



SKILLS FOR THE
GREEN
TRANSITION
IN SOUTH AFRICA Report | July 2024



Abstract

For South Africa's green transition to succeed, it is essential that the necessary skills to perform green jobs and green tasks are available among its current and future workforce. Many of the qualifications that are traditionally offered by the Post-School Education and Training (PSET) system already aim to equip graduates with a large part of the skills that are also relevant for green jobs. After all, many of the skills that are needed in green jobs are similar to those needed in non-green jobs. This includes transversal skills such as literacy, numeracy and a range of socio-emotional skills, as well as generic technical skills that are needed for a broad range of jobs, both in and outside of the green economy. But, there is also a need for 'green-specific' technical skills that are newly emerging as green industries and green processes develop, and to date not enough education and training programs have been updated or introduced to incorporate these particular skills. This is partly the result of insufficient signaling from the labor market on the labor and skill needs for the green transition which, in turn, is caused by gaps in strategic coordination, weak incentives, and methodological issues preventing the collection and dissemination of relevant data on skill needs for the green transition. Additionally, the PSET system, especially Technical and Vocational Education and Training (TVET), suffers from significant systemic weaknesses with a negative impact on the relevance, quality, and quantity of PSET provision, which contributes to skills gaps and mismatches across South Africa's economy, including for green jobs.

This report proposes the following reforms and interventions to improve the extent to which the PSET system caters to skill demand for the green transition:

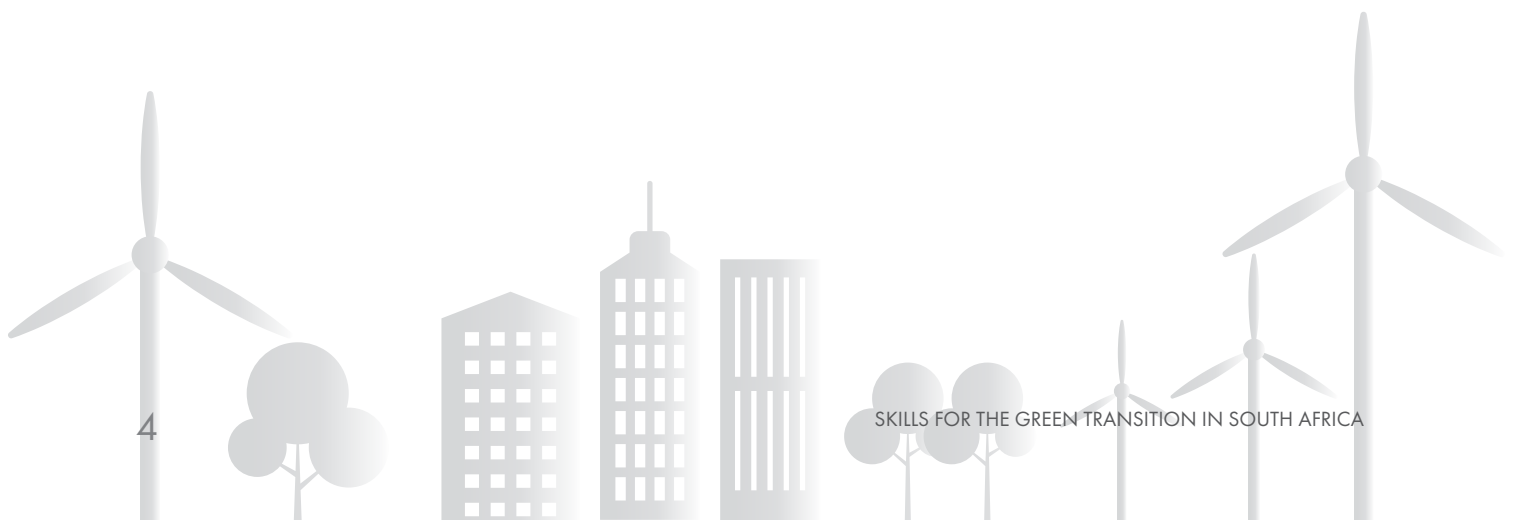
1. **Ensure effective coordination for developing skills for green jobs by establishing clear leadership and ensuring effective coordination between key stakeholders on the skills demand and supply side.** Objectives, approaches and responsibilities for building skills for the green economy need to be consistently understood and applied by all key stakeholders. This requires clear leadership, for example by the Presidential Climate Commission (PCC), and effective coordination between and among stakeholders on the skill supply and demand sides.
2. **Regularly and systematically collect, synthesize and disseminate data on skill needs for the green transition.** DHET could collaborate with SETAs to ensure that SSPs more consistently and clearly include data on skill demand for the green transition. Beyond SETAs, other parties can be encouraged to carry out skill demand assessments for the green transition, for example applying cross-sectoral, regional, or occupational approaches. As the number of skill needs assessment increases, a credible institution needs to take on the role of synthesizing the findings and disseminating them to PSET stakeholders in an actionable manner.
3. **Target and tailor interventions to industries, locations, jobs, and people where there is clear evidence of greening momentum and skill constraints.** Well-targeted interventions should address priority skill needs for the green transition. These can focus on skills for industries or regions where there is clear evidence of green transition momentum and a strong risk that these are derailed by skills constraints. Skills interventions should also be tailored to the learners' skill gaps and characteristics. For example, current workers in low-skilled jobs that require little adaptation can be trained on-the-job, while technician-level workers in jobs with more sophisticated new tasks may need short training.
4. **Support at-risk workers in maintaining their employability and livelihoods through skills development and other interventions.** At-risk workers and measures to safeguard their earnings potential should be identified timely. Support plans, which likely include retraining, should be integrated in the overall framework of greening strategies and policies. Training programs will be expected to provide at-risk workers with the skills needed to access available jobs that largely match their current skills profiles. Engaging and facilitating private training providers will be essential, since many of them already offer short programs to adults.

5. **Remove unnecessary red tape that delays or prevents the development of new qualifications and accreditation of TVET providers and enterprises.** The current processes are too cumbersome and should be reviewed and simplified. This includes specifically procedures set by the Quality Council for Trades and Occupations (QCTO) and Sector Education and Training Authorities (SETAs) to develop and update qualifications; approve TVET providers to offer programs for particular qualifications; and authorize firms to offer work placements to TVET students. The Red Tape Reduction Task Team within the Office of the President could potentially facilitate the easing of the most cumbersome processes.



TABLE OF CONTENTS

ABSTRACT	1
ACKNOWLEDGEMENTS.....	5
ABBREVIATIONS AND ACRONYMS	6
1. INTRODUCTION.....	8
2. THE DEMAND OF SKILLS FOR SOUTH AFRICA'S GREEN TRANSITION.....	11
2.1 Defining jobs and skills for the green transition.....	11
2.2 The expected impact of the green transition on labor and skill demand.....	18
3. THE CURRENT OFFER OF PSET FOR THE GREEN TRANSITION.....	23
3.1 Assessing PSET's responsiveness to the skill needs for the green economy	23
3.2 Strengths of the PSET system's responsiveness to the skill needs of the green economy.....	24
3.3 Weaknesses of the PSET system's responsiveness to the skill needs of the green economy.....	27
4. CONCLUSIONS AND RECOMMENDATIONS	34
REFERENCES	40
ANNEXES	45
Annex 1 – South Africa's process for aligning skills supply with demand	45
Annex 2 – Existing PSET offer related to energy.....	48
Annex 3 – Higher education institutions' research and education programs targeting the green economy.....	49
Annex 4 – South Africa's PSET programs by qualification level.....	51
Annex 5 – New engineers, apprentices and artisans per year.....	54



Acknowledgements

This Synthesis Note on “Preparing the Workforce for the Green Transition” was led by Elizabeth Ninan Dulvy (Program Leader, Human Development) and Margo Hoftijzer (Skills Development Expert, Consultant). The core team also included Jutta Franz (Skills Development Expert, Consultant), Ken Duncan (CEO, SkillSonics). The Note benefitted from inputs from Carmel Marock (REAL Institute, Wits University) and from peer reviewers Stephane Hallegatte (Senior Climate Change Advisor, World Bank) and Shiro Nakata (Senior Economist, World Bank).

The Note was finalized under the collective guidance and leadership of Satu Kahkonen (Country Director), Daniel Dulitzky (Regional Director, Human Development); Meskerem Mulatu (Practice Manager, Education), and Feyi Borroffice (Operations Manager).

Abbreviations and acronyms

ACDI	African Climate and Development Initiative
ADB	Asian Development Bank
CEDEFOP	European Centre for the Development of Vocational Training
CER	Centre for Energy Research
CET	Community Education and Training
CETA	Construction Education and Training Authority
CHIETA	Chemical Industries SETA
CRSE	Centre for Renewable and Sustainable Energy
CSIR	Council for Scientific and Industrial Research
CSL	Critical Skills List
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DHET	Department of Higher Education and Training
DQP	Development Quality Partner
DSI	Department for Science and Innovation
EC	European Commission
ERRP	Economic Reconstruction and Recovery Plan
ESCO	European Skills, Competences, Qualifications and Occupations
ETF	European Training Foundation
EWSETA	Electricity and Water SETA
GIZ	German Technical Cooperation
HICC	Hydrogen Infrastructure Centre of Competence
HRDC	Human Resources Development Council
HRDS	Human Resource Development Strategy
HySA Systems	Hydrogen South Africa Systems Integration Competence Centre
ICES	Institute for Catalysis and Energy Solutions
ICT	Information and Communication Technology
ILO	International Labour Organisation
ISCO	International Standard Classification of Occupations
IRP	Integrated Resource Plan
JET	Just Energy Transition
LMIP	Labour Market Intelligence Partnership
LOHD	List of Occupations in High Demand
merSETA	Manufacturing, Engineering & Related Industries SETA

MQA	Mining Qualifications Authority
NADAB	National Artisan Development Advisory Body
NAMB	National Artisan Moderation Body
NATED	National Accredited Technical Education Diploma
NBI	National Business Initiative
NCPC	National Cleaner Production Centre
NDC	National Determined Contribution
NDP	National Development Plan
NC(V)	National Certificate (Vocational)
NPC	National Planning Commission
NQF	National Qualifications Framework
NSA	National Skills Authority
OECD	Organisation for Economic Cooperation and Development
OFO	Organising Framework for Occupations
PCC	Presidential Climate Commission
PMO	Project Management Office
PSET	Post-School Education and Training
QCTO	Quality Council for Trades and Occupations
SAIAMC	South African Institute for Advanced Materials
SANEA	South African National Energy Association
SAPVIA	South African Photovoltaic Industry Association
SAQA	South African Qualifications Authority
SARETEC	South African Renewable Energy Technology Centre
SESSA	Sustainable Energy Society of Southern Africa
SETA	Sector Education and Training Authority
SJRP	Sector Jobs Resilience Plans
SSP	Sector Skills Plan
STEM	Science, Technology, Engineering and Mathematics
TETA	Transport Sector Education and Training Authority
TIPSASA	Thermal Insulation Products and Systems Association of South Africa
TVET	Technical and Vocational Education and Training
UNEP	United Nations Energy Programme
WBL	Workplace-based Learning
WEF	World Economic Forum



1. Introduction

South Africa is going through a ‘green transition’ to mitigate and adapt to climate change.

The government’s aims and strategies for the green transition are captured in various key documents. The principal pillars of the government’s strategy are a low-carbon, resilient economy, and a just society, as described in its 2011 National Development Plan (NDP). The NDP highlights that this implies reducing dependency on carbon, natural resources and energy, while ensuring that this transition contributes to increasing employment and reducing inequality.¹ These ambitions are aligned with the description of a green economy by the United Nations Environment Programme (UNEP) as “one that leads to improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities”.² The NDP’s vision is based, among others, on the Integrated Resource Plan (IRP) 2010–2030 that combines aims related to providing secure and affordable access to electricity, with reductions of water usage and greenhouse gas emissions.³ The 2021 Framework for a Just Transition in South Africa focuses on the social and economic consequences of climate mitigation and adaptation policies including by emphasizing decent work, inclusion, and poverty reduction. At the international level, South Africa’s commitments to reduce greenhouse gas emissions are incorporated in its National Determined Contribution (NDC) under the Paris Agreement, of which the 2021 version reflects strengthened mitigation ambitions compared to the previous 2016 version.⁴

The share of green jobs in South Africa’s economy is still small, but will rise quickly if green technologies are adopted. A recent study finds that workers in green jobs, defined as jobs that require executing at least one task that is directly linked to protecting the environment, are estimated to make up 5.5 percent of total employment.⁵ Once green industries expand and green technologies are adopted more widely across the economy, the share of workers in green jobs is expected to increase substantially.

1 NPC (2011)

2 UNEP (2011), p1

3 Department of Energy (2019). First promulgated in 2011, the IRP was updated in 2019, and a new revised draft was published for consultations in 2023 (Government Gazette No. 49974, January 4, 2024).

4 Republic of South Africa (2021)

5 Mosomi and Cunningham (forthcoming)

The green transition will have a huge impact on South Africa's labor market in various ways. As its economic structure changes, new jobs will emerge and the demand for these will gradually rise as the pace of the transition increases. The skills needed for existing jobs will also change, because work processes gradually become 'greener'. At the same time, jobs will be lost, especially when activities in carbon- and resource-intensive industries, such as the coal sector, are wound down.⁶ When handled well, the green transition may result in net job creation, and the resulting green jobs may on average be better paid than those in the non-green economy.⁷ But these positive implications are far from self-evident, and largely depend on the greening pathways that South Africa will follow, and the surrounding policies and institutions that build human capital and harness employability.⁸

It is crucial to align workforce skills with changing skill demand due to the green transition, both to enable the transition and to ensure that it is just. First, an appropriately skilled workforce is essential to make the green transition happen. Substantial gaps and mismatches in the supply of labor and skills may derail or delay the transition process, while the availability of a well-skilled workforce could even drive the progress toward climate-resilient growth.⁹ Second, for a just transition, workers who are displaced or at risk of displacement due to the green transition need support, which includes helping them acquire the skills needed to maintain their employability and access new jobs.¹⁰ Reducing individual losses and equitably sharing the gains from the transition will also be essential to maintain public buy-in and thereby political feasibility of the transition.¹¹

Equipping the current and future workforce with the skills needed for the green transition requires interventions across the entire education and training system. More immediate skill needs can be addressed by upskilling and reskilling the current workforce, with a special focus on workers in regions that are highly dependent on industries with negative environmental impacts that are expected to wind down or fundamentally transform.¹² Preparing the future workforce for the green transition requires adaptation in the entire education and training system, from including basic climate change education in general education¹³, to ensuring that technical and vocational education and training (TVET) and higher education equip learners with higher level and technical skills in response to the skill needs of the green economy.¹⁴

The government recognizes the importance of skills for the green economy in its new Human Resource Development Strategy (HRDS) and the Implementation Plan for the Just Energy Transition (JET) . The forthcoming HRDS, covering the period 2024-2033, includes the creation of an "adequate labour market pool of digital and green skills" as one of its six key objectives. The strategy highlights the benefits that will accrue from the green transition, as well as the need to ensure an equitable distribution of its benefits.¹⁵ The JET Implementation Plan includes skills as one of its six key portfolios that are considered essential to achieve the country's decarbonization goals.¹⁶

6 OECD (2023)

7 Deloitte (2023); World Bank Group (2021); ILO (2018); Vona et al (2019). OECD (2017) notes more cautiously that "overall job creation and job destruction tend to be of similar size for well-implemented green policies".

8 See for example Marin and Vona (2019) on EU member states; Consoli et al (2016) for the USA; Deloitte (2023) for Asia and the Pacific.

9 Deloitte (2023)

10 OECD (2023); IRENA and ILO (2023)

11 WB Climate Change Action Plan (2021)

12 OECD (2017), ILO (2019)

13 UNESCO-UNEVOC 2021, ADB 2023

14 Consoli et al (2016); Urban et al (2023)

15 HRDC (2023)

16 South Africa Presidency (2023)

This report aims to offer insights and guidance on how to better align post-school education and training (PSET) with the skill demands of the green transition, to aid decision-makers with responsibilities in the realms of the green transition and skills development. The report reviews how prepared South Africa's education and training system is to provide the skills required for the green transition, and proposes recommendations for improvement. The report's focus is on PSET, including higher education, TVET, and adult training.¹⁷ The report emphasizes skill needs for renewable energy value chains, given the government's current focus on JET, which has also resulted in the availability of several recent national analyses on skill needs for this segment of the economy.

This report is part of the World Bank Group's broader activities in support of inclusive economic growth in South Africa. It relates specifically to the World Bank Group's goals of promoting greater climate change resilience and environmentally sustainable investments, supporting just transition in key sectors, strengthening the ecosystem for small, micro and medium enterprises, strengthening employment services, and expanding access to relevant skills training programs.

This report is based on a review of relevant national and international literature and stakeholder consultations. Reviewed literature includes policy documents, strategies and analyses related to South Africa's green transition and system for PSET, complemented with global and regional analyses by international organizations and think tanks (see References). Interviews were conducted with key respondents from industry, government and civil-society organisations who are active in the field of the green transition and/or skill development. More information can be found in the background paper to this report.¹⁸

¹⁷ While acknowledging the importance for the green transition of foundational skills and basic climate education acquired through general education, these are outside the scope of this report.

¹⁸ Duncan (forthcoming)

2. The demand of skills for South Africa's green transition

2.1 Defining jobs and skills for the green transition

Global definitions and measurement

Despite increasing international discourse on the green transition and its labor market implications, there is no internationally agreed definition of green jobs. Broadly, definitions of green jobs tend to focus on the impact of jobs on the environment or green economy, their task content, the skills required to perform them, or a combination of these.¹⁹ Some organizations, like the UNEP and the International Labor Organization (ILO), add a social aspect by also referring to 'decent jobs' in their green jobs definition. Table 2.1 summarizes the definitions that are applied by various international organizations. No single definition is internationally agreed, and even within countries, there is often no commonly applied concept.²⁰

Table 2.1. Varying definitions of green jobs and their sources

Source	Green jobs definition
OECD (2023)	Jobs where at least 10 percent of tasks directly supports sustainable development
WEF (2023)	Roles that support greener economies and require specific "green skills" to perform them
ILO (2016)	Decent jobs that contribute to preserve or restore the environment, be they in traditional sectors such as manufacturing and construction, or in new, emerging green sectors such as renewable energy and energy efficiency
UNEP, ILO et al (2008)	Decent jobs in any economic sector that contribute to preserving, restoring, and enhancing environmental quality through (i) the production of environmental outputs or (ii) the use of environmentally friendly technologies in production

* OECD: Organization for Economic Cooperation and Development. WEF: World Economic Forum.

Beyond different definitions, there are also different taxonomies and methodologies to identify and measure green jobs. The approach to measuring green jobs can be output-, process-, and task-based, or a combination thereof. The output-based approach identifies industries that produce final products and services that reduce environmental impacts and/or conserve the environment, and considers all jobs in these industries as green. The process-based approach focuses on the production processes of goods and services, and considers them green when they, for example, integrate energy-saving technologies, reduce water usage, and reuse materials. The task-based approach identifies tasks that aim to produce greener outputs or reduce a firm's environmental footprint, and considers a job 'green' when it requires the execution of such tasks, regardless of the environmental footprint of the industry in which this job is carried out.²¹ Internationally, several relatively sophisticated quantitative methodologies to measure the number of green jobs have emerged, based on one or more of these taxonomies. For example, the ILO Taxonomy for Green Jobs applies a combined output- and process-based approach supplemented with attention to decent jobs, and the O*Net taxonomy for green occupations applies a task-based approach to identify green occupations.²² A recent World Bank report applied a task-based approach to identify and count the number of current green jobs in South Africa and to profile their workers and wages.²³

19 IRENA and ILO (2023)

20 CEDEFOP (2019)

21 World Bank (2023); Granata and Posadas (2022)

22 Urban et al (2023). O*NET, the Occupational Information Network, is the main source of occupational information in the United States, used worldwide as a basis for research. Its taxonomy classifies and codes occupations from major occupational groups to individual occupations.

23 Mosomi and Cunningham (2024)

Which taxonomy and methodology are preferable for measuring green jobs depends on purpose and on data availability. An output-based approach that focuses on green industries, for example, may be appropriate when policy makers want to apply a sector-based approach to workforce development. A task-based approach, on the other hand, may be preferable when policymakers want to identify jobs across sectors with a high green task content for which upskilling is particularly important.²⁴ The choice of approach may also be determined by data requirements, especially in contexts where data availability is a challenge.

Compared to green jobs, there seems to be even less consensus on how to define and conceptualize the skills needed for these jobs. Some sources refer to ‘green skills’, while others (like this report) prefer to use terms such as ‘skills for the green transition’ or ‘skills for the green economy’, to acknowledge that many skills that are required for the green transition are also needed in jobs that do not have a positive environmental impact. Conceptualizations of skills for the green transition vary, among others, in the scope of skills that are considered, especially whether these include non-technical skills and whether these skills should be exclusively required for green jobs. At one end of the spectrum is the European Commission (EC), for example, which defines green skills as “skills and competences but also knowledge, abilities, values and attitudes needed to live, work and act in resource-efficient and sustainable economies and societies”.²⁵ The recently developed taxonomy for green skills and knowledge concepts under the European Skills, Competencies and Occupations (ESCO) framework includes transversal skills in its concept of ‘skills that reduce the environmental impact on human activities’, and such skills make up a large share of the total number of identified green skills.²⁶ For example, nearly a quarter of the skills identified as green relate to communication, collaboration and creativity. What seems more common, however, is that analyses and discourse on skill needs for the green economy focus on technical skills. In practice, this regularly translates in a focus on skills in the fields of science, technology, engineering, and mathematics (STEM). Even more focused approaches zoom in on those technical skills that are exclusive to green jobs, such as, for example, the ability to install wind turbines or maintain electric vehicles. The focus on technical skills is also present in South Africa, as is reflected in section 2.2 below which summarizes the current knowledge on the demand for green jobs and the skills needed for those jobs in the country.

Textbox 2.1 provides the definitions of key concepts as that are used in this report. Dialogue on skills for the green transition can be confusing due to the lack of agreed definitions on key green terms. Therefore, textbox 2.1 describes the definitions that are applied in this report (unless when the report explicitly refers to different definitions as used by other sources). Textbox 2.2 further illustrates key terms related to green jobs by applying them to an example. Textbox 2.3 provides an example of the different skill needed for the green transition.

24 ADB (2023). Also see this publication for a more elaborate description of which methodologies may be more appropriate given aims and data availability

25 RENA and ILO (2023)

26 Urban et al (2023)

Textbox 2.1. Definitions of key green terms as applied in this report

THE GREEN ECONOMY AND RELATED TERMS

The **green economy** is a prosperous economy that does not negatively impact the current or future environment. The **green transition** is the ongoing process of changing from the current economic system to a green economy.

GREEN JOBS AND RELATED TERMS

Green jobs are jobs that contribute to the green economy or the green transition, and that either do not exist or have a substantially different task content in a non-green economy. **Green occupations** are a set of jobs with a high degree of similarity in tasks and duties, of which most or all are considered green jobs. Occupations are not always easy to distinguish from jobs. This report uses the term 'job', unless 'occupation' is clearly more appropriate or when referring to other sources that specifically use the term 'occupation'.

Green tasks. The tasks requirements of a job that make it a green job.

SKILLS FOR THE GREEN TRANSITION AND RELATED TERMS

Skills for the green transition are the skills needed to carry out the tasks and duties of green jobs (or occupations) in a satisfactory manner. Related terms are **skills for the green economy**, **skills for green jobs**, **skills for green occupations**, and **skills for the green economy**. Generally, this requires all of the following three types of skills:

- **Transversal skills** are cognitive and socioemotional skills such as literacy, numeracy, problem-solving skills that are required to some extent to carry out any type of job.
- **Generic technical skills** are technical skills that are needed to contribute to the green transition, but that are also needed in the non-green economy.
- **Green-specific technical skills** are technical skills that are particular to green jobs and therefore not, or hardly, needed in non-green jobs

NON-GREEN AND RELATED TERMS

Non-green refers to something that does not make a positive environmental contribution. The **non-green economy** comprises economic activities that do not improve or even harm the environment. **Non-green jobs** are jobs where the positive impact is minimal and overshadowed by activities that have a neutral or negative environmental impact. The **brown economy** or **brown jobs** refer to economic activities are jobs that have a negative environmental impact

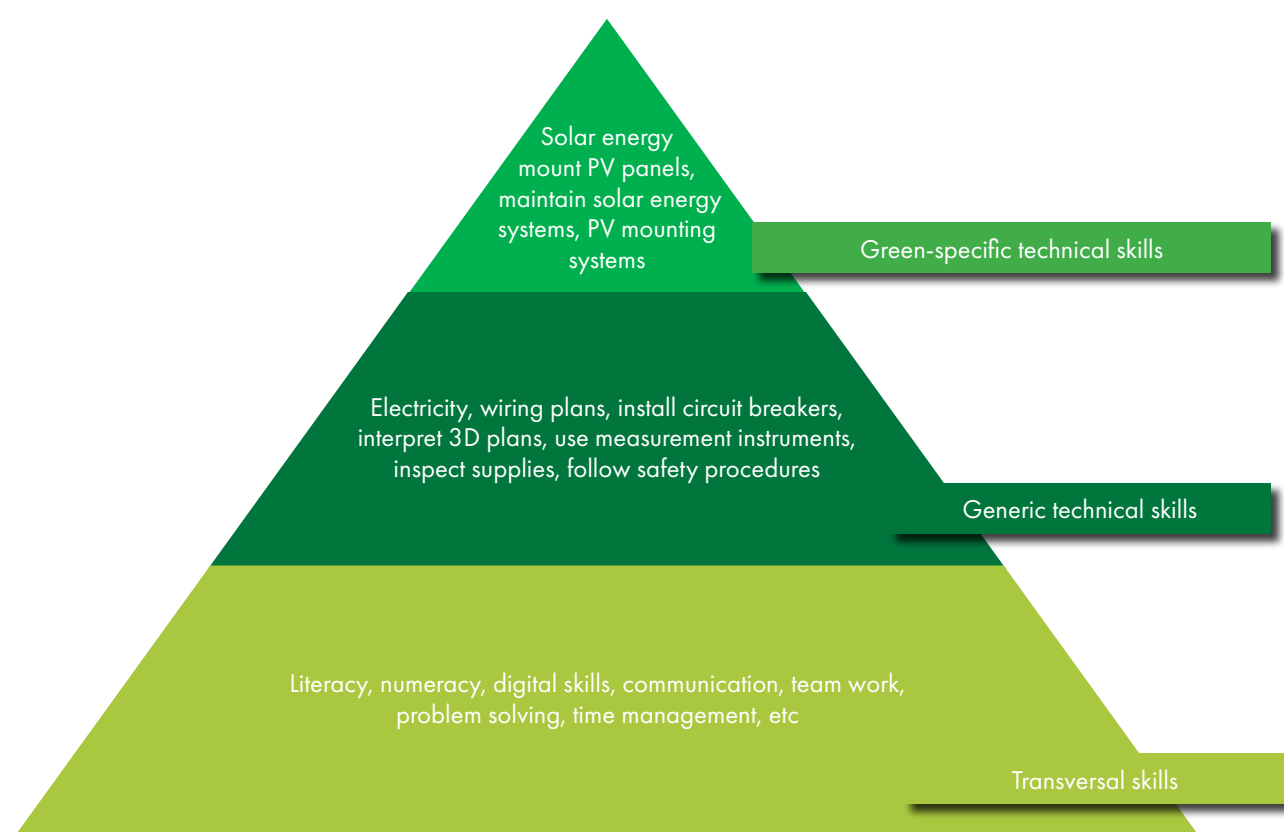
Textbox 2.2. Applying key terms related to green jobs to the example of a building inspector

A building inspector inspects buildings to ensure compliance with laws and regulations and advises on building requirements. South Africa's Organizing Framework of Occupations (OFO) considers a building inspectors a **green occupation**, and their **green tasks** include ensuring compliance with environmental laws and regulations. Jobs under this occupation include, among others, building surveyors, building certifiers, and construction inspectors, and these are considered **green jobs**.

Textbox 2.3. Applying key terms related to skills for the green transition to a solar energy technician

The below figure shows the skills requirement of a solar energy technician. The **transversal skills** are depicted at the base of the figure. The technical skills needs, distilled from the International Standard Classification of Occupations (ISCO), are grouped in generic technical skills and green-specific technical skills. **Green-specific technical skills** are exclusively needed to achieve a positive environmental impact, meaning that they are not (or rarely) needed outside of the green economy. For a solar energy technician these include, for example, knowledge about solar energy and skills to install and maintain photovoltaic panels. The solar energy technician also needs to be skilled in wiring, using measurement instruments, following safety procedures, etcetera. These skill needs are not exclusive to solar energy technicians: they are required by most electricians, whether they contribute to the green transition or not, which is why these are considered **generic technical skills**.

Source: ISCO. Solar panel technicians are recorded as ISCO 7411.1.4



Source: ISCO. Solar panel technicians are recorded as ISCO 7411.1.4

Defining green jobs and skills for green jobs in South Africa

The government's 2013 Organizing Framework of Occupations (OFO) is intended to be a crucial instrument to facilitate the alignment of education and training provision with labor demand. The OFO is a coded classification system that aims to encompass all occupations in South Africa, offering a common language across stakeholders when discussing occupations. The OFO captures jobs in the form of occupations, and groups occupations into successively broader categories and hierarchical levels based on similarity of tasks, skills and knowledge.²⁷ (See Annex 1 for a more elaborate

²⁷ LMIP (2020)

description of the OFO.) Employers are expected to use the OFO to report on their annual workplace skills plans, after which the aggregate data is used by Sector Education and Training Authorities (SETAs, see textbox 2.4) to develop Sector Skills Plans (SSPs), and by the Department of Higher Education and Training (DHET) to analyze and report on national labor market needs including, for example, by publishing the List of Occupations in High Demand (LOHD).²⁸ These various outputs are expected to be used by stakeholders in the PSET system to align the education and training offer with labor demand. The OFO's classification of occupations by skills level and the inclusion of brief descriptions of the task content of occupational groups is aimed to provide PSET stakeholders with broad indications of the qualification levels and skill content it should target.²⁹ Whether the OFO does indeed serve as a main tool to identify and report on labor and skill demand depends crucially on the inputs it receives from employers and SETAs. Incorrect reporting would result in incorrect interpretations of demand, weakening the PSET system's information base, and possibly resulting in resources being allocated to inappropriate areas.³⁰ Unfortunately, SETAs have struggled over the years to report with the level of consideration and consistency needed to result in correct interpretations of demand, among others because employers apparently do not always fully understand the logic of the OFO when reporting on scarce and critical skills.³¹

Textbox 2.4. Sector Education and Training Authorities

South Africa's network of 21 SETAs plays a critical role in the skills development system. The SETAs were established under the Skills Development Act and operate under the purview of the Skills Development Branch of DHET, since 2009. Driven by the principal labor market stakeholders, employers and labor union representatives, and funded through the Skills Development Levy, SETAs' are to be the link to industry in the implementation of the national skills development strategies and policies. They are responsible for planning, promoting, facilitating and funding skills development in and for the sectors they represent, and play a central role in work-based training and learning.

Source: World Bank (2020)

The OFO identifies occupations that are of particular importance for the green economy.

Since 2013, the OFO explicitly identifies occupations that contribute to the green economy. These occupations are divided in a main category of occupations that directly contribute to the government's greening objectives ('green occupations'), and a second category of occupations and specializations requiring changes in task content and associated skill sets to contribute to these same greening goals. Confusingly, the second category is called 'critical green skills', even though it consists of a list of occupations and does not articulate particular skills. Textbox 2.5 provides the OFO's definitions and offers several example occupations for both categories. All in all, out of the OFO's 1448 occupations, 96 are identified as green occupations and 51 as critical green skills, meaning that just over 10 percent of all occupations are explicitly considered to be relevant for the green economy.³² In addition, the OFO highlights that the green transition may result in increased demand for existing occupations that are neither classified as green occupations nor as critical new green skills, such as train drivers.³³

28 LMIP (2014)

29 LMIP 2014

30 LGSETA 2018

31 LMIP (2018); LGSETA (2020)

32 The OFO also identifies 17 specializations within occupations as critical green skills. A specialization can be regarded as an occupational concentration on a specific area of expertise (LMIP 2020). An example is the specialization of eye surgeon within the occupation of Ophthalmologist.

33 DHET (2013), p 12

Textbox 2.5. Green Occupations and Critical Green Skills in the Organizing Framework of Occupations

The OFO explains the terms 'green occupations' and 'critical green skills' as follows:

- **Green occupations** have as direct purpose the nationally identified priorities and initiatives of reducing negative environmental impact and contribute sustainably to environmental, economical and social sensitive enterprises and economies. This includes occupations with descriptors that directly reflect and contribute to the maintenance of processes related to national initiatives to develop and adopt renewable sources of energy; reduce consumption of energy, fossil fuels and raw materials; enhance energy and resource efficiency; reduce greenhouse gas emissions; decrease waste and pollution; recycle materials; and prevent the loss of biodiversity and restore ecosystems.
- **Critical Green Skills** are skills that are relevant for occupations that are not classified as green occupations but that will also contribute to processes, systems and activities related to the same national initiatives as those identified for the green occupations, and that require a shift in focus to be able to do so.

Table 2.2 provides examples of green occupations and critical green skills for all major occupational groups.

Table 2.2. Examples of green occupation and critical green skills in the OFO

Green occupations	Critical green skills
<i>Managers</i>	
132105 Power Generation Production / Operations Manager 134901 Environmental Manager 143901 Facilities Manager	121909 Sustainability manager 122103 Director of marketing 132201 Production / Operations Manager (Mining)
<i>Professionals</i>	
211101 Physicist 213105 Biotechnologist 213201 Agriculture Consultant 214201 Civil engineer 214402 Mechanical engineering technologist	214103 Production engineer 214104 Production engineering technologist 214403 Aeronautical engineer 216402 Transport analyst 243302 Sales representative (medical/pharm.)
<i>Technicians and associated professionals</i>	
311101 Chemistry technician 311201 Civil engineering technician 313105 Wind turbine power plant process controller 314201 Agricultural technician	311303 Energy efficiency technician 311906 Environmental engineering technician 313913 Chemical waste controller 325705 Safety inspector
<i>Clerical and support workers</i>	
N/a	N/a
<i>Service and sales workers</i>	
N/a	524904 Energy broker 541102 Hazardous materials removal workers

<i>Skilled agricultural, forestry, fishery, craft and related traders workers</i>	
642401 Building insulation installer 642601 Plumber 642602 Solar installer 671101 Electrician	621102 Forest and conservation workers 641101 House builder 641502 Carpenter 653101 Automotive motor mechanic
<i>Plant and machine operations and assemblers (exhaustive)</i>	
N/a	714202 Plastic Compounding and Reclamation Machine Operator 718201 Boiler or Engine Operator
<i>Elementary occupations (exhaustive)</i>	
831310 Surveyor's assistant 861101 Recycling or rubbish collector 861201 Refuse sorter 861202 Waste material sorter and classifier	821501 Forestry worker

Source: DHET (2013a)

The use of the OFO definitions of green occupations and critical green skills is not widespread, including among SETAs. While most SSPs refer to the green transition, they do so to varying degrees, and the use of the OFO definitions of green occupations and critical green skills seems rare if not absent altogether.³⁴ For example, the SSPs of the SETAs for manufacturing, engineering and related services (merSETA) and construction (CETA) refer to OFO levels or OFO codes and to green skills, but they do not use the OFO definitions for green occupations and critical green skills.³⁵ The SSP of the Energy and Water SETA (EWSETA) recognizes the existence of green occupations as identified by the OFO, but does not explicitly distinguish them in its priority occupations.³⁶ The use of the OFO's green definitions appears equally rare among stakeholders other than SETAs. Neither DHET's own 2020 List of Occupations in High Demand, nor its 2022 Critical Skill List, refer explicitly to the OFO's green occupations or critical green skills. A recent skill needs assessment for the hydrogen economy commissioned by DHET uses the OFO as a basis but does not explicitly refer to the OFO's green occupations, and instead conducts its own analyses to identify "occupations and associated capabilities that will be required [...] across the hydrogen value chain".³⁷ A recent analysis of over 200 pieces of work on skills in the energy sector found that most references to skill needs are too generic and do not use OFO classifications at all.³⁸

An important reason for the limited use of the OFO's lists of green occupations and critical green skills seems to be that important stakeholders do not consider them to be fit for their purposes. The EWSETA SSP observes, for example, that none of the occupations that are identified as sector priority occupations are considered as 'green' in the OFO, but that "the DHET must consider formally identifying these as 'green' occupations in the published OFO list".³⁹ In the same vein, the skill needs analysis for the hydrogen economy used international and national literature to identify 138 occupations that are required in the hydrogen value chain, of which 77 could not be matched to any existing OFO codes.⁴⁰ ILO (2019) also expresses concern about the quality of the methodology that is used to categorize OFO occupations as green, and concludes that the list is far from conclusive. The report observes that the inadequacy of the list might well be due to underperformance of SETAs, rather than methodological weaknesses.⁴¹

34 ILO (2019) notes that 17 of the 21 SSPs referred to skills for the green economy, but mostly without referring to specific skill needs or gaps.

35 merSETA (2021); CETA (2020)

36 EWSWETA (2021)

37 DHET (2024)

38 SANEA (2023)

39 EWSETA (2021)

40 DHET (2024)

41 ILO (2019)

The absence of an applicable framework for identifying green jobs and the skills needed to perform them constrains the development of those skills, because it does not offer PSET stakeholders with the information they need to align their education and training offer. While the lack of systematic and consistent data collection on jobs and skills for the green transition is not specific to South Africa, it does complicate the informed design of policies and interventions to make education and training more responsive to the skill demand for green jobs in the country.

2.2 The expected impact of the green transition on labor and skill demand

South Africa has high ambitions for a Just Energy Transition and there are promising areas of greening across the economy, but overall progress remains modest. A promising example includes Toyota's investment of R2.6 billion (around USD 140 million) to develop the Corolla Cross, South Africa's first locally produced Hybrid Electric Vehicle. The COEGA Development Cooperation is planning various renewable energy investments in its Special Economic Zone and the Nelson Mandela Bay Logistics Park, including wind farm projects planned with a total capacity of 183 MegaWatts (MW), a photovoltaic solar farm (12 MW), and bioenergy projects.⁴² On the other hand, major political, socioeconomic and financial challenges to achieving large scale decarbonization remain. With over 80 percent of South Africa's electricity still being produced by coal-fired power stations, replacing coal with renewable energy sources is a crucial element of a credible green transition. But, while initiatives such as the 2021 JET Investment Plan and JET Implementation Plan describe continued ambitions related to these goals, the intended closure of all coal mines has been delayed and, by the end of 2023, less than ten percent of available concessional finance to transition from coal to renewable energy had been spent.⁴³ In July 2024, the Minister of Electricity and Energy reported that South Africa will not meet its commitments under the Paris Climate Accords to cut emissions by at least 350 million tons by 2030, although its longer term goal to achieve net zero remained.⁴⁴ The disappointing results to date have a large number of causes, including the ongoing electricity crisis that increases opposition to mine closures; weak institutional capacity to implement reforms, including at sub-national administrative levels, and as documented by one observer, "[a] confusing mix of obstruction, wilful neglect, vested interests, incompetence and even sabotage".⁴⁵ The evolution of skills demand for the green transition in the coming years will depend to a large extent on when and how these challenges will be addressed. At the same time, the skills composition of the workforce is one of the drivers of the green transition, meaning that the extent to which workers have the skills to undertake particular green jobs is a determinant of the nature and pace of the green transition.

There is an emerging but still small collection of analyses on how South Africa's green transition will affect the demand for labor and skills. The World Bank's 2022 Country Climate and Development Report (CCDR) forecasts job creation and job losses in eleven industries that are expected to be most affected by the low carbon transition in the period from 2022-2050, and another assesses the share of employed people across South Africa's economy that are already in jobs that have a positive environmental impact.⁴⁶ Other recent reports focus on a particular sector or value-chain, such as the recent skill needs assessment for the hydrogen economy commissioned by the DHET and the Energy Skills Roadmap prepared by the South African National Energy Association (SANEA) and partners.⁴⁷ There are also several analyses that focus on employment vulnerability resulting from the green transition; the National Climate Change Response White Paper required the development of Sector Jobs Resilience Plans (SJRP), which were developed in 2020 for five value chains.⁴⁸ Combined, the still rather limited analyses to date do offer emerging findings on the potential impact of the green transition on jobs and skill demand.

42 See <https://coega.co.za/site/sez-investments/investment-sectors> (accessed June 12, 2024)

43 South Africa Presidency (2022) and South Africa Presidency (2023)

44 Reuters. 2024. South Africa appeals to donors to delay its climate targets, minister says. [https://www.reuters.com/sustainability/climate-energy/south-africa-appeals-donors-delay-its-climate-targets-minister-says-2024-07-15/#:~:text=PRETORIA%2C%20July%2015%20\(Reuters\),the%20new%20energy%20minister%20said](https://www.reuters.com/sustainability/climate-energy/south-africa-appeals-donors-delay-its-climate-targets-minister-says-2024-07-15/#:~:text=PRETORIA%2C%20July%2015%20(Reuters),the%20new%20energy%20minister%20said)

45 ECDPM (2023)

46 World Bank (2022); Mosomi and Cunningham (2024)

47 DHET (2024); SANEA (2023)

48 SJRPs were developed for agriculture, coal, metals, petroleum-based transport, and tourism. See TIPS (2020); TIPS (2020a); TIPS (2020b); TIPS (2020c); TIPS (2020d).

Among the various pillars of the green economy, the just energy transition receives most attention and may be most likely to impact labor and skills demand in the short and medium term. As early as 2011, the Department of Environmental Affairs (DEA) identified 8 main pillars of the green economy (textbox 2.6).⁴⁹ Once the pace and scope of the green transition picks up in all these pillars, then changes in the number, type, and task content of jobs can be expected in all of these pillars. For the time being, the government's focus on JET implies that substantive progress in areas such as agriculture, resources conservation, waste and water management may need to be expected only in the longer term.

Textbox 2.6. The eight main pillars of the green economy in South Africa

- 1. Energy:** renewable sources and efficient usage
- 2. Transport:** alternatives to propulsion by internal combustion engines, fuel efficiency, reduction of emissions, reduction of single-occupant vehicles on road and improved traffic management
- 3. Agriculture:** sustainable use of farming, forestry and fishery resources
- 4. Resource conservation:** sustainable use of eco-systems, management of indigenous flora and fauna and the reduction of invasive alien species
- 5. The built environment:** use of materials resources, energy efficiency in buildings and cleaner construction processes
- 6. Production and consumption:** sustainable use of resources and cleaner production
- 7. Waste management:** reduction of waste, efficient collection, safe disposal and recycling
- 8. Water management:** reduction of water consumption and water loss in reticulation, improved water harvesting, reduction in water pollution

Source: DEA (2011)

The CCDDR estimates that 1.6 million direct and indirect jobs can be created in the industries that will be most affected by the low carbon transition, and that 0.6 million jobs may be lost. Using an output-based approach, the CCDDR estimates that in the period from 2022 to 2050, job creation can occur mainly in the non-coal mining sectors (due to higher local and global demand for minerals and metals needed to produce cleaner energy sources) and in renewable energy production. Additional but smaller job creation potential may occur in renewable energy value chains (such as the hydrogen economy and fuel cells); green manufacturing; construction; and, to a lesser extent, services and utilities. In the same period, job losses are also expected to occur in these 11 industries, with the biggest losses in high-emitting sectors such as petroleum and coal. In total, about 0.6 million direct and indirect jobs are expected to be lost, resulting in a net job creation of around 1 million jobs in the 11 industries that were reviewed (Figure 2.1).⁵⁰ Other analyses present different findings. For example, reports from 2010 and 2011 forecasted job creation from 149,000 to 500,000.⁵¹ A recent World Bank analysis, using a task-based approach, found that 5.5 percent of the currently employed, equivalent to around 900,000 persons, are already in jobs that require the execution of at least one green task. The same analysis observed that as much as one third of the employed could be carrying out at least one task that has a positive environmental impact, depending on the way that the task is carried out.⁵² These large variations between findings are due to differences in definitions,

49 DEA (2010); DEA (2011)

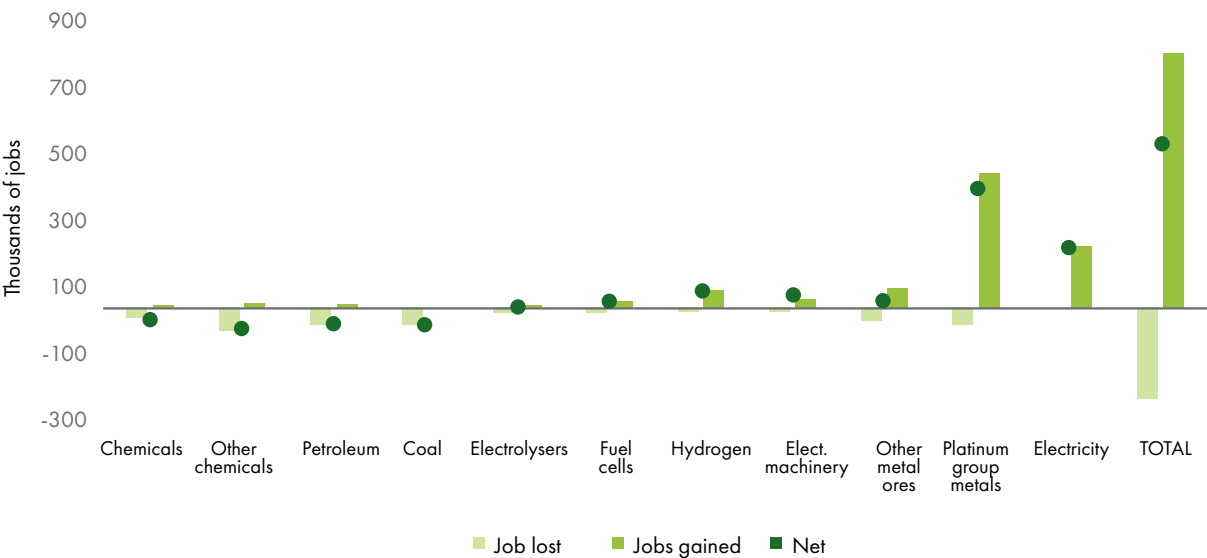
50 World Bank (2022)

51 See Rutovitz (2010) and Maia et al. (2011), as referenced in Mosomi and Cunningham (2024)

52 Mosomi and Cunningham (2024)

scope, and methodology, but also to large uncertainties about the direction and speed with which the green transition will unfold, which leads different analyses to apply different assumptions. This means that, while all analyses may provide insightful results, their interpretation requires a sufficient understanding of the applied scope and methodology, and the findings of different analyses should be compared with caution.

Figure 2.1. Direct job gains, losses, and levels in key industries closely associated with the low-carbon transition (2022–2050)



Source: World Bank (2022)

Available assessments for South Africa point to a high demand for workers in STEM fields.

This is reflected in table 2.3, which lists a selection of occupations that have been identified as being in high demand in the various available reports, categorized by jobs that require higher education and TVET qualifications (see Annex 4 for a summary of South Africa’s higher education and TVET qualifications and providers). While the table shows only a small sample, it illustrates the strong focus on STEM fields that emerges from the assessments. The table also reflects the need for STEM expertise at all skills levels, including technicians and artisans with intermediate-level skills and engineers with higher education qualifications. The latter may reflect the green economy’s use of sophisticated, innovative technologies, requiring higher level skills, and possibly also that higher-skilled jobs are particularly important while large parts of the green economy are still in development, while medium- and lower-level skills may become more important when green industries reach scale.⁵³

53 The initial higher importance of high-skilled labor and increasing importance of TVET in later stages of green industries’ development is described for the hydrogen economy in Cloete et al (2022), as referenced in DHET (2024)

Table 2.3. Occupations in high demand in a green economy, by higher education and TVET qualifications (selected)*

HIGHER EDUCATION		TVET	
Engineers	Other higher education	Technicians**	Artisans**
• Agricultural • Civil • Electrochemical • Energy • Environmental • Fuel cell • Industrial • Mechanical • Mechatronics • Metallurgical • Mining • Plant design • Power grid • Software • Solar panel designer • Transportation • Water resource • Statistical Modeller	• Actuary • Business Development Manager • Corporate General Manager • Customer Service Manager • Economist • Investment Advisor Lawyer • Market Research Analyst • Policy & Planning Analyst / Manager • Programme and project manager • Supply and distribution manager	• Agricultural technician • Battery installation & maintenance • Chemical process technician • Electrical Engineering Technician • Gas practitioner • Air conditioning and refrigeration mechanic • Mechanical technician • Mechatronics technician • Solar Photovoltaic (PV) panel assembler • Solar PV installer • Solar PV Service Technician • Wind-turbine servicer	• Building energy efficiency auditor • Carbon auditor • Crane driver • Electrician • Energy measurement and verification specialist • Pattern maker • Rigger • Truck driver: Abnormal vehicle & load

* Higher education includes academic and vocational programs offered by traditional, technical and comprehensive public universities and private universities. TVET is provided by TVET Colleges, Community Education and Training colleges, and private training providers. See also Annex 4.

** An artisan is qualified at NQF level 5 and certified after extensive work-based training. Technician is a loosely defined term referring to workers doing a wide range of technical work with or without a specific qualification

Sources: Duncan (2024).

The green transition may result in net job creation, but this does not mean that workers who lose their jobs can easily transition to new green jobs. Several analyses explore employment vulnerability due to the green transition, with varying levels of detail and attention to skills. The National Climate Change Response White Paper required the development of Sector Jobs Resilience Plans (SJRP), which were developed in 2020 for five value chains (agriculture, coal, metals, petroleum-based transport, and tourism).⁵⁴ The plans differ in the extent to which they are able to identify the location, number and characteristics of workers at risk, and in the extent to which they propose concrete interventions to safeguard their employability, including through skills development. The CDDR estimates a loss of over 300,000 direct jobs and 300,000 indirect jobs, with the biggest losses in high-emitting sectors such as petroleum and coal (see figure 2.1). In terms of timing, the largest job losses are expected to occur during the 2030s, when SASOL is expected to close its coal-to-liquid operations and Eskom should decommission several of its fuel/coal plants.⁵⁵ An important observation of the analysis is that even though the expected number of jobs that will be created is 2 to 3 times higher than the expected number of jobs lost, many workers who lose their job will not have access to these new green jobs, because the new jobs will emerge in a different location or time or require different (and often higher-level) skills.⁵⁶

54 TIPS (2020); TIPS (2020a); TIPS (2020b); TIPS (2020c); TIPS (2020d). For more info on the vulnerability assessment and SJRP toolbox, see: <https://www.tips.org.za/research-archive/sustainable-growth/green-economy-2/item/3988-sector-jobs-resilience-plan-national-employment-vulnerability-assessment-analysis-of-potential-climate-change-related-impacts-and-vulnerable-groups>

55 SASOL and Eskom are public companies. SASOL is an energy and chemical company that, among others, operates coal mines in South Africa. Eskom supplies over 80 percent of electricity generated in South Africa.

56 World Bank (2022)



Proposed government actions to support at-risk workers during the just transition include skills development components, but their actual implementation still seems surrounded by uncertainty. The SJRPs include explicit attention to skills development interventions in their recommendations. Broadly, most SJRPs propose to introduce or strengthen a) technological adjustments to mitigate the impact of climate change; b) economic diversification; c) active labor market policies; and d) social protection, and attention to skills development interventions is included in each of these focus areas to varying degrees. While the plans and proposal are a good start, there still appears to be little concrete information on whether, when and how the actual implementation of these interventions will take place.

There are important aspects of skill demand for the green transition that available analyses do not yet, or hardly, provide. The analyses provide useful information and emerging findings, but they are too fragmented, sporadic, and limited in scope to provide PSET stakeholders with the data they need to align their education and training offer with the skill needs of the green transition. The recent skill needs assessments of the hydrogen economy and energy sector offer strong analyses and a good starting point, but more depth is required to help PSET providers understand for which programs they need to expand (or reduce) enrolment capacity, and how they should adapt their programs' content to align it with emerging skill needs. Moreover, these assessments only cover a small part of the economy. (Section 3.3 elaborates on the limitation of current skill needs information.)

3. The current offer of PSET for the green transition

3.1 Assessing PSET's responsiveness to the skill needs for the green economy

To provide the necessary skills for a just green transition, the PSET system needs to perform well in all of the key dimensions of relevance, quality, quantity and inclusion. The conditions that the PSET system needs to meet to ensure the adequate supply of skills for a just green transition are, at its core, not fundamentally different from those that determine the system's overall performance. Specifically, PSET providers need to offer the right programs, with content that is aligned with the skills needed for green jobs (relevance). They need to deliver these programs in such a way that students' retention and pass rates are high, and graduates leave the programs having acquired the intended learning outcomes (quality). The number of learners enrolling in PSET programs that prepare them for work in the green economy should be high enough to satisfy the numbers demanded on the labor market (quantity), and access to these programs should be open to all potential students including those from vulnerable or otherwise disadvantaged population groups (inclusion).

Limited information on skills demand makes it hard to assess with any degree of precision to which extent the PSET system is providing the skills needed for the green transition. In part, these limitations are a systemwide challenge rather than specific to green jobs. In addition to concerns about the reliability of SSPs and derived products such as the LOHD, these analyses may identify critical occupations but less often provide quantitative estimates of worker shortages or expected job creation, or information on the task content and specific skills requirements of these jobs. This means not only that the available labor market data are insufficient to allow the PSET system to align its offer with labor demand, but also that they do not provide enough information to help gauge how demand-responsive the PSET system currently is. This challenge is exacerbated when zooming in on the PSET system's responsiveness to skill demand for the green transition because, as described above, not enough analyses are focused on this aspect of the economy.

Also on the supply side, there is not a lot of information to help understand how well the PSET offer is aligned with the demand for green jobs. There appears to be minimal structural reporting on the way in which the PSET offer responds to the labor and skill demand for the green transition. The statistical data that are annually reported by DHET, for example, disaggregate student enrolment and sometimes graduation data by broad fields of study such as engineering and technology, but they do not include explicit attention to programs that prepare graduates for jobs in the green economy. No comprehensive, periodic reporting on PSET provision, either qualitative or quantitative, seems to exist that does include a green focus, and information provision on the offer of green-focused PSET remains fragmented and ad-hoc.

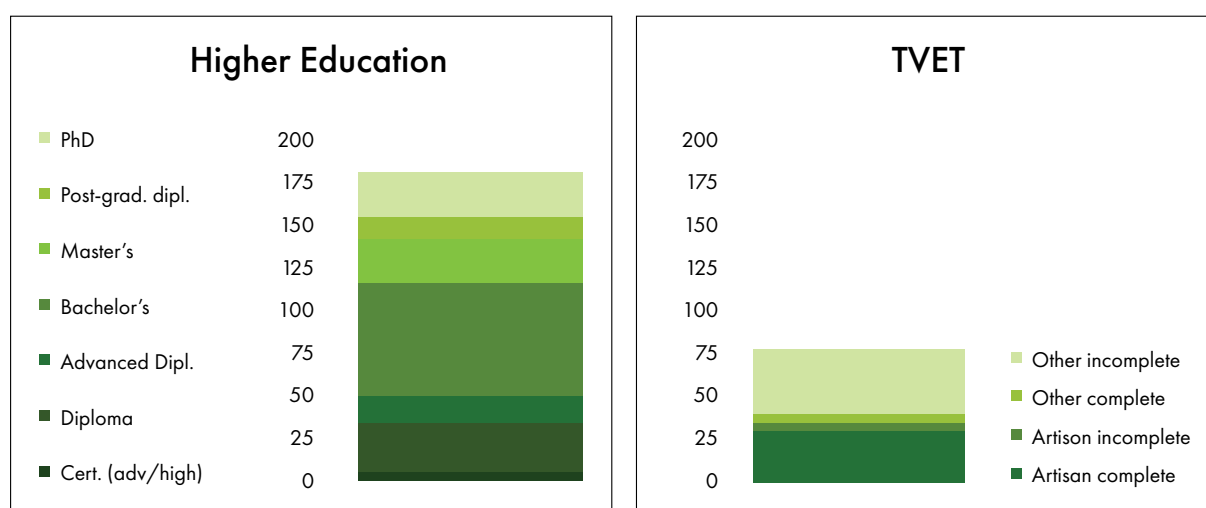
The remainder of this section highlights the strengths and weaknesses of the PSET offer in terms of its responsiveness to skills demand for the green economy, and describes the main causes of observed challenges. Section 3.2 summarizes PSET's strengths, focusing on the existing program offer and other initiatives that are of particular relevance for green jobs that already exist. While this section likely does not provide a comprehensive picture, it captures the main programs and initiatives as could be distilled from literature and consultations. Section 3.3 describes the key weaknesses in PSET performance regarding its responsiveness to skill demand for the green transition, and the main causes of this underperformance.

3.2 Strengths of the PSET system's responsiveness to the skill needs of the green economy

Many qualifications that are critical or necessary for the green transition already exist.

This is not because the PSET system has already responded to emerging skill demand for the green transition by introducing new qualifications, but because many of the skills that are needed in green jobs are also essential for jobs in the non-green economy. For example, industrial engineers, gas fitters, electricians, actuaries and most (if not all) jobs identified as critical for the green transition in table 2.3 are already common in the non-green economy, and PSET qualifications associated with these jobs have already been developed. These qualifications may not yet incorporate green-specific technical skills, but international knowledge and available national analyses such as DHET's recent report on the hydrogen economy suggest that these qualifications aim to equip graduates with most of the transversal and generic technical skills that are required for green and non-green jobs alike.⁵⁷ A recent broad review of existing qualifications with relevance for green jobs found around 260 such qualifications, mostly in STEM fields.⁵⁸ Around two thirds of these qualifications are higher education qualifications, ranging from more vocationally oriented Advanced and Higher Certificates to academic degrees up to the PhD level. Of the 78 identified TVET qualifications, almost half are at the artisan level. Strikingly, not even half of the identified TVET qualifications are considered fully implementable, a challenge which is discussed in section 3.3 below.

Figure 3.1. Existing higher education and TVET qualifications with importance for the green transition *



* See Annex 4 for a summary of higher education and TVET qualifications and providers

Source: Duncan (forthcoming)

Many PSET providers already offer the (STEM) qualifications that are of relevance for the green economy. For example, SANEA identified over 1,000 energy-related programs offered by public and private universities, colleges and training providers, even while recognizing that its review did not provide a full picture and particularly did not capture short programs offered by private providers and civil society organizations. (Annex 2 depicts the identified courses by qualification level.) Overall, SANEA finds that "traditional engineering and science-related disciplines are well represented across PSET".⁵⁹

⁵⁷ See textboxes 2.1 and 2.3 for definitions and examples of this terminology.

⁵⁸ Similar reviews have been conducted with a sector focus, such as for the hydrogen economy and the energy sector. For the hydrogen economy, 138 qualifications were identified that are required in the hydrogen value chain, of which 74 in higher education (DHET, 2024)

⁵⁹ SANEA (2023)

PSET providers, especially higher education providers, are also increasingly aligning the content of their existing programs with the skills needed for the green transition. Aligning the PSET offer with skill demand for the green economy will require introducing some new qualifications, but especially adapting existing ones by adding essential green-specific learning outcomes and curriculum content. Many South African universities, including technical, comprehensive, traditional, and private universities, have been offering green content for several years, among others by offering, within a broader field of study, modules that address the green economy as a cross-cutting theme.

Increasingly, higher education providers have research and education initiatives that are explicitly dedicated to the green economy, especially the energy transition. Various higher education providers have created centres, institutes and initiatives specifically focused on research and education on the green economy. This includes the Cape Peninsula University of Technology; the Nelson Mandela Metropolitan University; Northwest University; Stellenbosch University; the University of Pretoria; the University of South Africa, and the University of the Western Cape.⁶⁰ Also without such dedicated centres, various universities focus on greening through research, education (including short training programs), or both. Table 3.1 and annex 3 provide a (non-exhaustive) list and summary, respectively, of universities' green-focused centres and other activities. Most of the identified initiatives focus on renewable energy and, particularly, hydrogen. Little to no initiatives were identified that focused on other main pillars of the green economy that were identified by the DEA, such as agriculture, waste management and the built environment.⁶¹ While universities indeed do appear to focus their greening activities on the energy transition, it may also be the case that existing activities in other pillars were not identified due to this report's emphasis on the JET (see section 1).

Table 3.1 University centres, education and research dedicated to the green transition

University	Activity
Dedicated centres and institutions related to greening	
Cape Peninsula University of Technology	South African Renewable Energy Technology Centre (SARATEC)
Nelson Mandela Metropolitan University	Centre for Energy Research (CER)
Northwest University	The DST Hydrogen Infrastructure Centre of Competence (HICC)
Stellenbosch University	Centre for Renewable and Sustainable Energy (CRSE)
University of Pretoria	Centre for New Energy Systems focuses
University of South Africa	Institute for Catalysis and Energy Solutions (ICES)
University of the Western Cape	Hydrogen South Africa Systems Integration Competence Centre
Research on greening	
University of Cape Town	Catalysis Institute (research to advance the hydrogen economy) and Electrolyse Research Group
University of Johannesburg	SASOL / DSIS-NRF Research Chair in Green Hydrogen
Tshwane University of Technology	Task team to carry out research on hydrogen.
Vaal University of Technology	Funds to enable engineering students to conduct research in fuel cell innovations

⁶⁰ DHET (2024), SANEA (2023), ILO (2019)

⁶¹ DEA (2011)

Education on greening	
Durban University of Technology	Renewable energy technology installation and technical courses for wind, solar and grid connection.
University of Cape Town	MSc/ MPhil in Climate Change and Development
University of Witwatersrand	The School of Architecture and Planning Masters of Architecture in Sustainable and Energy Efficient Cities.
University of the Free State	M.Sc. in Integrated Water Management

Source: DHET (forthcoming); SANEA (2023), ILO (2019)

Partnerships with private sector stakeholders are at the heart of many of the higher education providers' green education and research activities. The South African Renewable Energy Technology Centre (SARATEC) at the Cape Peninsula University of Technology, for example, collaborated with merSETA and the South African Photovoltaic Industry Association (SAPVIA) to develop a training course in photovoltaic installation, and is certified by the Global Wind Organisation, a non-profit body founded by wind turbine manufacturing and operators. The Catalysis Institute at the University of Cape Town collaborates with Sasol, a large energy and chemical company, on converging carbon dioxide and green hydrogen to green chemicals and jet fuel. Stellenbosch University, through its Centre for Renewable and Sustainable Energy (CRSE), is one of various universities that partner with Eskom in the Power Plant Engineering Institute.⁶²

The greening of education and research in higher education institutions appears to be driven by the recognition of industry of the importance of investing in skills development, combined with a tradition of industry collaboration and autonomy regarding program design of higher education institutions. Industry stakeholders' willingness to invest time and resources in collaborating with education providers can be considered a sign that they see the availability of appropriate skills as a crucial requirement for doing business. Higher education institutions have a long history of collaborating with and receiving funding from industry to better align research and education programs with industry needs, especially in the applied sciences and technology. Moreover, they have the autonomy to develop and offer new qualifications and training programmes based largely on their own market assessment and internal processes. This allows them to adapt relatively quickly to new demand, including resulting from the green transition, especially compared to TVET and Community Education and Training (CET) colleges who depend on lengthy, external processes (see section 3.3).

Beyond higher education institutions, a variety of other, often private providers offer training programs specifically dedicated to greening. The National Cleaner Production Centre (NCPC) in the Centre for Scientific and Industrial Research, for example, developed various qualifications in energy-efficient production systems, and is currently training teachers at higher education and TVET institutions while accreditation of universities to offer the programs is pending. Courses are also provided by industry organizations such as SAPVIA, the Sustainable Energy Society of Southern Africa (SESSA), the Thermal Insulation Products and Systems Association SA (TIPSASA) and Uyilo, an initiative of the parastatal Technology Innovation Agency in the field of e-vehicles. The National Business Initiative (NBI), an independent business movement of national and multi-national member companies, includes promoting environmental sustainability among its key objectives. The NBI implements activities to raise awareness and build skills and capacity, among others to help firms integrate natural resource management into their business models. Courses offered by some of these organizations and other private training providers may be proprietary product-knowledge and may, therefore, not be easily taken up and offered by public PSET institutions. Overall, it appears that the offer of short courses is increasing on topics such as energy auditing, planning and management; financing of energy projects; electrical engineering; and the design, installation and maintenance of wind and solar technologies.⁶³

⁶² See <https://www.eppei.co.za/>

⁶³ SANEA (2023)

Also in TVET, there are examples of efforts to align the education offer with skill needs for the green transition, although these still appear few and far between. In 2013, Renewable Energy Technology was introduced as an elective subject in the curriculum for the National Certificate (Vocational) electrical program, and was reported to being offered at 19 colleges in 2019.⁶⁴ Under the small-scale Greening Colleges Initiative, DHET collaborated with the German Technical Cooperation (GIZ) to incorporate a variety of skills required for green jobs into the programs of seven TVET colleges.⁶⁵ Various occupational programs have been developed through SETA's and the Quality Council for Trades and Occupations (QCTO), such as the photovoltaic technician programme, which could usefully be turned into qualifications.⁶⁶ Overall, however, TVET institutions are adapting to the green transition at a substantially slower pace than universities, and there is a view that TVET institutions continue to offer their traditional programs without innovations to cater for the green economy.⁶⁷ In some cases, universities appear to be stepping in to help better prepare TVET graduates for green jobs. For example, the University of Pretoria has been training TVET graduates in hydrogen fuel cell systems, with funding from EWSETA and the Department for Science and Innovation (DSI).⁶⁸

3.3 Weaknesses of the PSET system's responsiveness to the skill needs of the green economy

Despite the above-described bright spots, there is no doubt that current and future skill gaps and mismatches risk delaying or derailing the green transition. Universities are increasingly aligning their research and training content to the demands of the green economy, with TVET lagging further behind, but challenges exist across the system that negatively affect the relevance and quality of both higher education and TVET, as well as the number of students that can access PSET. If these challenges are left unaddressed, the extent and negative implications of skill gaps and mismatches on the green economy will only increase as the green transition gathers pace.

In terms of relevance, many qualifications still need to be adjusted incorporate green-specific technical skills to become fully aligned with the green economy's needs. As described above, many qualifications that are relevant for the green economy already exist, but these often still need to be adapted to the demands of the green economy. While this is happening in some universities, it is not yet happening on the scale required. For example, the recent hydrogen skill needs assessment highlights numerous 'hydrogen capabilities' that need to be incorporated in the qualifications for a wide range of engineers, technicians and tradespersons, specialists, managers, and elementary occupational workers. These are capabilities related to knowledge and understanding of hydrogen properties, electrochemical reactions, hydrogen production processes, safety measures, and hydrogen-related regulations, standards, and codes, among others. Concretely, these include requirements such as the ability to interpret technical drawings with hydrogen equipment (for engineers); to maintain fuel cells (for National Certificate (Vocational) qualifications); and to modify hydrogen vehicles (for NATED programs).⁶⁹ While the absence of these green-specific technical skills in existing qualifications may not be surprising, given the nascent state of the hydrogen economy, the alignment of existing qualifications with these new skill needs will be essential to making the green transition work.⁷⁰

64 Freimann and Magnus (2023). The National Curriculum (Vocational), or NC(V) certificate is offered at the NQF levels 1-3. See annex 4 for a description of the PSET program offer at different NQF levels.

65 ILO (2019)

66 Freimann and Magnus (2023)

67 ILO (2019), SANEA (2023)

68 Mathibela (2020)

69 DHET (2024)

70 DHET (2024)

In addition to adapting existing qualifications, new ones need to be developed. New qualifications do need to be introduced to satisfy the skill demand for green jobs. SANEA (2023), for example, points out missing specializations at all levels related to, among others, automation and robotics engineering, and renewable energy.⁷¹ The hydrogen economy skill needs assessment points out that there is a need for bachelor-level programs in areas such as geophysics and welding engineering, and for diploma-level programs in geology and materials science, among others.⁷²

The pace of introducing or adapting existing qualifications is particularly slow in TVET. More than half of the TVET qualifications with relevance for the green economy are considered ‘incomplete’, meaning that they may not yet be formally offered. Among the ‘other’, non-artisan TVET qualifications, a complete package has only been developed for five out of 43 qualifications (figure 3.1). The long and complicated procedures for developing implementable packages that are the main cause of the large number of incomplete qualifications are further discussed in section 3.3 below.

The slow pace of greening TVET qualifications may be exacerbated by weak institutional capacity of TVET providers and the relatively high skill levels required for green jobs. Compared to universities, many TVET providers lack a tradition of employer engagement, and they may overall have weaker management capacity than universities. There are exceptions, and capacity may be higher among larger, more established, and private providers. Overall, though, these constraints prevent TVET institutions from taking effective actions to update their training offer. Moreover, industry might prefer engaging with universities over TVET institutions, not just because universities are easier to work with due to their higher capacity, but also because green jobs tend to require higher skills levels, especially at the early stages of the green transition.⁷³

Even where the right qualifications exist, PSET does not produce enough graduates. In addition to having the right qualifications in place, meeting skill demand for the green transition requires that adequate numbers of learners enroll in the relevant programs and that most of them graduate. This is currently not happening. Graduation rates at universities are very low. In 2021, the graduation rates in public universities for undergraduate certificate and diploma programs, Bachelor’s and Master’s degrees were all between 15 percent and 22 percent only.⁷⁴ In TVET, pass-rates are higher than in higher education, but still considerably lower than desirable, and many learners do not make it to the exam stage because of high drop-out rates.⁷⁵ In 2021, 48 percent of learners who registered for the NC(V) final exam passed the exam. For the National Accredited Technical Education Diploma (NATED), this share was 60 percent and 87 percent (at levels N6 and level N3, respectively).⁷⁶

Shortages are particularly observed in STEM fields. The number of newly registered engineers, for example, hovered around 3,000 per annum in the 2016-2021 period. This is low for a country with South Africa’s population, and insufficient even to replace the engineers exiting the workforce.⁷⁷ This is particularly worrying given that the number of engineers in South Africa is already very low: South Africa has just one engineer for every 3,166 people in the country, compared to one engineer per 543 people in Malaysia, one for 227 people in Brazil, and around one engineer for 40 people in most developed countries.⁷⁸ Despite ongoing efforts to increase the number of university graduates in STEM, there is a way to go before there will be a critical mass of engineers in the country.⁷⁹ At TVET level, the number of new graduates is well below what is needed, and apparently on the decrease in recent years. The NDP set a target of 30,000 newly certified artisans a year by 2030.⁸⁰ But, in the past years, the number has not been

71 DHET (2024)

72 DHET (2024)

73 Cloete et al (2022); Consoli et al (2016); IRENA & ILO (2023); Urban et al (2023)

74 DHET (2022a). This report does not provide HE graduation rates specifically for STEM or engineering fields.

75 WB (2020)

76 NATED courses are theoretical school-based programs that need to be complemented with work placements to culminate into a qualification. See annex 4 for a description of the types of TVET programs and their NQF levels.

77 ECSA (2021)

78 ECSA (n.d.)

79 DHET (2022a), p21

80 DHET (2022b), p10

higher than 21,151 certified per year.⁸¹ (See Annex 5 for figures showing recent trend new engineers and artisans.)

Finally, especially TVET institutions, do not equip their graduates with the required skills.

Employment outcomes of university graduates are relatively good. On average, three out of four university graduates find employment within six months of completing their studies, which can be considered an indication that they have the requisite skills.⁸² TVET graduates have a less advantageous entry in the labor market than university graduates, and there is a widely held perception amongst employers in South Africa that TVET graduates lack many of the technical and behavioral skills required in the workplace.

Weaknesses in responsiveness of the PSET system to skill demand for the green transition are partly due to systemwide weaknesses, and partly due to challenges that are specific to the provision of skills for green jobs.

Systemwide challenges cause skill shortages and mismatches across the board, including of those skills needed for the green economy. Green-specific constraints, on the other hand, particularly affect the adequate supply of skills needed for the green economy. The remainder of this section elaborates on five principal causes of PSET's underperformance regarding the delivery of skills for the green transition: weaknesses in stakeholder and policy coordination mechanisms; the availability of skill needs data, including on skills for the green transition; processes for creating and revising qualifications and programs; teaching capacity and physical infrastructure; and the availability of work placements. Several of these causes are green-specific, others are systemwide. Where they are systemwide, they are included in this list because they are found to specifically constrain the delivery of skills for the green transition.

1. Effective coordination mechanisms to align the PSET offer with skill needs for the green transition remain to emerge.

A strategic-level champion and coordination mechanism to prepare the workforce for the green transition does not yet exist.

Strong coordination mechanisms are needed to manage the large number of stakeholders, aims, and processes involved in preparing the workforce for the green transition. To date, no institution has effectively taken on the leadership to convene and coordinate the many stakeholders involved in skills for the green transition. The JET Implementation Plan 2023-2027 notes that despite the extensive policy mandate, "to date no adequate co-ordination mechanism has been established for the national planning and development of sustainability skills in South Africa". The Implementation Plan proceeds to not only recommend improved coordination at the national level, but also specifically between education providers and local communities.⁸³ ILO (2019) observes that there is insufficient policy coherence to drive the structural change needed for greening the economy, which provides the skills development mechanism with only a limited basis for identifying associated skill needs and shortages.

The JET Implementation Plan and the HRDC's new HRDS both announce initiatives to better coordinate skill development initiatives, but it is too early to tell whether these will be effective.

The need for improved coordination is recognized and coordinated approaches are announced in the JET Implementation Plan with a focus on the energy transition, and in the HRDS for the economy as a whole.⁸⁴ The JET Implementation Plan for 2023-2027 proposes the establishment of a National JET Skills Advisory Forum, comprising both public and private sector representatives, to support the coordinated development and implementation of skills plans targeting the renewable energy, hydrogen and electric vehicle industries. The HRDS, at the same time, considers creating an adequate labor market pool of green (and digital) skills as one of its six key goals in its new draft strategy, and proposes to integrate human resource development planning and implementation with industry policy and other relevant plans.⁸⁵ As the initiatives from the JET Implementation Plan and the HRDS both remain to materialize, it is too early to assess their effectiveness and, indeed, whether they are appropriately aligned with each other.

81 DHET (2023)

82 Altbeker & Storme (2013), p1 & SRI (2015), p11

83 South Africa Presidency (2023)

84 South Africa Presidency (2023); HRDC (2023)

85 HRDC (2023).

2. There is insufficient information on skill needs for the green transition

Existing efforts to capture information on skill demand do not provide a clear and coherent picture of skill needs. The JET Implementation Plan highlights several weaknesses related to labor market information affecting the energy transition that are also more broadly relevant for the way skills demand is captured across the economy. It notes that labor demand information is nearly exclusively based on employer's perceptions, which produces information that is not always accurate, that focuses on short term skill needs and that is seldom reducible to a set of tasks giving insights into what education is required to address skill needs.⁸⁶ This implies that it largely ignores other data generation and forecasting methods that can provide useful additional information.⁸⁷ The JET Implementation plan also notes that the different methodologies used by fragmented labor demand studies make it difficult to aggregate data to form a clear and comprehensive picture of labor and skill demand. This is particularly concerning in the absence of any institution that takes effective responsibility to distill reliable and usable data from these various studies.⁸⁸ SETA's face challenges to provide adequate skill demand analyses. DHET noted in 2013 that the data provided was overall insufficient to inform strategic decisions at the sectoral or national level. There have been improvements since then - for example, DHET established an in-house Skills Planning Unit that now produced reliable reports -, but SETA's do not appear to have fundamentally improved the quality of their outputs.⁸⁹

Labor analyses tend to provide particularly scarce information about skill needs for the green transition, making it difficult for the PSET system to respond to this demand. A review of the most recent SSPs of six SETA's central to the green economy did not find clear and forward-looking strategies for skill development for the green economy. Rather, the review found the available sections on these skills formulaic (drawing mostly on the DHET-supplied template and drawing upon many of the same source-documents), backward rather than forward looking, and describing at most vague interventions without attention to the expected impact.⁹⁰ The absence of this information seems partly by choice, in that there is a lack of focus on green jobs and the associated skills requirements in data collection and dissemination activities. But there also seem to be methodological challenges. For example, in addition to the absence of a common understanding of terminology for skills for green jobs, the methodology that SETAs are supposed to apply only registers skills that are in demand when a certain number of employers highlights them as important, and this is less likely to happen for nascent industries and technologies with a limited number of players, such as emerging green industries and green technologies.⁹¹

A consequence of the weak data on labor and skill demand for green jobs is that the PSET system does not receive systematic guidance to adjust its offer to these needs. This does not absolve PSET providers from the responsibility to align their offer with demand: labor data will always be surrounded by uncertainties, and the many positive examples of universities that already aligned their program offer show that this is possible even with the current data limitations. Still, to enable the PSET system to develop a more holistic and systematic response to the skill needs for green jobs, a stronger base of information on labor and skill demand is needed. For example, as long as there is not a clearer picture of which jobs risk becoming bottlenecks for the green transition, then PSET can hardly assess to what extent it is responding to the most critical skill needs.

86 South Africa Presidency (2023)

87 Hofmijzer (2015)

88 Having the opportunity to use a variety of studies that apply different foci and methodologies can help to produce a comprehensive picture of labor and skill demand, but it does take strong capacity to be able to distil and merge the right data to develop credible and relevant findings.

89 DHET (2013a), p60; OECD (2014), pp39-40; DHET & Redflank (2017); Oosthuizen & Kohler (2020)

90 Duncan (2024). The SSPs reviewed were of the construction, chemical, energy and water, manufacturing, mining, and transportation sectors.

91 ILO (2019), observations raised by SETA's during a training seminar by the Green Skills Initiative

3. Processes for introducing new and revised qualifications and programs are too complicated

The delays in introducing new or revised TVET qualifications and programs are caused by the QCTO and SETA procedures, combined with weak incentives and capacity of SETAs and TVET providers. The processes and their key challenges are summarized in textbox 3.1. QCTO's guidelines for introducing new qualifications result in a lengthy and multi-step process, involving a multitude of stakeholders who may not always have the necessary incentives or capacity to engage in qualification design and who may not always agree on substantive or procedural aspects of the process. The process requires the development of a series of documents, from occupational standards to learning programs. Subsequently, training providers need to comply with a range of QCTO criteria before they are accredited to offer the program, while industry needs to go through SETAs' time-consuming processes before they may offer work placements. The complexity and length of these processes make it difficult for TVET to respond quickly to changing demand. It causes delay in the finalization of qualifications that are initiated, and likely discourages SETAs and other industry stakeholders from starting the process at all, including because SETA's may not have strong incentives to focus their limited capacity on these complicated processes. TVET providers may also not have strong enough incentives to overcome system inertia and reform resistance and instead invest their limited resources and capacity in new or adjusted programs.

Textbox 3.1: The processes to introduce new occupational qualifications and programs

Many TVET qualifications are not considered completed and may therefore not be formally offered. South Africa has a broad range of qualifications and training programmes producing knowledge and skills with relevance for the green economy. However, training cannot take place in many occupational qualifications because one or more of the main elements are not yet in place, namely:

- An occupational profile
- An NQF-registered qualification
- A description of the required curriculum content
- Assessment criteria and standards
- A teaching and learning programme
- Education institutions accredited to offer the qualification
- Workplaces at which practical experience can be gained

Interviewees put much of the blame for the problem on the complexity and inefficiency of QCTO procedures for developing new qualifications and training programmes, and SETA procedures for approving workplaces. The development and approval of new occupational qualifications and their training programmes must follow a specific process. A SETA – presumed to be the voice of industry for this purpose – must first identify a need for specific skills. If the needed skills are not already covered by an existing occupation on the OFO, the SETA must oversee the definition of a new occupation incorporating those skills and, thereafter, the development of a qualification and training programme for them. This process must be led by a 'development quality partner' (DQP), usually the SETA itself but sometimes another agency, appointed by the SETA, which is in some notable way connected to the relevant industry. An occupational profile is developed, followed by a qualification incorporating the skills required to practise it and then a training programme leading to that qualification. The training programme must have three components - theory, practice, and workplace experience - and must include internal and external assessment specifications in a prescribed format. For this, a QCTO-appointed assessment body is required. If the QCTO is satisfied that the correct process has been followed, it will forward the documentation to SAQA for registration on the National Qualification Framework (NQF). Once that has been done, training providers may apply to the QCTO for accreditation as purveyors of the qualification. They need to be able to demonstrate to the QCTO, through submission of relevant documents and an on-site inspection, that their organisation is compliant with an extensive list of requirements regarding its legal registration, financial status, tax clearance, management policies, business accommodation, adherence to labour laws and health and safety regulations, and readiness to offer the programme, including its workplace experience component,

with all necessary personnel, equipment and materials at the time of application. In total, the prospective provider is assessed on 25 different criteria, some of which are categories of criteria in themselves.

All this makes for a lengthy process within which there can be many delays and derailments. For instance, the SETAs, the QCTO and regulatory and advisory bodies such as the National Skills Authority (NSA), the National Artisan Development Advisory Body (NADAB) and the National Artisan Moderation Body (NAMB), do not always see eye-to-eye on substantive and procedural issues, which has led to some lengthy impasses. SETAs' bureaucracies function slowly. Moreover, industry experts who contribute to the processes are usually on loan from their employers for very limited periods and rarely have time to see the whole process through to completion, especially when there are bottlenecks or blockages. Without their continuous presence, progress all too easily grinds to a halt.

The SETAs are responsible for approving workplaces as sites at which practical training for occupational qualifications can be conducted. The criteria that a workplace must meet were standardised by the DHET in 2013 and, like the QCTO's requirements for training service providers, include numerous requirements regarding legal registration, tax compliance, physical infrastructure, adherence to labour laws and health and safety regulations, and ratio of qualified practitioners to trainees. Employers willing to host trainees at their workplaces frequently question the relevance of some of these criteria and, more frequently, complain about the SETAs' failure to respond to requests for accreditation, unfamiliarity with the criteria and inconsistent application of them. Owners of small and medium-sized businesses are especially aggrieved on this issue and very few such firms host trainees for workplace experience.

Source: Duncan (2024)

Hurdles to create and update qualifications are a particular constraint for jobs in the green economy and other new and fast-changing occupations. The delays caused by the lengthy and bureaucratic processes affect the entire TVET system and are not specific to skills for the green economy, but they may be particularly harmful for the green transition and other economic trends that involve new industries and substantial and rapid changes in skill demand. Occupations for which qualifications already exist and that remain comparatively stable in terms of task content, suffer relatively little from the time-consuming and complex processes involved in creating or revising qualifications. Green jobs, however, not only require skills that need to be newly introduced in PSET programs, but these skill needs also change relatively often because technological developments rapidly change the task content of these jobs. When these changes are substantial, qualifications need to be updated, meaning that green qualifications must often be subjected to the time-consuming red tape surrounding this process. In addition, when green industries are still relatively nascent, they will only have a small pool of industry experts, making it more challenging to find persons with the relevant expertise who are willing and able to participate in these elaborate processes involved in qualification design. The same challenges apply, incidentally, to qualifications that prepare students for jobs that may not be explicitly green but where a lot of innovations and technological developments take place, for example in the fields of ICT.

4. It is challenging to ensure sufficient teaching capacity and equipment

Ensuring that teacher capacity and physical equipment are sufficient to ensure quality education and training delivery is a challenge across PSET, but particularly complicated for skills that are new and fast-changing, which includes many green-specific technical skills. Challenges with maintaining high-quality and up-to-date teacher capacity and equipment are common in PSET. They are especially pronounced for the teaching of new skills that are particular to nascent industries or jobs, such as those emerging for the green economy. Equipping teachers with these new green-specific technical skills, including through practical experience, is more complicated than equipping them with traditional skills. This is because the pool of persons, either in industry or in PSET, who have the right expertise to train teachers in these skills may still be relatively small, and because fast-changing technologies means that teachers need to be retrained often to keep their skills up-to-date. Similarly, identifying and procuring equipment to teach these new skills may be more challenging than purchasing equipment to teach 'traditional' skills, and may need to be done more often to stay up to date with the most current technologies.

5. Workplace-Based Learning opportunities are hard to find

While identifying enough good Workplace-Based Learning (WPBL) opportunities is a challenge in most countries, the difficulties are exacerbated in South Africa by cumbersome accreditation procedures. WPBL is essential to ensure that graduates achieve the intended learning outcomes, especially in TVET. Beyond acquiring technical skills that are fully aligned with labor market demand, the ‘real work-floor experience’ of work placements can also equip students with essential non-technical skills - such as problem solving, working in teams, and communication skills -, in a way that is not achieved through in-school teaching.⁹² The availability of work placements in South Africa is scarce.⁹³ Despite DHET having promoted the slogan “Every workplace a training space” for some years, the number of slots does not seem to have increased much. Across the world, but especially in countries with many informal and small firms, PSET providers tend to struggle to find work placements for all students.⁹⁴ In South Africa, this challenge is exacerbated by procedures that discourage firms to engage in WPBL. Especially smaller-sized firms often mention bureaucracy and administrative requirements, including for accessing WPBL-related financing, as constraint to offering WPBL opportunities. Firms that are willing to provide work places need to be accredited by SETA, which has put in place numerous complicated and time-consuming requirements. As a result, only larger firms with dedicated human resources departments tend to be willing and able to submit themselves to these procedures, while smaller firms that could have also offered meaningful WPBL opportunities are discouraged to do so. SETAs may have limited incentives to make it easier for small firms to offer work placements, among others because the public funding they receive is not tied to the extent to which they succeed in satisfying the needs of their associated industry.⁹⁵

WPBL opportunities to acquire green-specific skills are even harder to find than placements focusing on more traditional skills. The limited offer of WPBL placements by smaller firms is a particular constraint for, for example, students learning to provide renewable energy services for households (like installing solar panels), because these services are mainly provided by small- and medium-sized enterprises. The number of WPBL placements to prepare for green jobs is also still small because of the relatively native stage of most green industries. The recent DHET report on the hydrogen economy, for example, observes that work placements in more traditional industries for, for example, for mechanical engineers and electricians, can help develop relatively basic technical skills that are required both in the hydrogen economy and in the more traditional industries, but that work placements to acquire hydrogen-specific skills are limited due to the small number of firms currently involved in the hydrogen value chain.⁹⁶

Ensuring that PSET equips enough workers with the right skills is essential, but not enough to ensure that these workers will be applying their skills in green jobs. Before moving to the next section with proposed recommendations to make the PSET system more responsive to the skill needs of the green economy, it is important to note that PSET alone cannot ensure that the skills supply for green jobs is met, for various reasons. Since a lot of the technical skills required for green jobs can also be usefully applied in other jobs, workers may opt to apply these skills outside of the green economy if the conditions there are considered to be more preferable. Many engineers, technicians and artisans could deploy their technical skills in both green and non-green jobs. Or workers with the right technical skills to work in green jobs may opt to work in jobs that do not require these skills at all (a worker with a qualification as solar panel installer may become a taxi driver, for example), or they might make themselves unavailable for South Africa’s labor market by choosing to work abroad or not at all. While it is beyond the scope of this report to delve into these labor market aspects, considering all these aspects means that attracting well-skilled workers to jobs that contribute to the green transition within South Africa is likely to involve, among other things, ensuring competitive pay and other labor conditions for these green jobs, in addition to ensuring responsive PSET.

92 Hoftijzer et al (2018)

93 OECD (2014), p.59

94 Levin et al (2023)

95 Franz et al (2022)

96 DHET (2024).

4. Conclusions and recommendations

South Africa's PSET system, especially the higher education sector, has various strengths to build on for the supply of skills for the green transition. Higher education institutions have a tradition of collaborating with industry, a large degree of autonomy to shape their education offer, and, perhaps as a result, graduates' employment outcomes are relatively strong. Many qualifications that are critical or necessary for the green transition already exist, and are offered by PSET providers. Higher education institutions and private training providers have in recent years increasingly included a focus on skills for green jobs in their education and (adult) training offer.

The TVET system suffers from a range of challenges that severely impede its overall performance, including its ability to supply the skills needed for the green transition. The TVET system is a cause for concern, as TVET providers lag behind universities in adapting their education and training offer to the skill demand for green jobs, and the constraints that impede their performance appear particularly severe and persistent. As a result, TVET does not produce enough graduates in fields that are particularly relevant for green jobs, and those students who do graduate are not equipped with the necessary skills to perform well in those jobs. TVET's struggle to prepare students for green jobs is, in large part, due to systemwide constraint, even though they may disproportionately affect the provision of skills for the green transition. While not specific to green jobs, these systemic constraints do need to be addressed to enable TVET to structurally and adequately supply the skills needed for the green economy. Universities generally have made more progress than TVET providers in aligning their program offer with the skill needs for the green transition, but also have more work to do to, such as addressing the structural shortage of engineers and other STEM graduates.

Coordinated action among a wide range of stakeholders is essential to enable PSET providers to prepare the workforce for a just green transition. Understanding current and future skill needs; identifying critical skills needs and at-risk workers; disseminating this information to PSET providers in a useful manner; and strengthening the ability of PSET system to equip learners with these skills requires effective collaboration between a range of public and private sector stakeholders on the demand and supply side, at various institutional levels ranging from national-level institutions to individual firms and PSET providers. A strategic-level champion and the coordination mechanism to achieve this has not yet emerged.

The below recommendations serve to address the key constraints to PSET's ability to provide the skills needed for the green transition. The recommendations focus mostly on addressing constraints that are specific to skills for the green economy. An exception is the recommendation to remove unnecessary red tape to develop new qualifications, because this is considered such a crucial yet resolvable constraint to PSET's responsiveness to skill demand for the green transition. To achieve an optimal and sustainable impact, the below recommendations should be complemented with reforms that remove the other main constraints that impede the overall performance of the PSET system, some of which are described above. To conclude Textbox 5.4 illustrates how international expertise can be accessed to address knowledge gaps resulting from the nascent nature of green industries.

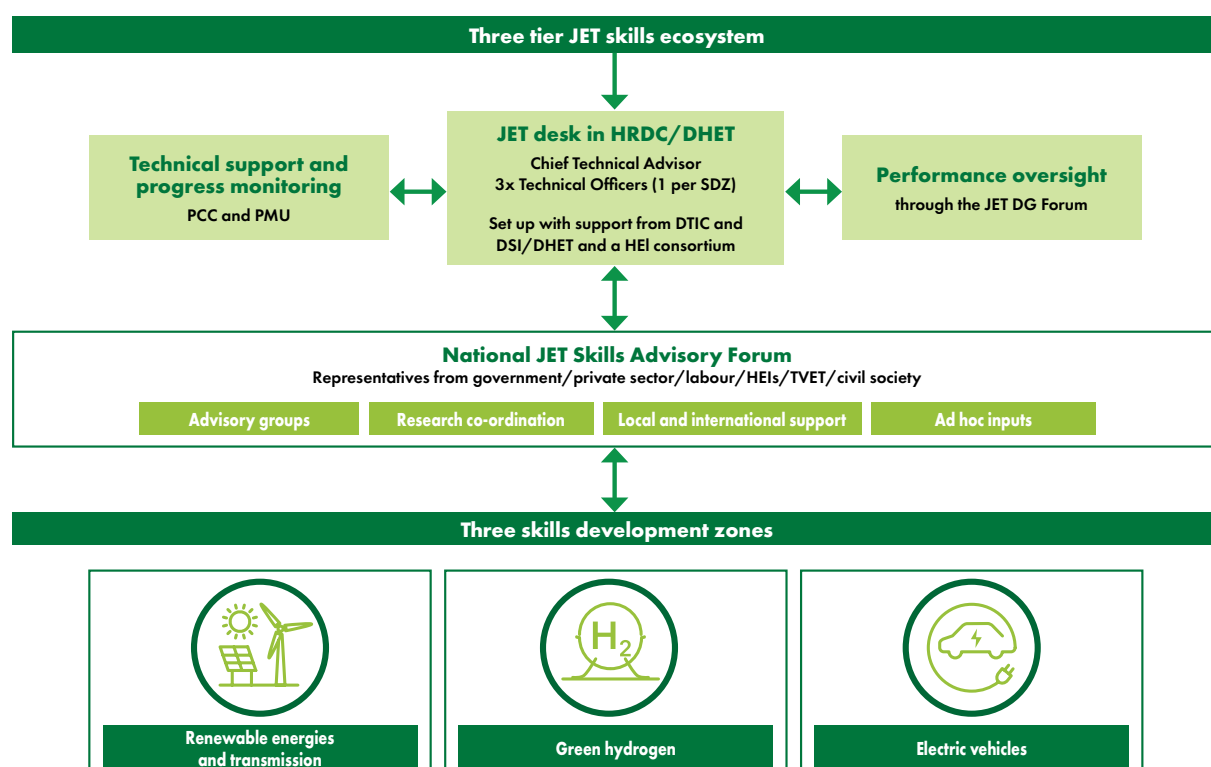
Textbox 5.1: Summary of recommendations to improve the supply of skills for green jobs

RECOMMENDATIONS TO IMPROVE PSET'S SUPPLY OF SKILLS FOR GREEN JOBS

1. **Ensure effective coordination for developing skills for green jobs** by establishing clear leadership and ensuring effective coordination between key stakeholders on the skills demand and supply side.
2. **Regularly and systematically collect, synthesize and disseminate data** on skill needs and skill gaps for the green transition
3. **Target and tailor interventions** to industries, locations, jobs, and people where there is clear evidence of greening momentum and skill constraints.
4. **Support at-risk workers** in maintaining their employability and livelihoods through skills development and other interventions.
5. **Remove unnecessary red tape** that delays or prevents the development of new qualifications and accreditation of TVET providers and enterprises.

Recommendation 1. Ensure effective stakeholder coordination for developing skills for green jobs. Objectives, approaches and responsibilities for building skills for the green economy need to be consistently understood and applied by all key stakeholders. This requires first of all clear leadership, for example from the Presidential Climate Commission (PCC), which could act as a champion and take on a convening role to ensure effective coordination between and among stakeholders on the skill supply and demand sides. Implementing a coherent approach requires a level of institutional coordination that currently does not appear to exist, such as between DHET (on the skills side) and, on the green transition side, the Department of Forestry, Fisheries and the Environment (DFFE, formerly DEA), the PCC and the Project Management Office (PMO) of the Presidency. The coordinated approaches announced in JET Implementation Plan (see figure 5.1) and the HRDS may offer an appropriate basis for further coordination initiatives.

Figure 5.1. The coordination mechanism proposed in the JET Implementation Plan



Source: South Africa Presidency (2023)

Recommendation 2. Regularly and systematically collect, synthesize and disseminate data on skill needs and skill gaps for the green transition.

An important step towards improved data availability is ensuring that SSPs more consistently and clearly include data on skill demand for the green transition. In addition to the SETAs, there is a clear role for DHET, which could start by exploring why SSPs include limited attention to skills for the green transition, including why SETAs do not use the current OFO concepts on green jobs and green skills (see textbox 5.2). Once the main constraints are clear, changes can be made to encourage the provision of more reliable and comparable data on skill demand for the green transition. This could include, among others, revising terminology as well as adjusting processes for data collection, analysis and dissemination.

Textbox 5.2. Improving information on the skill demand for the green transition

A first step in moving towards a more coherent and comprehensive collection of useful data on skill demand for the green transition is to review what is holding back SETAs to report on these skills and to apply the OFO definitions, which is something DHET is best placed to carry out. There could be several reasons why SETAs are not following through with linking skills needs to the green occupations or critical green skills from the OFO taxonomy. For example, there may be some discomfort with the OFO taxonomy, or insufficient clarity on the sector's expected development path towards greening; SETA's might lack incentives to focus on green jobs due to uncertainty about the benefits of singling these jobs out over other skill needs; data collection processes might be considered overly cumbersome; or SETAs might not have the right expertise to conduct the green skill demand analyses.

Beyond SETAs, other parties can be encouraged to carry out skill demand assessments for the green transition. Building a collection of skill needs assessments applying different angles and methodologies helps develop a comprehensive and diverse picture of current and future skill demand. For example, cross-sectoral, regional, value-chain or occupational angles can be useful additions to the sectoral approaches of SETAs. An example are the ongoing value-chain focused skill demand assessments that were recently initiated by the National Business Institute (NBI). The HRDC, DHET, or other institution that takes the lead in promoting skill needs assessments for the green transition can promote the development of such a collection of skill needs assessments, for example through providing financing; guiding stakeholders on the areas where critical information gaps exist and suggesting methodologies to address these; and disseminating findings to PSET providers and other key stakeholders through, for example, website and conferences (as discussed in the next point).

Findings from skill needs assessments needs to be synthesized and shared with PSET providers in an actionable manner. Synthesizing the findings from various analyses requires considerable technical capacity, given that they may apply different assumptions on green transition pathways, as well as different scopes, timeframes, methodologies and terminology. To an extent, analysts can be encouraged to harmonize their assumptions and approaches, but differences are likely to persist, among others because different scopes and methodologies help answer different questions.⁹⁷ The synthesized findings need to be disseminated to the relevant stakeholders across the PSET spectrum in an actionable way. This includes universities, TVET institution and adult training providers, but also all other stakeholders who can use this information to develop policies and actions to align the skill supply for the green transition with demand, such as enterprises, DHET, and the other stakeholders of South Africa's skills development system (figure 3). Disseminated data should clearly convey both quantitative aspects of labor and skill demand (i.e., how many workers will be needed in particular occupations and what are expected shortages) and qualitative aspects, including the particular critical skills needed for occupations in the green economy.

⁹⁷ For example, an analysis to understand which skills need to be developed to boost a priority green sector will focus on the critical labor and skills demand in that sector. A review of how engineering studies need to be adapted to meet the skill needs for the green transition will assess how the green transition will change engineering jobs across the economy. An analysis to design support for at-risk workers will focus on identifying workers that may lose their jobs, for example in coal mining.

Recommendation 3. Target and tailor interventions to industries, locations, jobs and people where there is clear evidence of greening momentum and skill constraints.

In a context with well-functioning labor market information and skills development systems, the right mechanisms to align skill supply with demand are largely in place, and education and training for green jobs (or any other jobs) would develop organically.⁹⁸ As it is, in South Africa, various systemic constraints prevent the demand-responsiveness of PSET supply, especially of TVET provision. While reforms to address these systemic challenges are designed, implemented and take effect, targeted additional interventions are necessary to address priority skill needs.

Targeted interventions could focus on skills development for industries or regions where there is clear evidence of green transition momentum, and a substantial risk that these might be derailed by skills constraints.

For example, it may currently be particularly appropriate to focus on skills for the renewable energy sector in which significant investments are ongoing compared to other main pillars of the green economy (see textbox 2.2), and where skills mismatches pose a serious risk to making further progress. Skills interventions can also be more narrowly focused, for example on facilitating one or several firms and their nearby PSET providers to develop and implement programs tailored to these firms' greening needs. Skills for green jobs can be prioritized when addressing some of the identified systemic constraints. For example, green jobs can be prioritized when embarking on the completion of the many TVET qualifications packages that still have missing elements, or when piloting simplified procedures for the accreditation of firms for offering work placements of TVET students. Green technologies can be prioritized when enhancing the financial and institutional capacity of higher education providers and TVET institutions for research and innovations.

Skills interventions should also be tailored to the nature of skill gaps and mismatches and to learners' characteristics.

For example, current workers in low-skilled jobs that require little adaptation can be trained on-the-job, while technician-level workers in jobs where new green tasks are more sophisticated or numerous may need to receive short term training, and workers in higher-level positions could benefit from workshops and conferences. The training required to upskill or reskill current workers can be provided by a range of stakeholders, including, for example, firms and employer organizations; TVET and higher education institutions; or private providers focusing explicitly on adult training. The government can facilitate training of current workers to better prepare them for green jobs in various ways. It can, for example, make it easier for firms and employees to access financing from the skills levy for reskilling and upskilling activities, including for non-formal training and training that is provided by private providers. The government can also, in collaboration with SETA's, promote the dissemination of information on critical skill needs of current workers to training providers so that these providers can align their program offer with demand; and provide workers and firms with up-to-date information on the available offer of relevant training opportunities. Overall, strengthening the engagement of private sector actors in skills development, by facilitating partnerships between sector associations or firms with PSET providers, or by making it easier for private providers to access SETA discretionary grant funding, would be a positive step towards improving the responsiveness to emerging skill demand like in green jobs.

Recommendation 4. Maintain the employability and livelihoods of at-risk workers through skills development and other support.

Well-targeted interventions should also support workers whose employability is, or risks being, reduced due to the green transition. This includes workers whose jobs are directly related to industries that will wind down or substantially transform (like coal mine workers) and workers whose jobs depend on these industries (such as shopkeepers in a town that relies mostly on income from mining). These workers and measures to safeguard their earnings potential and livelihoods, need to be identified timely. SJRPs, or similar plans, should be integrated in the overall framework of greening strategies and policies, and clear leadership and coordination for their implementation ensured (textbox 5.3).⁹⁹ As measures to support at-risk workers are likely to include a significant focus on skills development activities, there may be merit to establishing a single coordination structure for preparing the workforce for the green transition that combines meeting skill demand for the green economy with supporting at-risk workers.

⁹⁸ ILO(2010)

⁹⁹ TIPS (2020); TIPS (2020a); TIPS (2020b); TIPS (2020c); TIPS (2020d)

Textbox 5.3. Essential coordination to ensure that at-risk workers are adequately supported

The SJRP for the coal value chain notes that its implementation requires coordination across multiple stakeholders. This includes coordination between various public institutions, including at the municipal and provincial level, as well as with private stakeholders that need to be mobilized across the coal value chain. The SJRP emphasized that to enable effective coordination, there needs to be clarity about implementation responsibility and proposes that the national SJRP structure establishes an office in Mpumalanga to take implementation forward.

Source: TIPS (2020a)

Education and training providers will be expected to develop and implement training programs that provide at-risk workers with the skills needed to access available jobs that largely match their current skills profiles. These may be any type of good jobs for which the skills requirements largely match those of the at risk-workers. In some cases, these jobs may be green jobs, such as in Poland and Australia, where coal workers are being retrained for jobs in wind and solar energy.¹⁰⁰ Engaging and facilitating private training providers will be essential, since many of them already offer short programs to adults.

Recommendation 5: Remove unnecessary red tape that delays or prevents the development of new qualifications and accreditation of TVET providers and enterprises.

The process to follow- from the time that the need to develop or update a qualification is identified, until the moment that a TVET provider is accredited to offer the qualification and firms are accredited to offer associated WBL places- includes many different steps that are cumbersome, time-consuming, and not always clear or consistently applied. The current requirements do not strike the right balance between ensuring the quality and relevance of a new qualification and facilitating TVET institutions and, especially, smaller-sized firms to respond to changing skill demand timeously. The processes should be reviewed and simplified, to speed up these processes and encourage more industry stakeholders and TVET providers to partake in them. This includes specifically 1) procedures set by the QCTO to develop and update qualifications and related documentation such as assessment standards and learning packages; 2) accreditation processes set by the QCTO to approve TVET provider to offer occupational programs for particular qualifications; and 3) regulations set by SETAs that are applied to approve (accredit) firms to offer work placements to TVET students. The processes for accrediting firms to offer work placements particularly needs to be reviewed and simplified for smaller-sized firms. The Red Tape Reduction Task Team within the Office of the President could potentially play a facilitating role in easing the most cumbersome processes.

100 See <https://notesfrompoland.com/2023/10/19/poland-begins-retraining-coal-miners-to-work-in-wind-farms/> (accessed July 10, 2024); and <https://www.smh.com.au/business/companies/australia-starts-retraining-coal-workers-for-the-clean-energy-future-20220420-p5aenm.html> (accessed July 10, 2024).



Textbox 5.4. Accessing international expertise to address green industry knowledge gap

South African stakeholders involved in skills development for the green transition are likely to experience knowledge gaps due to the nascent nature of green industries and green technologies. There are various ways in which international knowledge can be drawn on to make up for the still limited expertise in South Africa's industry and PSET institutions. Options include, for example:

- **Overall knowledge sharing:** PSET providers engage in international center of excellence networks, or twinning arrangements with international education institutions. Such arrangements can result in longer term collaborations on any desired range of topics.*
- **Program design:** SETA's, PSET providers, or other actors taking responsibility for program design can engage international expertise from industry or PSET providers to develop green modules or qualifications that are well-aligned with the skill needs of green jobs. An efficient approach may be to adopt existing modules applied abroad, after any needed contextualization to the South African context. The DHET report on the hydrogen sector, for example, notes that Australia's 'Gas Industry Training Package' includes modules targeting the hydrogen economy that can be usefully adopted in South Africa.
- **Teacher training:** teachers could partake in teacher-training programs abroad, either in-person or remotely, and gain practical experience through 'teacher internships' in firms abroad. Alternatively, PSET institutions in South Africa can recruit international staff to both teach in regular programs and build capacity of other teachers.
- **Work-Based Learning:** an option to address the limited availability of work-placements for green-specific skills is to arrange work placements abroad. This is, however, a costly approach, and likely only a feasible option for a small number of students in the highest-level, most critical jobs.

* An example of an international knowledge sharing network for TVET providers is the ETF Network for Excellence by the European Training Foundation (ETF), which includes 'Going Green' as one of its priorities.

References

ADB	2023	Preparing the Workforce for the Low-Carbon Economy: A Closer Look at Green Jobs and Green Skills. ADB Briefs No. 262. Asian Development Bank. Manila, Philippines
Altbeker, A & Storme, E.	2013	Graduate Unemployment in South Africa: A much exaggerated problem. CDE Insight series. Johannesburg: Centre for Development & Enterprise
CEDEFOP	2019	Skills for Green Jobs. 2018 Update. European Synthesis Report. Cedefop reference report 109. Luxembourg.
CETA	2020	Sector Skills Plan, 2021/22 - 2025/26. Johannesburg; CETA
CETA	2020	Strategic Plan for the fiscal years 2021/22 to 2025/26
CHIETA	2022	Sector Skills Plan, 2023 - 2024. Johannesburg; CHIETA
Cloete et al	2022	The Green Hydrogen TVET Ecosystem Just Transition in South Africa: A Strategic Framework.
Consoli, D.; Marin, G.; Marzucchi, A.; Vona, F.	2016	Do Green Jobs Differ from Non-Green Jobs in Skills and Human Capital? Research Policy, 45, issue 5, p. 1046-1060.
DEA	2011	National Strategy for Sustainable Development and Action Plan (NSSD 1) 2011–2014. Pretoria, South Africa: DEA
DEA	2010	Environmental Sector Skills Plan. Pretoria; DEA
Department of Energy	2019	Integrated Research Plan 2019
DHET	2024	Identification of Skill Needs for the Hydrogen Economy. Research Report. Prepared by CSIR for DHET's LMI Research Programme
DHET	2023	National Artisan Development Statistics Presentation, 28/02/2023
DHET	2023a	Determination of the phase out date of NATED Report 191 N1 – N3 programmes. Government Gazette No. 3973
DHET	2022	Finalisation of the Critical Skills List, Technical Report. Labour Market Intelligence research program. DHET
DHET	2022a	Statistics on Post-School Education and Training in South Africa. Pretoria: DHET
DHET	2022b	Supply and Demand of Artisans in South Africa. Labour Market Intelligence research programme. Pretoria: DHET.
DHET	2021	Revised Strategic Plan 2020-2025. Pretoria: DHET
DHET	2013	The Organising Framework for Occupations. Pretoria; DHET
DHET	2013b	National Standardised Artisan Learner Workplace and/or Site Approval Criteria and Guideline. Policy Document.

DHET	2014	White paper on post-school education and training. Building an expanded, effective, and integrated post-school system
DHET & Redflank	2017	Evaluation of the Labour Market Intelligence Partnership Project. Pretoria: DHET
DNA Economics	2020	The 2020 List of Occupations in High Demand: A Technical Report. Produced for the Department of Higher Education and Training (DHET) as part of its Labour Market Intelligence (LMI) research programme.
Duncan, K.	2024	A review of green skills programmes in South Africa. Final report
ECSA	2021	<i>Annual Report 2020/21</i> . Johannesburg; Engineering Council of South Africa
ECSA	n.d.	The Engineering Skills Pipeline. Occasional news release. Johannesburg; ECSA
EWSETA	2021	Sector Skills Plan, 2022 - 2023. Johannesburg; EWSETA
Franz, J., Dulvy, E. & Marock, C.	2022	Engagement of Micro and Small Enterprises in Work-place-based Learning in South Africa. Washington; International Bank for Reconstruction and Development/ World Bank
Freimann, K.; Magnus, G.	2023	Skills for a Just Transition to a Green Future: Measuring the South African TVET System and providing input to support its development. Presented at the International Research Conference on Skills for a Just Transition, Johannesburg, 11-12 May 2023
Granata, J.; Posadas, J.	2022	Which Jobs Are Green? A Methodological Note on How to Measure Green Jobs for Skills Policy and an Application to Indonesia. Jakarta, Indonesia: World Bank.
Green Cape	2022	South African Renewable Energy Master Plan. Emerging Actions Discussion Document. Cape Town; Green Cape
Hoftijzer, M.	2015	Forecasting labor and skill demand by sector and occupation. Case studies and guidance. World Bank
Hoftijzer, M.; Stronkowski, P.; Rozenbaum, J.	2018	Getting Out of School and into the Workplace: Strengthening Work-Based Learning in Upper Secondary Technical Education in Poland's Swietokrzyskie Region. International Development in Focus
HRDC	2023	The Reconceptualized Human Resource Development Strategy: 2024-2033. Draft
ILO	2019	Skills for Green Jobs in South Africa. Geneva; ILO
ILO	2018	World employment social outlook 2018: greening with jobs. International Labour Office – Geneva
ILO	2016	What is a Green Job? https://www.ilo.org/global/topics/green-jobs/news/WCMS_220248/lang-en/index.htm , accessed Feb. 2024
ILO	2010	Skills for Green Jobs in South Africa: Unedited Country Background Study". Geneva; ILO

IRENA and ILO	2023	Renewable Energy and Jobs: Annual review 2023. International Renewable Energy Agency, Abu Dhabi and International Labour Organization, Geneva.
Levin, V.; Santos, I.; Weber, M.; Iqbal, S.; Aggarwal, A.; Comyn, P.; Katayama, H.; Hoftijzer, M.	2023	Building Better Formal TVET Systems : Principles and Practice in Low- and Middle-Income Countries (English). Washington, D.C. : World Bank Group.
LGSETA	2018	Local Government Organising Framework for Occupations (OFO) Code Handbook – technical report
LMIP	2020	Introductory workshop on the Organising Framework for Occupations (OFO)
LMIP	2014	Mapping links between occupations and Classification of Educational Subject Matter (CESM)
Maia, J., Giordano, T., Kelder, N., Bardien, G., Bodibe, M., Du Plooy, P., Jafta, X., Jarvis, D., Kruger-Cloete, E., Kuhn, G.	2011	Green jobs: an estimate of the direct employment potential of a greening South African economy
Marin, G. and Vona, F.	2019	Climate Policies and Skill-Biased Employment Dynamics: Evidence from EU Countries. Journal of Environmental Economics and Management, 98, p.102253.
Mathibela, X.	2020	UP training TVET Students in Hydrogen Fuel Cell Systems. University of Pretoria
merSETA	2021	Sector Skills Plan, 2022 - 2023. Johannesburg; merSETA
Mosomi, J. and Cunningham, W.	2024	Profiling green jobs and workers in South Africa: An Occupational Tasks Approach. Policy Research Working Paper #10779. Washington, D.C.: World Bank Group
MQA	2021	Sector Skills Plan, 2022 - 2023. Johannesburg; MQA
NADSC	2023	Presentation on National Artisan Statistics at NADAB Forum, 28 February 2023
NPC	2011	National Development Plan: Vision 2030. Tech. Rep. Pretoria: National Planning Commission.
OECD	2023	Job Creation and Local Economic Development 2023: Bridging the Great Green Divide. OECD Publishing, Paris
OECD	2017	Employment Implications of Green Growth: Linking jobs, growth, and green policies. OECD report for the G7 environment ministers
OECD	2014	A Skills Beyond School Review of South Africa. Paris; OECD Publishing

Oosthuizen, M. & Köhler, T.	2020	The Workplace Skills Plan and Annual Training Report: An Initial Review of the Data to Determine a Way Forward". Development Policy Research Unit (DPRU), School of Economics, University of Cape Town
Republic of South Africa	2021	Republic of South Africa. 2021. First Nationally Determined Contribution under the Paris Agreement. Updated September 2021.
Rutovitz, J.	2010	South African energy sector jobs to 2030: How the Energy [R] evolution will create sustainable green jobs
SANEA	2023	Energy Skills Roadmap for South Africa. Johannesburg; S.A. National Energy Association
South Africa Presidency	2023	South Africa's Just Energy Transition Implementation Plan 2023-2027.
South Africa Presidency	2022	South Africa's Just Energy Transition Investment Plan. Pretoria; the Presidency
SRI	2015	Matric Report: The South African labour market and the prospects for the matriculants of 2015". Pretoria; Solidarity Research Institute
TETA	2021	Sector Skills Plan, 2022 - 2023. Johannesburg; TETA
Tibane, E. (ed.)	2018	Official Guide to South Africa: Education. In <i>Official Guide to South Africa</i> (p. 12). Government Communications Information System
TIPS	2020	Sector Jobs Resilience Plan: Agriculture Value Chain. Trade & Industrial Policy Strategies.
TIPS	2020a	Sector Jobs Resilience Plan: Coal Value Chain. Trade & Industrial Policy Strategies.
TIPS	2020b	Sector Jobs Resilience Plan: Metals Value Chain. Trade & Industrial Policy Strategies.
TIPS	2020c	Sector Jobs Resilience Plan: Petroleum-Based Transport Value Chain. Trade & Industrial Policy Strategies.
TIPS	2020d	Sector Jobs Resilience Plan: Tourism Value Chain. Trade & Industrial Policy Strategies.
UNEP, ILO, IOE, and ITUC	2008	Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World. UNEP. Nairobi
UNEP	2011	Green economy pathways to sustainable development and poverty eradication: A synthesis for policy makers. Nairobi: UNEP
UNESCO-UNEVOC	2021	Skills Development and Climate Change Action Plans. Enhancing TVET's contribution. UNESCO
Urban, P.; Rizos, V.; Ounnas, A.; Kassab, A.; Kalantaryan, H	2023	Jobs for the Green Transition. Definitions, classifications and emerging trends. CEPS. Brussels.
Vally, Z.; Matlala, R.; Sibiya, T.; Makhoabenyane, T.	2020	African Continental Qualifications Framework (ACQF) Mapping Study. Country Report Working Paper. South Africa. African Union and Africa-EU Partnership

**Vona, F.; Marin, G.;
Consoli, D.; Popp, D.**

2019 Environmental regulation and green skills: an empirical exploration. *Journal of the Association of Environmental and Resource Economists*, 2018, 5 (4), pp.713 - 753

WEF

2023 Jobs of Tomorrow: Social and Green Jobs for Building Inclusive and Sustainable Economies. White Paper. World Economic Forum

World Bank

2023 Green Jobs - Upskilling and Reskilling Vietnam's Workforce for a Greener Economy (English). Washington, D.C. : World Bank Group.

World Bank Group

2022 South Africa Country Climate and Development Report

World Bank Group

2021 World Bank Group Climate Change Action Plan 2021 –2025: Supporting Green, Resilient, and Inclusive Development. World Bank, Washington, DC.

World Bank Group

2020 Skills Development in South Africa. Identifying Issues for further analysis.

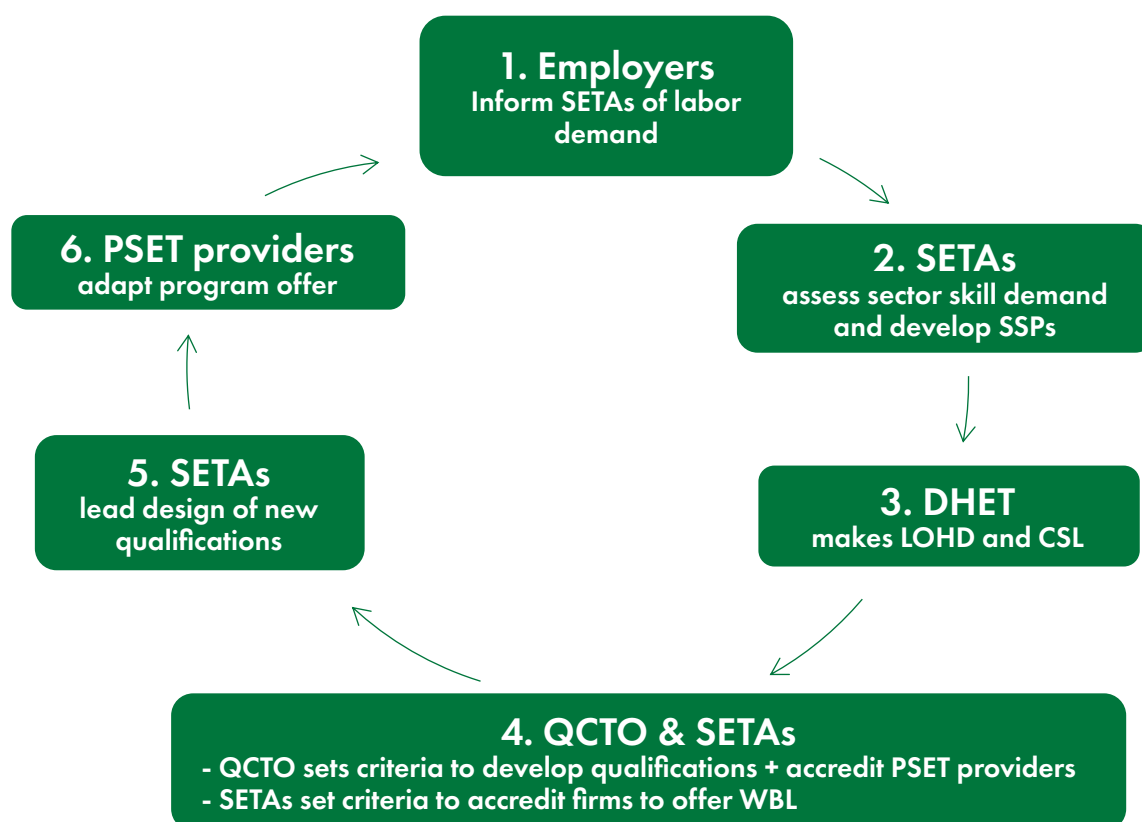


Annexes

Annex 1 – South Africa’s process for aligning skills supply with demand

The actors and processes intended to ensure that South Africa’s PSET system aligns its education and training offer to respond to the economy’s labor and skill demand are summarized in figure A1. The process starts with employers providing labor market information to SETAs (box 1 in the figure). SETAs then consolidate these data to produce an analysis of sectoral labor needs, and use these to develop Sector Skills Plans (box 2). SSPs, in return, are used by DHET to generate an economy-wide overview of labor and skill demand, including by producing the List of Occupations in High Demand (LOHD) and the Critical Skills List (CSL) (box 3). These lists serve to inform industry and PSET providers of where the most critical skills gaps are, so that they can take action to adjust the PSET offer to address these skill needs. The process of adjusting the PSET offer is guided by criteria that are set by the QCTO and SETAs related to the development of new qualifications, the accreditation of PSET providers to offer education programs for these qualifications, and the accreditation of employers to offer work placements associated with these qualifications (box 4). SETAs are expected to lead the development of new and adjusted qualifications, together with a range of other stakeholders (box 5, see also textbox 3.1 in section 3 above). Finally, PSET providers are expected to incorporate new and revised qualifications in their education offer (box 6), after which they produce sufficient numbers of graduates with the appropriate skills who will enter the labor market.

Figure A1. Key dimensions and responsible actors for ensuring adequate skills supply



The OFO's classification system of occupations serves to achieve a common language in the discourse about labor and skill demand. The purpose of the OFO is to provide a common language when talking about occupations. It aims to capture all occupations in South Africa, and categorizes these in occupational groups that range from various sub-groups ("Administration Professional") to broad classifications ("Professionals"), based on similarity of tasks, skills, and knowledge. Occupations themselves can include specializations, or alternative titles (see figure A2). The OFO is constructed from the bottom-up, based on an analysis of jobs that identifies similarities in terms of tasks and skills, after which they are classified in occupations and higher levels of occupational groups.¹⁰¹ The OFO does not describe tasks of individual occupations, but it does provide an indicative set of tasks for all groups, with the most level of detail at the 'unit group' level.¹⁰² For example, from the OFO 2013:

2424 Training and Staff Development Professionals Training and staff development professionals plan, develop, implement and evaluate training and development programs to ensure management and staff acquire the skills and develop the competencies required by organizations to meet organizational objectives.

Tasks include:

Designing, coordinating, scheduling and conducting training and development programs, ... etc.

Figure A2: Example of how the OFO is structured

Code	Occupational group	Level
2	Professionals	Major group
24	Business and Administration Professionals	Sub-major group
242	Administration Professionals	Minor group
2424	Training and Staff Development Professionals	Unit group
242402	Occupational Instructor/ Trainer	Occupation
	Business Skills Business Leadership/Executive Coach Maintenance Instructor Police Instructor Welding Instructor	Alternative titles and specialisations

Source: DHET (2013)

101 DHET (2013a)

102 LMIP (2018)

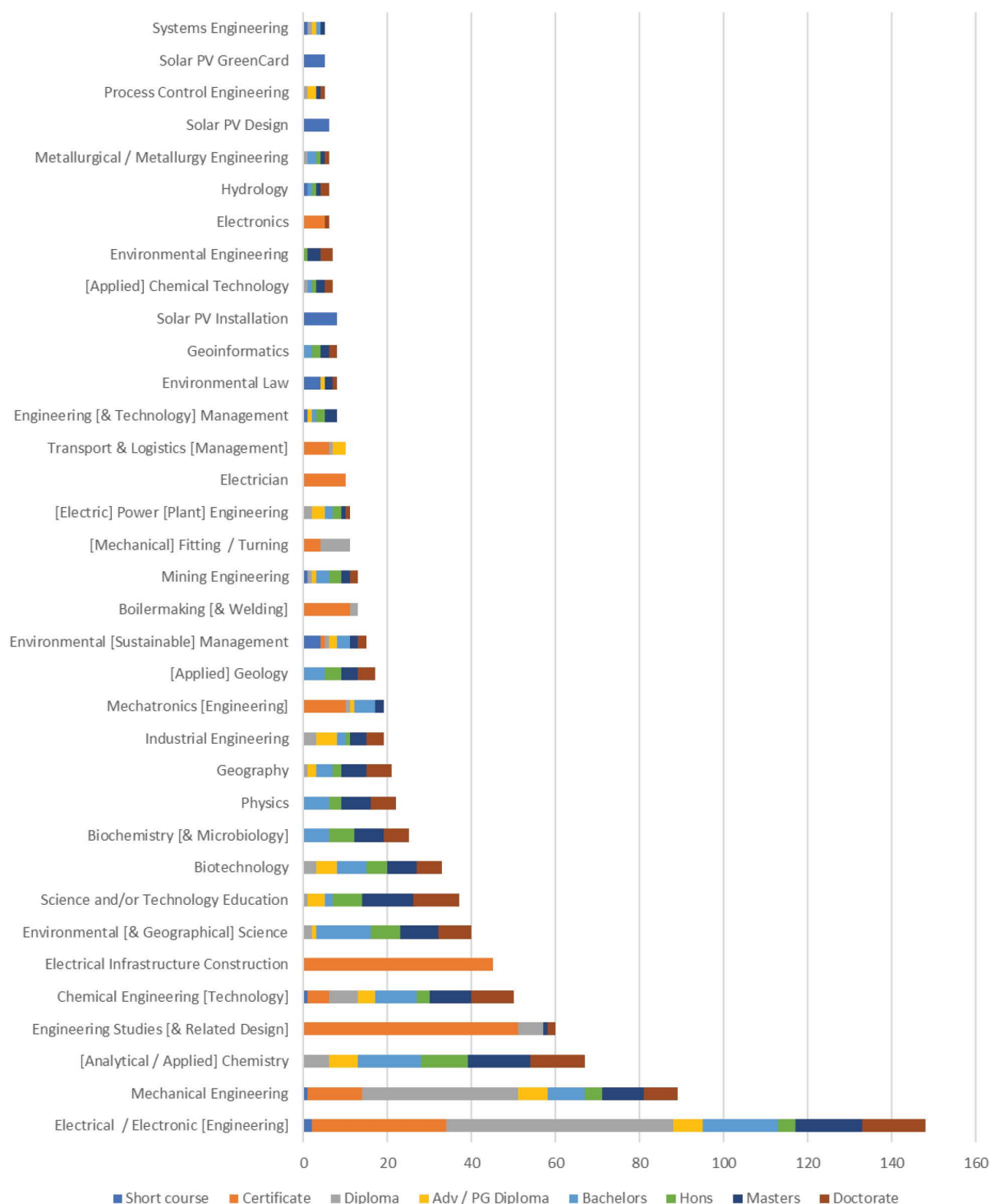


The OFO is considered a crucial instrument to ensure that the alignment of skills supply with demand is carried out effectively and adequately, although it currently does not fully live up to its expectations. Employers are supposed to use the list of occupations that are included in the OFO as the basis for articulating their labor and skill needs, and this information is subsequently used by SETAs to develop SSPs and by DHET to produce the LOHD and CSL. DHET may also use the labor market information provided by firms and SETAs to adjust the content of the OFO. This information then supports PSET stakeholders in understanding the nature of labor and skill demand, so that they can better align their PSET offer with the economy's needs. The value of the OFO of course depends on the adequacy of the labor market information that it is based on, which apparently regularly leaves to be desired.¹⁰³ Moreover, the 'translation' from labor market occupations to educational qualifications is not straightforward, as 1) the OFO provides limited information on the task content and skill needs of each occupations; and 2) there is not necessarily a one-to-one relationship between an occupation identified in the labor market and an educational qualifications as identified in the NQF (for example, a particular qualification can prepare a person for various occupations, or there are various qualifications that prepare a person for a particular occupation).

103 LMIP 2018

Annex 2 – Existing PSET offer related to energy

Figure A1. Current energy-related courses with more than five offerings across PSET, by qualification level



Source: SANEA (2023)

Annex 3 – Higher education institutions’ research and education programs targeting the green economy¹⁰⁴

Cape Peninsula University of Technology

The South African Renewable Energy Technology Centre (SARATEC) is a more technical, formal qualification centre, offering various courses for wind, solar and grid connection. SARATEC is certified by the Global Wind Organisation as a training facility for its courses in the installation, operation and maintenance of wind turbines. It also offers courses in wind energy applications from BZEE e.V. (the German Association of Training Centres for Renewable Energy). SARATEC collaborated with SAPVIA, GreenCape (a provincial government agency promoting green economic development in the Western Cape province), MerSETA and GIZ to develop a 1-week training course in PV installation. It hosts an annual training course in the European Energy Manager programme for technical experts and company executives responsible for energy management within their organisations.

Durban University of Technology

The Durban University of Technology offers a number of renewable energy technology installation and technical courses for wind, solar and grid connection.

Nelson Mandela Metropolitan University

The Centre for Energy Research (CER) focuses on energy storage and renewable energy generation. CER researches innovative applications of emerging technology, such as electro-luminescence imaging equipment that enables the testing of solar panels in the field, hybrid concentrator-photovoltaic systems and off-grid street lighting that harvests both sun and wind energy. CER offers an Advanced Diploma in Renewable Energy as well as a wide range of short learning programmes and modules in various aspects of renewable energy technology that can plug into other degree programmes.

Northwest University

The Hydrogen Infrastructure Centre of Competence (HICC) in the Faculty of Natural and Agricultural Sciences conducts research on hydrogen generation, storage, and distribution. The Faculty of Engineering has a strong emphasis on clean energy in rural areas and hosts the Infrastructure Centre of Competence of Hydrogen South Africa, developing applications and solutions for hydrogen production, storage and use. It offers a Master’s programme in a range of renewable energy issues.

Stellenbosch University

The Centre for Renewable and Sustainable Energy’s (CRSE) main research areas include solar thermal energy, wind energy, ocean energy, photovoltaic systems and biofuel energy. It hosts a research chair in PV systems and is a partner in Eskom’s Power Plant Engineering Institute. Hydrogen research in the Faculty of Engineering will cover technology development and intelligence, and systems engineering for application of hydrogen technologies. Energy Materials research group focusses on hydrogen generation by water electrolysis. Stellenbosch also offers green hydrogen courses towards their master’s and postgraduate diplomas in Engineering. CRSE offers two masters’ programmes focusing on renewable and sustainable energy. It runs also offers a number of practical, short-course, skills-training programmes on wind, storage and energy systems. CRSE also helps bring new technologies in green energy to the market, in collaboration with the national Technology Innovation Agency.

¹⁰⁴ Sources: ICRS (2023); ILO (2019); SANEA (2023); and others. This is not intended to be an exhaustive summary.

Tshwane University of Technology

There is a task team to carry out research on hydrogen. The university also plans curriculum development to enable upskilling in hydrogen, starting with government employees.

University of Cape Town

From 2012, the African Climate and Development Initiative (ACDI) offers an MSc/ MPhil in Climate Change and Development, an interdisciplinary one-year degree to provide knowledge of climate change and sustainable development for an African context. Research groups include the Catalysis Institute, through which the university collaborates with Sasol on the conversion of carbon dioxide and green hydrogen to green chemicals and jet fuel is carried out. The university also has an Electrolyser Research Group within the HySA Catalysis Competence Centre.

University of the Free State

The university offers a M.Sc. in Integrated Water Management

University of Johannesburg

The SASOL / DSIS-NRF Research Chair in Green Hydrogen focuses on the process from production to application of green hydrogen.

University of Pretoria

The Centre for New Energy Systems offers short courses on energy market operation, management and optimisation. The Department of Electrical, Electronic, and Computer Engineering focusses on the hydrogen economy in their Just Transition research group.

University of South Africa

The projects of the Institute for Catalysis and Energy Solutions (ICES), formerly known as the Institute for the Development of Energy for African Sustainability, include green hydrogen production.

University of the Western Cape

The South African Institute for Advanced Materials Chemistry (SAIAMC) runs various programmes including the Hydrogen South Africa Systems Integration Competence Centre (HySA Systems) and the and Green Hydrogen Programme. These programmes focus on hydrogen technology and skills development to upskill university and TVET graduates and other professionals for better transition from academia to the hydrogen industry.

University of Witwatersrand

The School of Architecture and Planning offers Masters of Architecture in Sustainable and Energy Efficient Cities.

Vaal University of Technology

The university received funding from the Chemical Industries SETA (CHIETA) to enable engineering students to conduct research in fuel cell innovations.

Annex 4 – South Africa’s PSET programs by qualification level

The different programs and program levels that are part of South Africa’s qualification framework are summarized in table A1 below.

Higher education can be both academic and vocational in nature, and include academically oriented bachelor’s and higher level degrees as well as professional level programs at NQF levels 5 to 7, including higher and advanced certificates and national and advanced diploma’s.¹⁰⁵ Public higher education institutions include traditional universities offering academic programs; universities of technology that offer vocationally oriented diplomas, higher education certificates and degree programs; and comprehensive universities that offer both academic and vocational programs. Additionally, there are private universities that mostly offer vocational degree and non-degree programs.¹⁰⁶

The TVET sector offers vocational, occupational and artisan education and training through public TVET colleges and Community Education and Training (CET) colleges, and private training providers.¹⁰⁷ TVET colleges offer vocational and occupational training courses at NQF levels 1-4, and some higher level professional programs in collaboration with universities. TVET colleges may also offer short courses in vocational and occupational skills requested and funded by industry.¹⁰⁸ CET colleges mainly offer adult basic education courses, up to NQF level 4, and a few occupational programs at NQF levels 2 and 3.¹⁰⁹ Private training providers mostly offer NATED programs and occupational qualifications (see below), as well as non-formal skills development programs and short courses.¹¹⁰

The two main TVET qualifications that are offered are Report 191 National Technical Education programmes (commonly known as NATED), and the National Certificate (Vocational), or NC(V) certificates.¹¹¹ The NC(V) program is a three-year, college-based course leading to a NQF level 4 qualification, equivalent to a grade 12 secondary school certificate. NC(V) programs exist in 19 vocational fields, including agriculture, construction, electrical and mechanical engineering, and transport and logistics. NATED programs are part-qualifications, offered until recently at six levels (N1 to N6) for engineering studies and four levels (Introductory and N4 to N6) for business and general studies. NATED programs at levels 1 to 3 were recently phased out, with the last batch of students enrolled in December 2023.¹¹² Each NATED level comprises three or six months of classroom-based instruction in the theory of a specific trade or occupation. These courses, complemented with 18-24 months of relevant work experience lead to a National ‘N’ Diploma pegged at level 5 on the NQF.¹¹³ On the workforce, persons with NATED or NC(V) qualifications or a National Diploma might be called ‘technicians’. To become an artisan, they need to complete a specified period of work-based training through an apprenticeship or learnership and pass an external trade test.

¹⁰⁵ Duncan (2024)

¹⁰⁶ <https://www.southafricaeducation.info/higher-education>

¹⁰⁷ DHET (2014) and Tibane (2018) in Vally et al (2020)

¹⁰⁸ Duncan (2024)

¹⁰⁹ Duncan (2024)

¹¹⁰ World Bank (2022)

¹¹¹ Vally et al (2020)

¹¹² DHET (2023a)

¹¹³ Duncan (2024)

Table A1. Programs and program levels in higher education and TVET in South Africa

ISCED	NQF	Higher Education	TVET
5-8	10 9 8 7/8	Doctorate Master's Post-graduate Diploma Bachelor's	
	7 6	Advanced Diploma National Diploma	National N Diploma
4	6 5	Advanced certificate Higher certificate	NATED courses (6) business / engineering NATED courses (5) business / engineering
3	4 1-3	National Sr. Certificate	NATED courses (4) business / engineering National Certificate (Vocational)
2		Lower secondary education	
1		Primary education	

- Academic education
- Combined/mixed academic/professional
- General education
- Vocational/professional

Sources: AU EU (2020) African Continental Qualifications Framework ACQF Mapping Study. Country report working paper South Africa; UNESCO UNEVOC (2022) South Africa TVET Country Profile

In addition to the NQF qualification, Occupational Certificates exist. They are obtained combining college-based instruction in the theory of a specific trade or occupation with extensive work-based learning and practical experience, usually delivered through an apprenticeship or learnership. Occupational qualifications are a relatively recent innovation – in their present form they exist since 2012 - but are intended to become the mainstay of the TVET colleges by 2030. They can be offered at NQF levels 1 to 8 but in practice, to date, focus on artisan trades. At present, only 13 occupational programmes, all leading to artisan qualifications in construction and engineering, are offered at 20 colleges in partnership with employers.¹¹⁴ Some others are finalized on paper but not yet offered. SETA's have been taking responsibility for the accreditation, implementation and certification of This responsibility was supposed to transferred from SETAs to the QCTO (which is already responsible for these processes for NQF qualifications) since the QCTO's inception in 2010, but progress has been slow. To accelerate the process, the accreditation of all SETA qualifications expired on June 2023 with a one year grace period for training providers to move to QCTO accreditation and a 3-year teach out period.¹¹⁵

In addition to the above programmes, TVET colleges may offer short courses in vocational and occupational skills requested and funded by industry.¹¹⁶

¹¹⁴ Duncan (2024)

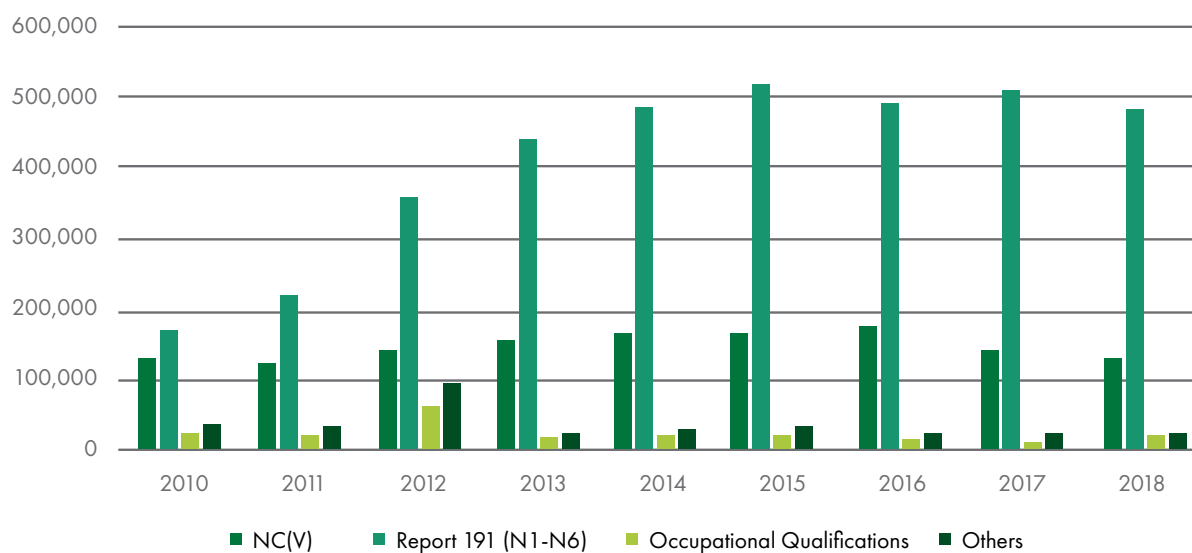
¹¹⁵ <https://insights.transcend.co.za/blog/understanding-the-changes-in-skills-development-what-you-need-to-know-about-the-qcto#:~:text=This%20means%20that%20a%20qualification,qualifications%20within%20their%20respective%20SETAs,;https://www.engineeringnews.co.za/article/skills-development-changes-on-the-horizon-2023-06-26>

¹¹⁶ Duncan (2024)

In terms of TVET enrolment, NATED (Report 191) programs are by far most important.

The number of students in NATED programs has far exceeded those in all other TVET programs during the 2010-2018 period. In 2018, the number of NATED learners approach half a million, compared to less than a third of students in NC(V) programs. Well under 50,000 students enrolled in occupational programs.¹¹⁷

Figure A1. Enrolment TVET Colleges 2010-2018

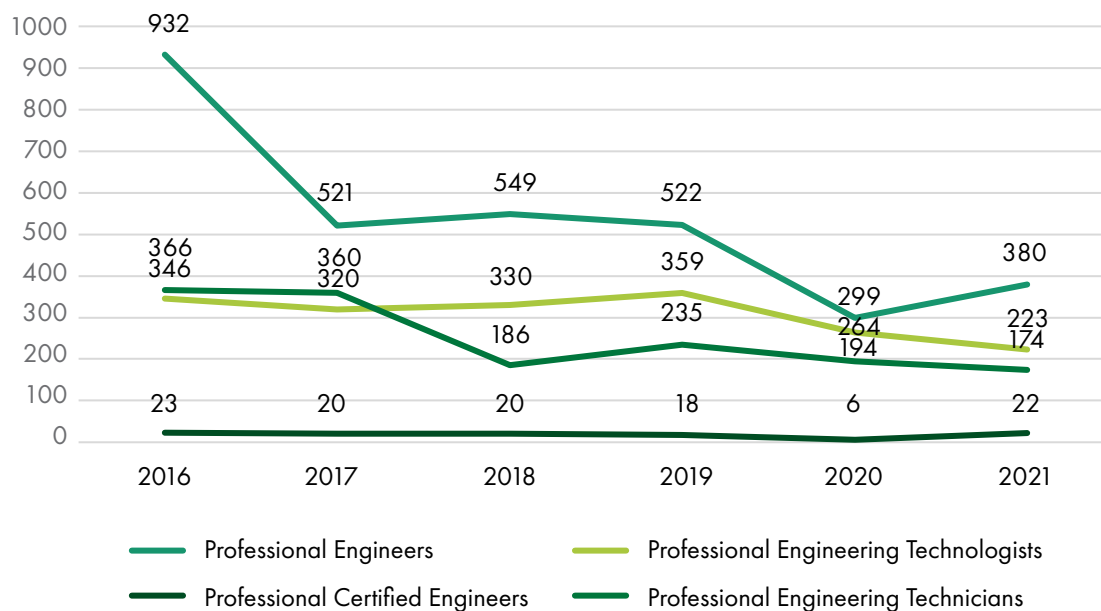


Source: WB (2020)

117 WB (2020)

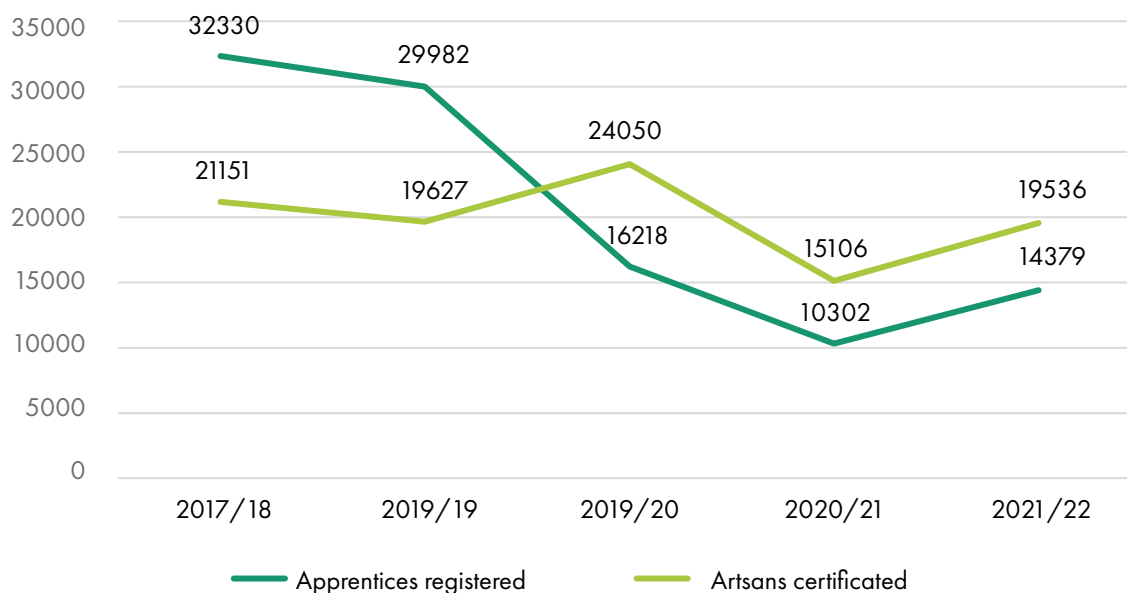
Annex 5 - New engineers, apprentices and artisans per year

Figure A2. Annual new registrations of professional engineers



Source: ECSA (2021)

Figure A3. Apprentices enrolled and artisans certified annually



Source: NADSC (2023)



WORLD BANK GROUP

