13,000 special education teachers; and 750 higher education lecturers (Scarce Skills List, Dept. of Labour, 2008). This is a total of approximately 43,000 additional staff required to meet current demands for work. The scale of the challenge to the skills sector of finding, recruiting, training and retaining these people should not be underestimated.

As a result the skills response from SETAs specific to green skills development has been absent. Taking account of the enormous potential for growth in renewable energy and the associated skills that would be required, relevant and available qualifications (from accredited training providers) are few and far

between. It is likely that the expansion of the private renewable energy sector would finance its own training programmes, meaning that the Skills Development Levy paid by all employers can be effectively used in demand driven skills development, with up to 70 per cent of the levy being reclaimable for exactly this type of skills development initiative (see Section 2.3).

The National Jobs Fund has been established to cushion the effects of additional retrenchments due primarily to the economic crisis and this is detailed above in Section 2.3.

The Expanded Public Works Programme (EPWP)

A significant effort has been made to cushion the effects of the 25 per cent+ unemployment rate in South Africa in the form of the **EPWP**. A major part of this programme is involved with environmental management (discussed below).

A large portion of the population does not have skills or opportunities to participate in the formal economy and earn a living. The EPWP is a government initiative aiming to create temporary work opportunities for the unemployed, with the emphasis on unskilled workers, using public money. All work opportunities are combined with training, education and skills development in order to increase the ability of people to earn an income once they leave the programme. The Department of Labour (DOL) and SETAs coordinate the training and skills development aspects of the programme.

The EPWP cuts across all departments and spheres of government. Under the EPWP, all government bodies and parastatals are required to make a systematic effort to target the unskilled unemployed. They must formulate plans for utilizing their budgets so as to draw significant numbers of the unemployed into productive work in such a way that workers gain skills while they work, so increasing their chances of getting out of the marginalized pool of unemployed workers.

The Department of Public Works is responsible for leading the programme. As part of its remit the Department of Public Works also formulates and coordinates EPWP programmes in the infrastructure sector, building on existing initiatives such as the Zibambeke road maintenance programme in KwaZulu-Natal province, the Gundo Lashu road construction programme in Limpopo province, the Zivuseni building maintenance programme in Gauteng, and the labour-intensive construction of water pipelines under the Department of Water Affairs' Community Water Supply and Sanitation programme.

The environmental sector's contribution to the EPWP involves employing people to work on projects to improve their local environments, under programmes such as the Department of Agriculture's Land Care programme; the Department of Environmental Affairs and Tourism's People and Parks, Coastal Care, Sustainable Land-based Livelihoods, Cleaning up SA, and Growing a Tourism Economy programmes; and the Department of Water Affairs and Forestry's Working for Water, Working for Wetlands, and Working on Fire programmes. A target of 200,000 employment opportunities over the next five years has been set for this sector (see Case Study 1 for details).

The Department of Trade and Industry is responsible for coordinating the EPWP in the economic sector, including programmes such as incubator programmes for small businesses, which obtain work from government and community-based income-generating projects. In the Social Cluster, the Department of Social Development is responsible for formulating and coordinating EPWP programmes in the areas of social and personal services (such as home-based care for people living with HIV/AIDS and early childhood development), and food and nutrition. The national sector coordinating departments are required to provide regular reports to Cabinet regarding progress made in implementing the EPWP in each sector.

Provinces and municipalities are the primary project implementing bodies for the EPWP, as the main delivery arms of government. They are supported by the national government departments responsible for sectoral coordination.

Overall the EPWP has been declared a success by the government as it met its target of creating 1,000,000 “work opportunities” by 2008, one year ahead of schedule. The scheme has since expanded into phase II and will target the creation of 2,000,000 full-time equivalent positions by 2014 as part of the process of halving unemployment by 2014.

3.1.4 Case studies

The first case study provides an example of retraining as part of a green crisis response, and to some extent, as part of active labour market policy measures to reduce unemployment.

Case Study 1: Occupations in the expanded environmental protection sector due to government induced restructuring (Working for Water Programme – Payment for environmental services)

Context: Invasive alien species and environmental protection; water scarcity in South Africa in general, exacerbated by invasive alien species

Invasive alien species are the single biggest threat to South Africa's biodiversity and are causing billions of rands' worth of damage to South Africa's economy every year. Invasive alien species are plants, animals and microbes that are introduced into countries, and then out-compete the indigenous species. Invasive alien plants (IAPs) pose a direct threat not only to South Africa's biological diversity, but also to water security, the ecological functioning of natural systems and the productive use of land. Le Maitre (2000) indicates that IAPs use up to 7 per cent of South Africa's surface water resources, intensify the impact of fires and floods, and increase soil erosion. IAPs can divert enormous amounts of water from more productive uses. Invasive aquatic plants such as the water hyacinth affect agriculture, fisheries, transport, recreation and water supply. It is estimated that these plants cover about 10 per cent of the country and the problem is growing at an exponential rate.

Climate change exacerbates South Africa's current environmental challenges: water scarcity, increased fire danger; and through increased extreme events. Furthermore, under climate change, the importance of invasive alien species as **invaders** is likely to increase (Richardson and van Wilgen, 2004). Removal of invasive alien plants is therefore considered to be a priority for maintenance of indigenous species, protection of water sources, and reduction of fire hazards both now in the face of future climate change. Removal of IAPs therefore falls under South Africa's environmental protection sector.

The fight against invasive alien plants in South Africa is spearheaded by the Working for Water (WfW) programme, launched in 1995 and administered through the Department of Water Affairs. This programme works in partnership with local communities, to whom it provides jobs and training, and also with Government departments including the Departments of Environmental Affairs, Agriculture, Forestry and Fisheries, and Trade and Industry, provincial departments of agriculture, conservation and environment, research foundations and private companies. WfW is part of the Expanded Public Works Programme of South Africa which aims to reduce unemployment and poverty by providing work opportunities funded by the government.

Since its inception in 1995, WfW has cleared more than one million hectares of invasive alien plants while providing work opportunities and training to up to 30,000 people per year, from among the most marginalized sectors of society per annum. WfW currently runs over 300 projects in all nine of South Africa's provinces.

Jobs created by WfW Programme, through the Expanded Public Works Programme

The programme trains unemployed people from local communities to use a range of methods to control and remove invasive alien plants. An integral part of the programme is the development of people as an essential element of environmental conservation and providing sustainable decent jobs. Short-term contract jobs created through the clearing activities are undertaken, with the emphasis on endeavouring to recruit women (the target is 60 per cent), youth (40 per cent) and people with disabilities (5 per cent). The programme (see Appendix 2 for details) provides various jobs including:

- Working for Water contractor
- Chainsaw operator
- Brushcutter operator
- Herbicide applicator
- Plant identification
- Health and safety representatives, peer educators, first aiders

Skills development and training

All employees receive comprehensive training on safety and technical aspects of the above jobs. Contractors undergo additional training: WfW contractor courses, business principles, and business finance. Advanced contractor courses include advanced entrepreneur course, and business of contracting. Health and safety courses include workplace risk assessment, fire awareness, first aid, health and safety, advanced driving, and dangerous animal awareness.

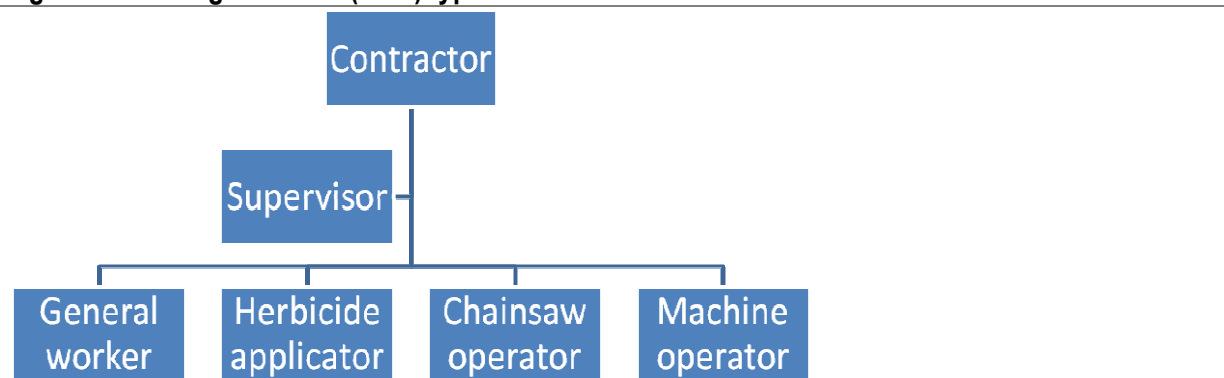
Social development (life skills) training is provided to all workers and includes: peer education, counselling, HIV/Aids, primary health care, personal finances, home based and frail care.

Training modules were conceptualized by WfW, and eventually formalized by the Agricultural SETA and the South African Qualifications Authority (SAQA), through which accredited training providers were identified or assigned. A few of the newer courses are US-aligned (for example herbicide applicator refresher course).

Team structure

Almost 30,000 individuals have been employed each year for an average period of 70-80 working days. During this time, employees work in small teams of 10-15 members, headed by a contractor and/or supervisor (see Figure 8). Recruitment starts with a local advisory committee which is formed in a local community close to the target area for IAP clearing (a minimum of 80 per cent of workers should be from the local area). Contractors are hired first and must demonstrate good management capacity, as well as other skills including numeracy and literacy skills to Grade 10 standard or above. Other workers can come in without any previous experience and unskilled workers are welcomed. All employees are contracted for 460 days work (i.e. 2 years of work) but this may be completed over the course of 5 years. This extends the period of employment under the programme and often gives employees the opportunity to undertake seasonal work for agricultural industries to increase long-term income.

Figure 8: Working for Water (WfW) typical team structure



Employment regulations

As is standard for Public Works Programmes, there are set regulations of employment to ensure fair and safe working conditions are provided for workers and adhered to. The contract of employment for workers (in terms of the negotiated Ministerial Determination on Special Public Works Programmes - SPWP) includes the following:

- Working hours are restricted to 40 hours per week.
- 1 day sick leave per month is allocated to each worker who works more than four days per week.
- Every worker has the right to work in an environment that is safe and without risk to his or her health.
- The management of every employer (contractor) engaged in a SPWP are required to do everything that is reasonably practicable to ensure the health and safety of persons working on a SPWP including providing: all necessary protective clothing; first aid kits; training for a First Aid Officer on every site; sufficient clean drinking water to all workers for the duration of the project; and adequate sanitation for all workers.
- A minimum of 2 days paid training for every 22 days worked.
- A minimum of 30 per cent of training must be accredited.
- Two per cent of project budget must be allocated to training.
- Balance quality of life, functional and entrepreneurship training; balance formal training with structured work-place training.
- Equip workers with skills that can be used to secure other employment opportunities.
- Identify possible career paths available to workers exiting the SPWP.

Because of these factors, WfW ensures a minimum standard of working conditions for all employees. The programme is designed to give skills to previously inexperienced workers, better enabling them to move into the formal workplace after the period of employment is completed (see Appendix 2 for details of training given to workers).

Potential for further future employment creation

The potential for further employment through WfW and other Payment for Ecosystem Service (PES) projects is enormous and has been targeted as part of the government's EPWP phase II, launched in April 2009, which aims to create 375,000 job opportunities by 2014 (equal to 111,000 full-time

equivalent positions). Currently work is carried out primarily on public land, but due to the fact that 75 per cent of South Africa is private land, a huge potential exists for private landowners to employ large numbers to clear invasive species. Furthermore, WfW provides the supply of workers for this type of private enterprise by training contractors and workers through its two year programme.

Additional spin-off benefits are being targeted for the future including river bank stabilization, and creation of a market for biomass that results from clearing invasive species. Skills required for these types of activities are very similar to those of the WfW programme and so institutionally speaking, it is well placed to scale up activities and provide employment for more people, providing sufficient funding is found from public and private sources.

There have been some challenges for the programme, for example how to increase the amount of work per person. Currently workers are allocated approximately 70-80 days per year which means it is by no means a full-time job. However, the sister programme, Working on Fire, has managed to solve this and provides 230 days work per year to each worker. Institutional arrangements have also been mentioned as a drawback due to the nature of running such a sizable programme from within a government department.

This labour intensive programme is globally recognized as one of the most outstanding environmental conservation initiatives on the continent. It enjoys sustained political support for its job creation efforts and the fight against poverty, and the many economic, ecological and social benefits that it has for the country. It has grown to be the biggest conservation programme in Africa, and has spawned similar programmes dealing with wild fires (Working on Fire), wetlands conservation (Working for Wetlands), integrated invasive species management (KwaZulu-Natal Invasive Alien Species Programme), land rehabilitation (Working for Woodlands) and labour-intensive energy foci (Working for Energy).

Case Study 2: Restructuring in the power generation sector - Co-generation in industrial processes

South Africa relies on the heavy industry and mining sectors for a large portion of its gross domestic production (approximately 20 per cent and 7 per cent respectively). In energy terms, industry and mining accounted for 36 per cent and 7 per cent respectively of final energy consumption in 2004 and helped keep the economy's energy intensity level high at 5MJ/Rand. South Africa ranks as a high CO₂ emitter globally and this is largely due to the fact that almost 90 per cent of electricity capacity comes from coal-fired plants.

Due to this reliance on heavy industry there is significant potential for energy efficiency gains to be made and in the Energy Efficiency Strategy for the Republic of South Africa (2005), the country set itself the target of improving national energy efficiency by 12 per cent by 2015. The specific target set for industry and mining was an improvement in energy efficiency of 15 per cent by 2015. ***However, these targets are a long way from being met. Monitoring of the employment landscape since 2005 has not been sufficient (and is not sufficiently frequent) to allow evaluation of changes in employment such as disappearance or restructuring of jobs.***

One of the barriers to implementation noted in the strategy is the lack of capacity around energy efficiency both within industry and in the general public. For example the strategy states that South Africa lacks Electricity Service Companies (ESCOs), whose primary service is to reduce energy costs. DME's role is to create a more formal framework of operation for ESCOs, including accredited

performance standards, approved methodologies and a skills training accreditation aspect (DME, 2005). The industry and mining sector programme outlines norms and standards for horizontal technologies such as technical standards to be developed for industrial boiler efficiency, electric motors and thermal insulation. Measures to be undertaken include training of inspectors and operators. The transport sector programme includes the output of instigation of Roadworthy tests including an emissions test. This would require training vehicle inspectors in this aspect.

The strategy also states its expectation that alongside improvements in efficiency will come job creation. Attempts to fulfil this expectation have commenced, with Eskom driving the Demand Side Management (DSM) programme. This was originally designed guided by the aforementioned BBEE strategy: The DSM strategy implementation model for establishing ESCOs was designed with a view to creating job and business opportunities for previously disadvantaged South Africans. Capital was made available through the DSM fund, managed by Eskom, to finance emerging ESCOs and to incentivize their work in designing energy saving mechanisms and strategies in business under a model where resultant savings accrued in part to the ESCO, in part to the implementing business and in part to Eskom. Eligible ESCOs (to the fund) had to demonstrate their BEE status. Little training was given (the energy SETA was not responsive to the DSM policy driven needs) and most ESCOs established under this strategy housed emerging skills rather than experienced or retrained engineers, largely as a result of the BEE requirement. The result was an under-developed skills base coupled with slow progress in establishing the DSM mechanism - thus low savings through energy efficiency in South Africa - arguably an area we can save considerable generation capacity in an energy-short economy. South Africans did not grow up in an energy efficient economy meaning that skills development and training did not include this rather important orientation. We are now attempting to fix this problem in the absence of skilled, trained engineers and electricians and in an environment of poorly coordinated formal skills development and retraining.

Currently there is little in the way of monitoring and verification of energy use within industry but there are now tax incentives for companies to do so. There is however little detail of training and education plans with which to bring about this capacity expansion. The SETAs (see the skills development strategy section, 2.3) are well placed to play a role in developing accredited training programmes and standards to support education and training plans developed on demand). The SETA is running an industrial energy auditors course and unit standards¹⁴ and an industrial energy manager's course. Statistics on course participation were not available at the time of publishing this report. Furthermore, although renewable and nuclear energy are mentioned in the Energy SETA Scarce Skills Report, this is in the absence of a recognition of climate change as being a driving factor and climate change is not mentioned in the Sector Skills Plan, 2008-09.

Traditionally South Africa has enjoyed some of the cheapest electricity prices in the world, owing to its vast reserves of coal. However this is no longer the case as more and more coal-fired power plants are becoming expensive to run as they reach the end of their lifespan, and mining costs continue to increase. This, coupled with greater awareness amongst industrial producers that using coal-based electricity increases their carbon footprints, means that the viability and popularity of alternative energy sources is increasing. However, renewable energy sources are mostly likely to be in addition to, rather than in place of fossil fuel generation capacity. The rapid rise in demand for energy as the economy grows (and with Eskom's plans for new coal-fired power stations) increases the likelihood that

¹⁴ *Industrial Energy Auditor Skills Programme & Unit Standards*, by Dr Andries van der Linde for the Capacity-Building, Leadership & Action (CBLA) (undated), can be found at:
<http://www.cbla.org.za/files/Complete%20Unit%20Standards%20IEA%20Program%202.pdf>

fossil fuel generation is not going to decrease (see Section 3.1.1.). The viability of renewable energy and the fact that its use will increase does not mean that use of fossil fuels is going to decrease. The demand for skills in fossil fuel energy generation is therefore not likely to decrease either. This implies that new skills are required in the development of renewable energy and that the SETA sector plans to reflect this need.

Steam generation for industrial processes has good potential efficiency gains. Associated Energy Solutions (AES) provides outsourced energy solutions through various methods of fuel-switching and efficiency gains. As South Africa's second largest supplier of steam to industry, AES currently has 150MW of steam generation under operation and all processes have involved substantial efficiency gains to industrial producers. Employment varies between different technologies but in some cases gains are considerable.

Typical employment for a 6MW green power generator using forest biomass fuel

Biomass energy generation can be a labour intensive industry, with most of the labour required in the biomass (fuel) collection and preparation processes. A 6MW biogas steam generator capable of directly supplying industrial processes or feeding into the grid can provide employment for 207 people during its lifecycle in the following breakdown:

- 51 jobs during construction
- 138 jobs during operation (see below)
- 18 jobs during decommissioning

Of the jobs during operation, approximately 80 per cent are relatively low skilled occupations driving the process of collecting and preparing biomass for combustion (for example drivers, loaders, machine loaders, material handlers, etc). These jobs do not require specific green skills, but are performing part of the greening process.

The other 20 per cent are occupations located within the factory premises and generally require considerable skills specific to green technologies. These include turbine operators, steam generation plant staff, maintenance staff, as well as mechanical and electrical engineers. Whilst most of these occupations are replicated in other non-green industrial sectors, there is a significant element of training required to adapt workers from one technology to another. This adaptation process, depending upon the occupational skill level, takes approximately two years of on-the-job training. (No information was available on what this type of training entails at the time of writing this report. On the job training generally entails informal training, where a worker shadows a trained worker, and gradually acquires the skills required to take over the job.)

Artisans, maintenance staff and operational staff are in short supply. This skills gap tends to be in workers between the ages of 35-45 years, and can be at least partially attributed to the exodus of white South Africans from South Africa during the mid-1990s, which left a void of skilled workers. Since then, new/restructured training programmes have not yet managed to rebuild the loss of this skills base, as explained elsewhere in this report. The result is that there are workers in their thirties who are trained artisans, but they lack the experience required to work in these types of industrial processes without supervision or significant training.

Potential for job creation

South Africa currently houses 600MW-800MW of steam generation for industrial processes, all of which is powered by coal-based electricity from the national provider. The potential for job creation is

enormous should a large portion of this electricity be sourced from biomass energy. One could expect around 20,000-26,000 jobs to be created over the project lifetimes, of which 14,000-18,000 would be full-time operational jobs, and these would be split roughly between 80 per cent low-skilled labour, creating local employment, and 20 per cent (OneWorld, 2009) skilled labour ranging from bio-energy plant maintenance staff to mechanical and electrical engineers. However, some realism should be applied to these figures as it is highly unlikely that enough biomass material could be sourced within South Africa to provide such large energy requirements. Furthermore, labour shortages in other sectors would occur during this expansion. It is likely that as the price of electricity increases, alternative and innovative fuels for electricity production will become viable (such as waste materials from the paper and rubber industries, amongst others). The labour intensity of other industries is less than for biomass, which generally requires material collection over large areas, but the skilled component of labour, and the associated changing skill set to meet the technology will remain similar.

Training artisans to adapt to various technologies is likely to be very specific to the industrial process with which they work. Therefore training courses and up-skilling would be most efficient coming from employers, as generic skills training plans from public entities such as SETAs would probably prove inefficient as there is little cross-over between, for example, a biomass energy plant and a wind farm. AES reported that there is a skills gap in basic analytical skills and logical approaches to problem solving. Both are essential for millwrights and maintenance staff working with industrial plant. These aspects should be taught during primary and secondary education and such problems are common across all sectors. Furthermore, AES suggested that not enough focus is put on careers counselling for learners, and therefore students are not aware of the opportunities available to them on leaving school, irrespective of the qualifications they hold.

Case Study 3: Photovoltaic (PV) panel manufacturing plant

This case study deals with skills required for photovoltaic (PV) panel manufacturing. For such a manufacturing plant, it is anticipated that the majority of workers are being (or can be) retrained from other manufacturing processes, in other words it is using existing skills from the manufacturing industry. Therefore, although PV is a “new” form of power generation in South Africa, it has been included in this section (rather than under new green collar skills/jobs) because it relates to green structural change and retraining.

Solar power technology has made significant progress over the past decade and opportunities are arising for manufacturing plants to be set up in South Africa. Capital and land has already been acquired to begin producing photovoltaic (PV) panels in the country mainly due to a new improved panel design from Vivian Alberts, a professor at the University of Johannesburg. Thinner and cheaper than current PV panels produced elsewhere in the world, the units will begin production in the Western Cape in 2012. This development in the renewable energy market is deserved of a case study here as it speaks to a number of aspects regarding green skills in South Africa.

Firstly it brings to light the fact that in certain sectors, academia and research and development (R&D) skills exist in clusters of sufficient levels to foster fruitful greening outcomes and provide systems and technology that result in significant employment opportunities. Vivian Alberts patented the copper-indium-gallium-diselenide (CIGS) module PV design in 2003. The results of his and his team's skills have been heralded as “the greatest breakthrough in solar power this decade”. The most important aspects of Alberts' design are that his panel can be 5 microns thick (ordinary solar panels are 350 microns thick) and at a commercial scale, can produce 60 W at a cost of R650. (Previous designs of solar panels produced 50 W at a cost of about R2100). Such a breakthrough speaks to the levels of skills in this

sector as well as the support garnered to foster them. Although this achievement is miniscule in comparison to most developed world countries, such a level is impressive for a developing country such as South Africa. However, it is very important to note that these high level green skills (academic and/or R&D) are concentrated amongst a very small percentage of the population, typical of a divided, highly unequal country.

Secondly, the development of this work into a commercial plant brings to light the skills required to operationalize green ideas, inventions or breakthroughs in South Africa. While these might not be green skills in the purest sense, they are an essential component to the greening process in a macro sense, and green skills and the development of green skills into commercial or industrial products or services would not come about without them. A number of parties have come together to facilitate the operationalization of this green idea and product in South Africa. South Africa's state-owned Central Energy Fund, Sasol (a 40 per cent interest), the University of Johannesburg (UJ) and the National Empowerment Fund are pursuing the South African project jointly as a public-private partnership (PPP). Foreign capital has also been accessed with The European Investment Bank lending €40-million to the PPP to support the construction of the local PV production facility. This also shows the ability of South Africa to attract such international financial flows for green enterprise. Training is to be provided through German partners who have the PV manufacturing skills although this has limitations as the technology is innovative. The University of Johannesburg have post graduate students working on the project in a research and design capacity and the University is set to establish some of the necessary training as the facility becomes established.

Lastly, and most importantly as it concerns the plant itself, the size of the operation dictates how many jobs will be required and whether or not those skills are available currently at a given viable market value. The facility, to be established in the Western Cape, will have a capacity to produce 40 MW worth modules yearly. Based on work conducted by Agama Energy, a study by Earthlife in 2004 states that the plant could create 1,400 jobs directly - in manufacture, installation and maintenance. A skills shortage lies in the manufacture at a blue collar level. Significant training will be required so that an efficient wage rate can be used. ***Skills needs and scarcities for the PV industry are outlined in the section on the PV industry in section 3.1.1.***

3.2 New and changing skill needs

3.2.1 New green collar occupations

Solar water heating (SWH)

The solar water heating sector has large potential for job creation. Solar water heaters are a relatively simple technology and already have an established presence in the South African economy. Moreover, Eskom, the parastatal power company which runs the national transmission grid and much of the power generation in the country, offers consumers subsidies for the purchase of solar water heaters. If every house in South Africa were to be fitted with a solar water heater (equivalent to 13,560 GWh - significantly more than government's 2013 target) it would create 118,000 direct jobs, and a further 240,000 indirect jobs (Agama Energy, 2003). Direct jobs in this sector are dominated by skilled and semi-skilled artisans who work in the manufacturing supply chain, as well as in the installation and maintenance side. (Some of these jobs may be said to be new occupations, for example ***solar water heating technicians*** (see Case study 4) whilst others are rather greening of existing occupations, for example where a plumber learns new skills for the SWH industry. As SWH is essentially a consumer product, it also entails jobs in retail and distribution. South African-designed and -manufactured SWHs

are starting to go into production, although not yet at the level which could realize the target of 1,000,000 SWHs installed over the next five years, set recently by the energy minister.

There are two types of solar water heating systems emerging from the industry: low-tech units targeted at low-income housing, and more hi-tech units which are targeted at middle- to high-income housing. The costs of each type vary greatly, as do the skills requirement for installation and maintenance. The low cost units can be installed by a relatively unskilled worker with two to four days on the job shadow training (***explained in more detail in Case Study 4: Solar water heating***). (Here, training is on-the-job, that is, unskilled labour working with semi-skilled technicians and learning on the job. This is largely on an *ad hoc* basis, and training will depend on the aptitude of the individual learner as to how long the training takes.) These units do not have an electrical component, and work on gravity, therefore they do not require an electrical component or electrical expertise. The hi-tech units carry electrical backup and this implies a broader skill-set requirement for installation and maintenance technicians incorporating both plumbing and electrical knowledge. This was a problem during the 1970s when SWH technology was first implemented in South Africa, as the skills required were not available in the industry, resulting in poorly installed and maintained products. Recently, however, unit standards¹⁵ have been designed in both the electrical and construction Standards Generating Bodies (SGB) regarding SWH, which addresses the need for both construction and electrical skills for this field. ***Both types of installation refer to a technology which did not exist previously - or certainly not to the extent to which it will in future. Therefore this report considers that this is a new green collar occupation, rather than greening an existing one. (In addition, the numbers of people required for SWH will not become available from existing electricians or plumbers retraining as they are already in short supply.)***

Retail

As awareness of the global demand for increasing sustainability of business processes, combined with the push for greener economies begins to gather pace in South Africa, businesses are increasingly employing ***sustainability managers*** to ensure that they can control certain aspects of the production and distribution process as well as their supply chain partners. This is a new but relatively common occupation in South Africa, especially amongst multinational corporations and those who rely on EU or US-based export markets where the demand for such controls on green aspects of products and services is greater. Skills requirements for sustainability managers will differ from company to company and from industry to industry, however generic skills requirements will include some in-depth knowledge of carbon and water footprinting, sustainable agriculture and sustainable labour practices. In general, sustainability managers require strong operational knowledge of their businesses in order to strictly monitor sustainability criteria and identify ways in which processes can be improved. Labour for these roles is likely to come from within the company, and it is unlikely that a generic training course could be designed to suit all sustainability managers.

Carbon footprinting

Demand for increased knowledge around carbon footprinting will undoubtedly lead to demand for carbon auditors across many industries. Future demand could also be policy driven due to the government's Energy Efficiency Strategy (DME, 2005) which stipulates that all sectors across the economy will have to come up with a plan to improve their energy efficiency. The implications for

¹⁵ A unit standard is an official (registered) document that covers the outcomes and skills relating to an aspect of a particular field of study. Unit standards are grouped into courses (one-year certificate or two year diploma courses).

carbon and energy efficiency experts during the design and implementation of these plans in the coming years are likely to be significant. Prerequisites are generally good math and analytical skills, something which South Africa has struggled to produce from the majority of school leavers, and so a skills shortage in this area is likely. Carbon footprinting skills can however also be integrated into existing occupations in certain industries, such as agriculture (see Section 3.2.2).

Skills for this type of work exist in South Africa, albeit on a small scale, but the first (internationally) accredited training course for carbon and energy auditing (run by the Global Carbon Exchange, a private company that works globally) has recently been launched nationwide, demonstrating that the market is beginning to react to the global push for greening. The Global Carbon Exchange (GCX) is an international carbon and energy measurement, management and reduction consultancy, set up in response to climate change. GCX works with organisations to reduce their greenhouse gas emissions. It provides "GCX certified" three-day courses for various aspects of carbon and energy efficiency, at venues around the country. (The company is in the process of getting accreditation by South Africa's accreditation body, SAQA.) Courses offered are carbon footprint analyst (see Appendix 6), energy efficiency auditor (see Appendix 7) and a carbon literacy course. The energy auditors' course addresses issues energy in the context of lighting, building envelope, heating, ventilation and cooling, and hot water generation. The carbon footprint analyst course addresses issues such as carbon markets, the Clean Development Mechanism, and various tools available for assessing carbon footprints. The carbon literacy course is a broad course in issues related to carbon, and is generally attended by management and executives who need the background understanding the course provides in order to make executive decisions related to the running of their businesses. There are no entry requirements for the course. Approximately 150 people have completed the various courses (combined), since they began in July 2009.

Construction

New occupations in the construction sector are focussed around architectural design teams (see Case Study 5). The demand for these occupations will be influenced by policy in relation to building standards (currently under development), the extent to which construction companies see the benefits of going green, and awareness of office buildings and residential housing consumers in relation to energy savings and the potential of green buildings.

3.2.2 Greening existing occupations

Improved energy use and energy generation; water use and waste reduction

South Africa does not enjoy a culture of resource use efficiency and conservation. This is partly because until 1994, we had an apartheid-driven economy that did not focus on delivering basic services such as electricity and water, as well as land, to South Africa's non white populations. Also, we have a history of cross subsidizing industrial water and energy use and costs through domestic consumption charges. The combination of these legacies now makes it difficult to drive resource use efficiency in populations that until recently enjoyed little or no access at all.

South Africa has enjoyed a history of cheap electricity owing to its numerous coal-fired power stations using coal from its vast domestic reserves. Only 70 per cent of the population have access to grid-based electricity but this figure has been rising steadily from just over 30 per cent in 1994 (Mbendi). Furthermore in certain areas (most notably Soweto), electricity bill payment rates are as low as 24 per cent, indicating that a large portion of society does not actually pay for electricity and the ability of Eskom to recover debts and cut-off service to non-payers has been poor. The value of the service is not

being fully appropriated to those who use it, therefore there is currently little incentive for a large portion of society to start taking note of, and even reducing, the amount of electricity they use. Another motivating factor to reduce electricity consumption would be an awareness of climate change and the potentially environmentally damaging effects that fossil fuel-based electricity generation have, but as previously mentioned, South Africa is hardly even at the start of a learning curve in terms of raising awareness on this issue. ***A more immediately compelling case for energy conservation is the combination of the afore-mentioned power generation crisis and fast rising electricity prices.***

A similar issue exists with respect to water consumption. Since 2001 the government has employed a Free Basic Water policy which allocates 6,000 litres of water to each household per month based on eight people per household (DWAF, 2001). Whilst having some major benefits in terms of raising standard of living and giving millions free access to crucial water supplies, the full cost of the water service is not attributed to all customers and therefore the incentive to conserve water is not as great as it could otherwise be and there is a lack of awareness around water conservation.

This lack of awareness regarding conservation of energy and water also transfers into the workplace and employers can find it difficult to motivate staff, especially those on minimum wages, to change working practices to encourage energy efficiency. (One such example comes in the retail sector where all cashiers in a particular nationwide retail chain were briefed to encourage shoppers to reuse plastic bags. They were also encouraged to use energy saving tactics such as switching off lights when not in use and turning off electricity consuming appliances. The project had little success and experience showed that workers had little incentive to employ these measures in addition to their normal duties. See Case Study 6).

However, there is potential for huge gains to South Africa if it can increase awareness amongst the most common occupations of the drive for energy and water efficiency. The country has a large number of unskilled jobs in manual labour, predominately in the agriculture and construction sectors (both private and public), which employ approximately 750,000 and 350,000 unskilled labourers respectively. These jobs will require some additional skills specific to the greening process common to both sectors, principally in the areas of waste management and basic energy and water efficiency. Labourers in both industries come into contact with significant quantities of materials and chemicals. Correct disposal of these, along with efficient use of energy and water, can significantly reduce negative environmental impacts. Benefits include waste reduction, reduced water footprint, improved water sanitation, and reduced carbon footprint of the industries concerned. Simple but important changes to working practices will need to be instilled in all workers from the bottom up.

Typically, labourers will need the ability to:

- Identify different types of waste materials and select the appropriate disposal method.
- Ensure water is used efficiently and minimize loss.
- Ensure water leaving the site does so with minimal contamination from industrial processes.
- Use electricity only when necessary (i.e. recognize and implement basic energy-saving measures such as switching off appliances when not in use).
- Monitor and minimize use of carbon emitting machinery where possible.

Agriculture

One aspect of adaptation to climate change in the South African agricultural sector (which is also an example of greening an existing occupation) is the use of irrigation technology to reduce vulnerability

to increased climate variability. Although there is no official recognition, it is well-known throughout the industry that skills and knowledge of modern efficient irrigation technologies is limited in the country. To obtain and implement better irrigation methods to increase water efficiency South Africa will need skills in three key areas. Firstly, expertise is required to identify appropriate irrigation technologies that could improve water conservation, import them into the country (if applicable) and develop the market for them. Secondly, consultants and private businesses will be required to undertake market studies to ensure an effective rollout plan can be implemented to facilitate active selling and distribution at an economically viable scale. Finally, the end users (i.e. farmers and farm workers) need skills in using and maintaining the technology appropriately. This suggests that the demand for irrigation specialists will increase as agriculture and industry are required to improve water conservation. This could be driven either by market forces where end customers favour products which have an environmentally friendly production process, or by policy where the government enforces the pre-existing National Water Act which gives first preference of water use to human consumption (at the household level) and the environmental reserve.

Increasing levels of irrigation can have some potentially negative employment impacts. Irrigated agriculture employs approximately 1.5 per cent of the national total which is similar to its contribution to national GDP, giving it an employment-capital ratio close to the national average. The same ratio for the entire agriculture industry (both irrigated and non-irrigated) is higher than this, indicating that irrigated agriculture does not hold above average employment potential and is relatively capital intensive (DWAF, 2004). Furthermore, any expansion of irrigation should first consider legislation in the National Water Act 1998, which puts the needs of human consumption and the environmental reserve before those of agriculture and industry. ***This process of allocating water resources and analyzing where savings could be made and what technologies should be employed has implications for demand for water resource analysts and water auditors to improve monitoring and verification of water usage and conservation.***

In agriculture, greening also relates to growing crops in a sustainable, environmentally friendly manner. Using the deciduous fruit industry as an example, greening of the sector has had little impact on skills requirements at the less skilled level. Different chemicals are required for tree spraying, and methods of controlling pests and disease may change but in effect labourers still perform very similar functions as before and do not require particular knowledge around climate change, or up-skilling to be able to perform new tasks. With increased awareness of greening, however, employers will be encouraged to take note of the more generic skills mentioned above, and training implications across the entire agricultural sector could be sizable.

In addition to labourers, farm managers must be trained in the area of sustainable production as he/she will make decisions around production methods, water usage, technology implementation and pest control. This represents a skilled profession and considerable knowledge is required to assess waste treatment options and identify areas of potential improvement for energy use. In the fruit industry, sustainability of agricultural processes is not a new idea so in this case there is not a sizable skills gap. This has been partly led by export-demand as EU consumers favour environmentally friendly goods, but also because of the long-term nature of the fruit industry.

Greenhouse gas (GHG) footprinting has been taking place in South Africa in the fruit and wine industry through the “Confronting Climate Change” initiative (<http://www.climatefruitandwine.co.za/>). This initiative has launched a carbon footprint study that will enable both growers and service providers to determine their carbon footprint. It will also allow the user to identify “carbon hotspots”, with the objective of finding ways of reducing carbon emissions. The tool is downloadable and free. This three-

year research project will provide a “standardised, credible and scientifically robust” way for producers and packhouses to measure their carbon emissions. The tool provides data collection templates, calculations and reporting, and this will provide the user “insight to GHG emission hotspot areas within their supply chain”. The Protocol (version 1.1, Feb. 2010), available for free on the website, guides the user through all aspects of measuring their carbon footprints, entering the data, and using this to assess carbon footprint and carbon hotspots. ***There is no training component: the project runs only through the website and its tools.*** The Protocol explains the “context, assumptions and technical information” to use as a guide when using the calculator. The major funder of the carbon footprint research project is the Regional Standards Program (RSP) of the ComMark Trust, using funding from the UK’s Department for International Development, with other backers being the Post Harvest Innovation Fund (funded by the Department of Science and Technology), and the wine and fruit industries.

This experience has shown that, given the right tools, little specialist knowledge is required to assess the carbon footprint of a business process. Farm managers were capable of using the service effectively and the only prerequisite was knowledge of business operations and access to the internet, rather than any specific carbon or energy usage experience. Demand for this kind of addition to farm managers’ occupations is growing, especially in export-led industries, as mentioned above. Furthermore, the increases in energy prices in South Africa are also driving those farmers with domestic customers to think about their energy usage and therefore their emissions, despite the relative lack of concern on the part of the South African end consumer when compared to overseas markets.

Many agricultural sectors which function on a more short-term basis, such as the maize industry, will see greening as a new idea, and skills gaps in these industries are likely to be considerable. Currently there is already a deficit of farm managers of around 250,000 across the country and therefore pressures on public training providers (SETAs) to meet those primary needs are likely to take preference. Because of this, training for sustainable agriculture will almost certainly have to come from the private sector.

Engineering and construction sectors (see Case study 5)

Engineers and designers from all sectors of the economy have a big part to play in greening all future structures, vehicles, and industrial processes. Twenty to 30 per cent of all mitigation potential lies in energy efficiency in buildings. The IPCC (2007) gives the following table relating to mitigation potential in buildings in developed and developing countries, including South Africa:

Table 7: GHG emissions reduction potential for the buildings stock in 2020^{a)}

Economic region	Countries/country groups reviewed for region	Potential as % of national baseline for buildings ^{b)}	Measures covering the largest potential	Measures providing the cheapest mitigation options
Developed countries	USA, EU-15, Canada, Greece, Australia, Republic of Korea, United Kingdom, Germany, Japan	Technical: 21%-54% ^{c)} Economic (<US\$ 0/tCO ₂ -eq): 12%-25% ^{d)} Market: 15%-37%	1. Shell retrofit, inc. insulation, esp. windows and walls; 2. Space heating systems; 3. Efficient lights, especially shift to compact fluorescent lamps (CFL) and efficient ballasts.	1. Appliances such as efficient TVs and peripherals (both on-mode and standby), refrigerators and freezers, ventilators and air-conditioners; 2. Water heating equipment; 3. Lighting best practices.
Developing countries	Myanmar, India, Indonesia, Argentina, Brazil, China, Ecuador, Thailand, Pakistan, South Africa	Technical: 18%-41% Economic (<US\$ 0/tCO ₂ -eq): 13%-52% ^{g)} Market: 23%	1. Efficient lights, esp. shift to CFLs, light retrofit, and kerosene lamps; 2. Various types of improved cooking stoves, esp. biomass stoves, followed by LPG and kerosene stoves; 3. Efficient appliances such as air-conditioners and refrigerators.	1. Improved lights, esp. shift to CFLs light retrofit, and efficient kerosene lamps; 2. Various types of improved cooking stoves, esp. biomass based, followed by kerosene stoves; 3. Efficient electric appliances such as refrigerators and air-conditioners.

a) Except for EU-15, Greece, Canada, India, and Russia, for which the target year was 2010, and Hungary, Ecuador and South Africa, for which the target was 2030.

b) The fact that the market potential is higher than the economic potential for developed countries is explained by limitation of studies considering only one type of potential, so information for some studies likely having higher economic potential is missing.

c) Both for 2010, if the approximate formula of $Potential\ 2020 = 1 - (1 - Potential\ 2010)20/10$ is used to extrapolate the potential as percentage of the baseline into the future (the year 2000 is assumed as a start year), this interval would be 38%–79%.

d) Both for 2010, if suggested extrapolation formula is used, this interval would be 22%–44%.

Source: Table TS.5, IPCC (2007) http://www.ipcc.ch/publications_and_data/ar4/wg3/en/tssts-ts-6-2-mitigation-technologies.html

Architects and engineers need to expand their knowledge base to include new technologies and sustainable design features that minimize the environmental impact of buildings, during construction and operation. These are highly skilled jobs but technological change also plays a big part. Designers need to keep abreast of advances in technology and therefore continual up-skilling is required in that respect. The country already suffers from a chronic lack of engineers across virtually all industries and therefore it is likely that the skills shortage will extend into green engineering in the future.

Greening in the retail sector (see Case Study 7)

Procurement, particularly in consumer-demand-driven sectors such as retail, will also undergo significant changes due to greening. This is already happening in some companies in South Africa although this tends to be those with a higher-income target customer (such as Woolworths - see Case Study 7). Greening in retail essentially means ensuring that the supply chains for various goods meet certain criteria for environmental sustainability. The criteria to qualify as a green supplier vary from company to company but the onus is always on the supplier to meet targets across a range of indicators. The skills requirement within the retail sector is therefore relatively small in comparison to the potential skills requirement in the supply where any changes need to be effected. In this report the role of overseeing this process is considered as the responsibility of a sustainability manager and is a

new occupation. However, many changes to existing roles within a company need to occur to enable policies and key sustainability ideas to be successfully implemented. This is dealt with in more detail in Case study 7.

One energy intensive aspect of the supply chain is cold chain management. This involves the entire process of keeping chilled food at the correct temperature on its journey from the producer to the store. Various people are involved in the process (for example, drivers and packers). Significant quantities of products go to waste due to poor management of the cold chain process. Increasing thermal efficiency of vehicles delivering goods and up-skilling in this sector could have important ramifications for reducing food waste and improving energy efficiency.

An important precursor to large scale greening of any sector is robust research and development programmes into changing technologies and working methodologies. Jobs will be created in science and research but will be less academia focused and more around applied research in the workplace to implement greener practices. This will help to direct green markets and test new technologies. One programme aimed at providing the necessary skills for changing industrial requirements (including those of the green economy) is the Technology and Human Resources for Industry Programme (THRIP). Funded jointly by the Department for Trade and Industry and the National Research Foundation, the THRIP was established in 1991 to respond to the shortage of high-level technical skills in South Africa and attempt to slow the “brain drain” of skilled workers to other industrialized countries.

3.2.3 Identification of skill needs

The skills identification framework in South Africa works through a demand-led process which essentially engages industry to identify skills gaps, and then formulates education and training programmes to facilitate capacity building to fill those gaps.

The National Qualifications Framework (NQF) currently abides by two principles on which its setting and quality assurance processes are based. The first incorporates the idea that knowledge has become an interconnecting commodity that can have grave consequences when ignored. Knowledge is created through various partnerships and is no longer reserved for certain groups of people formerly known as ‘experts’. Therefore, it must be taken into consideration for uplifting the standard of skills currently in place. The second principle is more specific, as it acknowledges the economic need for education to comply with labour demands. Quality education must be balanced with skills training that will cater to the range of circumstances people face. This will widen the range of opportunity for the individual, while simultaneously meeting societal and economic needs.

New occupations and new skills requirements are then identified using these two basic principles. SAQA, as discussed in Section 2.3, is comprised of representatives from education and training stakeholders in South Africa, who are responsible for making and implementing policy. SAQA consists of two ‘arms’ that represent its standards settings and quality assurance. Standards are defined by the Directorate of Standards Setting and Development, and then evaluated and updated periodically through Consultative Panels. Various backgrounds are present and pertinent to effective policy decision-making in this sector of the framework, which stands by the first principle. At the sub-structure of this arm is the Standards Generating Bodies (SGBs), which review standards and recommend criteria to the Consultative Panels.

There are 23 Sector Education Training Authorities (SETAs), (see list in Appendix 5) each linked to a different industry and convened by the Minister of Labour. The SETAs are funded by the National Skills

Levy paid by employers (at 1 per cent of payroll) and were set up to serve the education and training needs of those employers' workers. *The SETAs undergo regular consultations with industry and work closely with the Standards Generating Bodies for each industry to identify the skills requirements that are anticipated within the sector.* Learnerships are *planned and structured learning components* that are created by the SETAs based on the demand for a certain set of skills within each sector. This is monitored through the submission of annual training reports by organizations. These reports require participating organizations to identify the scarce and critical skills in their industry. The SETAs then design and register learnerships with SAQA. SETAs must also become an accredited Education and Training Quality Assurance Body. Once this process is complete, the SETAs can then accredit independent training providers who wish to give training on particular unit standards or qualifications. The structure of this framework is summarized in Figure 2.

The outcomes are based on the economic need for education to comply with labour demands, and to raise the level of national standards and qualifications. The NQF strongly states the importance of meeting global standards to create a competitive economy that can successfully compete on the global market. It aims to do so by creating curricula that incorporate a participatory learning process, and are monitored by the second 'arm', representing quality assurance. The purpose of Education and Training Quality Assurance bodies (ETQAs) is to evaluate these programmes, and has national stakeholder representation during decision-making processes. These programmes are thus tailored to circumstance and aim to ultimately meet global standards while meeting national economic and labor demands. This will be accomplished by incorporating a certain range and level of skills into curricula, which are then followed up by the ETQA to ensure success.

While there is no direct mention of new green occupations, redesigning educational curricula to incorporate new skills and jobs creates a unique opportunity to introduce green jobs. *Some examples of where green skills have been incorporated into curricula can be found in the following section.*

Higher education and training (HET)

The Department of Labour (2008) has reported that

"(1) the greatest bulk of engineering output from Further Education and Training (FET) colleges is at the pre-matric (grade 12) National Qualifications Framework (NQF) skills levels 1 and 2, suggesting that further upskilling will be needed in the work environment before these students can perform effectively;

(2) 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;

(3) 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."

Table 8: 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	4,447	- Less than 1,000 qualify annually with NQF Level 3 - Close to 20,000 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	20,329	- Over 20,000 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	6,988	- Over 1,000 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 renewable and nuclear options, there is a poor match which may not be sufficient to meet (increased) demand.

Source: DME (2008b)

The report concludes that from a skills supply point of view, three priority areas should receive focus: the need for further in-house training at Level 3 within the sector; the need to ensure that Further Education and Training (FET) course materials are made more relevant to practical on-the-job requirements; and *the need to promote careers in renewable and nuclear technologies*.

3.2.4 Skills response

South Africa has well designed mechanisms for providing vocational education and training to the labour force and identifying skills gaps in the economy. However, it is clear from engagement with the private sector during the writing of this report that there is still work to be done—and perhaps a need for structural changes, such as the introduction of the Quality Council for Trades & Occupations

(discussed in Section 2.3.2) – to convince many that the framework for skills development in South Africa can be applied successfully.

With respect to the main sectors with greening potential which are focussed on in this report, energy, construction, and agriculture, it seems to be the case that industry does not use the SETAs to their full potential, and nor do they engage with them as much as was intended in the design of the skills framework.

The Expanded Public Works Programme is an example of a successful skills development, job creating project that has created thousands of work and training opportunities over the past few years. Furthermore, although not driven as a reaction to the push for greening globally, it has had a strong focus on greening through its projects in the environmental conservation sector.

The National Jobs Fund and associated training layoff scheme, although only recently initiated, can act as a strong opportunity for firms to train employees in sustainable working practices if they so choose, although this was not the primary aim of the scheme.

The Department of Science and Technology's Technology and Human Resource for Industry Programme (THRIP), mentioned earlier, can fund significant levels of research and development into new technologies in the science and research arena. Furthermore, all projects have a large element of human resource development and must aim to adapt the South African economy to suit global markets. The programme works by forming Public Private Partnerships (PPPs) with industry to jointly fund research projects which are led by academic staff from Higher Education Institutes (HEIs) and train students throughout the duration of the project. Almost 1,000 students have gone through the programme in the past two years and they are generally directed into small and medium sized enterprises based in technology development sectors (THRIP, 2009). Through partnering with other schemes such as the Innovation Fund and the Support Programme for Industrial Innovation, the THRIP has managed to inject strong elements of human resource development into these technology advancement programmes, such as in the solar water heating industry. They are also expected to be involved in the aforementioned PV factory development (case study 3). As the green sector expands in the coming years, PPPs such as this one could have extremely beneficial effects for technical green skills in South Africa.

University and other higher education institutions

Some examples of curricula offered in universities that include green aspects are:

- The Energy Resource Centre at the University of Cape Town (UCT) offers an MSc (Engineering) in Sustainable Energy Engineering, which includes courses in energy efficiency and demand side management, and new and renewable energy technologies. UCT's mechanical engineering B degree includes a course in energy efficiency & demand side management covering energy efficiency management and technologies used in heating and electrical equipment as well as in buildings; analysis of energy balances, energy audits, efficiency economics and tariff structures. Another course covers air quality and emission legislation; emission and pollution formation processes; in-cylinder & after-treatment control and electronic engine management; fuel and lubricant effects; emission measurements.
- UCT's Advanced Building Technology course (part of its B Architecture degree) includes a focus on "contemporary building and environmental technologies". The architecture degree also includes a course on environment and services, which "introduces global, regional and local environmental sustainability aiming to establish an understanding of the links between renewable resource utilization and built environment design issues"

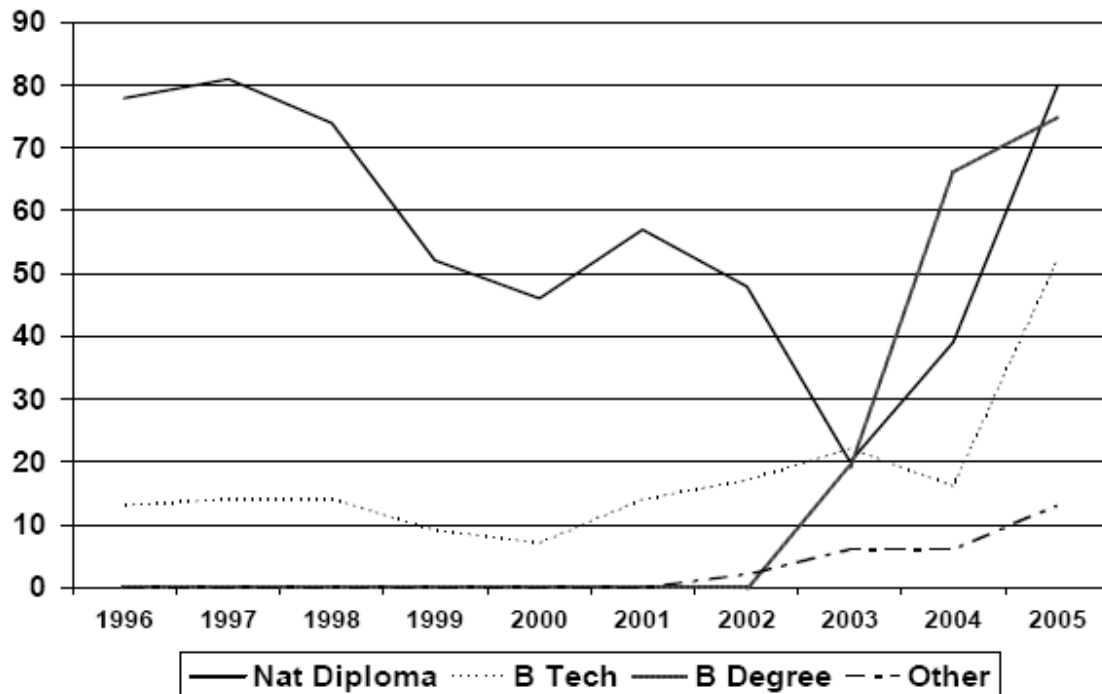
- A UCT civil engineering degree includes a course on energy policy and sustainable energy engineering.
- A UCT Chemical engineering degree includes an "Introduction to environmental process engineering", which covers interaction of industrial processes with the natural environment; mechanisms of pollution; air pollution theory and examples (Cape Town, the Highveld, global issues); energy related environmental issues; industrial water use and effluent treatment; acid mine drainage; municipal and industrial solid waste management; life cycle assessment; sustainability and sustainable development.
- The University of the Free State's agriculture degree includes courses on sustainable production practices.
- The Faculty of Science and Agriculture at the University of KwaZulu-Natal offers courses such as Sustainable Community Agriculture which covers the principles of agroecology, traditional farming, and organic farming, and introduces plant production, including effects of environment, cropping practices, and their effects on the environment. Another course offered is Soil Processes, Ground Water, and Atmospheric Pollution, which aims to give an understanding of soil processes that lead to pollution of waterways and of the atmosphere (including factors affecting leaching and effects on groundwater pollution, and processes involved in gaseous emissions of nitrous oxide, ammonia and methane from soils)
- The Sustainability Institute in the Western Cape works in partnership with the School of Public Management and Planning of the University of Stellenbosch in various areas of education including Masters and PhD degrees in Sustainable Development Planning and Sustainable Agriculture. Modules offered at a B Phil level are biodiversity and sustainable agriculture, systems and technologies for sustainable agriculture, managing sustainable agriculture enterprises, policy and legal framework for rural development in the agricultural sector, and food security and globalised agriculture.

Note: The above list is not exhaustive; it is a sample of what some universities in South Africa offer, and relating only to some courses.

Higher (tertiary) education: An example focussing on the renewable energy sector

The Department of Labour commissioned a report in 2008 entitled "Projected skills demand and supply for the electrical energy sector". This report found that whilst the numbers of graduates in conventional qualifications for electrical energy is established and growing, *"output from Higher Education and Training 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"*. This is shown in Figure 9: Renewable energy resources graduates from Higher Education Institutions (HET): 1996 to 2005

Figure 9: Renewable energy resources graduates from Higher Education Institutions (HET): 1996 to 2005



Source: Figure 4.11, DME (2008).

Implications of these supply trends in the output of graduates from FET and HET institutions are that "(1) 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;

(2) 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;

(3) 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;

(4) There has been a ... modest improvement in [numbers of] post-graduates of all races; and

(5) *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.*" (bold/italics are this author's).

This report also analyzed changes in enrollments in tertiary institutions as a tool to understand and predict trends in graduate training. It stated that the Human Resource Development Review conducted

by the HSRC in 2003 had found that training by the private sector declined during the late 80s and 90s in South Africa (from approximately 250,000 in 1988 to approximately 50,000 in 1998). The training of apprentices using the “structured apprenticeship model” also declined from 10 758 in 1991 to 3129 in 1999 (Kraak 2007). The new post-apartheid government then passed legislation to promote skills training and development, notably the Skills Development Levy Act and the Employment Equity Act. The Sector Education and Training Authorities (SETAs) were also established, creating a national regulatory framework. These combined initiatives led to “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).

Public and private sector training and skills development

Since the government’s ‘green sector plan’ is only expected to be finalized in July 2010 (by the Economic Sectors and Employment Cluster), there is as yet no coordinated or articulated public sector push towards developing skills for a green economy; it has yet to be developed. Since industries are generally doing much of their own training, detailed information regarding training is hard to come by, and varies from company to company and from sector to sector. Much training appears to be given on needs-driven basis, that is, employees are given the training they need, not necessarily within a delineated framework. Most of the industries that were interviewed during the preparation of this report were unable to give specific details about their training and skills development, which generally seemed to be provided on an *ad hoc* basis.

With regards to the sectors discussed in sections 3.2.1 and 3.2.2, the following details are provided for sectors where information was available.

- Agriculture and Retail and manufacture - an example is (at least partially) provided in Case study 7.

The following is an example of green skills training provided by an NGO.

Training offered by a Non-governmental organization (NGO): Environmental educators' courses

The Wildlife and Environment Society of South Africa (WESSA) was established in 1926 and claims to be South Africa’s oldest and largest non-government, membership-based environmental organization. It employs professional environmental staff to work with the public, local, provincial and national government and with other environmental organizations for the protection of the environment. WESSA’s website states that it is represented on national and regional conservation bodies and investigatory commissions, and is a founder member of the World Conservation Union (formerly the International Union for the Conservation of Nature - IUCN).

WESSA offers two **Environmental Educators Courses** (one part-time and one full-time) at NQF Level 5: “Addressing environmental issues and risks through education for sustainable development”. WESSA is an accredited training provider, a WESSA offers the Environmental Educators’ course to align with three unit standards: Demonstrate knowledge of EE (Environmental Education) goals, principles and methods of their appropriateness in different contexts; Review a variety of approaches to learning, teaching and evaluation; and Network broadly to source information and support a key environmental issue or risk.

The courses are accredited by the Education, Training and Development Practices Sector Education and Training Authority (SETA). The courses cover: an introduction and orientation to Environmental Education; fieldwork and practical activities; environmental interpretation; identification of environmental issues and risks and approaches for action; teaching materials and resources.

The part-time course is five days, and covers “addressing environmental issues and risks through education for sustainable development”. The full-time course (previously known as the Southern

African Development Community (SADC) Professional Attachment Courses: Education for Sustainable Development¹⁶) is a ten-day course, that includes the five-day Environmental Educators' Course. Applicants need a minimum entry level of Level 4 (equivalent to Matric / Grade 12). Computer literacy is a requirement for the full-time course. The course is also offered "on a themed basis according to workplace-related environmental issues". Minimum number of participants: 10.

The course structure includes theory and practice, where participants receive a resource file and Learner Manual and work on their Portfolio of Evidence (a collection of work produced by the learner that is used for assessment purposes). Activities and resources are adapted to local conditions. This is described as a "hands-on" course requiring a high level of involvement from participants. The course is made up of "brief lectures, extensive fieldwork, group discussions and projects."

Learners from an organization that pays a monthly Skills Development Levy are able to claim back the cost of the accredited training via their Workplace Skills Plan.

Source: WESSA website: <http://www.wessa.org.za/index.php/Education/Environmental-Training.html>

Solar water heating (SWH) skills and training

Recently three national unit standards related to SWHs have been designed. Two are entitled *Install and maintain solar water heating systems*: one is an elective of the National Certificate in Electrical Engineering (NQF Level 3) from the Standards Generating Body (SGB) Electrical Engineering and Construction; and one is an elective of the Further Education and Training Certificate in Plumbing (NQF Level 4) from the SGB Building Construction. The third is entitled *Mount solar water heating systems* and is a core unit of the National Certificate of Hot Water System Installation (NQF Level 2) from the SGB Civil Engineering Construction. One service provider is registered (as at Apr. 2010) to offer these unit standards.

Training provided by a public-private partnership and the Southern African – German Chamber of Commerce: Solar Water Heating installation

The Builders Training Centre in Soweto, a large township near Johannesburg, is a project of the Southern African–German Chamber of Commerce and Industry. The centre is accredited as a training provider by the Construction Education and Training Authority (Construction SETA), and sponsored by the Department of Labour and the National Skills Fund. Established in 1993, the centre offers other construction courses (although these make no mention of green skills). In December 2009, a solar water heater (SWH) installation and maintenance training centre was launched at the centre, with a pilot phase. The project is partly funded by German Development Bank Deutsche Investitions und Entwicklungs-gesellschaft (DEG), who are contributing about Euro 125,000 for the training programme over the next two years. The training component is managed by the solar division of a KwaZulu-Natal aluminium manufacturing facility. A German solar solutions manufacturer is providing the SWH module equipment and expertise.

¹⁶ The purpose of the Regional Environmental Education (EE) Programme is to enable environmental education practitioners in the Southern African Development Community (SADC) region to strengthen environmental education processes for equitable and sustainable environmental management choices. The aim is to achieve this through enhanced and strengthened environmental education policy, networking, resource materials and training capacity.

The course is not yet open. The first phase of the training is the plumbing module, which takes 45 training days. ***The second part of the course is a general 12-day course on solar energy, focusing on solar heating and installation basics.*** The whole course will therefore take approximately three months. People who have already done the plumbing training can take the solar part of the course separately. The second part of the training is provided by an expert trainer from the German manufacturer partner, and will focus specifically on installation and maintenance of their SWH modules, along with an engineer from the KwaZulu-Natal company. The products being used in the training are thermal collectors, which do not require connection to the existing heating system as the closed system operates by force of gravity without a circulation pump, electronic control or connection to the mains. (Therefore the main training component is plumbing, with no electricity component.)

The training centre is planning to train three groups of 16 participants, a total of 48 people, in the months between opening in 2009 and July 2010.

3.2.5 Case studies on new green collar occupations

Case Study 4: New Green Collar Occupations – Solar Water Heating Installation Technician (referencing the Kuyasa Housing Project Case Study)

Kuyasa near Cape Town, South Africa, was built as a low-income government housing project. Kuyasa is now piloting the installation (retrofitting) of solar water heating (SWH), along with insulated ceilings and energy efficient lighting in low-income housing. The project, known as the Kuyasa CDM Pilot project was designed by NGO SouthSouthNorth for the City of Cape Town, with funding from the Department of Environment and Tourism's Social Responsibility Programme and Provincial Government's Department of Housing. The implementer is the South African Export Development Fund who underwrote the finance. By September 2009, 1,500 installations were complete.

South African cities have an acute shortage of low-to middle income housing and given a limited budget and the urgency of the need for basic housing for large numbers, low-income housing has generally been built without prioritizing energy, thermal efficiency or the health and safety of the occupants. South Africa has built over 2.5 million low-income homes in the past fifteen years, and is targeting a further 3 million by 2025. The quality of these houses and therefore their energy efficiency is generally poor and as such the opportunity to reduce the energy intensity of this housing sector is enormous. For example, if all low-income housing built since 1994 had included thermal insulation and solar water heating (SWH) (at a total of R10,000 extra per house) this would have cost R25 billion and would have avoided the need for 4MW of coal fired power generation (currently costing R95 billion to construct). Kuyasa is Africa's first CDM project and the world's first Gold Standard Project due to its focus on pro-poor investment, sustainable development, and job creation. (Kuyasa CDM Project, 2009).

The project involves retrofitting of SWHs, insulated ceilings and energy efficient lighting in over 2,300 low-cost homes and to-date more than 1,500 installations are complete. Job creation and up-skilling of locals is at the heart of the Kuyasa project. To date, 85 **full time** jobs have been created in the SWH retrofitting project (of which 50 are youth, 28 are women, and three are disabled). Many other jobs have been created that are part-time, or not permanent. In total Kuyasa has paid over 22,000 man days, or approximately 85 man years. To meet the requirements for ongoing maintenance and servicing of the SWHs, insulation, and light bulbs the project has established a sustainable energy services entity

operating from within the township which is run by, and employs, locals thus creating permanent employment. The sale of carbon credits part-finance these ongoing activities.

Furthermore, employment has been created as an offshoot to the project, including ceiling and SWH installation teams who serve private clients, and an edu-tourism initiative bringing fee-paying tourists or conference delegates who visit the project. Kuyasa has now started installing 800 locally manufactured SWHs, which means the local supply has begun to expand and increase employment as the demand for goods and services in this sector growing.

The occupations involved in the project vary from site managers, stock controllers and liaison assistants, to electricians, plumbers, roof drillers and frame assemblers. Thus far training has been given by the project itself. *In total the project has employed over 409 individuals (including the 85 full-time jobs mentioned above), broken down as per the categories in Table 9. The additional jobs are either part-time or not permanent.*

Table 9: Kuyasa employment breakdown (including full time jobs)

Category	Number of individuals	Total paid working days
Clerical	2	531
Labourer	239	2,565
Semi-skilled	145	15,001
Skilled	19	3,989
Supervisor	2	596
Total	409	22,682

Source. Kuyasa CDM Project (2009)

The main demand for workers is in the semi-skilled category (70 per cent of man days). With regards to SWH installation, the main demand is specifically for plumbers (both skilled and semi-skilled). A SWH team consists of two dedicated unit installers, and several support workers who prepare the roof for installation by drilling holes, assembling and fixing the mounting frame. The project has targeted gender equality in all roles and has successfully employed females in roles which are traditionally considered as belonging to males. Although initially the project used people with some experience in plumbing to install SWHs, most SWH installers on the project have had no previous experience in the sector, and came from the unskilled applicant pool. In the space of a few days (2-4) on the job (shadow) training, the project produces workers who can install and maintain SWHs to a high standard. (In fact a survey of Kuyasa indicated that 96 per cent of households were either very satisfied (86 per cent) or satisfied (10 per cent) with the installation and maintenance of their SWH systems).

Training

Some accredited training was provided at a nearby Further Education and Training college. For example during 2009 (to September), 24 people were trained in heavy electricity and heavy current electricity, with each person receiving five, ten or 15 days' training (apparently either because training was based on one to three unit standards or because training was offered to different levels). Twenty-nine people received training in plumbing: 15 days training. Training targets were set at 14 people for heavy current electrical, 31 people for carpentry and 15 for plumbing. These targets were all met.

Non accredited training was given to 140 people (May 2008 to Sep. 2009) in the form of on-the-job shadow training, for example: six people were given one day training in basic SWH installation; 23 people received insulated ceiling training ranging from 4-5 days; three people were trained as plumbers (3 days training); six people received frame assemblers training (3 days training); six people received ceiling installation training (1 day); ten people received a more extensive SWH training (4 days). In addition, various life skills courses were given, such as home based care (1 or 4 days); urban agriculture course (seven people: four days' training); hotbox and gardening (about 500 people - 1 day training).

The potential for job creation is large and has been made more attainable by the Energy Minister's target of installing 1,000,000 SWHs over the next 5 years. The minister estimated that this would create approximately 100,000 jobs across the value chain and this assumes a significant portion of local manufacture. This figure meshes well with the level of job creation seen in the Kuyasa project.

It would seem likely that relevant skills for installation of SWH would be drawn from the fields of plumbing and electricians. The 2008 Scarce Skills List (Dept of Labour, 2008) indicates that there is a shortage of 2,930 plumbers and of 5,315 electricians. However, from the experience in Kuyasa it would seem that the prerequisite skills requirements for installation and maintenance of SWHs are low, and training requirements are generally no more than several days on-the-job training (although the national unit standard offered as part of a wider qualification would provide a wider skill set to the participant). These unit standards can be found on: * <http://www.labour.gov.za/documents/useful-documents/skills-development/national-scarce-skills-list-2008/> (Dept of Labour, 2008).

It would therefore appear that the existing skills gap for solar water heater installation and maintenance workers can easily be filled by similar on-the-job shadow training or by courses such as the one outlined in section 3.2.4.

Case Study 5: New Green Collar Occupations – Climate Change Advisor/Climatologist

Climate change and the related need for adaptation and resilience building is resulting in the need for new professions in addition to re-skilling in existing sectors. The role of a **climatologist** for example originates from the study of climate science. This is a highly skilled occupation involving the development of climatic models that identify patterns and relationships within climate data on an inter-annual, inter-decadal, and inter-centurial basis. Climate science professionals research and analyze the fundamental changes in climate which are beginning to affect the entire global population as climate related impacts become more severe.

At a global level, climatologists build Global Climate Models (GCMs) which have informed much of the current understanding of climate change. At a regional, national, and local level, climatologists are able to build models to forecast climatic variability at a much smaller scale. In many areas of business, not least agriculture, information about both potential variability and long-term climate change is critical. Public awareness and understanding of climate change is growing around the world. Both governments and the private sector are becoming more conscious of the potential for climate change to negatively impact upon business, industry, and many human security issues. Because of this, the demand for downscaled modelling, risk based assessments and research analysis from climatologists, resource economists, development professionals and sociologists to mention a few, is increasing rapidly to enable all stakeholders to fully assess their exposure to climate variability.

Climate change related research capacity in South Africa is based at the University of Cape Town (UCT) in the Climate Systems Analysis Group (CSAG); at Wits University, at the University of Tshwane

(Pretoria) and at the Council for Scientific and Industrial Research (CSIR). Research capacity also exists at private institutions and within the private sector, particularly in the insurance and mining sectors. Currently the sector comprises of approximately 50 full time academic staff and research professionals, of whom about one third hold a PhD and the remainder are educated to MSc level. The gender breakdown is around two males to every female. Even without the added urgency for skills brought about by climate change, the sector already experiences skills shortages with regards to South African candidates. This is especially true for black applicants who are severely underrepresented in the sector. One reason for this is the high demand across all sectors of the economy for black university graduates from all disciplines, who are often given preference by large companies who need to fulfil their Black Economic Empowerment (BEE) obligations. Potential black entrants to the climatology sector may be tempted by more attractive job offers and benefits elsewhere. In addition, the sector lacks the necessary funding from government and private sources to offer bursaries for studies in climatology and there are no dedicated bursaries for undergraduate studies in this field.

In addition to the skills shortage in the academic arena, there is a void of skills which enable climate science research and modelling to be converted into useful information and adaptation on the ground, especially in climate-reliant industries such as agriculture. This new type of occupation, a **climate change advisor**, in the case of agriculture, would be filled by people with an agro-meteorology qualification. Additional skills could be built in data analysis, as well as knowledge of agricultural practice and changing land use patterns in response to climate. An ideal vehicle for this would be an apprenticeship programme where students receive training in both basic analytical climatology skills and agricultural land practices, whilst working in the agricultural sector. The aim would be to create a stronger link between research and practice whilst further enabling the greening of the agricultural sector in response to climate scientific research. Essentially this occupation provides interpretation of climate projections and offers practical adaptation solutions to businesses as well as government departments.

The potential for this type of climate change advisory role to be replicated across other industries is significant and would involve two types of training. Firstly, there is a strong aspect of climate model understanding and interpretation which would be required across all industries. This would be a technical course given by an academic institution for which the prerequisite would be a solid mathematics and science background to at least matriculation level. The second requirement would be hands-on, practical knowledge of the concerned sector's functions and climate-affected processes, gained through apprenticeship training. To date there are no training programmes set up with this specifically in mind, possibly due to the cross-cutting nature of climate change in business. Each industry will be affected slightly differently and so training would work more effectively if incorporated into existing training programmes.

To date the skills shortage has not been officially recognized by any government body, and despite the University of Cape Town's climate change unit recently being named a Centre of Excellence by the Department of Science and Technology, there have been no programmes specifically designed to increase the intake into climate science. The responsibility for recognizing the skills gap lies with each sector's SETA and the Department of Labour, and will be driven by the immediate concern from industry and the public sector. However, in order for sectors to adapt successfully to the effects of climate change, significant foresight is required. As such, increasing capacity and knowledge of the effects of climate change upon business and industry and the potential adaptations available should be encouraged through public private partnership sponsored schemes to deploy climate change advisors to various sectors.

There is currently some activity in this area as some businesses are employing climate change advisors, although not always named as such. For example, several large mining and oil companies operating in South Africa have teams dedicated to assessing the impact of climate change on future projects. They also work closely with government on strategy and negotiation positions on emission reductions. The reinsurance industry employs actuaries to model insurance risk and cost, based on climate change advice from inside employees, although these are often international.

3.2.6 Case studies on greening existing occupations

Case Study 6: Greening existing occupations – Architect / Green Buildings Advisor (referencing the Green Buildings Council)

A significant portion of global emissions has been attributed to buildings and the construction process. Globally, energy efficiency in buildings has the biggest potential to limit emissions of greenhouse gases and could do so by 20 to 30 per cent of total mitigation potential (ILO, 2007). The concept of greening when applied to buildings and construction refers to “designing structures that are environmentally sound and follow the codes of sustainability. Such buildings consume less energy, are durable and can be recycled. During all phases the building saves resources and places fewer burdens on the environment, protects workers, and minimizes health exposures.” (LEHIGH, 2009)

The construction sector in South Africa accounts for more than 4 per cent of GDP (Stats SA, 2009) and employs upwards of 500,000 workers across a wide variety of professions. This figure is expected to increase to around 700,000 by 2010 (BMI Building Research Strategy Consulting Unit CC, 2006). Therefore the potential for additional skills requirements due to the drive for greener buildings (both new and existing) is significant. Furthermore, the national government has taken note of this need and has included several measures that will help it achieve the target of reducing energy demand from commercial and public buildings by 15 per cent by 2015 (DME, 2005). These include establishing an Energy Efficiency Standard for Office Buildings which will be integrated into National Buildings Regulations, increasing awareness of energy efficiency, and implementing mandatory energy audits for commercial buildings.

Additional skills will be required to enable South Africa to build greener buildings, and retrofit existing buildings with energy saving measures. Firstly, the design team will require different skill sets, and secondly, all other workers including contractors, labourers, and artisans. The **design team** of a construction project encompasses many different occupations including but not limited to architects, financiers, project managers, engineers (mechanical, electrical, structural, landscape), quantity surveyors, environmental specialists, health and safety officers, and sustainability consultants.

Additional skills required in the design team for a new structure arise from the approach that design decisions should be made bearing in mind lifecycle costs, and not only the initial capital costs associated with a building. Designers need knowledge and training related to energy efficiency-related technologies such as rainwater harvesting, solar water heating, photo-voltaic power systems, biogas digesters, grey water treatment systems, waterless urinals, low volatile organic compounds materials (such as paints, carpets, adhesives) and other tools. Training on specific products is often given by the suppliers of these products, who market them by increasing awareness of environmental benefits and appropriate usage.

Knowledge of other environmental architectural methods such as orientation, cross ventilation, and passive methods to control building techniques are also required on the design team, and are usually

provided by an architect. This role of “green buildings advisor” is to advise and direct on sustainability and environmental issues regarding all aspects of building design and construction. Training on this aspect of design and construction is given by the Green Buildings Council throughout South Africa (GBCSA) where participants find out how to integrate green issues into project design and operation and gain skills required to rate buildings on their level of green application. The skills needs would have been identified by annual reports through the Construction Sector and Education Training Authority (SETA).

The World Green Building Council is the coordinating body for national Green Building Councils in 13 countries including Brazil, Canada, Germany, India, Japan, United Kingdom and United States. The GBCSA became the thirteenth member Council of the World GBC in September 2008. The global organization was founded in 1998 and its vision is to “provide a balanced and integrated global platform in which to collaborate and advance the work of the national green building council organizations”. The individual green building councils “support the development and implementation of high performance/green building principles, standards, rating and certification systems, performance measures, technologies, products, resources and projects.” Green building councils are open, non-profit membership coalitions of the building industries diverse sectors.

The Green Buildings Council runs the **Green Star SA Accredited Professional Program**, which gives accreditation to industry professionals who complete the *Green Star SA Accredited Professional course*, and who successfully pass the *Green Star SA Accredited Professional* examination. The course is suitable for academics, as well as professionals in the industry such as architects, contractors/builders, developers, cost planners, engineers, facilities managers, general managers, interior designers, landscape architects, marketing managers, policy advisers, town planners, product manufacturers, project managers, quantity surveyors, solicitors and others. Course participants receive a manual that also explains the use and application of the Green Star Rating Tool. The rating tool used in certifying that green building strategies have been followed is the *Green Star SA rating system*, which assesses content and practical application of green principles during the building design and construction process. Certification allows the marketing of the building as a “Green Star SA certified building”.

The core course of the GBCSA is the *Green Star SA Accredited Professional course*. This is a one-day course, and course content covers:

- The GBCSA: history and operation
- The Green Star SA environmental rating system of buildings: origins and overview
- Green Star SA environmental impact categories: core credits
- Green Star SA and other rating tools on the market: interaction
- Accredited Professionals: role on the design team
- Green Star SA certification: process, roles and responsibilities. (This aspect refers to the process of certification of buildings as having been built according to green strategies and principles.)

The course format is made up of lectures, Q&A, case study examples and exploration of the categories and credits in the Green Star SA system, in multidisciplinary groups.

Approximately 1,000 individuals completed the course during 2009 alone, and 160 have taken and passed the exam to become accredited professionals (as at March, 2010). There is no requirement for a previous qualification in order to attend the course and write the examination, however, most

participants are industry professionals. Applicants from all areas of construction (not only architects and designers) are encouraged to attend even if they are not intending to take the exam and so this represents a significant amount of **greening of existing occupations**. The course is promoted as being suitable for a range of professions (apart from construction): academics, architects, developers, cost planners, engineers, facilities managers, policy advisors, town planners, product manufacturers, project managers, quantity surveyors, solicitors, and others.

Demand for qualified green design teams is largely market driven as clients become more aware of the potential for energy savings and the impact of energy intensive buildings. Combined with more stringent building regulations around energy efficiency (see above) the demand for greener construction should increase. There are currently almost 50,000 workers employed in some type of core design team occupation such as architects, construction managers, engineers and related professionals (Stats SA, 2009), all of whom will require certain aspects of training in green building function and design. The first building in South Africa to have a four star green rating from the Green Buildings Council was passed in 2009, so the green buildings push is still in its infancy.

This type of high level training is unlikely to come from government but institutions of higher education already include fundamentals of sustainable design in undergraduate programs. One such academic programme is the University of Cape Town's civil engineering degree which includes material on environmental management in construction.

In addition, the South African Council for the Architectural Profession (SACAP) is allowing members of the architectural community to obtain Continuing Professional Development (CPD) credits by buying a copy of Volumes 1 or 2 of the Green Building Handbook. Architects and associated professionals need to obtain credits in order stay registered with SACAP, which is required to allow them to practice. The Handbook chapters will be grouped together into learning modules which have been approved for accreditation by the South African Council for the Architectural Profession (SACAP). From April 2010 architectural professionals will be able to get Category 1 CPD credits (the highest level) from the same Modules in the Handbooks by writing and passing the online multiple choice tests for each chapter.

The Green Building Handbooks are aimed at property owners, architectural professionals, engineers, product and service providers, government, home owners, students and other related stakeholders in the built environment sector. They contain contributions from South African experts and product suppliers, and intend to provide insights into green building designs, technologies, materials and solutions relevant in the South African context and the effect that each has on the environmental impact of buildings.

Case Study 7: Greening existing occupations - Biological farming for the retail sector (referencing Woolworths)

In terms of environmental impact, the retail sector often has to manage the aggregate of the environmental issues occurring at each node of the supply chain that feeds into it. Therefore greening in this sector usually entails greening the supply chain and production and distribution facilities, up until and including the point of sale. In this way many sectors are affected - such as agriculture, manufacturing, buildings and business - all of which require skills to facilitate the process and as an ongoing concern. Agriculture and manufacture alone employ over 1.5 million workers (Stats SA, 2009) and if greening each position is required, this has significant implications for skills development. Based on research and interviews with retail executives, greening in this sector has been, and will continue to be, driven by changing consumer preferences, corporate social responsibility compliance and

marketing, as well as fierce competition. Cost reduction has also played a role, although to a lesser extent.

Having only really formally taken hold in the past five years or so, the process of greening is still in its infancy in the South African retail sector and is positioned for future growth. It is only being carried out by a limited number of firms that are positioned at the higher end of the market, such as Woolworths and Pick 'n Pay and other smaller boutique operations. These retailers now have sustainability policies or strategies in place, usually as a component of a broader sustainability policy that addresses transformation and other social issues simultaneously. It seems that these initiatives are mainly being driven by anticipation of future policy requirements and these firms' desire to capture strategic markets that are in the process of developing.

Sustainable or low impact farming in the food retail sector is an example of this (and of greening of an existing occupation). Woolworths' "Farming for the Future" programme is a case in point. Woolworths is moving to phase out conventional farming in favour of more sustainable methods by its suppliers. Farmers are required to adhere to certain standards with regard to produce; in particular the aspects of soil, pest and plant management, water management, biodiversity management, and waste water management. A group of recognized, independent scientific experts (soil scientist, biodiversity, waste water and agriwaste scientist, carbon footprint specialist and legal expert) do the initial assessment and identify any problems. Where problems exist, the relevant expert (or experts) visits the farm (or other organization, such as a packing-house) for a day of consultation with the farmer or owner (along with the farmers' own experts, should he have them), which is paid for by Woolworths. Thereafter, the farmer/supplier (or owner or CEO, in the case of a packing-house) must pay for further consultations required. Generally, farmers usually have around four full days of consultation per year (although this may be broken up into mornings/hours, etc., as required. When the required targets are met, the farmer is given more business in the following financial year. The assessment of indicators is repeated annually. Sometimes the process of reaching the required standard of compliance may take a few years, and has to be phased in, for example when phosphates build up in soil. The annual assessments determine the level of Farming for the future integration, provide targets and measure results.

The Farming for the future techniques aim to improve soil and water quality, promote water saving and encourage biodiversity (Woolworths Press Release, 3 Nov. 2009). This is done by monitoring various aspects of the enterprise, and giving the necessary expert advice/feedback to the farmer.

Soil mineral management consists of reducing the use of synthetic fertilizers by increasing on-farm nutrient cycling and measuring to determine if the minerals in the soil are correct, in preference to routine conventional chemical use. Soil structure, soil microbial activity and soil carbon are built by reducing the use of synthetic fertilizers, herbicides and pesticides by increasing on-farm nutrient cycling (compost and organic fertilizer). Integrated pest management principles are used to reduce reliance on chemical pesticides and herbicides, which also reduces resistance to pesticides, chemical contamination of the environment and/or food, and health risks to spray operators. Plant management techniques used involve leaf analysis, monitoring plants, seed treatment, foliar fertilizing, fertigation, intercropping, growth stimulants, hydroponics and atmospheric management. Water management is by optimizing the use of water per kilogram of product produced. Crops receive the optimum amount of water required rather than routine irrigation. Biodiversity management methods help improve biodiversity on farms by managing threatened eco-systems, invading alien plants, veldt-fires, corridors and habitat fragmentation, restoration and rehabilitation, game management in natural areas and the impact of agricultural by-products (plastic containers, plastic from hydroponics etc.). Waste water

management methods are used to help prevent the negative impact of effluent water on the environment. (ibid) The initiative is supported by the WWF.

The programme seems to have been effective in that despite some initial resistance, farmers have been willing to pursue and comply with the programme's requirements. The programme is of course difficult to implement where farmers may only sell a certain small percentage of their produce to Woolworths, or where they are surrounded by farmers using conventional methods.

Rather than implement an extensive centralized training programme (which is almost impossible to do given the locations and variety of farms and suppliers throughout South Africa), external consultants are hired to conduct assessments and facilitate the implementation of greening Woolworths' local produce suppliers by *giving consultation/training on a farm-by-farm basis*. Farmers are responsible for all aspects of further training and upskilling of their workers. The farmers/suppliers provide this training in different ways. For example the pesticide advisor will train the supervisors and they train their teams. Some farmers/suppliers send their people to a recognized institution; whilst others provide in-house, on-the-job training. (However, as explained in further detail below, there is a gap in formal provision of training for workers in the agricultural sector, and in general training is given by the enterprise).

The system is not entirely organic but an environmentally friendly middle-ground has been achieved, optimized for each farm - 105 of them. It is heralded as a success within the firm. The programme is in the process of being rolled out through the various levels of suppliers and secondary suppliers, and through various types of produce, beginning with fresh produce (fruit and vegetables). By the end of 2012, the company aims to have 85 per cent of its produce from compliant farms, (perhaps best called biological farms), at no extra cost to the consumer.

Relevant unit standards from the SAQA

Two relevant unit standards in the SAQA framework (at NQF Level 1) level that apply to this type of training are:

- *Demonstrate an understanding of the basic concepts of sustainable farming systems.* The unit standard requires the learner to demonstrate a basic knowledge of: Basic concepts of sustainable farming systems; basic environmental patterns and processes; elementary comprehension of farming systems and designs; measurable indicators of sustainability; local veld types; importance of carrying capacity of local veld types; local weather and climate; basic local ecosystems; importance of biodiversity in local farming systems; basic input sources; markets (local and other); income sources on a farm; needs and aspirations of local communities; social indicators; economic indicators; and ecological indicators.
- *Understand how sustainable farming systems conserve natural resources;* Demonstrate an understanding of the impact of farming operations and practices on the environment; Identify farm and domestically generated waste and pollutants and apply environmentally friendly methods of disposal and/or re-use; Apply practices to maintain and increase biodiversity; Understand how to control invasive alien plant species and noxious weeds; Prevent the spread of veld fires using farm firebreaks and/or fireguards.

Agricultural programmes (ranging from certificates and diplomas to degrees) are offered at six universities of technology, at eight universities, at eleven agricultural colleges, (as per the AgriSETA's Sector Skills Plan, 2006-2010, appended). Of the Further Education and Training Colleges (FET: Grades

10 to 12), 14 currently offer agricultural programmes (PASA, 2010). According to a document of the Publishers' Association of South Africa (2010), compiled for the purposes of calculating actual enrolments in 2010, 1,860 learners are enrolled at Level 2, 787 at Level 3 and 370 at Level 4, making a total of 3,017. According to the Sector Skills Plan, 8,000 learners are enrolled at Higher Education and Training level (at eight universities and six universities of technology). However the document notes that the level of training at Agricultural Colleges needs to be improved.

The document also notes the low level of participation of learners in these programmes, and calls on employers to utilize the training opportunities.

The SSP goes on to say that Annual Training Reports for 2004-2005 indicate that 51,000 out of a total workforce of 107,000 were exposed to some form of training (about 50 per cent), although there is some doubt as to the accuracy of this figure, and includes informal and structured on-job training. Other points noted were most training is aimed at lower skilled workers (51 per cent); most of the training is done by large enterprises (82 per cent) although this figure may not reflect smaller enterprises that do training but do not submit annual training reports. Only 12 per cent of the training was focused on black owners and managers, which is seen to be a concern.

Skills priorities development identified

The document states the following: "The Organising Framework for Occupations (OFO) template, prescribed by the Department of Labour for capturing scarce and critical skills needs do not make provision for capturing information related to small-scale and subsistence farmers - thus not allowing the capturing of needs of this critical constituency within the agricultural sector. ... The above indicated OFO template also does not incorporate all the "occupations" identified within the sector and more importantly does not make sufficient provision to capture specific skills needs within an occupation. It was subsequently felt that the "richness" of training and skills development needs identified as a result of the consultation process would be lost if not captured elsewhere." (AgriSETA SSP, 2006).

Note: The Skills sector plan (2006-2012) does not mention green skills at all, although a biofuel project is mentioned as part of the infrastructure investment and programmes.

Skills demand and scarce skills in the agriculture sector

The Sector Skills Plan of the Agricultural Sector Education & Training Authority (AgriSETA) 2006-2010 (AgriSETA, 2006) identifies the organizations / persons consulted in identifying skills priority needs as the following:

- Workshops with sub-sector skills committees (e.g. sugar, tea, fruit packaging, poultry, etc.)
- Meetings / interviews with commodity organizations (such as Fruit South Africa; Fruit Packers Association; Milk Producers Organization); organized agriculture (farmers and employer organizations); organized labour; and large farming enterprises (for farmer perspectives).

Demand for skills (as at 2006)

In the Skills Sector Plan, 2006-2010, the AgriSETA identifies four key target groups to be served:

(1) The commercial farming sector (primary agriculture) with an estimated 925,000 employees of whom 350,000 are employed on a temporary basis (seasonal or contract workers);

(2) emerging farmers (primary agriculture) with an estimated 650,000 beneficiaries who need support to improve their efficiency and profitability and grow and expand their ventures into commercially viable enterprises;

(3) secondary agricultural enterprises (upstream and downstream enterprises) with approximately 300,000 employees;

(4) the Department of Agriculture, who need support in developing Extension Officers and in addressing scarce and critical skills categories in national and provincial agriculture departments.

Skills supply issues relating to the sector are the large number of people with little or no formal education, especially in the primary sector. This relates mainly to farm labourers. It is estimated that at least half the workforce requires further education (either in the Grade 1 to Grade 9 level or in Adult Basic Education & Training). Shortfalls are seen as the need for “decentralized and mobile training service delivery, and the ability to offer training in the vernacular” in order to reach those in need in the agriculture sector. Most of the agricultural workforce is largely “unskilled”, but the need for skilled workers is seen as being important, and requiring a change in labour practices. This implies a need for retraining and upskilling of workers. Employers identified constraints to enrolment of learners on training programmes such as for example lost productivity through lost days during training. Training deliver providers should therefore attempt to provide “phased and on-site delivery”.

South Africa’s “emerging farmers” (who are beneficiaries of land reform initiatives) are identified in the Skills Sector Plan (SSP) as lacking farm management and business management skills. Further Education and Training colleges provide such courses but of too general a nature and not directed to farmers’ needs. Tailor made programmes that have successful deliver mode models (such as phased and decentralized training, and at the right level) are required. The Skills Sector Plan notes that mentoring is an “extremely appropriate and effective means of providing emerging farmers with the full complement of skills, competencies and attitudes required for success.”

Within the commercial sector, training of black managers and owners should be increased, to allow sectors and enterprises to become BEE compliant.

Department of Agriculture needs include the following occupations, where they experience shortages (vacancies): veterinarians, agricultural engineers, plant health specialists (nematology, entomology, plant pathology), statisticians (specialized agri knowledge), plant health pest risk analysts, ICT specialists, agricultural economists (production and resource economists), agricultural food and quarantine technicians, agro-meteorologists / early warning specialists, graphic artists, pasture scientists, plant production specialists (e.g. ornamental crops, hydroponics), specialized food analysts (pesticide residue analysts, processed food and dairy analysts, wine and spirit analysts). The need for extension officers is noted. (*ibid*)

Scarce skills identified in the Sector Skills Plan include 500 extension officers/advisors, 1,000 artisan assistants (irrigation skills), 100 micro biologists; general machine operators (critical: 1,000), first line managers (critical: 1,500), advisors to emerging farmers with broad knowledge (600, including business development, human resources knowledge). 5,000 workers are needed at a multi-skilled level. Other scarcities were: Pest control - 2,000; and pest control officer assistant - 500, environmental health and safety reps - 200 (critical);

Strategic plan and priority focus areas

This section identifies the need to develop readiness and ability of the sector to “realize global market opportunities”, for example environmental standards. Opportunity certainly lies here in the future for greening.

Opportunities for greening of the sector

Basic skills development and sector competitiveness that would allow the sector to compete better in international arenas are essential. In addition, considerable opportunities for greening this sector lie in changing land use and land use management practices. Deforestation (and resultant land degradation) as a result of practices such as clearing forests for wood-fuel and for unsustainable agricultural use present serious obstacles for sustainable environmental management, and for sustainable agriculture. Skills development should focus on these areas, amongst others. These effects are multiplied under climate change. However, as yet, these factors are not reflected in the agricultural sector’s main priorities, which remain more focused on supporting emerging farmers and general upskilling.

4. Conclusions

4.1 Main “greening” shifts in economies and labour markets

South Africa is at the beginning of the greening and low carbon economy curve and in many respects is yet to experience a significant structural shift in the economy or labour markets. With respect to greening specifically there is currently no labour legislation in place in preparation for a strong shift in the economy towards greener products and services. Some work is being done on policy and over the past 5 years several national government documents have been released relating to climate change strategies, energy efficiency plans, and water resource management. Environmental management is certainly at the forefront of South African policy and the enforcement of much the recent National Environmental Management Acts will drive changes in working practices across many sectors in years to come. Furthermore, the renewable energy generation targets, and the creation of the renewable energy feed-in tariff system provides creates a platform from which alternative energies can thrive given the right support.

However, as a developing economy South Africa still has many environmentally negative aspects, such as prolonged coal-fired electricity generation, that are entrenched in the national economy and will not disappear for a long while to come. Due to the rapid increase in demand for electricity, the growing need for decentralised energy and the energy crisis however there are opportunities for renewable energy to provide green energy in fairly sizable portions alongside traditional fossil fuel generation. These market driven changes generally affect heavy industries, and those sectors with sizable markets. Consumer preferences domestically have changed somewhat, but really only in the middle-high income bracket which ignores the vast majority of South African demand.

The most realistically viable of these renewable technologies currently solar water heating which has a good combination of government, market, and skills development support and could provide significant employment across the country. Smaller scale projects have been successful in reducing emissions and energy use, whilst employing the previously unskilled and providing sustainable jobs of decent quality. Employment potential of biofuels is also significant, although less realistic given significant conflicts between food, energy, and current skills shortages in agriculture.

Some industries are more advanced than others in initiating the green economy. Construction for example has a strong awareness of greening and it well positioning to expand this to cover mainstream construction rather than the current one-off projects. Knowledge is certainly growing in this sector.

Changing working practices, and therefore skill sets, have been observed in agriculture although these have been focussed in export industries whose target markets are in the western world. This is beginning to change however as domestic consumers become more aware of environmental issues. Also, the global drive for improved land use management practices (and related finance mechanisms) that ensure the creation of carbon sinks and low carbon agricultural development is likely to stimulate a more uniform response that does not only cater for the export based producers. The retail sector is beginning to pay attention to aspects of sustainability and the controls and certification standards are being sought to ensure supply chain alignment with company policies.

All changes in the economy need to be underpinned by robust research and development and this is an area in which South Africa has struggled to produce workers of acceptable skills or in high enough quantities. Climatology, a fundamental science for modelling weather patterns is experiencing a serious undersupply of graduates, and this is generally the case amongst many sciences and engineering professions. The path to a greener South African economy will be paved with conflicts over the lack of technical skills available across all sectors, minimal policy incentives to go green, and the lack of an overarching approach to creating the skills required to promote greening. Market drivers, especially in globally-integrated industries, are beginning to force changes where up-skilling is performed on an ad-hoc basis by the parties directly involved.

4.2 Skills implications and development

4.2.1 Anticipation and identification of skill needs

As explained in Section 2.3, in addition to a generally robust, internationally recognised skills base, South Africa has a well developed, globally recognised skills identification framework although it seems to lack any reference to greening of the economy and green jobs. Employers, through the National Skills Levy, finance the National Qualifications Framework (NQF) which oversees skills identification and design of response programmes. It is supported by the South African Qualifications Authority (SAQA), the Education and Training Quality Assurance (ETQA) body, the Standards Generating Bodies (SGBs) for each industry, and the Sector Education and Training Authorities (SETAs) who aim to listen to industry requirements and provide education and training in response.

Currently understaffed, this collection of organisations has generally not been used to its full potential by private businesses. It is industry who should regularly access the training opportunities provided by the NQF but there is a lack of confidence and support for the process. As a result the lack of communication between parties means training is often provided in the private sector as and when it is needed. This system partially prevents any public bodies from taking a longer term strategic view of where skills are headed and what might be needed. Although there are enormous skills requirements of existing industries without even considering the need to re-skill workers for the green economy.

Training in relation to green occupations should develop organically through the demand and supply design of the framework, but this hasn't happened to-date and there has been no national public recognition of green skills requirements.

4.2.2 Response policies and programmes

There have been no labour policies or programmes focusing specifically on the creation of low carbon economy or green jobs in South Africa. However, it is early days for a country with development pressures and a young democracy such as South Africa's and yet there are a few schemes in place which lend themselves to the development of skills for the low carbon and green sector, although this is not necessarily their primary focus.

The National Jobs Fund was created as a cushioning mechanism in response to economic crisis-related retrenchments. The aim is to allow employers to temporarily reduce their workforce in order to employees to undergo training, for which they are paid a training wage by the Fund. If demand exists for green skilling of certain workers, this could certainly be included to up-skill workers in green aspects of their industries.

The Expanded Public Works Programme (EPWP) has provided over 1,000,000 work opportunities since its inception. The EPWP focuses on infrastructure, economic, social, and environmental programmes. The environmental section deals with important ecosystem functions and has developed globally recognized payments for ecosystem services structures to employ large numbers of the public to reduce environmental problems, whilst simultaneously giving training to all employees and encouraging the establishment of small businesses post completion of employment.

4.2.3 Effective delivery mechanisms

As is evident throughout this report, South Africa has some effective mechanisms in place that can be tapped into to coordinate the development of a low carbon economy green skills base - be it through establishing new skills or creating portable skills out of existing skills. Generally the latter is more easily accomplished, and, as is again evident in this study, the most needed.

Institutional arrangements for skills development and training are robust. The national skills development strategy, framework and related structures function, albeit with room for improvement, effectively, and can definitely be drawn on in their existing format. COSATU, as an effective Trade Union Federation that is an integral component of South Africa's political and economic machinery is a key delivery mechanism that with a little prompting and sound education and awareness, can fulfill a pivotal role in green skilling our economy as we transition to a low carbon economy. Finally, the private sector is critical. It has a long tradition in developing skills and providing training (directly and indirectly) in South Africa and this capacity is useful and critical to greening our economy.

The coordination needs to take place at the highest level, with drive coming from political will and policy action, with cross sectoral institutional arrangements coming out of the Office of the State President. South Africa's current Minister for Economic Development (Zuma government appointed May 2009), Ebrahim Patel, sits in the office of the State President and has a strong trade union background. With a background in trade union activities and negotiations in the food, textile and footwear industries, he and his office are well placed to ensure coordinated delivery of green skills into a transitioning low carbon economy.

5. Recommendations

5.1 Policy recommendations

While it is evident that there are several market forces at work which have begun, or will soon begin, to drive changes in some sectors towards greening, South Africa is lacking with respect to official legislation which encourages the development of green skills. Moreover, there is not currently an overarching body to collate and analyze trends, demand, and skills gaps linked to the potential of the green economy. Nationally South Africa has yet to feel the pressure to green its economy due to other long term challenges such as income inequality, poverty, and access to basic services. But as it continues to develop and become more integrated at a global level, it will become essential to take note of worldwide trends in skills development in other green economies.

Policy recommendations from this paper are:

- The establishment of a National Low Carbon Economy Skills Forum to monitor and direct the NQF to ensure that essential skills for greening the economy are considered. The objective of this body would be to take a long term view on skills requirements by observing international trends, changing consumer preferences, and market forces to ensure that fundamentally important green skills are included into training programmes on an ongoing basis. SETAs already recognize the importance of designing training programmes to meet the needs of future industry changes (Energy SETA, 2009). This body would be included in consultations between SETAs, SGBs, industry and academic institutions to ensure representation of the green economy in all consultation.
- Existing environmental policy should be more strictly enforced. South Africa has made good progress on national policies regarding environmental management, energy efficiency, and the National Water Act. However, because of several reasons (such as a public sector skills shortage) it lacks the capacity to rigidly enforce legislation. Strengthening this area of governance would inevitably drive changes in working practices, which in turn has implications for human resource development in respect of green skills.
- Public skills institutions should support the numerous private skills development initiatives which are being developed throughout the country. The National Qualifications Framework should recognize successful training programmes within industry (where the demand for such training may not have been picked up by SETAs due to a lack of communications) and use them as a template to disseminate training at a larger scale to relevant sectors.

5.2 Recommendations for education and training

It is clear from engagement with the private sector that South Africa is severely under supplied with graduates from secondary education (13 years of schooling) who have the basic skills in mathematics and science. This means that industry finds it difficult to acquire workers who can be trained to technician standard, an area which is chronically under skilled in South Africa. This is however already being addressed by the Department of Education.

The Department of Education has identified the following skills as being in short supply and subsequently these skills will be targeted in the re-capitalization of Further Education Training colleges:

- Engineering (Light and Heavy Current, Mechanical and Civil Construction);
- Information technology;
- Financial management;
- Marketing;
- Tourism;
- Manufacturing and assembly;
- Fabrication and extraction; and
- Primary agriculture.

From the research undertaken during the writing of this paper it is clear that with respect to greening, the sectors most in need of more graduates from FETs are engineering and primary agriculture.

The overriding lack of sufficient basic skills in South Africa is the major inhibiting factor to the development of the green economy, in the same way that it holds back development of the rest of the country. This is already recognized by the Department of Education and any success in this area will be beneficial to the future of the green economy.

A coherent response to climate change presents significant opportunities for skills development and skills replacement, but these are only achievable if South Africa thoroughly integrates climate change responses into its mainstream economic development. At times, this appears to be at odds with current approaches to national economic development, with South Africa often adopting the approach of “develop now, worry about emissions later” - an approach that was globally adopted in the 70s with consequences that the world is grappling with now. However, this is likely to change with the government’s adoption of the LTMS “required by science” approach to emissions reductions, and the incorporation of a low carbon development pathway into future policy. Furthermore, the international technology transfers and adaptation funding that were negotiated at COP 15 may be able to be accessed to facilitate and enable skills development in South Africa, if well coordinated. However, exactly how these funds will translate into funding for this area is currently unclear and the international negotiation process (to which South Africa is a strong participant) is still underway. The financing mechanisms are part of the COP 16 (Mexico) agenda.

In addition, as mentioned earlier, in response to the global economic crisis, the South African Government has made a sum of money available through the SETAs for a re-skilling programme, on the basis that during a recession, retrenching companies are less likely to have money available to support re-skilling programmes. Coordination between outgoing skill users and emerging skill markets would ensure a proactive, coordinated response and an opportunity to ensure, in a coordinated way, that South Africa is able to embark on low carbon economy and green skills path with the requisite skills to support it.

Adaptation measures in response to climate change that reduce the reliance on industrialized methods will create jobs and lessen vulnerability. International donor funding will be very useful for addressing existing skills and utilizing them. The experiences of donor countries will expedite the process of applying these measures. A longer term approach can be implemented by incorporating climate change

activities into educational curricula at all levels. Industries are also encouraged to raise awareness in their companies about climate change and initiatives that can be applied. Employment opportunities are a constant priority for the government, thus syncing responses to climate change with employment would be very beneficial to the country as a whole.

5.3 Recommendations for further research and data collection

Whilst there have been some studies undertaken on the skills requirements for the renewable energy sector, the broader skills needs of greening the economy have not been officially investigated. Therefore a thorough examination and mapping exercise should be undertaken into the current green training activities that are being performed in South Africa. This should be carried out by the National Low Carbon Economy Skills Forum as suggested above.

In addition it is important that the National Low Carbon Economy Skills Forum understands not only the domestic market but also global trends in order to accurately model future patterns of demand for green goods and services.

Immediate research projects should be commissioned to:

- Map all public and private green skills training activities in South Africa.
- Identify global trends in consumer behaviour in the market for green products and services.
- Identify domestic trends in consumer behaviour in the market for green products and services.

5.4 Recommendations for delivery mechanisms

Appropriate, coordinated delivery mechanisms are the most important ingredient in ensuring that the emerging green and low carbon economy in South Africa is adequately and timeously skilled. It is evident that the structures - both formally and informally - are in place. Formally in that the legislation and skills development frameworks and strategies exist, governing both the private and the public sector, and informally in that the private sector has for a long time played a significant role in skilling the labour market appropriately. This has meant (and still means) that skills development is largely demand driven. This is generally appropriate, however, the nature of a green skilled low carbon economy is so cross-sectoral and embedded in existing industries and sectors, that a demand-driven only approach is likely to lag with opportunities not being realized at the right time.

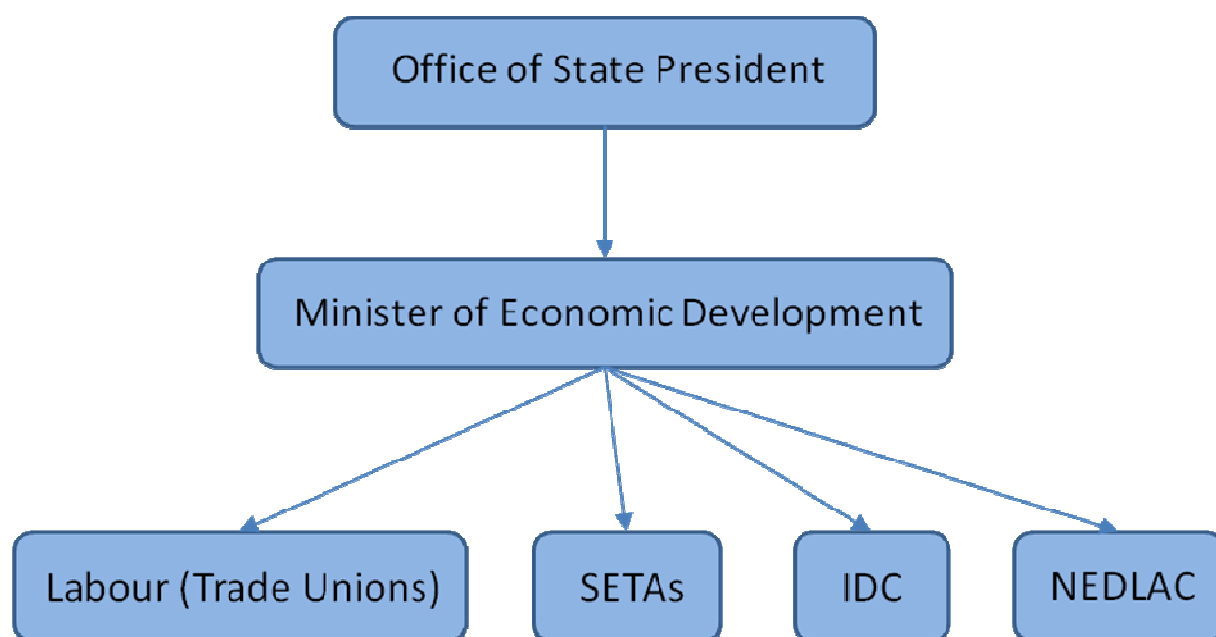
An appropriate skills base is essential to transitioning to a low carbon economy. Simply put, if we don't produce the skills, we will not make this transition that is in national and global interests - as clearly evidenced in the international Climate Change negotiation process.

Public private partnership (PPPs) programmes are the only likely success scenario and as indicated, requires coordination at the highest level. A proposed institutional structure is suggested in Figure 10. In considering these are any related institutional arrangements, two important issues are worth noting. One is that whilst South Africa has seen a few successful public-private partnerships, this is not the norm in this country. The other is that we are generally good at making policy but often without enabling institutional arrangements, sometimes rendering the policy redundant. Political will is another critical success factor, and as indicated South Africa has demonstrated political commitment to skills

development, job creation and equity. It has demonstrated this through the way in which it facilitates FDI (cheap power purchase agreements for example), through the sophisticated suite of labour and related legislation and policy, and through job creation programmes such as the aforementioned EPWP.

That skills development and job creation is a major focus of South Africa's Minister for Economic Development as part of the Office of the State President is a further, positive indication of political will. However, commitment to a low carbon economy has not been cohesive and although South Africa has just announced voluntary emission reduction targets at COP 15, there is skepticism as to whether or not this is genuine, or really just a negotiating tool. Having said that, some provinces have been putting climate change adaptation and mitigation strategies in place and Gauteng, South Africa's most heavily industrialized province and biggest consumer of coal based electricity and other fossil fuels has announced its intention to design a climate change response strategy that will be focused on mitigation. Furthermore, Transnet, the transport parastatal that dominates the transport sector in South Africa, has also initiated a climate change response strategy in response to the 2008 Cabinet approved Long Term Mitigation Scenarios, which advocate heavy emission reductions in the South African economy.

Figure 10: A PPP for green skills development in South Africa



It is evident that a commitment to a LCE will stimulate the development of green skills. However, if those skills are not in place, this commitment cannot be achieved. Hence the need for PPP, as per Figure 10. A conference in South Africa between industry, government, labour (trade unions) and civil society is strongly recommended based on the outcomes of this important international study, with the objective of facilitating dialogue and stimulating action. As mentioned, this envisaged structure is driven from the Office of the State President (Ministry of Economic Development), and includes coordinating participation in policy development from all segments of the economy central to driving both skills AND low carbon economy policy implementation. The trade unions as well as business (with

emphasis on certain key sectors such as labour intensive high energy users) and institutions that provide the country's skills development (via the SETAs) are therefore seen as key participants.

6. References

- Agama Energy. 2003. *Employment potential of renewable energy in South Africa*.
- BMI Building Research Strategy Consulting Unit CC. 2006. *Strategic research into the opportunities for job creation, new enterprise development and empowerment in the value system of the building industry*. The Construction Industry Development Board and the DTI.
- Center for Development and Enterprise. 2008. *South Africa's electricity crisis: How did we get here? And how do we put things right?*
- Daniels, R.C. 2007. *Skills shortages in South Africa: A literature review*. School of Economics, University of Cape Town, Development Policy Research Unit. DPRU Working Paper No. 07/121.
- Davies, R.; Thurlow J. 2009. *Formal-informal economy linkages and unemployment in South Africa*. Centre for poverty, employment and growth. HSRC.
- DEAT (Department of Environmental Affairs and Tourism). 2004. *A national climate change response strategy for South Africa*.
- DEAT (Department of Environmental Affairs and Tourism). 2006. *South Africa environment outlook - A report on the state of the environment*.
- DEAT (Department of Environmental Affairs and Tourism). 2007. *Long term mitigation scenarios: Strategic options for South Africa*. (Scenario building tea).
- DEAT (Department of Environmental Affairs and Tourism). 2008. *A national framework for sustainable development in South Africa*.
- DEAT (Department of Environmental Affairs and Tourism). 2009a. *The national climate change response policy: Discussion document drawn for the 2009 National Climate Change Response Policy Development Summit*, Gallagher Convention Centre, Midrand, 3-6 Mar. 2009.
- DEAT (Department of Environmental Affairs and Tourism). 2009b. *DEAT media statement*, 9 Dec. Retrieved from <http://www.deat.gov.za/>
- Department of Labour. 2008a. *National scarce skills list 2008*. Full list can be found at: <http://www.labour.gov.za/documents/useful-documents/skills-development/national-scarce-skills-list-2008/>
- Department of Labour. 2008b. *Projected skills demand and supply for the electrical energy sector*.
- Department of Labour. 2009. *A guide to the training layoff scheme*.
- Designated National Authority. 2009. CDM presentation. Cape Town.
- DME (Department of Minerals and Energy). 2003. *White Paper on renewable energy*.

- DME (Department of Minerals and Energy). 2005. *Energy efficiency strategy of the Republic of South Africa*.
- DWAF (Department of Water Affairs and Forestry). 2001. *Free basic water implementation strategy*.
- DWAF (Department of Water Affairs and Forestry). 2004. *National water resource strategy*.
- Edkins, M.; Winkler, H.; Marquard, A. 2009. *Large-scale rollout of concentrating solar power in South Africa*. Energy Resource Centre, University of Cape Town. Retrieved from: http://www.erc.uct.ac.za/Research/publications/09Edkins-et-al-Rollout_of_CSP.pdf
- Energy SETA. 2009. *Draft sector skills plan 2010-2011*.
- Eskom. 2008. *Together, rising to the challenge. Annual Report 2008*.
- Maroga, J. Eskom. 2009. *Update on the power system and the build programme: A presentation to the Media*.
- Frost and Sullivan Consulting. 2008. *Cogeneration in South Africa set for intense growth - Press Release*.
- ILO (International Labour Organization). 2007. Retrieved from: http://www.ilo.org/wow/Articles/lang-en/WCMS_083900/index.htm
- IPCC (Intergovernmental Panel on Climate Change). 2007a. *Impacts, adaptation and vulnerability. Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report Summary for Policymakers*
- IPCC (Intergovernmental Panel on Climate Change). 2007b. *Fourth assessment report: Climate change 2007. Working Group III: Mitigation of climate change*.
- KE Consulting. 2008. *Cogeneration technology in South Africa*.
- Kuyasa CDM Project. 2009. *Status report: Sep. 2009*.
- Le Maitre, D.V. 2000. *Impact of invading alien plants on surface water resources in South Africa: A preliminary assessment*. Water Research Commission, Vol. 26, No. 3, pp. 397-408.
- LEHIGH. 2009. *LEHIGH education glossary*. Retrieved from: <http://www.lehighcement.com/Education/Lehigh-Education-Glossary.htm#G>
- Mbendi. undated. Retrieved 2009 from: <http://www.mbendi.com/indy/powr/af/sa/p0005.htm>
- Mbohwa, C. 2008. *Cogeneration for cleaner energy and sustainable consumption in South Africa*. Department of Quality and Operations Management, University of Johannesburg.
- Minister in the Presidency. 2009. *Together doing more and better. Medium term strategic framework: A framework to guide government's programme in the electoral mandate period (2009 - 2014)*.
- OneWorld. 2009. *Biomass employment potential analysis*, Oct.
- Petrie, B. 2008. "Biofuels for Africa?" in *Research Africa*, 19 Aug.

Publishers' Association of South Africa (PASA). 2010. *Consolidated actual enrolment*. Spreadsheet prepared for use in assessing numbers of textbooks required.

Richardson, D.M.; van Wilgen, B.W. 2004. "Invasive alien plants in South Africa: How well do we understand the ecological impacts?" in *South African Journal of Science*, Vol. 100, Jan./Feb. 2004.

SAQA (South African Qualifications Authority). 2009. Retrieved from: <http://www.saqa.org.za/>

Statistics South Africa. 2009a. *GDP Quarterly Release*.

Statistics South Africa. 2009b. *Quarterly Labour Force Survey*.

THRIP (Technology and Human Resources for Industry Programme). 2009. THRIP Presentation.

UNEP/ILO/IOE/ITUC. 2008. *Green jobs: Towards decent work in a sustainable, low carbon world*.

UNEP (United Nations Environment Programme). 2009. *Global environment outlook*. Retrieved from GEO Data Portal: <http://geodata.grid.unep.ch/results.php>

van der Linde, A. undated. *Industrial Energy Auditor Skills Programme & Unit Standards* (Capacity-Building, Leadership & Action (CBLA)). Retrieved from: <http://www.cbla.org.za/files/Complete%20Unit%20Standards%20IEA%20Program%202.pdf>

7. Bibliography

Agama Energy. 2003. *Employment potential of renewable energy in South Africa*.

Biogas for Better Life - An African Initiative. 2008. *South Africa - Household biogas feasibility study*.

BMI Building Research Strategy Consulting Unit CC. 2006. *Strategic research into the opportunities for job creation, new enterprise development and empowerment in the value system of the building industry*. The Construction Industry Development Board and The DTI.

Center for Development and Enterprise. 2008. *South Africa's electricity crisis: How did we get here? And how do we put things right?*

DEAT (Department of Environmental Affairs and Tourism). 2004. *A national climate change response strategy for South Africa*.

DEAT (Department of Environmental Affairs and Tourism). 2006. *South Africa environment outlook - A report on the state of the environment*.

DEAT (Department of Environmental Affairs and Tourism). 2008a. *Government's vision, strategic direction and framework for climate policy*.

DEAT (Department of Environmental Affairs and Tourism). 2008b. *A national framework for sustainable development in South Africa*.

DEAT (Department of Environmental Affairs and Tourism). 2009. *DEAT Media Statement*, 9 Dec. Retrieved from <http://www.deat.gov.za/>

Department of Labour. 2008. *National scarce skills list 2008*. Full list can be found at: <http://www.labour.gov.za/documents/useful-documents/skills-development/national-scarce-skills-list-2008/>

Department of Labour. 2009. *A guide to the training layoff scheme*.

Designated National Authority. 2009. *CDM presentation*. Cape Town.

DME (Department of Minerals and Energy). 2005. *Energy efficiency strategy of the Republic of South Africa*.

DME (Department of Minerals and Energy). 2003. *White Paper on renewable energy*.

DWAF (Department of Water Affairs and Forestry). 2001. *Free basic water implementation strategy*.

DWAF (Department of Water Affairs and Forestry). 2004. *National Water Resource Strategy*.

Energy SETA. 2009. *Draft Sector Skills Plan 2010-2011*.

Eskom. 2008. *Together, rising to the challenge. Annual Report 2008*.

Frost and Sullivan Consulting. 2008. *Cogeneration in South Africa set for intense growth - Press Release*.

ILO (International Labour Organization). 2007. Retrieved from: http://www.ilo.org/wow/Articles/lang-en/WCMS_083900/index.htm

KE Consulting. 2008. *Cogeneration technology in South Africa*.

Kuyasa CDM Project. 2009. *Status report: Sep. 2009*.

Le Maitre, D.V. 2000. *Impact of invading alien plants on surface water resources in South Africa: A preliminary assessment*, Water Research Commission, Vol. 26, No. 3, pp. 397-408.

LEHIGH. 2009. *LEHIGH education glossary*. Retrieved from: <http://www.lehighcement.com/Education/Lehigh-Education-Glossary.htm#G>

Mbendi. undated. Retrieved 2009 from: <http://www.mbendi.com/indy/powr/af/sa/p0005.htm>

Mbohwa, C. 2008. *Cogeneration for cleaner energy and sustainable consumption in South Africa*. Department of Quality and Operations Management, University of Johannesburg.

OneWorld. 2009. *Biomass employment potential analysis*, Oct.

SAQA (South African Qualifications Authority). 2009. Retrieved from: <http://www.saqa.org.za/>

Statistics South Africa. 2009a. *GDP quarterly release*.

Statistics South Africa. 2009b. *Quarterly labour force survey*.

THRIP (Technology and Human Resources for Industry Programme). 2009. THRIP presentation.

UNEP/ILO/IOE/ITUC. 2008. *Green jobs: Towards decent work in a sustainable, low carbon world*.

UNEP (United Nations Environment Programme). 2009. *Global environment outlook*. Retrieved from GEO Data Portal: <http://geodata.grid.unep.ch/results.php>

8. List of key resource persons

Following are the main experts consulted during the course of the project who directed the material but in addition there were numerous individuals from other organizations and government departments who aided the process.

Hugh Campbell - Deciduous Fruit Producers' Trust Research

Shelly Fuller - Project Manager - Confronting Climate Change, A South African Fruit and Wine Initiative

Andrew Standring - Managing Director - Associated Energy Services

Denis Williams - Marketing Director - Associated Energy Services

Peter Johnston PhD - Climate Systems Analysis Group - University of Cape Town

Justin Smith - Head of Sustainability & Manager: The Good Business Journey - Woolworths

Kobus Pienaar - Food technologist: Farming for the Future - Woolworths

Mfundo Mbatha - Sector Skills Development Planning, Energy Sector Education and Training Authority

Lungile Tshabalala - Skills Development and Planning Officer, Energy Sector Education and Training Authority

Dr Guy Preston - Chairperson, Working for Water Programme - DWAF

Mr Ahmed Khan - Acting Director Support Services - Working for Water Programme

Gareth Morgan - Shadow Minister of Water and Environmental Affairs - Democratic Alliance

Mike Munnik - Director - Agama Energy and Green Buildings Council South Africa

Carl Wesselink - Kuyasa CDM Project, South African Export Development Fund

Koos Sihlangu - Agriculture Sector Education and Training Authority

Kate Shead - Regional Director Western Cape (& Human Resources Expert) - Siyakha

Arthur Chapman - Hydrologist and Climate Change Expert - OneWorld Sustainable Investments

Stephanie Midgely - Climate Change, Agriculture, and Food Security Expert - OneWorld Sustainable Investments

9. Appendices

Appendix 1: National Scarce Skills List 2008, adapted for green economy

The following is an adaptation of the National Scarce Skills List (Dept of Labour, 2008) by OneWorld, for the purposes of this report. This table forms the basis of Figure 7 in section 3.1.2.

SCARCE SKILLS LIST 2008 ADAPTED FOR GREEN ECONOMY					
Occupation Grouping	Category	Potential knock-on greening effect	Direct importance to green economy	Magnitude of scarcity	Overall score
Engineering professionals	Professionals	3	4	4	11
Natural and physical science professionals	Professionals	3	4	4	11
Specialist Managers	Managers	3	3	4	10
Construction, distribution and production/operations managers	Managers	3	3	4	10
Building and engineering technicians	Technicians and Trades Workers	2	4	4	10
Mechanical Engineering trades workers	Technicians and Trades Workers	2	4	4	10
Agricultural, medical and science technicians	Technicians and Trades Workers	2	4	4	10
Human resource and training professionals	Professionals	3	4	3	10
Architects, designers, planners and surveyors	Professionals	3	4	3	10
Chief execs, general managers, legislators	Managers	4	4	2	10
School teachers	Professionals	2	3	4	9
Construction and mining workers	Elementary Workers	1	4	4	9
Farm, forestry and garden workers	Elementary Workers	1	4	3	8
Misc specialist managers	Managers	2	2	3	7
Sales, marketing and public relations professionals	Professionals	2	2	3	7
Bricklayers, carpenters and joiners	Technicians and Trades Workers	1	3	3	7

SCARCE SKILLS LIST 2008 ADAPTED FOR GREEN ECONOMY					
Occupation Grouping	Category	Potential knock-on greening effect	Direct importance to green economy	Magnitude of scarcity	Overall score
Electricians	Technicians and Trades Workers	1	3	3	7
Financial brokers and dealers and investment advisors	Professionals	2	3	2	7
Plumbers	Technicians and Trades Workers	2	3	2	7
Floor finishers and painting trades workers	Technicians and Trades Workers	2	3	2	7
Glaziers, plasterers and tilers	Technicians and Trades Workers	2	3	2	7
Manufacturing and process technicians (power plants)	Technicians and Trades Workers	2	4	1	7
Misc technicians and trades workers (power generation)	Technicians and Trades Workers	2	4	1	7
Health diagnostic and promotion professionals	Professionals	1	1	4	6
Call or contact centre information clerks	Clerical and Administrative Workers	1	1	4	6
Health and welfare support workers	Community and Personal Service Workers	1	1	4	6
Mobile plant operators	Machinery Operators and Drivers	1	1	4	6
Sales assistants and salespersons	Sales Workers	1	1	4	6
Sales support workers	Sales Workers	1	1	4	6
Events, hospitality, retail and service managers	Managers	2	1	3	6
Information and organisation professionals	Professionals	2	1	3	6
Arts and Media Professionals	Professionals	2	1	3	6
Social and welfare professionals	Professionals	2	1	3	6
Business and systems analysts, and programmers	Professionals	1	2	3	6
Fabrication engineering trades workers	Technicians and Trades Workers	1	2	3	6
Accountants, auditors and company secretaries	Professionals	2	2	2	6

SCARCE SKILLS LIST 2008 ADAPTED FOR GREEN ECONOMY					
Occupation Grouping	Category	Potential knock-on greening effect	Direct importance to green economy	Magnitude of scarcity	Overall score
Higher education lecturers	Professionals	2	3	1	6
Misc education and training professionals	Professionals	2	3	1	6
ICT and telecommunications technicians	Technicians and Trades Workers	1	1	3	5
Automotive electricians and mechanics	Technicians and Trades Workers	1	1	3	5
Food trades workers	Technicians and Trades Workers	1	1	3	5
Printing trades workers	Technicians and Trades Workers	1	1	3	5
Wood trades workers	Technicians and Trades Workers	1	1	3	5
Contract, program, project and office administrators	Clerical and Administrative Workers	1	1	3	5
Personal assistants and secretaries	Clerical and Administrative Workers	1	1	3	5
General clerical workers	Clerical and Administrative Workers	1	1	3	5
Clerical and office support workers	Clerical and Administrative Workers	1	1	3	5
Purchasing, supply, transport and despatch administrators	Clerical and Administrative Workers	1	1	3	5
Child carers and education aides	Community and Personal Service Workers	1	1	3	5
Personal carers and assistants	Community and Personal Service Workers	1	1	3	5
Prison and security officials	Community and Personal Service Workers	1	1	3	5
Personal service and travel workers	Community and Personal Service Workers	1	1	3	5
Cleaners and laundry workers	Elementary Workers	1	1	3	5
Other factory process workers	Elementary Workers	1	1	3	5

SCARCE SKILLS LIST 2008 ADAPTED FOR GREEN ECONOMY					
Occupation Grouping	Category	Potential knock-on greening effect	Direct importance to green economy	Magnitude of scarcity	Overall score
Stationary plant operators	Machinery Operators and Drivers	1	1	3	5
Machine operators	Machinery Operators and Drivers	1	1	3	5
Automobile, bus and rail drivers	Machinery Operators and Drivers	1	1	3	5
Truck drivers	Machinery Operators and Drivers	1	1	3	5
Electronics and telecommunications trades workers	Technicians and Trades Workers	2	1	2	5
MISSING TITLE ONE HERE (includes jewellers and operational process controllers)	Technicians and Trades Workers	2	1	2	5
Panelbeaters, and vehicle body builders, trimmers, and painters	Technicians and Trades Workers	2	1	2	5
Legal professionals	Professionals	2	2	1	5
ICT network and support professionals	Professionals	1	1	2	4
Financial and insurance clerks	Clerical and Administrative Workers	1	1	2	4
Defence force members, fire and rescue officials and police	Community and Personal Service Workers	1	1	2	4
Factory Process workers	Elementary Workers	1	1	2	4
Other workers	Elementary Workers	1	1	2	4
Store persons	Machinery Operators and Drivers	1	1	2	4
ICT managers	Managers	2	1	1	4
Air and marine transport professionals	Professionals	2	1	1	4
Health therapy professionals	Professionals	2	1	1	4
Midwifery and nursing professionals	Professionals	2	1	1	4
Database and systems administrators and ICT security specialists	Professionals	2	1	1	4
Animal attendants and trainers	Technicians and Trades Workers	2	1	1	4

SCARCE SKILLS LIST 2008 ADAPTED FOR GREEN ECONOMY					
Occupation Grouping	Category	Potential knock-on greening effect	Direct importance to green economy	Magnitude of scarcity	Overall score
Textile, clothing and footwear trades workers	Technicians and Trades Workers	2	1	1	4
Receptionists	Clerical and Administrative Workers	1	1	1	3
Accounting clerks and bookkeepers	Clerical and Administrative Workers	1	1	1	3
Misc administrative workers	Clerical and Administrative Workers	1	1	1	3
Hospitality workers	Community and Personal Service Workers	1	1	1	3
Sports and fitness workers	Community and Personal Service Workers	1	1	1	3
Freight handlers and shelf fillers	Elementary Workers	1	1	1	3
Delivery drivers	Machinery Operators and Drivers	1	1	1	3
Insurance agents and sales representatives	Sales Workers	1	1	1	3
Real estate sales agents	Sales Workers	1	1	1	3

Appendix 2: Working for Water training matrix

1. Functional courses

WORKING FOR WATER TRAINING MATRIX - ACCREDITED COURSES AND NQF LEVELS															
NO	JOB CATEGORY	PRIORITY	ACCREDITED Yes / No	ACCREDITATION NUMBER	SAQA NQF LEVEL	SAQA NQF CREDIT	CONTRACTOR	WORKERS	DRIVERS	CHAINSAW OPERATORS	BRUSHCUTTER OPERATORS	HERBICIDE APPLICATOR	HEALTH & SAFETY REPRESENTATIVES	PEER EDUCATORS	FIRST AIDERS
	FUNCTIONAL			SAQA NQF											
No	Induction	First Course	YES	117049	2	1	3	3	3	3	3	3	3	3	3
	Chainsaw Operations	Before Operations	YES	117058; 117062	2	4				10					
				117062	2	2									
	Chainsaw Refresher	Annually	NO, US Aligned	117058, 117062	0	0				3					
	Brushcutter Operations	Before Operations	YES	123243	2	5					10				
	Brushcutter Refresher		NO, US Aligned	1123243	0	0					3				
	Herbicide Applicator	Before Operations	YES	117966, 252,453	1 2	2 3	3					3			
	Herbicide Applicator Refresher	every 6 months	NO, US Aligned	117966, 252453	0	0									
	Plant Identification	Before operations	YES	tbc											
	Herbicide Limited Pest Control Certificate	1st 6 months	YES	tbc			5								

2. Health and safety courses (Working for Water training matrix contd.)

NO	JOB CATEGORY	PRIORITY	ACCREDITED Yes / No	ACCREDITATION NUMBER	SAQA NQF LEVEL	SAQA NQF CREDIT	CONTRACTOR	WORKERS	DRIVERS	CHAINSAW OPERATORS	BRUSHCUTTER OPERATORS	HERBICIDE APPLICATOR	HEALTH & SAFETY REPRESENTATIVES	PEER EDUCATORS	FIRST AIDERS
FUNCTIONAL			SAQA NQF												
NEW H&S COURSES															
	Workplace Risk Assessment	First 6 months	YES	115101	2	4	3						3		
	Understanding COIDA Procedures	First 6 months	YES	116508	1	2	3						3		
	Fire Awareness	Before fire season/region specific	YES	117079	1	2	3	3	3	3	3	3	3	3	3
	First Aid I	Before Operations (certificate expires after 2 years)	YES	116509	1	2	3						3		3
	First Aid II	Within 6 months	YES	120496	2	5							5		5
	First Aid III	Within 12 months	YES	120336	3	6							5		5
	Health & Safety Level 1	Before Operations	NO, US ALIGNED	116533	0	0	2						2		2
	Health & Safety Level II	Within 6 months	YES	116533	2	2							3		3
	Preliminary Incident Investigation	Within 6 months	YES	115087	2	2	3						3		
	Advanced Driving	Within 3 months	YES	257025	2	4			5						
	Dangerous Animal Awareness	Within 3 months	NO		0	0	2	2	2	2	2	2	2	2	2
	Safety & First Aid in Working for Water(Refresher)	Annually	NO	0	0	0	1	1	1	1	1	1	1	1	1

3. Social development training; and Contractor development Level 1 (Working for Water training matrix contd.)

NO	JOB CATEGORY	PRIORITY	ACCREDITED Yes / No	ACCREDITATION NUMBER	SAQA NQF LEVEL	SAQA NQF CREDIT	CONTRACTOR	WORKERS	DRIVERS	CHAINSAW OPERATORS	BRUSHCUTTER OPERATORS	HERBICIDE APPLICATORS	HEALTH & SAFETY REPRESENTATIVES	PEER EDUCATORS	FIRST AIDERS
SOCIAL DEVELOPMENT TRAINING															
	HIV/AIDS	Every 6 months	YES	8494	2	4	1	1	1	1	1	1	1	1	1
	Peer Educator Course	1st 3 months	Yes	9224	5	4								5	
	Counselling		Yes	13203	5	3								10	
	Primary Health Care	Every 6 months	yes	14659	1	4	1	1	1	1	1	1	1	1	1
	Personal Finances	1st 6 months	Yes	15092, 11912	1	5	1	1	1	1	1	1	1	1	1
	Diversity (Race and Gender)	First year of Working	Yes	14664	1	3	2	2	2	2	2	2	2	2	2
	Home-based Care														
	Frail Care														
	Literacy / Numeracy - ABET	Ongoing from start of OPS	Yes	19083	1	4	30	30	30	30	30	30	30	30	30
CONTRACTOR DEVELOPMENT															
Contractor Level 1															
	WFW Contractor Course Unit 1-11	Before Operations			No	No	10								
	WFW Contractor Course Practical	Before Operations			No	No	2								
	Business Principles		YES	10006	1	2									
				10009	1	3									
				14444	1	7									
	Personal finance			15092	1	5									
				119912	2	3									
	Business Finance			9976,	2	8									

4. Contractor Levels 2 and 3 (Working for Water training matrix contd.)

NO	JOB CATEGORY	PRIORITY	ACCREDITED Yes / No	ACCREDITATION NUMBER	SAQA NQF LEVEL	SAQA NQF CREDIT	CONTRACTOR	WORKERS	DRIVERS	CHAINSAW OPERATORS	BRUSHCUTTER OPERATORS	HERBICIDE APPLICATORS	HEALTH & SAFETY REPRESENTATIVES	PEER EDUCATORS	FIRST AIDERS
Contractor Level 2															
	WfW Contractor Course Unit 12-16	1st 4 contracts			NO	NO	3								
	WfW Contractor Course Unit 17 to 19				NO	NO	2								
	Advanced Entrepreneur Course														
	Business Finance			9976	2	8									
	Business of Contracting			11553	2	12									
				9980	2	15									
				9981	2	20									
				9986	2	12									
				9987	2	10									
Contractor Level 3															
	Business finance			9526	3	6									
				7469	2	2									
Total Training Days					51	101	78	44	49	57	57	47	71	59	62
Additional															
	Chainsaw Appreciation	Before Operations	YES	117062	no	no	5								
	Brushcutter Appreciation	anually	YES	112343	NO	NO	5								

5. Inactive health and safety courses; and Aquatic Weed teams (Working for Water training matrix contd.)

NO	JOB CATEGORY	PRIORITY	ACCREDITED Yes / No	ACCREDITATION NUMBER	SAQA NQF LEVEL	SAQA NQF CREDIT	CONTRACTOR	WORKERS	DRIVERS	CHAINSAW OPERATORS	BRUSHCUTTER OPERATORS	HERBICIDE APPLICATORS	HEALTH & SAFETY REPRESENTATIVES	PEER EDUCATORS	FIRST AIDERS
INACTIVE HEALTH AND SAFETY COURSES(DoL Database)															
	Advanced Driving	1st 3 months	YES	4567	2	6			2						
	Health and Safety Phase 1	Before Operations	YES	14659	1	4	2						2		
	Health and Safety Refresher	annually	NO				2						2		
	Health and Safety 2	First 3 months	YES	110064	2	4									
	Incident Investigation	First 3 months	NO	Nil	Nil	Nil									
	COIDA Training	First 6 months	NO					5					5		
	Fire Awareness	Before fire season/region specific	YES	13961	2	4	2	2	2	2	2	2	2	2	2
	First Aid	Before Operations (certificate expires after 2 years)	YES	9823	1	5	3								3
AQUATIC WEED TEAMS															
	Water Training Basic	Before Operations	US Aligned	8647, 10208	N/A	N/A		2							
	Water Training Advanced	Within 3 months	US Aligned	8647, 10208		N/A		2							
	Water Safety Training and Dangerous Animal Awareness	Before Operations	US Aligned	115,102,116,520	N/A	N/A		2							
	Life Saving Basic	Before Operations	US Aligned	115101, 116520	N/A	N/A		2							

Appendix 3: Excerpts from: Medium Term Strategic Framework 2009-2014 (July 2009)

The following excerpts illustrate how the government's Medium Term Strategic Framework 2009-2014 addresses the government's strategic priorities of the skills and human resource base, and sustainable resource management and use.

39 Strategic Priority 4: Strengthen the skills and human resource base

... 39.9 Ensuring that training and skills development initiatives in the country respond to the **requirements of the economy, rural development challenges and social integration**. The main aim would be to **increase the number of skilled personnel** in the priority skills areas such as design, engineering and artisanship categories that are critical to manufacturing, construction, cultural activities and other priority economic sectors identified in the National Industrial Policy Framework. Additionally skills development programmes will be implemented, purposefully aimed at equipping the unemployed and vulnerable with requisite skills to overcome poverty and unemployment.

- The Further Education and Training (FET) sector with its 50 colleges and 160 campuses nationally will be the primary site for skills development training. Other specialized institutions such as agricultural colleges will form part of the skills development institutional base.
- Through a comprehensive suite of programmes and measures to make learning environments more attractive, FET will play a significant role in providing second chance education for those who do not make it in the 12th year programme of education.
- Support FET colleges and Sector Education and Training Authorities to link with business, industry, and other advanced education and training programmes and to strengthen management capacity to respond to and involve employers/firms more meaningfully
- Put measures in place to ensure FET colleges are able to recruit and retain highly skilled and experienced instructors.
- Provide and support staff development and exposure for FET instructors to link classroom experiences with practical, workplace-based learning experiences.
- Strengthen the capacity of FET colleges to partner with other governmental agencies and civil society programmes that create and incubate small enterprises.
- Put in place mechanisms to ensure better coordination and integration of the relevant government departments and agencies responsible for skills development, including State-owned Enterprises (SOEs).

44 Strategic Priority 9: Sustainable Resource Management and use

South Africa, like the rest of the world, is vulnerable to the impacts of climate change, biodiversity loss and diminishing water resources. To fulfil its obligations to both current and future generations, South Africa ratified the United Nations Framework on Climate Change in August 1997 and acceded to the Kyoto Protocol in March 2002. In 2004, the Climate Change Response Strategy was launched. The 2006

State of the Environment Report provided a comprehensive analysis of the state of South Africa's natural resources and ecosystems, which advances the need for a balanced approach.

The main objective of government is to encourage sustainable resource management and use by focusing on various interventions including the diversification of the energy mix in pursuance of renewable energy alternatives and promotion of energy efficiency; adopting waste reduction practices by encouraging the re-use of waste outputs as productive inputs; enforcing a zero tolerance approach to illegal and unsustainable exploitation of resources; improving air and atmospheric quality for health and well being of citizens; supporting local and sustainable food production; sustainable water use and preserving quality of drinking water and enhancing biodiversity and the preservation of natural habitats. Key programmes will, among other things, include the following:

- Establishing a national framework response on **climate change mitigation** and adaptation whilst maintaining our reputation as a global player.
- A common **system for environmental impact management** across government in developing the Environmental Impact Management Strategy that will ensure improved efficiency and effectiveness.
- Implementing the **Water for Growth and Development strategy**: strengthening institutional capacity for water management so that water scarcity is not exacerbated by ineffectual management, and finding the right mix of mechanisms to effect change in behavior, including regulatory, self-regulatory, market-based instruments and awareness and education. Projects such as the Mokolo River Augmentation Project and the Lower Sunday's River aimed at improving water availability and irrigation especially for poor farmers and providing previously disadvantaged users access to user rights will continue.
- Finalise a policy process on market-based instruments such as taxes, charges and incentives that can be used to **promote environmental protection and biodiversity conservation**.
- Implementation of the National **Framework for Sustainable Development** to ensure that the country follows a sustainable development trajectory for now and into the future.
- Promote **innovation and diversification** towards alternative production of resources.
- To pursue and explore further the concept of **green jobs** including scaling up labour intensive natural resources management practices that contribute to decent work and livelihood opportunities. In particular projects and industries are being pursued in the fields of marine aquaculture development, wildlife management, waste services and ecosystems rehabilitation programmes.
- Efforts to meet the **energy efficiency** target of 12 per cent by 2015 and **renewable energy** target of 10,000 GWh by 2013, will be enhanced by creating an enabling environment for renewable energy, through for example implementing the renewable energy feed-in tariff and building the local renewable energy manufacturing capacity.

Source: http://www.thepresidency.gov.za/docs/pcsa/planning/mtsf_july09.pdf accessed 23 Mar. 2010

Appendix 4: Registered Unit Standards for solar water heating

A. Mount solar water heating system - Available from:

<http://pcqs.saqa.org.za/showUnitStandard.php?id=244499> and

B. Install and maintain solar water heating systems – Available from:

<http://fqas.saqa.org.za/showUnitStandard.php?id=262784>

A. Mount solar water heating system



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SOUTH AFRICAN QUALIFICATIONS AUTHORITY REGISTERED UNIT STANDARD:

Mount solar water heating system

SAQA US ID		UNIT STANDARD TITLE		
262784		Mount solar water heating system		
ORIGINATOR		REGISTERING PROVIDER		
SGB Civil Engineering Construction				
QUALITY ASSURING BODY				
-				
FIELD			SUBFIELD	
Field 12 - Physical Planning and Construction			Civil Engineering Construction	
ABET BAND	UNIT STANDARD TYPE	OLD NQF LEVEL	NEW NQF LEVEL	CREDITS
Undefined	Regular	Level 2	NQF Level 02	20
REGISTRATION STATUS		REGISTRATION START DATE	REGISTRATION END DATE	SAQA DECISION NUMBER
Registered		2009-04-08	2012-04-08	SAQA 0581/09
LAST DATE FOR		LAST DATE FOR ACHIEVEMENT		

ENROLMENT	
2013-04-08	2016-04-08

In all of the tables in this document, both the old and the new NQF Levels are shown. In the text (purpose statements, qualification rules, etc), any reference to NQF Levels are to the old levels unless specifically stated otherwise.

This unit standard does not replace any other unit standard and is not replaced by any other unit standard.

PURPOSE OF THE UNIT STANDARD

Learners accredited with this Unit Standard will understand the relevant theory regarding solar water heating systems and be able to install the system taking due cognisance of roof types and other related matters. Importantly, the installer will work under the supervision of a qualified plumber at all times.

Learners credited with this standard will be able to:

- Explain the theory regarding solar water heating systems.
- Demonstrate and apply knowledge of roof trusses in order to complete installation of solar water heating systems.
- Plan and prepare for installation of solar water heating systems.
- Install solar water heating systems.

LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING

- Communication at NQF Level 1.
- Mathematical Literacy at NQF Level 1.
- Unit Standard: Apply plumbing principles as they pertain to the installation of a hot water system.

UNIT STANDARD RANGE

Systems include but are not limited to direct/indirect, pump/thermo-siphon; flat plate/evacuated tube; split/close couple; retrofit/new installation; pre-heat/feed; freeze protection; scale protection, hail protection; thermal locks, air locks, combinations each with its own dynamics.

Specific Outcomes and Assessment Criteria:

SPECIFIC OUTCOME 1

Explain the theory regarding solar heating water systems.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

The basic installation criteria are explained to or in order to ensure that installation is according to manufacturer's instructions and specification.

ASSESSMENT CRITERION 2

The dangers of solar heating are explained so that special care is taken during installation to limit exposure.

ASSESSMENT CRITERION 3

The aspects pertaining to the various solar water heating configurations are explained to determine impact on installation.

ASSESSMENT CRITERION 4

Problems regarding the solar water heating system are identified and reported to plumber or supervisor.

SPECIFIC OUTCOME 2

Demonstrate and apply knowledge of roof trusses in order to complete installation of solar water heating system.

ASSESSMENT CRITERIA**ASSESSMENT CRITERION 1**

Specified dimensions are accurately understood from plumber instructions according to regulations.

ASSESSMENT CRITERION RANGE

Includes SANS 10400, Part L, SANS 10254, SANS 10252 Part 1.

ASSESSMENT CRITERION 2

Carpentry tools, machines and equipment are identified, checked for functionality and used.

ASSESSMENT CRITERION 3

Preparation of trusses is explained and implemented according to plumber's instructions and drawings.

ASSESSMENT CRITERION 4

Work on roof in preparation for installation of solar heating system is explained and performed according to plumber's instructions.

ASSESSMENT CRITERION 5

National Building Regulations and safety legislation are explained and applied in order to ensure compliance.

SPECIFIC OUTCOME 3

Plan and prepare for installation of solar water heating system.

ASSESSMENT CRITERIA**ASSESSMENT CRITERION 1**

Appropriate hand and power tools and equipment are identified, selected and used according to manufacturer's specifications.

ASSESSMENT CRITERION 2

Personal protective equipment is selected according to the work functions to be performed and worn in

accordance with manufacturer's recommendations.

SPECIFIC OUTCOME 4

Install solar water heating system according to plumber's instruction.

OUTCOME NOTES

Pre-site assessment is completed by qualified plumber and the relevant information is conveyed to the hot water system installer per task.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

The location, orientation and positioning of solar heating components are completed as per instructions and procedure.

ASSESSMENT CRITERION 2

Solar water heating systems' components are assembled as per procedure.

ASSESSMENT CRITERION 3

Solar heating systems are installed for a variety of roof types.

ASSESSMENT CRITERION 4

Heat transfer fluids are used to fill solar collectors and cylinder heat exchangers according to installation procedure.

ASSESSMENT CRITERION 5

The controls are installed, set and programmed to ensure efficient operation.

ASSESSMENT CRITERION 6

Solar water heating systems are pressure tested according to specifications.

ASSESSMENT CRITERION 7

Site instructions are complied with to ensure that installation is completed safely and to the client's satisfaction.

UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS

- Anyone assessing a learner or moderating the assessment of a learner against this unit standard must be registered as an assessor with the relevant ETQA.
- Any institution offering learning that will enable the achievement of this unit standard must be accredited as a provider with the relevant ETQA.
- Assessment and moderation of assessment will be overseen by the relevant ETQA according to the ETQA policies and guidelines for assessment and moderation.
- Moderation must include both internal and external moderation of assessments at exit points of the

qualification, unless ETQA policies specify otherwise. Moderation should also encompass achievement of the competence described both in individual unit standards as well as the integrated competence described in the qualification.

UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE

Names, functions and locations of:

- Safety equipment and protective clothing requirements to be used when installing solar water heating systems.
- Electrical mains and connections to ensure safe installation.

Purpose of processes and procedures of:

- The application of basic plumbing principles in the context of solar water heating systems installation and maintenance.
- The purpose and use of the different types of solar heating components.
- The purpose and use of the different types of hot water cylinders.

Attributes, properties, characteristics related to:

- Solar energy and its uses in domestic water heating.

Cause and effect, implications of:

- The health implications of working on water supply mains.
- The implications of harsh climatic conditions and necessary adaptations.
- The effects of water quality on solar water heaters.
- Backflow.
- Thermal locks, air locks.
- The implications of electrical power and live circuits.

Categories of components, processes, concepts:

- Installation of pipes includes bracketing and support of pipes within specified tolerances.

Procedures and techniques:

- The location, orientation of solar heating components.

Regulations, legislation, agreements, policies:

- National Building Regulations.
- Code of Practice for the application of the National Building Regulations (SANS 10400).
- SANS Codes of Practice: 10252 Part 1, and 10254 and 10106.
- Relevant by-laws of local authority.
- Occupational Health and Safety Act.

Theory - rules, laws, principles:

- The different regulations and purpose pertaining to the preservation of water quality, prevention of backflow, and the disinfecting of domestic installations, including the implications of potable water contamination thermal stagnation.

Relationships, systems:

- Tools, equipment and materials used in the installation and maintenance of solar water heating systems and manufacturers specifications for maintenance of tools and equipment and storage of materials.

UNIT STANDARD DEVELOPMENTAL OUTCOME

N/A

UNIT STANDARD LINKAGES

N/A

Critical Cross-field Outcomes (CCFO):

UNIT STANDARD CCFO IDENTIFYING

Identify and solve problems in which responses display that responsible decisions using critical and creative thinking have been made when:

- Interpreting roof layout drawings.
- Selecting appropriate tools and equipment.

UNIT STANDARD CCFO WORKING

Work effectively with others as a member of a team, group, organisation, community to:

- Install the solar water heating/hot water system.
- Ensure the safety of all personnel during installation.
- Ensure that process of determining the quality of food products runs smoothly and efficiently.

UNIT STANDARD CCFO ORGANISING

Organise and manage oneself and one's activities responsively and effectively when:

- Interpreting roof layout drawings.
- Selecting appropriate tools and equipment.
- Installing the solar water heating system.
- Test pressure of the system.
- Identify and select the appropriate tools and equipment.
- Ensuring the safety of all personnel during installation.

UNIT STANDARD CCFO COMMUNICATING

Communicate effectively using visual, mathematical and/or language skills in the modes of oral and/or written presentation to:

- Prepare for and install solar water heating system.

UNIT STANDARD CCFO SCIENCE

Use science and technology effectively and critically, showing responsibility towards the environment and the health of others by:

- Using the equipment according to manufacturer's instructions.

QUALIFICATIONS UTILISING THIS UNIT STANDARD:

	ID	QUALIFICATION TITLE	OLD LEVEL	NEW LEVEL	STATUS	END DATE
Core	65858	National Certificate: Hot Water System Installation	Level 2	NQF Level 02	Registered	2012-04-08

PROVIDERS CURRENTLY ACCREDITED TO OFFER THIS UNIT STANDARD:

This information shows the current accreditations (i.e. those not past their accreditation end dates), and is the most complete record available to SAQA as of today. Some Quality Assuring Bodies have a lag in their recording systems for provider accreditation, in turn leading to a lag in notifying SAQA of all the providers that they have accredited to offer qualifications and unit standards, as well as any extensions to accreditation end dates. The relevant Quality Assuring Body should be notified if a record appears to be missing from here.

NONE

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B. Install and maintain solar water heating systems



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SOUTH AFRICAN QUALIFICATIONS AUTHORITY REGISTERED UNIT STANDARD:

Install and maintain solar water heating systems

SAQA US ID		UNIT STANDARD TITLE		
244499		Install and maintain solar water heating systems		
ORIGINATOR		REGISTERING PROVIDER		
SGB Building Construction				
QUALITY ASSURING BODY				
-				
FIELD			SUBFIELD	
Field 12 - Physical Planning and Construction			Building Construction	
ABET BAND	UNIT STANDARD TYPE	OLD NQF LEVEL	NEW NQF LEVEL	CREDITS
Undefined	Regular	Level 4	NQF Level 04	10
REGISTRATION STATUS		REGISTRATION START DATE	REGISTRATION END DATE	SAQA DECISION NUMBER
Registered		2007-09-12	2010-09-12	SAQA 0172/07
LAST DATE FOR ENROLMENT		LAST DATE FOR ACHIEVEMENT		
2011-09-12		2014-09-12		

In all of the tables in this document, both the old and the new NQF Levels are shown. In the text (purpose statements, qualification rules, etc), any reference to NQF Levels are to the old levels unless specifically stated otherwise.

This unit standard does not replace any other unit standard and is not replaced by any other unit standard.

PURPOSE OF THE UNIT STANDARD

This unit standard will enable plumbers and related role-players to improve professionalism and enhance the quality and effectiveness of services by being able to install and maintain solar water heating systems.

A person credited with this unit standard is able to:

- Understand solar energy as a source of heat.
- Prepare and plan for the installation of solar water heating systems.
- Install solar water heating components, pipes and fittings.
- Maintain solar water heating components, pipes and fittings.

This unit standard will contribute to the development of the learner within the context of the plumbing discipline. Learners who have achieved this unit standard will increase their opportunities for further development and employability within the plumbing environment.

LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING

It is assumed that the learner has the following knowledge and skills:

- Communication at NQF Level 3.
- Mathematical literacy at NQF Level 3.

UNIT STANDARD RANGE

- The installation, repair and maintenance of hot and cold water systems are according to the following qualitative specifications:
 - > SABS 0254: 2000 The Installation, maintenance and repair of fixed electric storage water heating systems.
 - > SABS 0252: 1994 Water supply and drainage for Buildings.
 - > Part 1: Water Supply installations for Buildings.
- Pipes include but are not limited to: galvanised mild steel (GMS), copper, Cross linked polyethylene (PE-X), polybutylene, chlorinated PVC (CPVC).
- Solar heating components include but are not limited to: Solar collectors, heat exchangers, water storage cylinders, and associated reticulation
- Installation includes but is not limited to: Split system installation, forced circulation installation.
- Solar Heating types include but are not limited to: Integral solar water heaters, separate collector storage solar water heaters, (or thermosyphons), close-coupled solar water heaters, and solar water heaters for swimming pools
- Hot and cold water supply systems include but are not limited to: Direct, indirect and balanced systems for domestic supply.
- Joining of pipes includes but is not limited to: The cutting and threading of galvanised pipes, the joining of similar pipes, and the joining of dissimilar pipe types.
- Water quality includes but is not limited to: Consideration of total dissolved solids (TDS), calcium carbonate and chloride contents, including corrosion factors.
- Fittings include but are not limited to: Cocks, valves, taps, full way valves, house water stations, thermostatic valves, control valves, pressure reducing valves, mixers, expansion relief valves, vacuum breakers etc.
- Types of hot water cylinders include but are not limited to: Combination hot water cylinders push through type, and high pressure hot water cylinders
- Installation of hot water cylinders includes but is not limited to: The drip tray, valves, overflow, thermostats, etc.
- Roof types include but are not limited to: Tiled roofs, sheet metal roofs, asbestos roofs, slate roofs,

thatched roofs, flush-mount/skylight installation, pitch roofs greater than 30 degrees, and low or flat pitched roofs.

- Harsh climatic conditions include but are not limited to: Low temperatures (below 5 degrees C) - inclusion of antifreeze, snow, frost and hail conditions, temperatures below -7 degrees C (special designs required).
- Electrical connections are made according to SABS 0142 - Code for the wiring of premises.
- Solar Water Heating components are manufactured according to the requirements of SANS 1307: 2003.
- Existing services and built-in items that are to be identified and protected include but are not limited to: Other plumbing pipes and fittings, fire protection systems, electrical cables, ducts and units, air-conditioning installations, communication ducts or cables, fixtures and fittings.

Specific Outcomes and Assessment Criteria:

SPECIFIC OUTCOME 1

Understand solar energy as a source of heat.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

Solar energy and its uses in domestic water heating are explained.

ASSESSMENT CRITERION 2

The basics of solar water heating and its applications are described.

ASSESSMENT CRITERION 3

Conventional water heating and the differences to solar water heating are described.

ASSESSMENT CRITERION 4

The benefits and risks associated with solar water heating are explained.

ASSESSMENT CRITERION 5

The types of solar water heaters are listed and described.

SPECIFIC OUTCOME 2

Prepare and plan for the installation of solar water heating systems.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

Cold and hot water pipe systems used in solar water heating are identified and selected according to purpose required.

ASSESSMENT CRITERION 2

Solar heating components are identified and selected according to drawings and specification requirements.

ASSESSMENT CRITERION 3

Solar heating systems and reticulation are sized according to project requirements.

ASSESSMENT CRITERION 4

The location, orientation and positioning of solar heating components are described according to roof structural capabilities, maximisation of energy source, and proximity to water supply.

ASSESSMENT CRITERION 5

The effects of harsh climatic conditions are described and adaptations are identified.

ASSESSMENT CRITERION 6

The effects of water quality on solar water heaters is described.

ASSESSMENT CRITERION 7

The uses and applications of solar heating components are described.

SPECIFIC OUTCOME 3

Install solar water heating components, pipes and fittings.

ASSESSMENT CRITERIA**ASSESSMENT CRITERION 1**

Solar heating components are assembled using pipefittings.

ASSESSMENT CRITERION 2

Solar heating systems are installed for a variety of roof types.

ASSESSMENT CRITERION 3

Heat transfer fluids are used to fill solar collectors and cylinder heat exchange jackets according to manufacturers' specifications.

ASSESSMENT CRITERION 4

Solar water heating systems are pressure tested according to specifications.

ASSESSMENT CRITERION 5

Solar water heating systems are started-up and commissioned according to established procedures, and handed-over.

ASSESSMENT CRITERION 6

Electrical connections are made according to specification.

SPECIFIC OUTCOME 4

Maintain solar water heating components, pipes and fittings.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

Solar heating systems faults are identified and their causes explained.

ASSESSMENT CRITERION 2

Solar heating faults are repaired in accordance with manufacturer's specifications and industry codes of practice.

ASSESSMENT CRITERION 3

Defective components are identified and replaced.

ASSESSMENT CRITERION 4

Solar heating systems are inspected and tested in accordance with manufacturer's specifications and industry codes of practice.

ASSESSMENT CRITERION 5

Solar heating systems are maintained in accordance with warranty conditions and industry codes of practice.

UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS

The assessment will be governed by the policies and guidelines of the relevant Education and Training Quality Assuror (ETQA) that has jurisdiction over this field of learning.

The assessor will (at the very least) be accredited and have a relevant qualification and be a subject matter expert in this learning area and at least have 3 years experience in the skills specific area.

The learner can be assessed against this unit standard to obtain credits or as part of an integrated assessment for a qualification.

- Internal moderation.
- External moderation.
- An assessor, accredited by the relevant ETQA, will assess the learner's competency.
- Assessment procedures will be supplied by the ETQA in alignment with SAQA requirements.
- All assessment activities must be fair, so that all candidates have equal opportunities. Activities must be free of gender, ethnic or other bias.
- Assessment and moderation procedures, activities and tools must be transparent, affordable and support development within the field, sub-field and NQF.
- Questions and answers to determine theoretical knowledge are expected.
- Assessment of a portfolio of evidence.
- Direct observation in simulated and/or controlled work conditions.

UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE

Names, functions and locations of:

- Safety equipment and protective clothing requirements to be used when installing and maintaining solar water heating systems.

Purpose of processes and procedures of:

- The application of basic plumbing principles in the context of solar water heating systems installation and maintenance.
- The purpose and use of the different types of solar heating components.
- The purpose and use of the different types of hot water cylinders.

Attributes, properties, characteristics related to:

- Solar energy and its uses in domestic water heating.

Cause and effect, implications of:

- The health implications of working on water supply mains.
- The implications of harsh climatic conditions and necessary adaptations.
- The effects of water quality on solar water heaters.

Categories of things, processes, concepts.

- Installation of pipes includes bracketing and support of pipes within specified tolerances.

Procedures and techniques:

- The location, orientation of solar heating components.

Regulations, legislation, agreements, policies:

- National Building Regulations.
- Code of Practice for the application of the National Building Regulations (SANS 10400).
- SANS Codes of Practice : 10252 Part 1, and 10254.
- Industry standards indicated in the Skills Register for the designated trade of Plumbing.
- Occupational Health and Safety Act.

Theory - rules, laws, principles:

- The different regulations and purpose pertaining to the preservation of water quality, prevention of backflow, and the disinfecting of domestic installations, including the implications of potable water contamination.

Relationships, systems:

- Tools, equipment and materials used in the installation and maintenance of solar water heating systems and manufacturers specifications for maintenance of tools and equipment and storage of materials.

UNIT STANDARD DEVELOPMENTAL OUTCOME

N/A

UNIT STANDARD LINKAGES

N/A

Critical Cross-field Outcomes (CCFO):**UNIT STANDARD CCFO IDENTIFYING**

Identifying and solving problems in which responses display that responsible decisions using critical and creative thinking have been made when:

- Recognising, problems relating to fault finding and repairs to solar water heating systems.
- Obtaining information from the client in instances where instructions or information on drawings is insufficient.
- Identifying and pro-actively correcting issued of non-availability of resources and materials i.e labour, plant and materials.
- Non-conformances detected in previous installations are reported to the client.

UNIT STANDARD CCFO WORKING

Working effectively with others as a member of a team, group, organisation, and community during:

- Working in unison with client, co-workers and other trades on site.
- Communicating and receiving advice from client.

UNIT STANDARD CCFO ORGANISING

Organising and managing oneself and one's activities responsibly and effectively when:

- Setting out the work area and preparing to carry out installation and maintenance of solar water heating systems.
- Access equipment is acquired and prepared at the worksite.
- Performing activities in accordance with industry standards.
- Selecting plumbing tools and equipment in accordance with the requirements of the task.
- Ensuring tools, equipment and plumbing materials are securely stored.
- Maintaining minimum quantities of plumbing materials in accordance with task requirements.
- Safety equipment and clothing is selected and prepared in accordance with legislative requirements.

UNIT STANDARD CCFO COLLECTING

Collecting, analysing, organising and critically evaluating information to better understand and explain:

- Carrying out written and/or verbal site instructions issued by the client, correctly and efficiently.
- Correctly interpreting information contained in drawings.
- Setting out work areas from provided control positions and levels in accordance with instructions and

drawings.

- Complying with the instructions issued by the Client, and suppliers.

UNIT STANDARD CCFO COMMUNICATING

Communicating effectively using visual, mathematical and/or language skills in the modes of oral and/or written persuasion when:

- Issuing clear verbal instructions to team members.
- Actively listening to feedback received from team members.
- Evaluating and reporting problem situations to the client.

UNIT STANDARD CCFO SCIENCE

Using science and technology effectively and critically, showing responsibility towards the environment and health of others when:

- By applying the appropriate tools and materials for the installation and maintenance of solar water heating systems.
- Understanding and applying the principles of solar water heating systems.

UNIT STANDARD CCFO DEMONSTRATING

Demonstrating an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation when:

- The inter-relatedness of solar water heating systems to other energy sources and hot and cold water systems.

QUALIFICATIONS UTILISING THIS UNIT STANDARD:

	ID	QUALIFICATION TITLE	OLD LEVEL	NEW LEVEL	STATUS	END DATE
Elective	58782	Further Education and Training Certificate: Plumbing	Level 4	NQF Level 04	Registered	2010-09-12

PROVIDERS CURRENTLY ACCREDITED TO OFFER THIS UNIT STANDARD:

This information shows the current accreditations (i.e. those not past their accreditation end dates), and is the most complete record available to SAQA as of today. Some Quality Assuring Bodies have a lag in their recording systems for provider accreditation, in turn leading to a lag in notifying SAQA of all the providers that they have accredited to offer qualifications and unit standards, as well as any extensions to accreditation end dates. The relevant Quality Assuring Body should be notified if a record appears to be missing from here.

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Appendix 5: List of SETAs

Sector Education and Training Authorities (SETAs)

[This is the list of SETAs in August 2005, after the Minister of Labour announced the merges that significantly changed the following SETAs: DIDTETA, POSLEC SETA, PAETA and SETASA. The first two were merged to form the SAS SETA and the last two were merged into the AgriSETA.]

Acronyms	Full name	Telephone no.	Website address	Postal address
AgriSETA	Agriculture Sector Education and Training Authority	012 325 1655	http://www.agriseta.co.za	PO Box 26024, Arcadia, Pretoria 0007
BANKSETA	Banking Sector Education and Training Authority	011 805 9661	http://www.bankseta.org.za	PO Box 11678, Vorna Valley, 1686
CETA	Construction Education and Training Authority	011 265 5900	http://www.ceta.org.za	PO Box 1955, Halfway House, 1685
CHIETA	Chemical Industries Education and Training Authority	011 726 4026	http://www.chieta.org.za	PO Box 961, Auckland Park, 2006
CTFL SETA	Clothing, Textiles, Footwear and Leather Sector Education and Training Authority	031 702 4482	http://www.ctflseta.org.za	PO Box 935, Pinetown, 3600
ESETA	Energy Sector Education and Training Authority	011 689 5300	http://www.eseta.org.za	PO Box 5983, Johannesburg, 2000
ETDP-SETA	Education, Training and Development Practices Sector Education and Training Authority	011 628 5000	http://www.etdpseta.org.za	Private Bag X105, Melville, 2109
FASSET	Finance, Accounting, Management Consulting and other Financial Services Education and Training Authority	011 476 8570 or 086 101 0001	http://www.fasset.org.za	PO Box 6801, Cresta, 2118
FIETA	Forestry Industries Education and Training Authority	011 712 0600	http://www.fieta.org.za	PO Box 31276, Braamfontein, 2017
FOODBEV	Food and Beverages Manufacturing Industry Sector Education and Training Authority	011 253 7300	http://www.foodbev.co.za	PO Box 245, Gallo Manor, 2052
HWSETA	Health and Welfare Sector	011 607 6900	http://www.hwseta.org.za/	Private Bag X15,

Acronyms	Full name	Telephone no.	Website address	Postal address
	Education and Training Authority			Gardenview, 2047
INSETA	Insurance Sector Education and Training Authority	011 544 2000	http://www.inseta.org.za	PO Box 32035, Braamfontein, 2017
ISETT	Information Systems, Electronics and Telecommunications Technologies Education and Training Authority	011 805 5115	http://www.isett.org.za	PO Box 5585, Halfway House, 1685
LGSETA	Local Government Sector Education and Training Authority	011 456 8579	http://www.lgseta.co.za	PO Box 1964, Bedfordview, 2008
MAPPP-SETA	Media, Advertising, Publishing, Printing and Packaging Sector Education and Training Authority	021 910 3001	http://www.mappp-seta.co.za	PO Box 2847, Bellville, 7535
MERSETA	Manufacturing, Engineering and Related Services Education and Training Authority	011 484 9310-6	http://www.merseta.org.za	PO Box 5821, Tygervally, 7536
MQA	Mining Qualifications Authority	011 630 3500	http://www.mqa.org.za/	Private Bag X118, Marshalltown, 2017
PSETA	Public Service Sector Education and Training Authority	012 314 7251	http://www.pseta.gov.za	Private Bag X916, Pretoria, 0001
SASSETA	Safety and Security Sector Education and Training Authority	011 347 0200 0861 102 477	http://www.sasseta.org.za (This website will merge the previous two: http://www.didteta.org.za and http://www.poslecseta.org.za .)	PO Box 7612, Halfway House, 1685
SERVICES SETA	Services Sector Education and Training Authority	011 715 1800	http://www.serviceseta.org.za	PO Box 3322, Houghton, 2041
TETA	Transport Education and Training Authority	011 781 1280	http://www.teta.org.za	Private Bag X10016, Randburg, 2125
THETA	Tourism and Hospitality Education and Training Authority	011 803 6010	http://www.theta.org.za	PO Box 1329, Rivonia, 2128
W&RSETA	Wholesale and Retail Sector Education and Training Authority	012 452 9200	http://www.wrseta.org.za	PO Box 2176, Brooklyn, 0075

Appendix 6: Global Carbon Exchange: Certified Carbon Footprint Analyst (Level 1)

Purpose: To educate individuals on the key areas required in order to become a carbon footprint analyst. This is a hands on course where the learners will be taken through the logical steps required to complete a carbon footprint assessment. On completion learners will have the skills and knowledge required to complete a small business carbon footprint assessment.

Course content

Day 1: Why should we measure carbon?

- **What is Climate Change?**

- Climate and weather
- What makes the climate change?
- How has the climate changed in the past?
- The greenhouse effect.
- Have people contributed to changing the climate?
- Is the globe warming?
- Climate change and the future
- What are the implications of global warming and climate change?

- **The Carbon Markets: An Introduction**

- The history of carbon markets and the Kyoto Protocol
- The Clean Development Mechanism
- The Mandatory Market
- The Voluntary Market
- The state of Carbon Markets

Day 2: How do we measure carbon?

- What is a Carbon Footprint?
- Why do a Carbon Footprint?
- Planning to undertake a Carbon Footprint?
- What are the Standards for Carbon Footprinting?
- What tools are available to undertake a footprint?
- How to undertake a Carbon Footprint for a business
 - Step 1: Setting boundaries
 - Step 2: Collecting data
 - Step 3: Data analysis
- Quality control and Verification
- Reporting and Disclosure
- South African Legislation

Day 3: Doing the Footprint

- Practical example via case study

Source: <http://www.globalcarbonexchange.co.za/certified-carbon-footprint-analyst-level-1.html>

Appendix 7: Global Carbon Exchange: Certified Energy Efficiency Auditor (Level 1)

Purpose: To educate individuals on the key areas required in order to become an energy efficiency auditor. This is a hands on course where the learners will be taken through the logical steps required to become an Energy Efficiency Auditor. On completion learners will have the skills and knowledge to be able to complete a small business energy audit. This will include sufficient knowledge to recommend the steps required to become a more efficient business.

Course content

Day 1

- What is an Energy Audit?
- Why conduct an Energy Audit?
- Energy Audit Equipment
- Energy Audit Methodology
- Walk Through Audit
- Historical Data Collection
- Establishing an Energy Consumption Profile

Day 2

- Lighting
- Building Envelope
- Heating, Ventilation and Cooling
- Hot Water Generation

Day 3

- Motors, Pumps, Fans and Drives
- Compressed Air Plant
- Refrigeration Systems
- Boiler and Steam Systems
- Conclusions
- Case Study

Source: <http://www.globalcarbonexchange.co.za/certified-energy-efficiency-auditor-level-1.html>

Appendix 8: Level Descriptors of the National Qualifications Framework (NQF)

Level descriptors, as the nomenclature suggests, provide a description of each of the eight levels on the National Qualifications Framework (NQF). The purpose of such description is to assist a writer of standards or qualifications in designing a qualification by allocating a level to a unit standard or a qualification, and to formulate outcomes and criteria for assessment that could clearly indicate the level of knowledge of a learner required to successfully achieve the unit standard or qualification.

The NQF consist of three bands, namely General Education (level 1 – schooling up to grade 9 and ABET), Further Education and Training (levels 2 – 4: grade 10 – 12), and Higher Education (levels 5 – 8). After completion of level 1 of the NQF, a learner could achieve a GETC and after completion of level 4 of the NQF, an FETC.

NQF LEVEL	BAND	QUALIFICATION TYPE	
8	HIGHER EDUCATION AND TRAINING	- Post-doctoral research degrees - Doctorates - Masters degrees	
7		- Professional Qualifications - Honours degrees	
6		- National first degrees - Higher diplomas	
5		- National diplomas - National certificates	
FURTHER EDUCATION AND TRAINING CERTIFICATE			
4	FURTHER EDUCATION AND TRAINING	National certificates	
3		(Grades 10, 11 and 12)	
2			
GENERAL EDUCATION AND TRAINING CERTIFICATED			
1	GENERAL EDUCATION AND TRAINING	Grade 9	ABET Level 4
		National certificates	

Notes

ABET: Adult Basic Education and Training

In line with the level descriptors, qualifications and unit standards are registered at the specified level of the NQF with a number of credits allocated to it. This means that a learner could accumulate credits for successful completed unit standards towards a qualification making learning more flexible to meet learner needs.

Source: South African Qualifications Authority (SAQA) website: <http://www.saqa.org.za/show.asp?include=focus/ld.htm>