

Enabling Green Skills: Pathways to Sustainable Development

A Source Book to Support Skills Planning
for Green Economies

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green skills
Building capacity for a sustainable future

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Green Skills Source Book

'Environment' is a new area in South Africa's education, training and skills development landscape. It is a rapidly growing field of practice with about 500 000 people employed in environmental jobs. However, no strong structures exist for dealing with environment as a cross-cutting concern in the education and training landscape. Government at all levels must create enabling conditions through policies, funding and other support mechanisms.

The Green Skills programme (2015-2018) helps key role players to plan for and develop green skills. It is a three-year programme funded by the Green Fund of the Department of Environmental Affairs (DEA) through the Development Bank of Southern Africa (DBSA). The implementation partners include Rhodes University's Environmental Learning Research Centre (ELRC), the Centre for Researching Education and Labour (REAL) at Wits University, the University of Cape Town's African Climate & Development Initiative (ACDI), the Further Education and Training Institute (FETI) at the University of the Western Cape, as well as several other environmental partners.

The Green Skills Programme has been established to build system capacity for green skills development in South Africa. It is committed to develop the capacity to unlock green work and to reflect the emerging demand for greening work in occupational frameworks. To support this work, a number of 'occupationally directed green skills studies' have been conducted by the Green Skills Programme. Within these studies, and previous studies such as the development of the Environmental Sector Skills Plan (DEA, 2010a), a range of resources have been developed to enable a more proactive and anticipatory identification of and support for emerging green occupations and the greening of existing occupations.

Purpose

The purpose of this source book is to support skills planning entities to work with employers to identify and anticipate green skills needs and to build these needs into occupational descriptors and sector skills plans. Thus, the source book complements the existing Enabling Document (DEA, 2010b) and provides guidelines to support Sector Education and Training Authorities (SETAs) to embed environmental considerations, related occupations and green skills into their skills planning processes.



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Product

The short introductory section of this source book introduces the green economy and green jobs. It is followed by a selection of resources that aim to support sector skills planning processes and processes of greening work. The resources have been divided into sections:

- ◆ A description of where in the skills planning and development process the resource could be used and what value it would add;
- ◆ An example of where the resource has been used in a Green Skills study along with a set of questions to inform the use of the resource; and
- ◆ Descriptions of how to use the resource along with supporting materials and references.

The source book will be complemented by various templates and checklists which are intended to assist with work in the field.

The structure of the source book is outlined below.

1	Background to Green Skills Planning in South Africa
2	Green Economy, Green Jobs, Green Skills
3	Building the Business Case for Greening and Green Skills
4	Identifying Environmental Change Drivers – PESTEL
5	Value Chain Analysis
6	Sector / Product / Service Analysis and Prioritisation
7	Environmental Hotspot Analysis
8	Backcasting – Defining Actions from Envisioned Futures
9	Green Occupations and Green Skills Analysis
10	Multi-Levelled and Mixed Method Approach to Understanding Green Skills

References

Department of Environmental Affairs (DEA). 2010a. *Environmental Sector Skills Plan*.

Department of Environmental Affairs (DEA). 2010b. *Integrating the Environmental Driver into Sector Skills Plans; An Enabling Document for all SETAs*.

These and other relevant reports are available on the Green Skills website (resources tab): www.greenskills.co.za

Background to Green Skills Planning in South Africa

In a study on the 'green' skills in South Africa's economy, the International Labour Organisation (ILO) noted that 'new skills and retraining needs for the greening sector should filter successfully through the 'demand and supply' process' (ILO, 2010, p.19). However, despite the National Qualifications Framework's (NQF) commitment to responsive skills development and lifelong learning, several recent studies (including DEA, 2010; HSRC, 2009) have highlighted many skills and competence related issues within environmental provisioning. There is a skills development focus and a greening focus but there is little articulated alignment between the two.

Following in-depth country studies in 2011, the ILO conducted a review to assess the policy coherence between environmental policy and skills development policies in 21 countries. The graph below, extracted from the ILO report, illustrates how South Africa featured. Although South Africa has evolved in the environmental field at strategic levels, it is still experiencing implementation

challenges. Central within this are the implementation mechanisms of training responses to improve skills for greening the economy as noted by this ILO comment: "South Africa is yet to develop a comprehensive and coordinated approach" (Strietska-Illina, 2011, p.40).

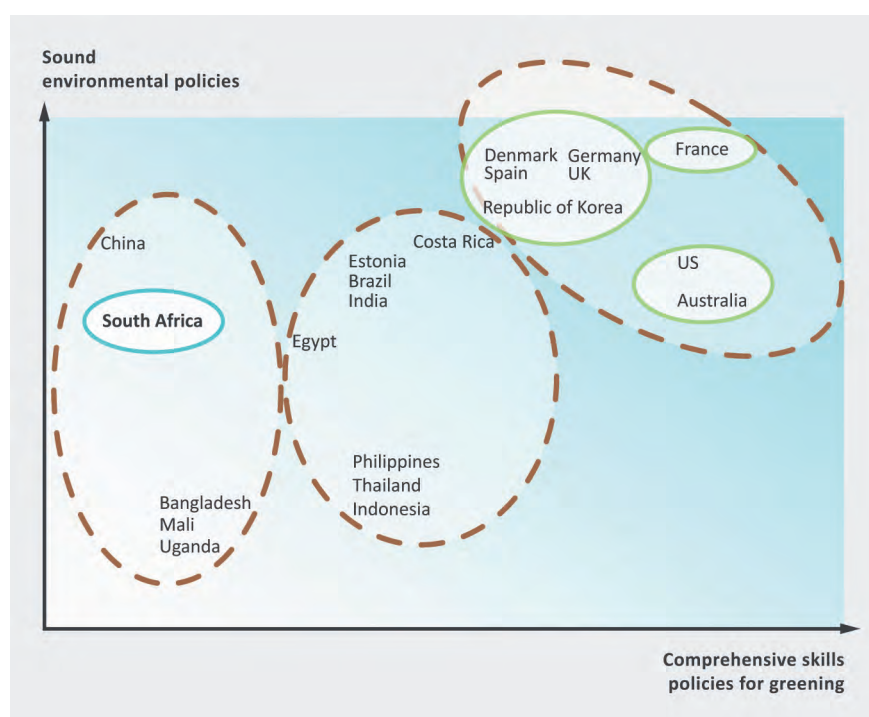


Figure 1: Coherence between greening skills policies and environmental policies (Strietska-Illina, 2011, p. 33)



The UNEP Foresight report (2012) concurs, highlighting ‘Transforming Human Capabilities for the 21st Century: Meeting Global Environmental Challenges and moving towards a Green Economy’ as key issues facing the 21st century. The report notes that

adapting to global change and attaining a green economy will require a variety of new capabilities, in particular new job skills, modes of learning, management approaches and research efforts. Action is needed to close the skills gaps in the green sector; update educational institutions to better meet educational needs for sustainability work; train managers to better identify and respond to global environmental change; and encourage research to address the sustainability challenge. (ibid., 2012)

Within South Africa, environmental skills development and planning is currently happening in pockets of praxis, but uptake and upscaling into the skills development landscape is limited (DEA, 2010).

Two national studies investigating these issues (DEA, 2010; HSRC, 2009) show that the broad and cross-cutting environmental ‘sector’ has neither a dedicated SETA nor organised industry bodies to drive skills development. As a cross-sectoral concern, environmental skills planning is best integrated across all SETAs (DEA, 2010). However a short study by Lotz-Sisitka, Malema and Olvitt (2004), involving a desktop review of five SETA Sector Skills Plans (SSPs), highlighted that SSPs were being developed without giving adequate attention to the skills requirements associated with sustainable development policy and legislation relevant to the sector and that there were varying interpretations of environment and sustainability issues in the SSPs that were not consistent with those in the National Environmental Management Act of 1998. The figure below outlines some of the main processes that have shaped human capital development initiatives in the sector and the Green Skills Programme.

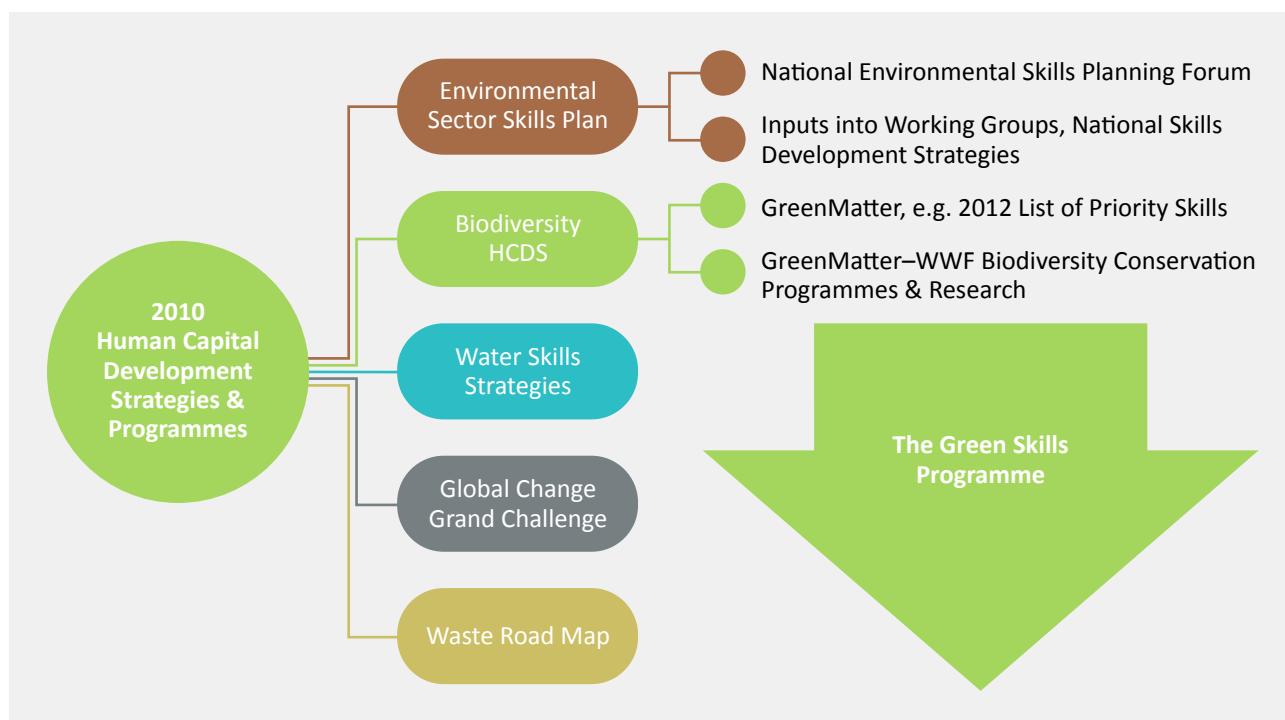


Figure 2: Processes shaping human capital development initiatives in the sector and the Green Skills Programme

The unit for Sector Education, Training and Development in DEA led the development (with Rhodes University Environmental Learning Research Centre) of a National Environmental Sector Skills Plan (2010). Following the launch of the ESSP, the DEA unit convened a National Skills Planning Forum which produced a document for Enabling Environment across the Sectors and made input into the development of the National Skills Development Strategy (NSDS) III. As a result, the Forum was tasked with commenting on all Sector Skills Plans, to ensure they are aligned with the environmental agenda set out in the Medium Term Strategic Framework (MTSF). DEA's capacity to provide this input is not aligned with the scope of the task at hand, and the dearth of environmental human and capacity development (HCD) specialists, reported in the ILO study, was highlighted.

For these and other reasons, planning and provisioning for environmental skills development in South Africa has been '**inadequate, ad hoc, fragmented, reactive and inefficient**' (DEA, 2010, p. 5). The studies listed above collectively estimate shortages of over 800 environment-related scientists and 1500 environment-related technical skills in the public sector, affecting service delivery and implementation of core national legislation. Despite a dire need to up-skill staff, environmental agencies have been unable to effectively source SETA funding (DEA, 2010). Employers tend to provide generic training at levels too low to address identified skills needs and line function budgets are often used to provide more relevant training (DEA 2010) which reflects inefficient use of funding at a broader systemic level.

There is also very little evidence of skills development initiatives (outside of short courses in universities) that are providing direction for coping with new environmental challenges or new environmental policy directives. For example, while the National Environmental Management: Waste Act (No. 59 of 2008) requires a 'cradle-to-cradle' approach to waste management or an avoidance approach, most of the training in the waste management sector is in end-of-pipe approaches (DEA, 2010).

Conceptualising skills development needs within a context where tomorrow's jobs will be different from those we know today, is challenging and requires new models of proactive skills planning that can comprehend what skills will be needed in 10-15 years. The rapidly emerging Green Economy discourse has elevated the profile of environment as an economic driver.

As interest in the opportunities presented by the green growth path escalates, so too does the recognition that investment in green skills planning is critical for long-term performance of a greener economy. The table below provides a segmented view of the net direct green job creation anticipated to emerge in the formal economy and highlights job creation potential.

The table illustrates that greening the economy has implications for many sectors of the economy. It also gives us an idea of the size and scope of this emerging sector. When thinking about the green job potential, it is important to explain that not all green jobs will be new jobs; some will involve 're-skilling' or changing work practices as new green skills are introduced into existing jobs. Some countries (for example, the USA) are calling them 'derivative jobs', jobs that are being derived from existing ones and which involve a skill specialisation.

The DBSA 2011 report also points out that due to South Africa's extensive natural capital, job creation in natural resource management will dominate over both the long term and short term. It

estimates a 45% increase in job creation in natural resource management in the short term and 50% in the long term (Maia et al., 2011). These environmental practices cross elementary, intermediate and high skills levels and will therefore require diverse learning pathways. This will necessitate transversal engagement across the NQF as sustainability practices are located across schooling, higher education, and occupationally directed training. This emerging scenario will further burden the currently overextended and inefficient skills development system.

As discussed, sustainability practices are contested and complex and research in the sector (DEA, 2010) has shown that the whole system of training provisioning for workplace learning and sustainability practices is poorly constituted and unresponsive to the rapidly changing nature of the sector. This foregrounds the contention that there are issues that exist between the environmental sector (where certain new forms of training are needed) and the education and training system that is not geared to offer such training.

Table 1: *Scope of Green Jobs Projections in South Africa*

Sectors	Current employment	Potential additional employment (by 2025)
Waste management (including recycling)	36 960-131 130 jobs (90% unskilled), including 40 000 in plastic recycling, 10 000 in scrap metal, 35 000 in metal beverage cans (DTI, 2009)	165 134-351 314 jobs (90% unskilled labour) (DTI, 2009) but only around 16 000 direct jobs (Maia et al., 2011)
Biodiversity and natural resource management	73 392 biodiversity-specific personnel but 1 158 264 jobs in biodiversity-related sectors (Vass et al., 2009; SANBI and the Lewis Foundation, 2010) 23 000 full-time equivalent/ person-years employment to low-skilled workers in ecosystems restoration with the Working for Water programme (Peter et al., 2010)	110 000 additional full-time equivalent per person-years employment with the Working for Water programme (Maia et al., 2011) As much as 350 000 person-years in soil and land management through payment for ecosystem services (Blignaut et al., 2008)
Sustainable/ public transport	Unknown	41 642 jobs in bus rapid transit in the long term (mostly in operations and maintenance after the decline of construction work) (Maia et al., 2011) and 148 000 with the Gauteng mass rapid transit railway and bus system (Gautrain) (Naidoo, 2009)
Wind energy	Negligible	5 000 jobs in long term (Maia et al., 2011)
Solar energy	Very low	Minimum of 16 500 direct jobs (13 500 in photovoltaic and 3 000 in concentrated solar power) including 9 000 in manufacturing (Maia et al., 2011)

Sectors	Current employment	Potential additional employment (by 2025)
Waste-to-energy	Unknown	37 000 direct jobs in the biomass industry, 10 000 in cogeneration and 7 000 in landfill gas, anaerobic digestion and pyrolysis/gasification (all essentially in operations and maintenance) (Maia et al., 2011)
Biofuels (bioethanol and biodiesel)	Unknown	More than 50 000 direct jobs, mostly from the growing of crops for raw material supply (Maia et al., 2011)
Building and housing energy efficiency	Limited	6 500 direct jobs in building, construction and installation (Maia et al., 2011)
Solar water heating	Approximately 700 people (including 200 in manufacturing and 400 in installation) (Maia et al., 2011)	17 620 new direct jobs, 16 278 of which in installation and 1 225 in manufacturing (Maia et al., 2011)
Electric vehicles and lithium-ion batteries	Less than 100 people	10 000 in manufacturing (production of electric cars and buses, and of lithium-ion batteries) conditional to government support (Maia et al., 2011)

Sources: Based on the DTI (2009); Maia et al. (2011); Vass et al. (2009); SANBI and the Lewis Foundation (2010); Peter et al. (2010); Blignaut et al. (2008) and Naidoo (2009) as cited in TIPS Report (Montmasson-Clair, 2012)

Plotting a way forward: Sustainable Development Goals and the National Development Plan

The Sustainable Development Goals (SDGs), known as the Global Goals, are a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. In committing to the realisation of the 2030 Agenda for Sustainable Development, all member states (South Africa included) committed to an agenda that will “leave no-one behind”. This Agenda 2030 offers a new lens through which to look at the world and the urgent challenges we are facing and signals a paradigm shift for the global development agenda.

In South Africa, the National Development Plan (NDP) constitutes the overarching long-term plan for the country. The SDGs and the NDP are mutually reinforcing, and together they set the direction for a profound national transformation.

This sourcebook supports the vision of decent work for all in achieving sustainable development which aims to “promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all” (NBI, 2016).

An inclusive green economy is much more than an economic growth agenda, it is an opportunity to advance both sustainability and social equity as functions of a stable and prosperous economic

system. It is hence a pathway towards achieving the 2030 Agenda for Sustainable Development, supporting the eradication of poverty while safeguarding the ecological thresholds, which underpin human health, well-being and development.

Both the workforce and enterprises need new or upgraded skills sets and business practices in order to green working methods and build sustainable societies.

To achieve the decent work sustainable development goals it is necessary to review current value chains, re-imagine jobs tasks with integrated sustainability, identify skills needs, plan skills development and provide opportunities through training and other means for workers to gain or upgrade technical as well as vocational and entrepreneurial skills for green jobs and enterprises. Developing new skills for greening work can be integrated into efforts to achieve the SDGs.

Ensuring that the commitments of the SDGs and NDP are translated into effective action involves all sectors, government, business, labour and civil society. Achieving our national goals and the SDGs will hence involve capacity building, implementation, financing, co- investment, partnership and transformation. The figure below (NBI, 2016) illustrates how the objectives of the NDP and the SDGs can be aligned so the country can work towards creating an action plan for sustainable development.



6 CLEAN WATER AND SANITATION



Partner with Municipalities to address Wastewater Treatment

8  3

2 NDP objectives from Chapter 4: Economic Infrastructure

1 NDP objective from Chapter 5: Environmental Sustainability and Resilience

7 AFFORDABLE AND CLEAN ENERGY



Incorporate a Greater Share of Gas in the Energy Mix

5  3

2 NDP objectives from Chapter 4: Economic Infrastructure

1 NDP objective from Chapter 5: Environmental Sustainability and Resilience

8 DECENT WORK AND ECONOMIC GROWTH



12  7

7 NDP objectives from Chapter 3: Economy and Employment

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



8  1

1 NDP objective from Chapter 4: Economic Infrastructure

10 REDUCED INEQUALITIES



Support Nation Building and Social Cohesion

10  3

1 NDP objective from Chapter 3: Economy and Employment

1 NDP objective from Chapter 11: Social Protection

1 NDP objective from Chapter 15: Nation Building and Social Cohesion

11 SUSTAINABLE CITIES AND COMMUNITIES



10  8

1 NDP objective from Chapter 4: Economic Infrastructure

3 NDP objectives from Chapter 5: Environmental Sustainability and Resilience

4 NDP objectives from Chapter 8: Transforming Human Settlements

12 RESPONSIBLE CONSUMPTION AND PRODUCTION



11  2

2 NDP objectives from Chapter 5: Environmental Sustainability and Resilience

13 CLIMATE ACTION



5  3

3 NDP objectives from Chapter 5: Environmental Sustainability and Resilience

14 LIFE BELOW WATER



10  1

1 NDP objective from Chapter 5: Environmental Sustainability and Resilience

15 LIFE ON LAND



12 ◆ 1

1 NDP objective from Chapter 5:
Environmental Sustainability and Resilience

16 PEACE AND JUSTICE
STRONG INSTITUTIONS



12 ◆ 6

5 NDP objectives from Chapter 13:
Building a Capable and Developmental State
1 NDP objective from Chapter 14:
Fighting Corruption

Strengthen Partnerships
with Local Government

17 PARTNERSHIPS
FOR THE GOALS



19 ◆ 2

2 NDP objectives from Chapter 7:
South Africa in the Region and the World

Cross-cutting Role of NBI in
Supporting Collaboration



SUSTAINABLE DEVELOPMENT GOALS

There is a general pattern of intent between the NDP Objectives and Actions and the SDG Goals and Targets. However, these objectives did not map exactly to SDG targets:

1 NDP objective from Chapter 4:
Economic Infrastructure

1 NDP objective from Chapter 9:
Improving Education, Training and Innovation

2 NDP objectives from Chapter 10:
Health Care for All

2 NDP objectives from Chapter 11:
Social Protection

Key: Top Actions Forming the Business NDP Action Plan

(Source: NBI, 2016)

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Green Economy, Green Jobs, Green Skills

Although the green jobs movement can be traced back to the 1970s, and its socio-political roots have been traced to various environmental, social, economic, and political goals as represented in the figure below, there has been a renewed impetus for its support since the financial crisis of 2008. The core idea has been that environmental sustainability can be a driver of economic growth.

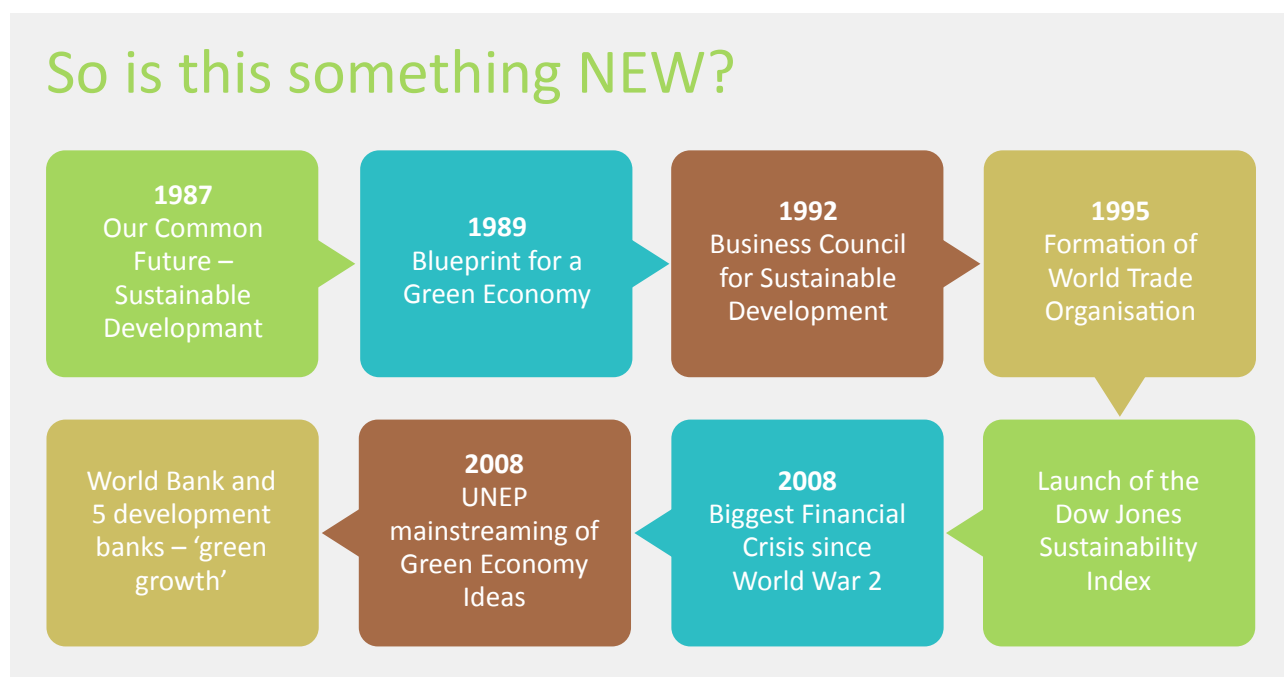


Figure 1: Historical overview: Can environmental sustainability be a driver of economic growth?

The moment of crisis thus represented an opportunity to act. In 2012, the United Nations Conference on Sustainable Development (Rio+20) was a focal point for the green economy internationally and post Rio+20 economies were challenged to become green and inclusive. Moving forward, the Sustainable Development Goals provide a platform for reintegrating the green economy into the sustainable development agenda. Thus, achieving sustainability rests almost entirely on getting the economy right.



In studying the emergence of green economy in the USA, Peters, Eathington and Swenson (nd) tracked references to green jobs in newspaper and newswire stories. The graph below illustrates the rapid explosion of the green economy discourse in 2008. This furthers shows that the idea of a “green economy” has moved out of its specialist place in environmental economics and into the mainstream of policy discourse across the world.

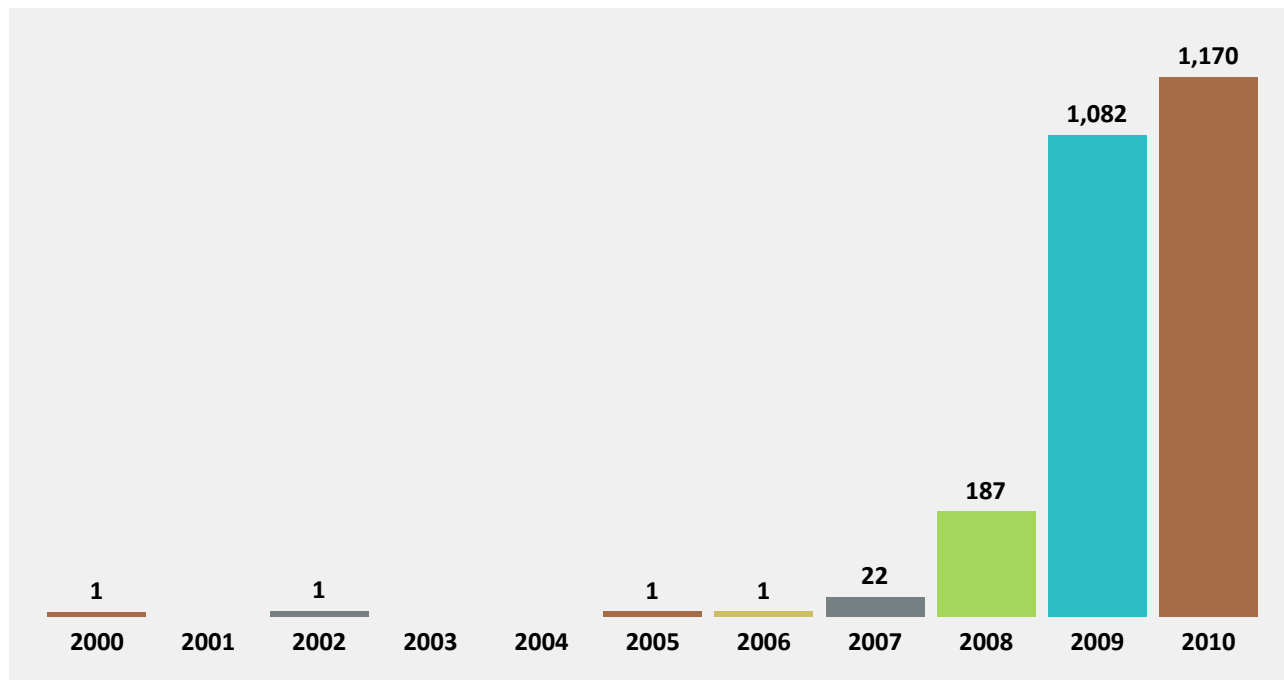
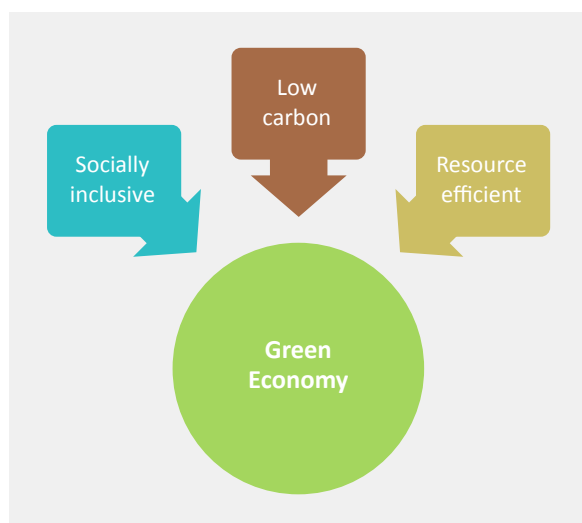


Figure 2: Growth in the use of ‘Green Jobs’ in US newspapers over the last decade

The rapid support depicted in the graph is often linked to the financial crisis of 2008.

What is a Green Economy?

UNEP (2011) has defined a green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.



The green economy deals head-on with some widespread myths, firstly that there is an inescapable trade-off between environmental sustainability and economic progress, and secondly that a green economy is a luxury only wealthy countries can afford as it would restrain development and perpetuate poverty in developing countries. There is growing evidence across the world of how the transition to a green economy can create and enhance jobs and economic development.

Figure 3: Ideas central to a green economy

After Rio+20, UN Environment felt the need to update the Green Economy Initiative, in particular by strengthening the notion of ecological thresholds and better integrating the concern over equity and inclusiveness. An Inclusive Green Economy is an alternative to today's dominant economic model, which generates widespread environmental and health risks, encourages wasteful consumption and production, drives ecological and resource scarcities and results in inequality. It is an opportunity to advance both sustainability and social equity as functions of a stable and prosperous financial system within the contours of a finite and fragile planet. It is a pathway towards achieving the 2030 Agenda for Sustainable Development, eradicating poverty while safeguarding the ecological thresholds, which underpin human health, well-being and development (UNEP, 2011).

What are Green Jobs?

There is no agreed or accepted definition of green jobs. UNEP defines green jobs as work in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but non-exclusively, this includes **jobs that help to protect ecosystems and biodiversity; reduce energy, material and water consumption through high-efficiency strategies; de-carbonise the economy and minimise or altogether avoid the generation of all forms of waste and pollution** (UNEP, 2011).

At the enterprise level, green jobs can produce goods or provide services that benefit the environment, for example green buildings or clean transportation. However, these green outputs (products and services) are not always based on green production processes and technologies. Therefore, green jobs can also be distinguished by their contribution to more environmentally friendly processes. For example, green jobs can reduce water consumption or improve recycling systems. Yet, green jobs defined through production processes do not necessarily produce environmental goods or services.

As illustrated in the diagram, a distinction can thus be drawn between employment in green economic sectors from an output perspective and job functions in all sectors from an environmentally friendly process perspective. For the ILO, green jobs are all those jobs that fall in the striped area (ILO, 2016).

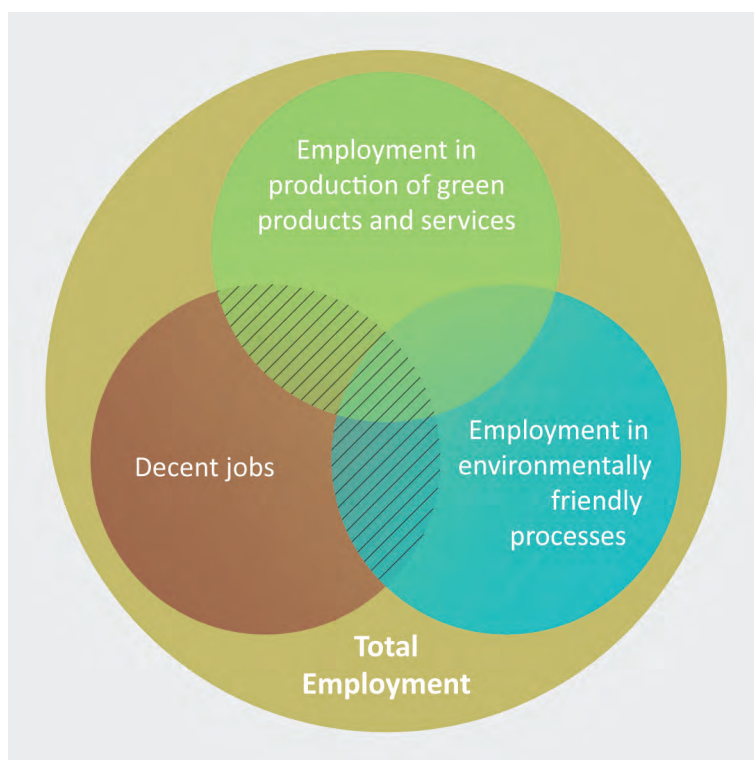


Figure 4: *What is a green job?*
(Source: ILO, 2016)

Defining 'Green' is Difficult



The ambiguity surrounding the notion of what is green has resulted in different characterisations of green. For example, the ILO talks of DIRECT and INDIRECT green jobs, the Australian literature discusses 'deep green jobs' and 'light green jobs' and several typologies have emerged that help people to determine what is green. Here we provide two widely used examples. The ILO report uses the typology in the diagram on the left to assess green and decent work.

Figure 5: Framework for Green and Decent work (ILO, 2016)

The Australian framework presents a more comprehensive idea that enables a categorisation of Deep Green, Mid Green and Light Green.

	Deep Green	Mid Green	Light Green
Mode	Pro-active	Integrative	Reactive
Scope	Long-term	Intermediate term	Short-term
Nature	Transforming	Reforming	Confirming
Objective	Redefine growth	"Ecologise" growth	Enhance growth
Operation	Rejectionist	Reinventionist	Accommodationist
Aim	Ecological sustainability	Ecological modernity	Sustainable development
Jobs	Preserving nature	Greening industry	Remedying ecological decline

Figure 6: Australian Green Jobs typology (Source: Goods, 2014)

Within South Africa, we needed a typology relevant to the South African skills system and occupations framework; hence we have found it useful to categorise skills as in the diagram that follows.

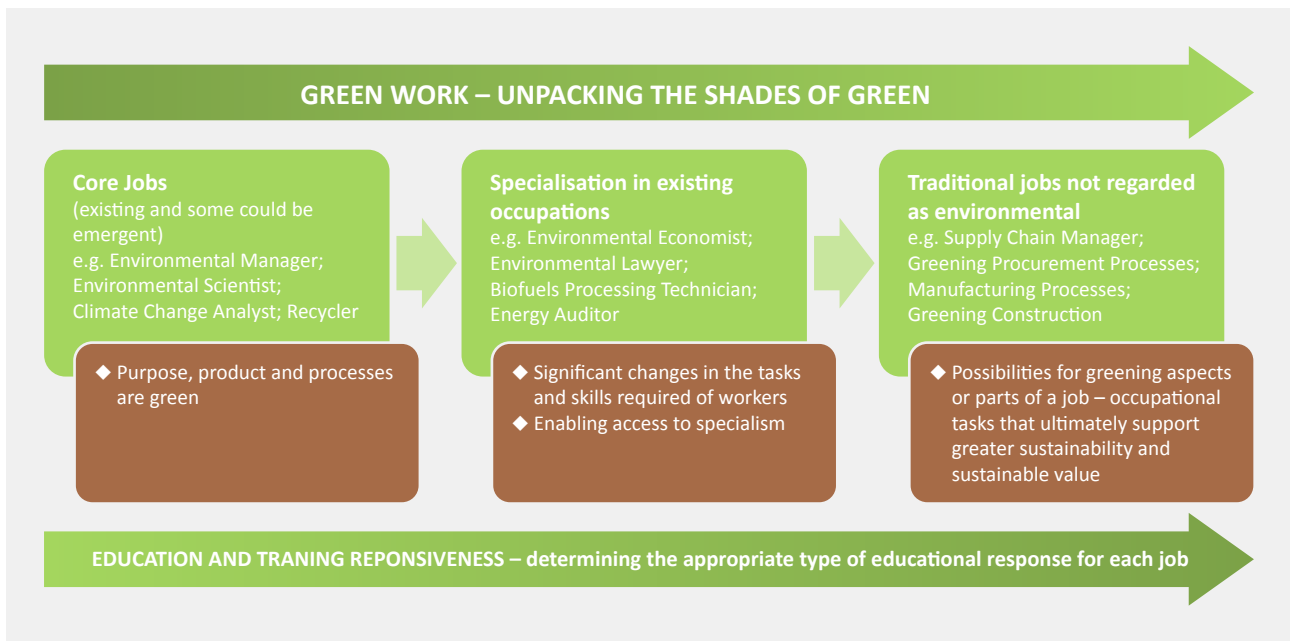
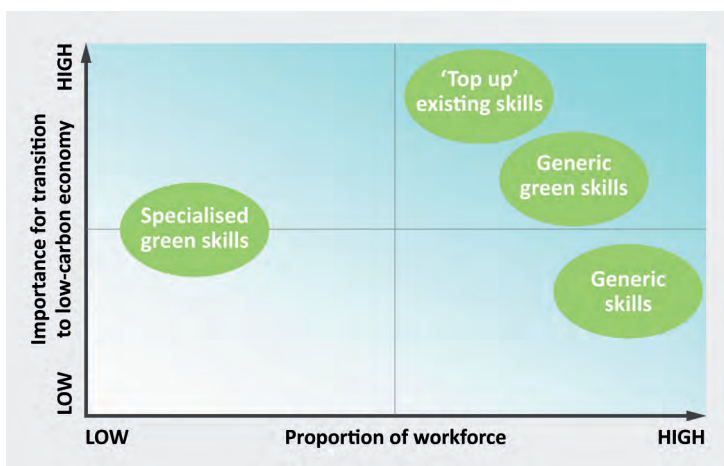


Figure 7: South African framework to analyse Green Work (GreenSkills Project, 2015)

Skills development plays a crucial role in seizing opportunities and unlocking the potential of green jobs. The need for skills to support transition to a green economy in developing countries is an important enabling factor. **Some generally used definitions of green skills include:**

- ◆ Green skills are the abilities, values and attitudes people need to build and support a sustainable and resource-efficient society (Cedefop, 2012).
- ◆ Green skills are the technical skills, knowledge, values and attitudes needed in the workforce to develop and support sustainable social, economic and environmental outcomes in business, industry and the community (Australian Green Skills Agreement, 2009).
- ◆ Green skills can be defined as the skills needed by the workforce, in all sectors and at all levels, in order to help the adaptation of the products, services and processes to the changes due to climate change and to environmental requirements and regulations (OECD/Cedefop, 2014).

Other recent studies (Cedefop, 2010; Strietska-Illina, 2011) have argued that existing skill shortages in STEM skills (science, technology, engineering, and mathematics) could be aggravated in the



move towards a greener economy. There will be a greater reliance on the technical skills possessed by engineers, to support the transition to a low-carbon economy, as green innovation is largely technology-driven. In addition to technical skills, more generic skills like resilience, cognitive adaptability and problem-solving have also been identified as important in the green economy (Consoli et al., 2015; Strietska-Illina, 2011).

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Building the Case for Green Skills Development

The agenda of finding safe and just pathways of development (Raworth, 2012, 2017) is gaining international attention at the macro-governance level. This occurs in the context of planetary boundaries (Rockström et al., 2009; Steffen et al., 2015), the transgression of which may threaten biophysical systems on planet Earth, and human development imperatives associated with poverty eradication and equity. International agreements and national strategies and legislation articulate and commit to this agenda of sustainable development. In working with employers, it is often necessary to bring this macro-governance perspective down to the level of individual businesses. This resource is designed to support this process of making the case for business engagement with sustainable development and it shares the implications for skills planning at a business and sectoral level.

For government, civil society and business, key questions regarding the purpose of business and the ability of capitalism to contribute to safe and just pathways of development are increasingly coming to the fore. The King IV Report on corporate governance makes it clear that governing bodies, both government and corporate, are required to oversee the process of value creation within their organisations. Here, value creation is defined as the process that “results in increases, decreases or transformations of the capitals caused by the organisation’s business activities and outputs”. The capitals referred to are financial, manufactured, intellectual, human, social and natural capital. Significantly, it is the governing bodies that should “appreciate that an organisation’s ... risks and opportunities ... performance and sustainable development are all inseparable elements of the value creation process”. (IoDSA, 2016)

This shift of focus from the maximisation of shareholder profit to the creation of value across a wide range of stakeholders, including social and environmental value, requires a fundamental rethink of the way that businesses operate. Emerging concepts and practices include corporate social responsibility (Elkington, 1994), the creation of sustainable value (Hart & Milstein, 2003; Senge, 2008), the creation of shared value (Porter & Kramer, 2011) and business models for sustainability (Vertigans, Idowu & Schmidpeter, 2015). The long-term perspectives and significant innovation required by these new approaches to value creation in business require new approaches to skills planning. More specifically, the identification and development of skills will require both assessments of near term skills requirement and the anticipation of strategically informed skills needs.



It is critical that skills processes embody important shifts from a position which pits development and environment against each other, to a position where they are considered together – thus giving effect to the notion of ‘deep’ sustainable development. This is echoed in Principle 4 of the King IV Report on Corporate Governance for South Africa (IoDSA, 2016) which requires that governing bodies *create value across the environmental, social and economic spheres* and across the six capitals mentioned in the Integrated Reporting Framework (IoDSA, 2016). The figure below depicts the six capitals and the flow of value creation.

Green Economy benefits to business include:

- ◆ More resilient supply chains
- ◆ New investment opportunities
- ◆ Increased consumer demand for sustainable goods and services
- ◆ Sales growth and duration of sales
- ◆ Training and job creation
- ◆ Reduced dependency on natural resources
- ◆ Mitigation against the negative financial risk from environmental impact

(UNEP, 2011)

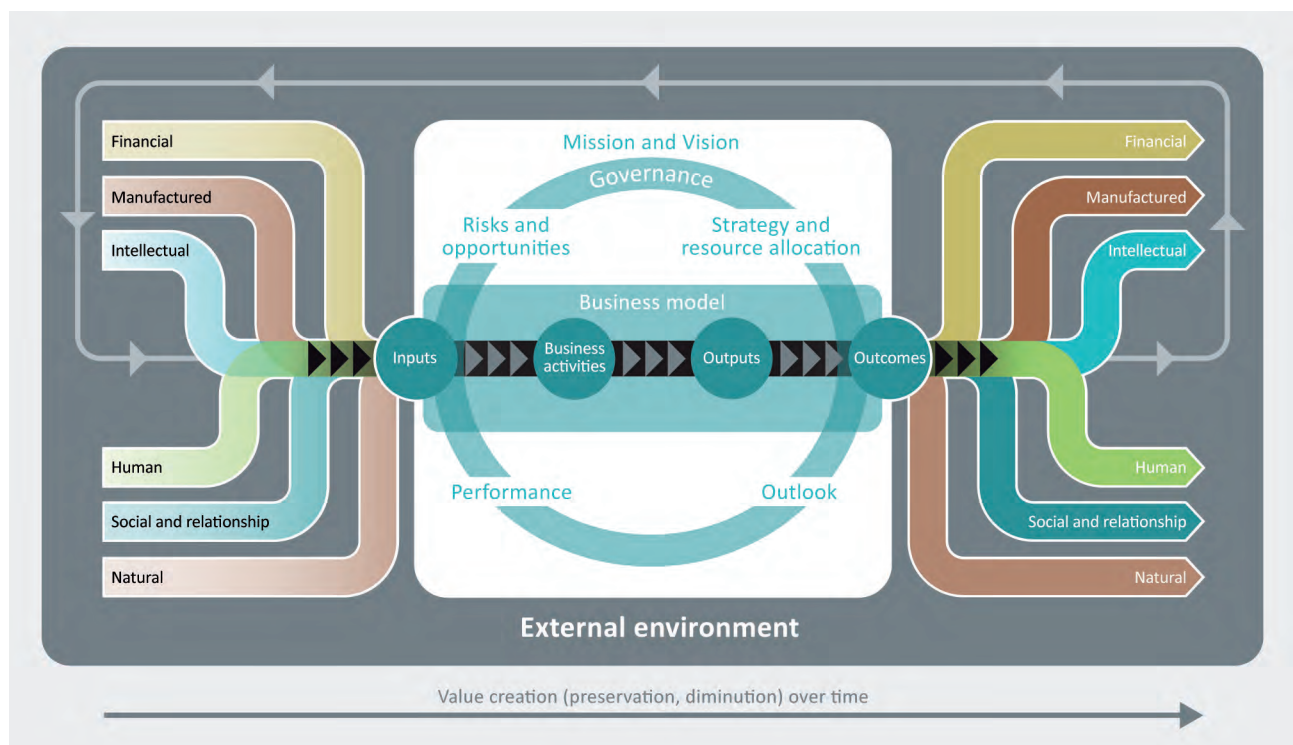


Figure 1: Six forms of capital in the Integrated Reporting Framework and the flow of value creation across the environmental, social and economic spheres (IoDSA, 2016)

In 2013 the European Foundation published a report entitled “Greening of Industries in the EU: Anticipating and managing the effects on quantity and quality of jobs”. This report was based on 48 case studies of companies that were engaged in some form of green or sustainability transition. These case studies provide insights into the drivers for the sustainability transitions, the impact on jobs and the implications and approaches to skills development within these companies. The following insights are derived from one case study from this research process.

Tesco PLC is an UK based retailer that operates around 5 600 stores in 13 countries and employs approximately 500 000 people worldwide. With its global footprint, Tesco is a significant emitter of carbon dioxide. Recognising the impact of these emissions on global climate change, Tesco implemented a climate change strategy to curb carbon dioxide emissions from its business, ultimately aiming to become a zero-carbon business by 2050.

The corporate responsibility agenda, driven by the Board, committed the company to actively addressing climate change and to pursuing sustainable profits in the long term.

High awareness of climate change among the UK public put pressure on the company while simultaneously enabling Tesco to make a value proposition to its customers.

The company recognised the risks that climate change had for its supply chains, customers' lives and on the operation of their stores.

A carbon reduction strategy reduced costs and business risks through lower energy use and thus higher resource efficiency in preparation for a carbon-constrained future.

The case study lists the following as drivers and motivations for this sustainability transition:

- Overall, Tesco saw an opportunity to position itself as a leading business in terms of the climate change agenda while simultaneously implementing desirable changes in its business operations.
- An evaluation of the Tesco value chain revealed three major sources of greenhouse gas emissions within the business: energy consumption in buildings; energy consumption in the distribution of goods; and fugitive emissions of refrigeration gases.
- A wide range of responses were implemented including energy efficiency measures; renewable energy generation; the reduction of hydrofluorocarbon (HFC) refrigerant gas emissions; and the implementation of performance management tools to incentivise energy efficient operations. In the distribution sector, Tesco sought to optimise truck loads; minimise mileage travelled and maximise fuel efficiency through driver training and monitoring and through technical vehicle enhancements.

The case study recognises that green skills are significantly different among different groups of employees. New green jobs included a team of climate change experts and policy advisors as well as environmental specialists that were recruited to the property and distribution teams to support them on function specific carbon reduction measures. All jobs within the property team were transformed by upskilling employees to achieve carbon reductions. Truck drivers were trained in fuel efficient driving skills and shop and warehouse workers were educated on the links between their daily tasks and the ongoing monitoring of the carbon footprint linked to their work. By 2010 Tesco UK had reduced its absolute emissions by 5% while simultaneously growing the business by 7%. A press release issued in December 2011 said that green business practices implemented since 2006 had yielded estimated savings of £200 million in global energy costs in 2010.

Building the Business Case with Employers

There are many ways in which companies think about creating value. Most importantly, strategies and business models need to account for the current state of a business and how it will be in the future. A simple but powerful model for thinking through this process is a matrix that is divided along two axes. The vertical axis runs from the present to the future while the horizontal focuses on stakeholders internal and external to the organisation. The resulting quadrants represent the four areas of risk reduction, reputation, innovation and growth that a company needs to consider for the creation of value.

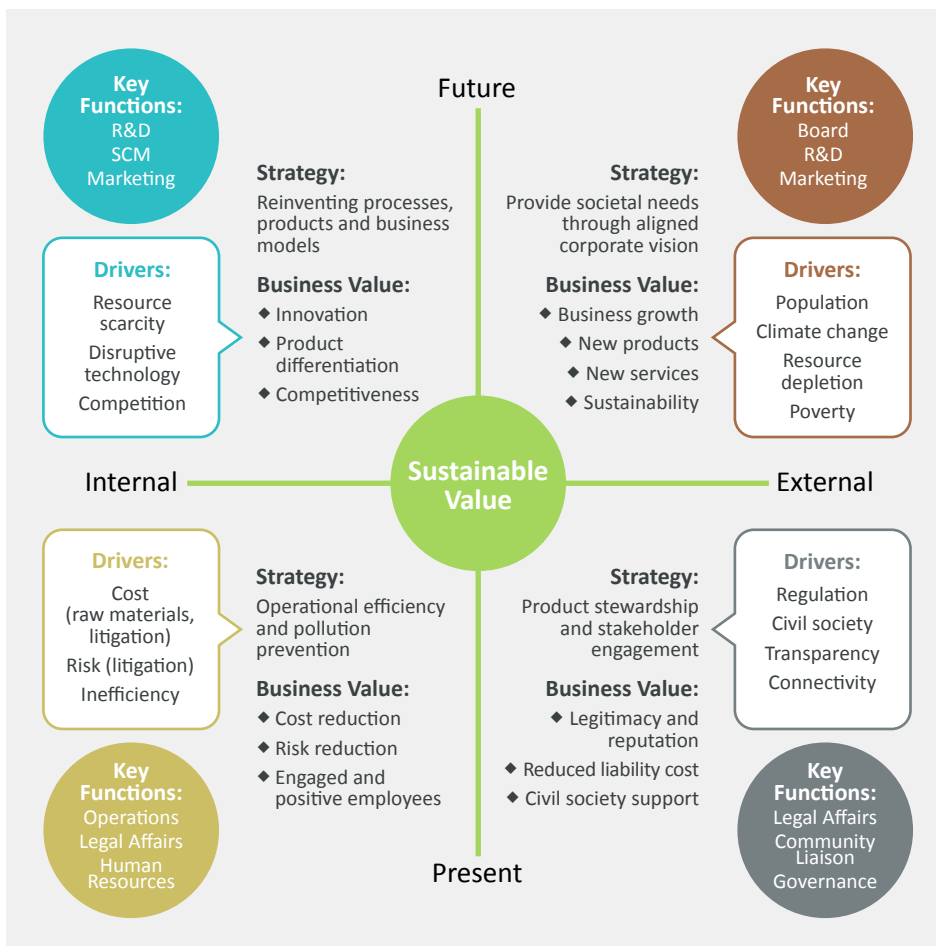


Figure 2: Sustainable value framework
(Source: Adapted from Senge et al., 2008)

In the lower left quadrant, internally and in the present and near future, managing costs and reducing exposure to risk are important considerations for enhancing value. In the lower right quadrant, also focused on the near term but turning attention to external stakeholders, reputation with a range of stakeholders is important for reducing cost of capital, a licence to operate and increasing the value ascribed to an organisation and its products or services. The upper left quadrant, an internal focus on the future, highlights the importance of innovation to maintain a competitive advantage in a changing world. The upper right quadrant, with an external and future orientated focus, requires businesses to develop new products and services that address market needs. Taken together, these four quadrants are one way of representing and thinking through how a company can create value for its shareholders. However, as has been noted above, environmental, social and economic conditions are demanding that businesses do more than focus narrowly on maximising profit for shareholders. What then would this value creation matrix look like if one brought a sustainability focus to the four quadrants?

In the lower left quadrant, drivers such as increasing levels of pollution, unsustainable levels of material consumption and waste (including inefficient use of resources) are leading to increased legislation on pollution prevention and new opportunities related to resource efficiency. By engaging employees in processes such as LEAN production or circular economies, companies can reduce risks and costs while at the same time enhancing employee commitment. In the lower right quadrant, drivers include radical transparency and connectivity driven in part by social media and the Internet. This has resulted in greater scrutiny of business operations across global supply chains.

By integrating stakeholder views into business processes, companies can enhance their reputation and legitimacy and thus differentiate themselves in the market place. In the upper left quadrant with its focus on internal processes into the future, businesses are needing to respond to and drive new disruptive clean technologies and new ways of doing business that develop the sustainable competencies and thus competitive advantages of the future. And finally, the upper right quadrant, with its focus on external stakeholders and influences into the future, is being driven by issues such as climate change, resource depletion, poverty and inequality. Here, leading companies are developing sustainable growth paths that respond to environmental and social needs through new products and services and ways of doing business.

Using these frameworks, it becomes possible to work through a process with employers to identify firstly what sustainable or shared value creation may entail and based on this, what skills may be required in the future. A six-step process is mapped out below that could support this engagement with employers.

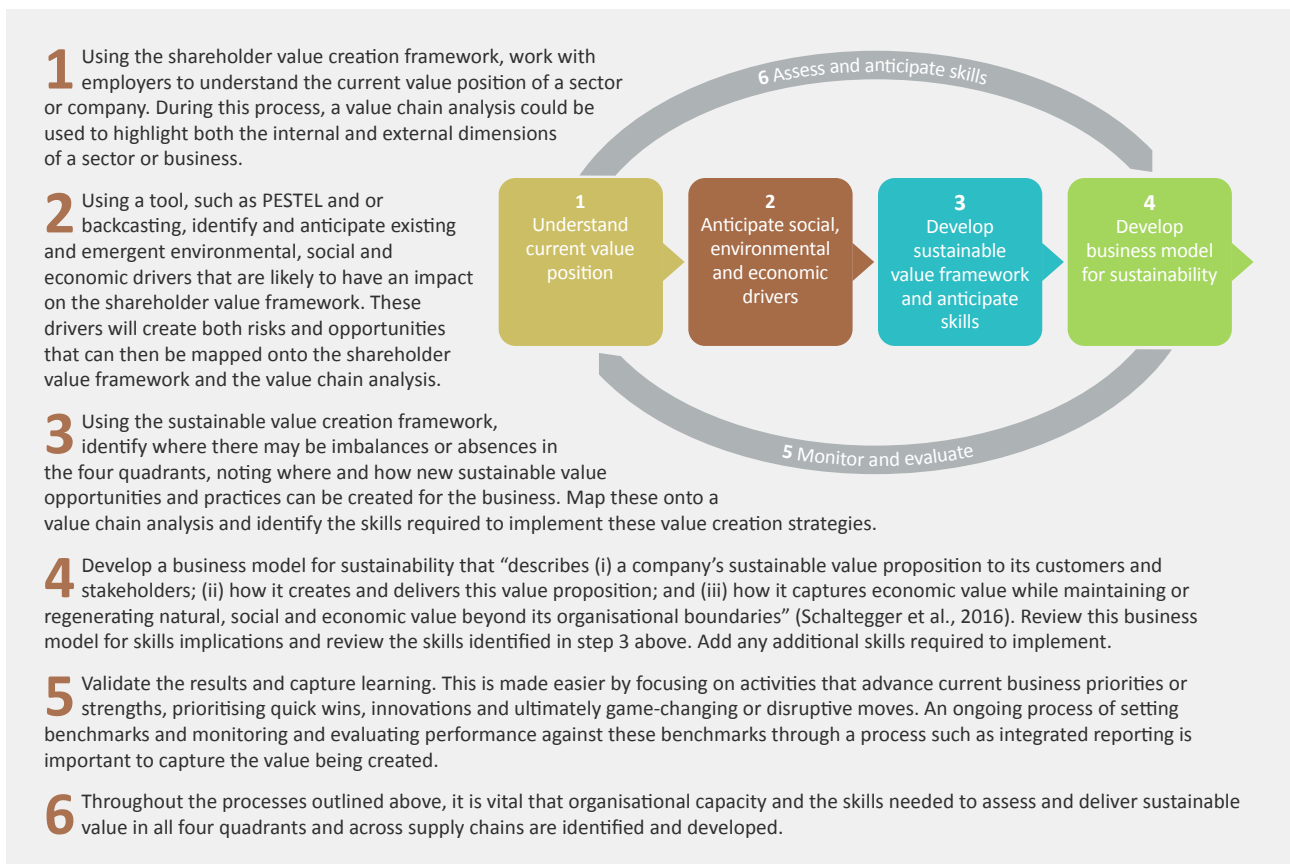


Figure 3: A six-step process for engaging with employers

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Identifying Change Drivers

Under the broad heading of “Key Skills Issues”, an important consideration is Change Drivers. One of the guiding questions that can help to focus this area of study is: “What are the major factors impacting on skills demand and supply in the sector?” A commonly used resource for analysing external factors that may influence either a sector or a particular organisation is PESTEL analysis. PESTEL stands for Political, Economic, Social, Technological, Environmental and Legal; another category significant to environmental work is historical. In most instances, a particular SETA or organisation within a sector would already have worked through some kind of process that identifies major external factors impacting on skills demand and supply relevant to their area of operations. The general format and use of the PESTEL analysis tool will therefore not be discussed in this resource. Rather, a more focused use of the tool will be shared that can be used to inform and structure a consideration of environmental factors in greater detail.

Before describing the kinds of questions that could be considered, it is useful to consider how the PESTEL analysis could be done. There are various options: an individual with environmental expertise, or the time to conduct research into the environmental dimensions of each factor, could do an analysis. Alternatively, the PESTEL analysis could be conducted as a workshop process with key considerations or influences for each factor brainstormed and then considered in terms of significance for the particular sector or organisation. These insights could be fed into a SWOT analysis where these external considerations could be used to populate the ‘opportunities’ and ‘threats’ components of the analysis.

What would an environmentally focused PESTEL analysis consider? Firstly, it would consider each of the factors from an environmental or sustainable development perspective. This would result in a more detailed analysis of the factors. For example, the Political factor would explore the implications of international agreements such as the Sustainable Development Goals and the Paris Climate Agreement for a particular sector or organisation. The Economic factor may have a more explicit focus on the Green Economy and the potential to grow this economy within the sector under consideration. The Social factor may consider the impacts of rapid urbanisation on environmental resources such as water. Technological developments such as renewable energy may be considered for their implications on a particular sector or organisation. The Environmental factor could be



considered in more detail than in a more generic PESTEL analysis. Finally, the analysis of the Legal factor could focus specifically on environmental legislation and its implications for the sector or organisation under consideration. (See more specific questions that could be considered at the end of this resource.)

Once an environmentally focused PESTEL analysis has been conducted, it could be considered alongside the more general PESTEL done in the Sector Skills Plans. This would provide a useful way of highlighting absences in a particular SSP (e.g. the omission of climate change agreements and their implications). It would also be important to consider the relative importance and influence of the change drivers and their implications for skills planning identified in the generic PESTEL analysis and the environmentally focused PESTEL (see Box 1).

Conducting an Environmentally Focused PESTEL Analysis

Although a PESTEL analysis can be done through a brainstorming process, it is extremely unlikely that this would provide the depth of insight needed to inform a green skills study. It is therefore strongly suggested that one or two competent researchers with an understanding of sustainable development and more specifically, the environmental field, are given the task of analysing the key drivers. It must also be noted that since it is likely that the Sector Skills Plan and organisational strategic processes would have conducted a more generic analysis of change drivers, this resource focuses on enhancing the insights into the drivers and barriers specifically related to the environment and thus green skills.

The following diagram is an example of how the contextual drivers can be clustered and represented. This diagram also highlights the emergent nature of many of the change drivers. This supports a focus on both new developments and trends in the different sectors.

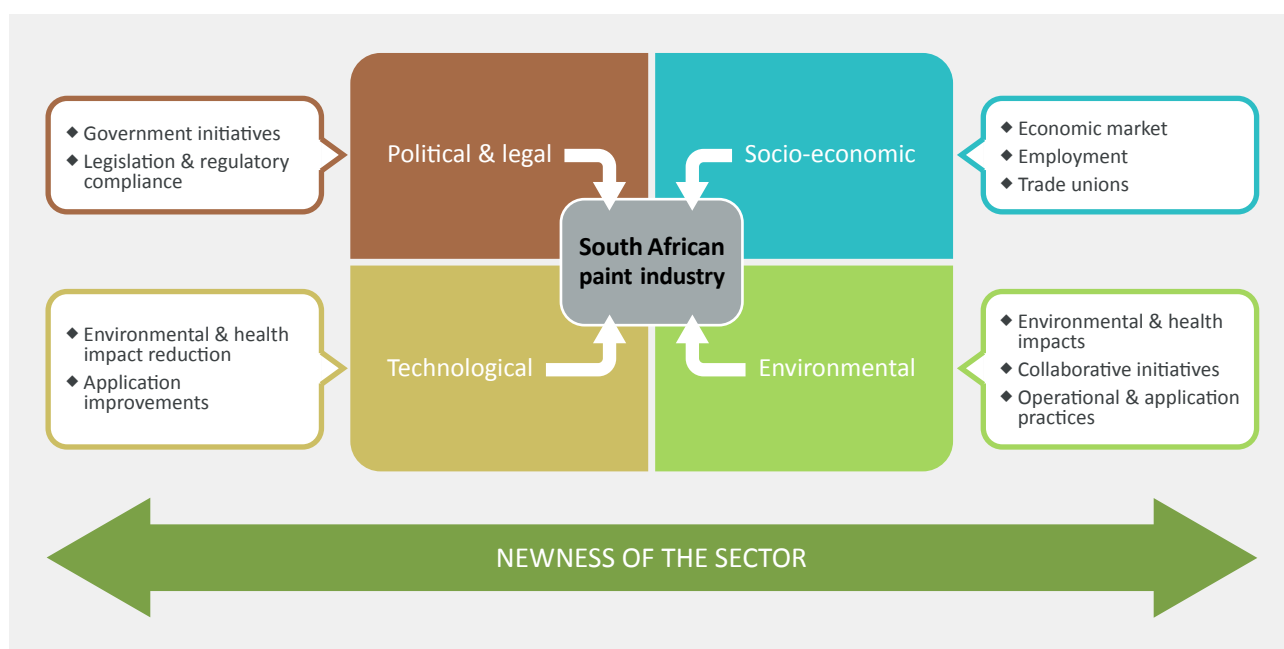


Figure 1: Key contextual drivers for the SA paint industry (Source: CHIETA – GreenSkills, 2016, p.18)

Box 1

Examples of Change Driver Identification

It must be noted that the identification of change drivers and their implications for skills demand and supply can be achieved and reported in many ways. The PESTEL analysis highlights the key areas to consider but these may be examined to a greater or lesser degree and or combined in different ways to enhance their relevance to the sector or organisation under consideration.

The Environmental Sector Skills Plan (DEA, 2010) took a strong national focus to the identification of drivers of skills demand and supply in the environmental sector. The plan highlighted: political drivers (including the Medium Term Strategic Framework and the National Environmental Management Act); macro-economic drivers (including the Green Economy Accord and the Industrial Policy Action Plan); macro-ecological drivers (including key responses to environmental degradation such as the South African 10 Year Innovation Plan and the Global Change National Research Plan); skills system drivers (including national studies on the quality of education in South Africa) and new science and technology drivers (including the implications of global trends such as sustainability, biomimicry, renewable energy on South Africa's research agenda). Given the scope of this study (the entire environmental sector), the authors used a very focused approach that foregrounded national drivers of change.

In a study entitled *Green Skills for the Mining Sector* (Rosenberg et al., 2015), a contextual analysis was conducted in a way "somewhat similar to the environmental scans or PESTEL analyses that are used in strategic and business planning to assess market growth or decline, and opportunities for organisational positioning" (ibid., 21). This resulted in the following structure: socio-economic considerations in a historical context; technological drivers in the coal industry; policy and legal context of mining and coal mining in South Africa; and environmental considerations in mining and coal mining in South Africa. This study combined broader contextual factors (e.g. the history of mining in South Africa and the global issue of climate change) with more specific drivers such as the relevant environmental and skills planning legislation in South Africa. This approach enabled useful integrations such as 'worker health and the environment' (i.e. social and environmental considerations) as well as comparisons across scales such as the levels of CO₂ emissions per value of GDP produced at the global level and at a South African level. These integrations across factors and comparisons showed the importance of working across the PESTEL framework to develop insights, trends and discrepancies.

In the CHIETA-funded study on the paint sector, a contextual profile was used to "better understand the political, socio-economic, environmental, technological and economic landscape within which the SA paint industry operates and the drivers influencing the demand for green skills..." (Jenkin et al., 2016). Here global studies on the paint industry were used to identify areas that had not yet received substantial consideration in the South African context. A similar approach was used in an occupationally directed study into the skills requirements for supporting green supply chain management in the public sector in South Africa (Ward et al., 2016). In this review, two separate studies were initially conducted that examined the global 'Drivers, Barriers and Enablers' of green SCM and, in a separate study, the national drivers of green SCM that considered national legislation as well as the institutional structures that were responsible for public procurement. Again, the juxtaposition of global and local drivers revealed instances where South Africa has been particularly innovative (e.g. the provision within the Constitution of categories of preference in the allocation of contracts) and areas where South Africa could learn from international practices.

Within the broad framing of change drivers and using a PESTEL analysis framework, the following questions could help to identify key factors for consideration in a green skills study.

POLITICAL

- ◆ What are the international sustainable development commitments (e.g. Sustainable Development Goals) and their implications?
- ◆ What are the international environmental commitments (e.g. Paris Climate Agreement) and their implications?
- ◆ What are the regional agreements (e.g. SADC Regional Indicative Strategic Development Plan) and their implications?
- ◆ What are the national planning frameworks (e.g. the National Development Plan) and their implications?
- ◆ What are the key political statements (e.g. State of the Nation Address) saying about the environment?

ECONOMIC

- ◆ What is the current situation with regard to the green economy in markets relevant to the sector or organisation under consideration?
- ◆ What resources are available or likely to become available for further development of the green economy?
- ◆ What environmental considerations or social movements may have a significant impact on a particular sector?

SOCIAL

- ◆ What are the demographic and migration trends that may have a significant impact on the sector or organisation (e.g. increased demand for water in urban areas due to population increase and urbanisation)?
- ◆ What is the expected direction of social change?

TECHNOLOGICAL

- ◆ What new disruptive technologies may support a decoupling of economic growth from environmental degradation in the sector under consideration?
- ◆ What technologies are available for restoring ecosystem services that may have economic and/or social value in the sector under consideration?

ENVIRONMENTAL

- ◆ What are the contextually relevant environmental issues: global (e.g. climate change, biodiversity loss); regional (e.g. water shortages, flooding); or local (e.g. pollution of water supplies)?
- ◆ What are the trends or expected future impacts of environmental change (e.g. water shortages, food insecurity)?

LEGAL

- ◆ What existing legislation (e.g. Constitution, environmental legislation, or sector specific legislation with environmental implications) may be relevant?
- ◆ Which pending or future legislation may have significant environmental implications?
- ◆ Is there any potential legislation that could change the sector or context within which an organisation operates (e.g. clauses related to green public procurement)?
- ◆ What new standards or guidelines (e.g. King IV) have emerged and what implications do they currently have or will they have for the sector or organisation under consideration?
- ◆ Which legislation and frameworks have implications for education and skills development (e.g. the National Skills Development Strategy; the White Paper on Education and Training; the Organising Framework for Occupations? Approach these documents with a particular focus on what they say about green skills or emerging fields requiring new educational responses.

Policy Documents linked to Green Economy

Below are some policy documents linked to green economy processes that could assist in identifying leverage points within your sector.

- ◆ Industrial Policy Action Plan
- ◆ National Development Plan Vision 2030
- ◆ New Growth Path, Green Economy Accord & Green Jobs Report
- ◆ Environment Fiscal Instruments (e.g. carbon tax, green fund)
- ◆ 10-Year Innovation and Global Research Plan
- ◆ National Water Resource Strategy
- ◆ Agriculture and Rural Development
- ◆ 2009 South African Framework for Responding to Economic Crisis
- ◆ National Green Economy Summit and Programmes Report
- ◆ Integrated Resources Plan and Integrated Energy Plan
- ◆ National Climate Change Response Policy
- ◆ National Strategy for Sustainable Development and Action Plan

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Value Chain Analysis

Having selected a particular focus for the study, it is useful to consider the full range of activities that are required from conception to end of use for the sub-sector, commodity, product or service under consideration. Value chain analysis is one way of doing this and provides a number of tools with which to understand the processes, the different actors and the multiple relationships within a given value chain. This supports a consideration of environmental impacts across the full life cycle of the product or service as well as a comprehensive framework for identifying the different occupations within or related to a specific value chain (ILO 2014a, 2014b).

The first step in the value chain mapping process is the creation of a basic flow chart identifying the core transactions from conception to end of use of the product or service under consideration. This mapping was sometimes referred to as 'cradle to grave'; however, the development of concepts such as the circular economy terms like 'cradle to cradle' highlight the importance of reuse and recycling. Key to this process is defining system boundaries and grouping related activities under collective headings within the value chain. In the example on cars developed to inform a PSETA study on public procurement, a number of mining, processing and recycling activities are grouped under the heading of 'raw materials'. However, in order to inform discussion it was important to show that there was a choice between mining and recycling as they have very different environmental impacts and thus potential for green occupations, jobs and skills. How the system boundaries are defined and the core transactions labelled are important considerations and need to be determined by the detail required and the intended use of the value chain analysis. We can use an expanded notion of value chains, similar to the value webs that are identified to explain and explore new development and environmental mitigation opportunities through 'circular economies' (as, for example, promoted by the Ellen MacArthur Foundation; see also Figure 1 below).

Value chains are commonly used to present the activities a sector or industry undertakes to convert inputs to outputs and profits. Graphically, they are often presented in a linear fashion. In practice, we found that industrial systems operate more like interconnected value webs (think of the links between Eskom, Sasol and the coal industry). This allows us to look, in addition to the core business, at interdependent and enabling segments and interactions. An example would be regulatory functions, which are governed inter alia by the Water, Energy, Health and cross-cutting Environmental sectors



or the R&D innovation sector, with its strong links to Science and Technology, higher education and investment sectors.

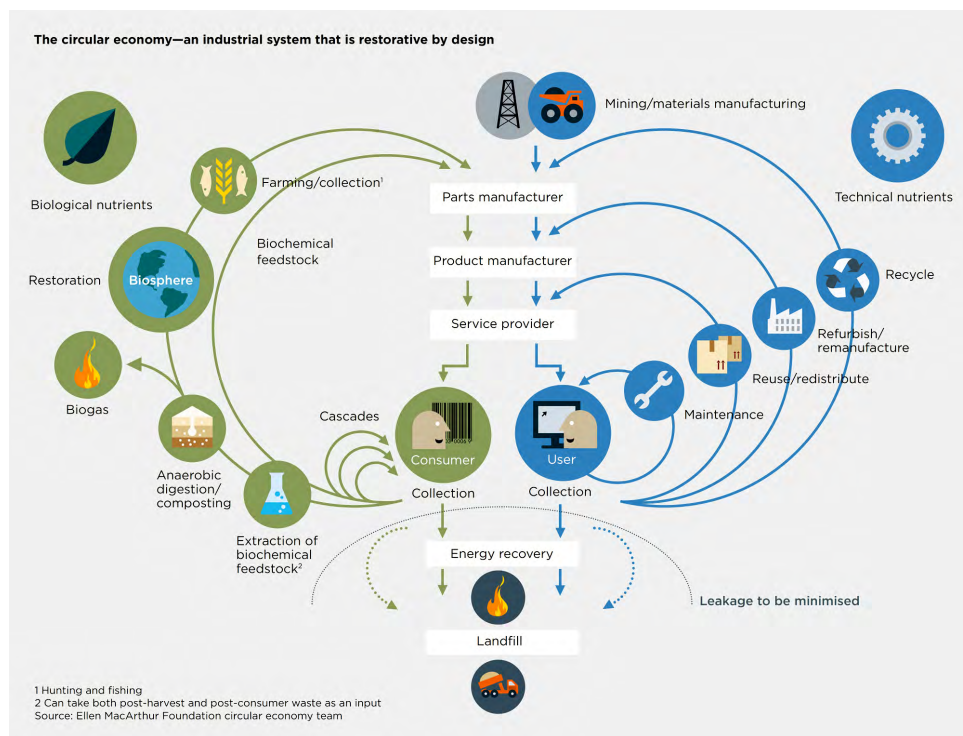


Figure 1: Circular economies (Ellen MacArthur Foundation, 2013)

Box 1

Examples of Value Chain Analysis

Given the ability of value chains to map complex processes in relatively simple graphics, they are useful for supporting the development of shared understandings, creating a focus for discussion and revealing contradictions or tensions that require change. They also provide a useful model around which to structure the consideration of processes, actors, occupations and relationships. Based on these attributes, value chain analysis has proved a useful tool within a number of occupationally focused green skills studies.

As depicted in the example from coal mining in Figure 2, to understand the green skills needs in the value chain it is important to look at the expanded view of the value chain. Key aspects to overlay when examining the value chain are regulation, innovation and risk. With this more expanded view of the value chain, it is then easier to identify the green skills.

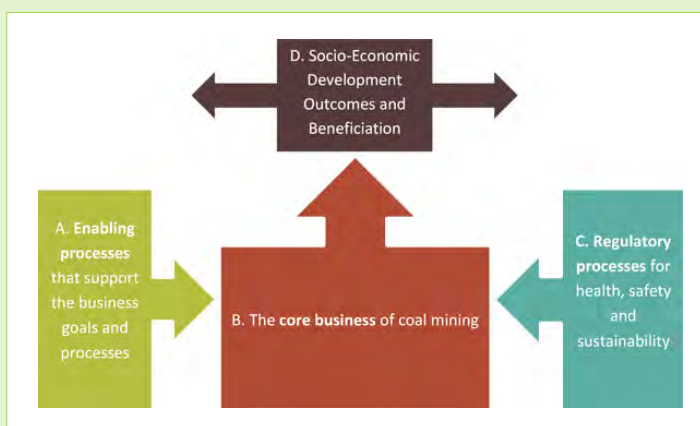


Figure 2: Value chain analysis of coal mining example (Rosenberg et al., 2015)

Conducting an EXPANDED Value Chain Analysis

The first part of a value chain analysis involved the identification of all of the process stages required for the production or provision of a good or service. In many instances, these process chains are already contained in industry literature or can be quickly developed with some knowledge of the goods or services. The following example is taken from a Green Skills study (Ward et al., 2017) for CHIETA on the petroleum sector.

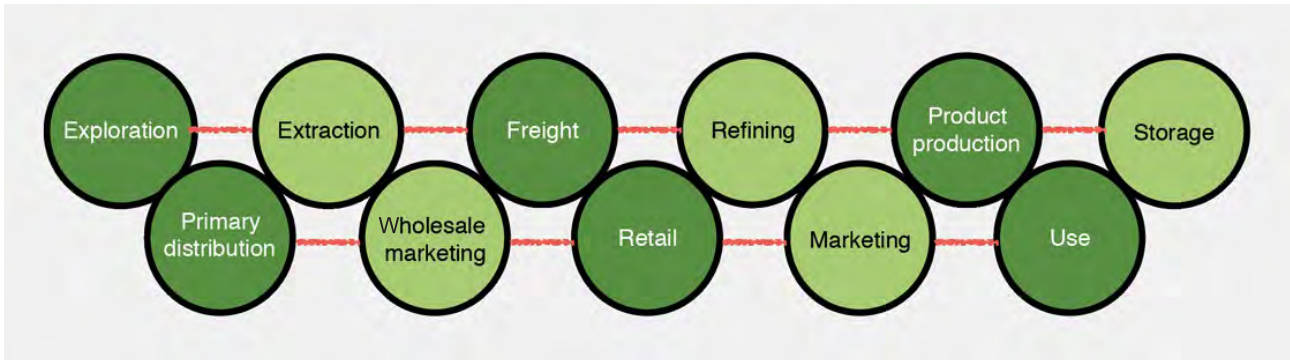


Figure 3: An expanded value chain analysis example from the petroleum sector (Ward et al., 2017)

In some instances, it may be necessary to disaggregate process stages due to significant differences (e.g. virgin material or recycled materials in the PSETA study). In the petroleum sector in South Africa, it is useful to distinguish between coal and crude oil for a number of reasons. Alternatively, where multiple steps are normally undertaken by a single actor it may be useful to group process stages into a single unit. This process is usually informed by some background research into the sector and the specific industry, good or service. In many instances, only a small part of the value chain will fall into a particular sector. Thus, for example, in the case of the broader petroleum sector, the MQA would serve the industries involved in the extraction, the TETA would serve the transport sector and the MICT SETA would service the marketing sector. The value chain thus provides a useful way to represent the processes within a value chain on which a particular study will focus while at the same time identifying upstream and downstream actors and relationships.

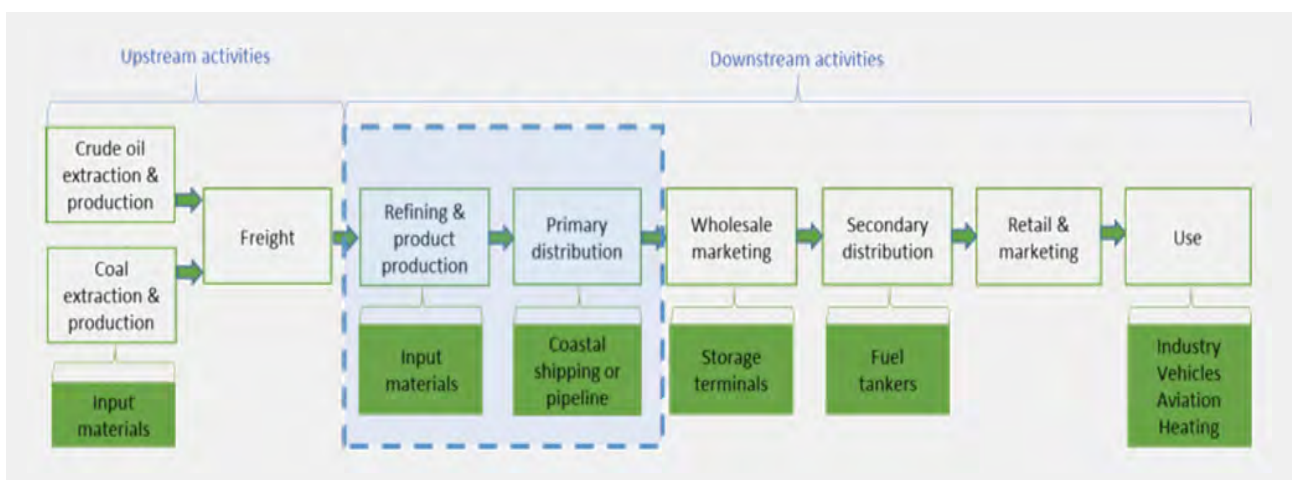


Figure 4: The South African petroleum value chain (Source: Ward et al., 2017)

It may be useful at this point to do some quantitative analysis on the different component processes to identify material aspect of the value chain. Thus, for example in South Africa, 72% of the input into refineries comes from imported crude oil and 28% from coal and natural gas which is predominantly locally produced. With a refining capacity of 250 million barrels per year, South Africa is the second largest refining country in Africa. This kind of quantitative analysis is useful for recognising the significance of a particular sector and sub-components of the sector as well as identifying important or material areas of focus within a value chain.

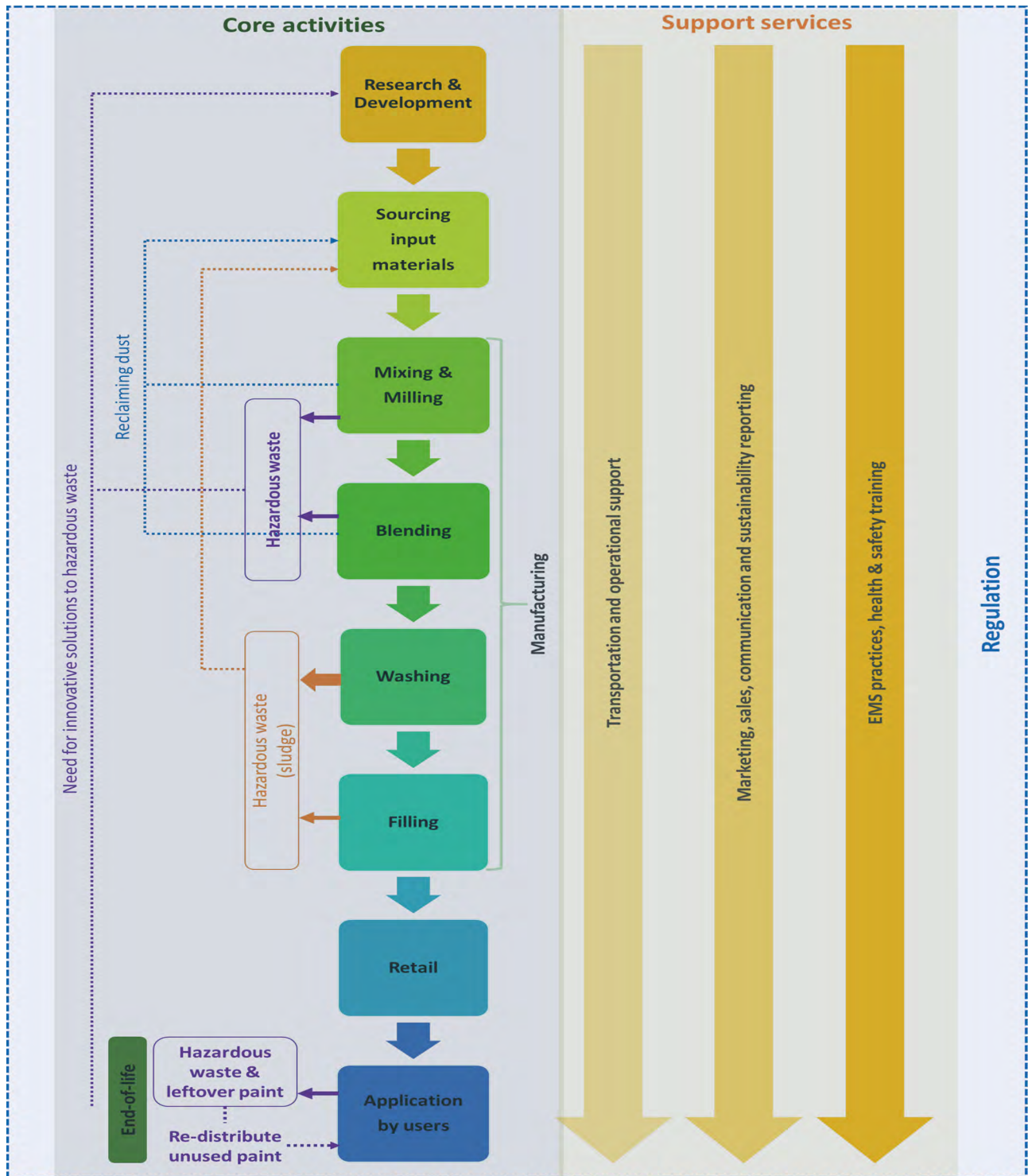


Figure 5: The expanded value chain developed for the paint sector in South Africa (Jenkin et al., 2016)

Given the focus of this source book on green skills, it is also important to map out the actors involved in a particular sector. The value chain provides a useful tool for identifying the actors directly and indirectly involved in the value chain and their position within and across the process stages. This mapping helps to identify particular occupations, jobs and skill sets that may be required for the production and provision of a good or service.

This becomes particularly significant as some actors are identified as operating within a process or series of processes that have a substantial environmental impact or have the potential to reduce the environmental impact through new processes. One way of refining the actor map for green skills studies is to produce a narrow mapping of actors with environmental significance and subjecting this list to further analysis in terms of green skills. This process can be informed by environmental hotspotting (see resource on hotspotting in this source book). The following diagram gives an example of high level actor mapping that was conducted for the petroleum industry study (Ward et al., 2017).

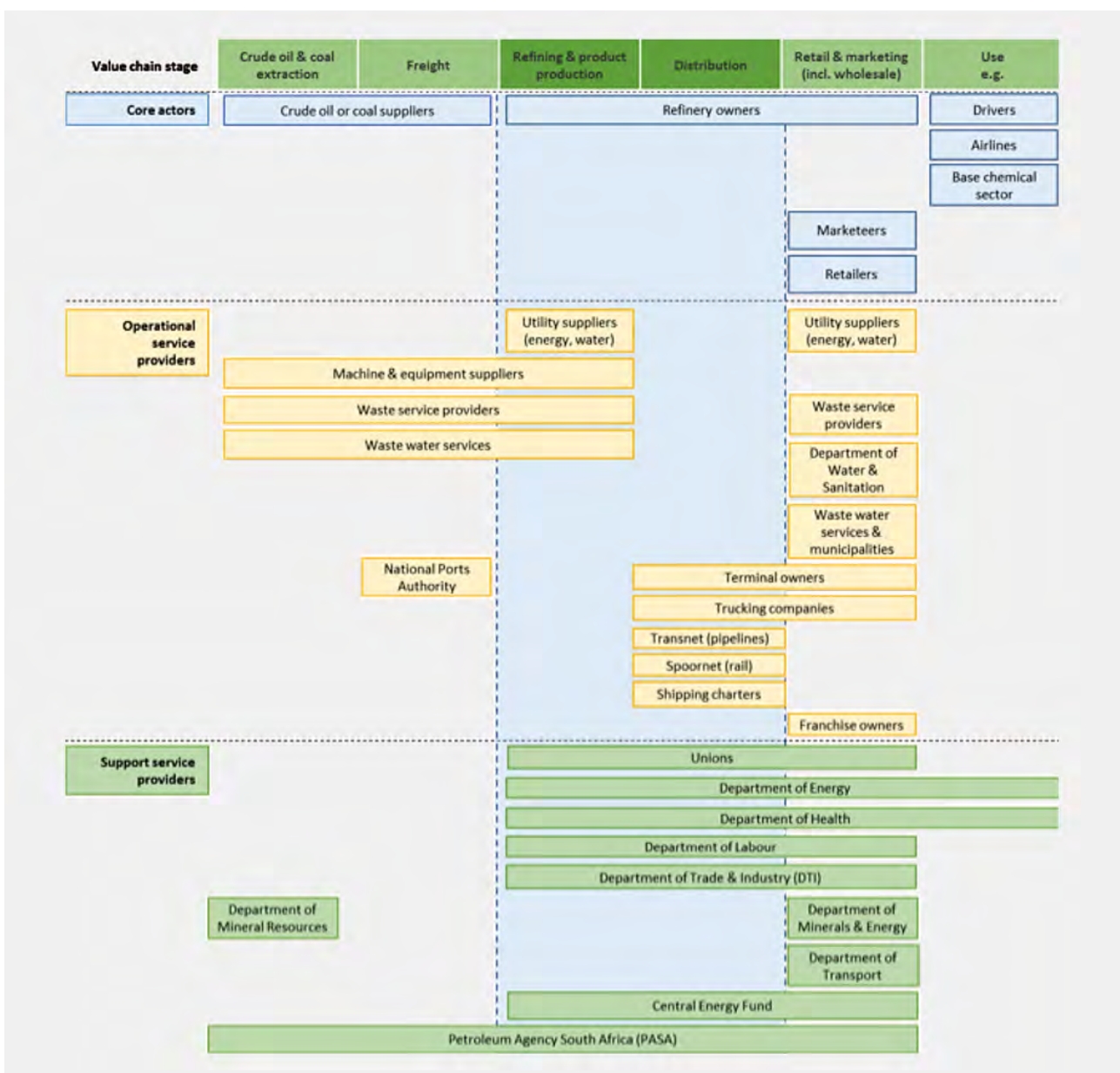


Figure 6: High level actor mapping conducted for the petroleum industry study (Ward et al., 2017)

It must be stressed that from a green economy development perspective, value chain mapping needs to be informed by other tools such as LCA, LEAN and circular economy in order to identify environmental impacts across extended value chains as well as possibilities for waste reduction within the value chain and through closing biological and material loops.

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- These and other relevant reports are available on Green Skills website (Live Projects tab): www.greenskills.co.za



Sector/Product/Service Analysis and Prioritisation

Sectors (and even an organisation) may encompass an extremely wide range of products and services. This in turn would have implications for the diversity of occupations and skills considerations that need to be covered within a green skills study. In developing insights into green skills, it is often useful to conduct more detailed case studies on particular items or sites of activity in order to develop more detailed and grounded findings. These findings need not be representative of an entire sector. It is more important that they provide information that reflects the actual processes, tasks and skills as they play out in specific contexts. These insights can then be reviewed in the light of the more general high-level studies (international and national level) for trends, discrepancies, contradictions or silences.

To narrow the scope of a study, it may thus be necessary to focus on a specific sub-sector, product, service or organisational function. However, this often requires some form of justification to ensure the relevance of the selection and thus the significance of the study. In some instances, the person requesting the study may provide enough focus so that no further refinement of focus or justification is required. When this is not the case, careful dialogue with the person commissioning the study is required to ensure that all parties agree on the focus of the study.

Broadly, the justification for focus is likely to hinge on a range of economic, social and environmental factors and the sector's or organisation's ability to adapt to these factors. It is thus a combination of external drivers and internal importance and an ability to engage with and influence the external drivers. The external drivers may well have been identified through a PESTEL or similar analysis. One approach would be to do a quick scoping of key drivers including an environmentally focused scoping as detailed in the first part of this source book (Background to Green Skills Planning). This could inform the initial selection of a sub-sector, product or service after which a more detailed analysis of the change drivers within this focus area could be conducted.

Some areas that could be considered include:

- ◆ The economic value of the sector/ product/ service to the country or organisation;
- ◆ The environmental impact across the value chain of a sector or the life cycle of a product/ service;
- ◆ The pressure from government, interest groups, customers to reduce the environmental impact;



Box 1

Examples of Sector, Product or Services Identification

As is evident from the above, the identification of sub-sectors, products or services to support focus and depth within a green skills process requires the ability to use the contextual analysis and identification of change drivers in an iterative and strategic way. This can be done in different ways and the following examples provide some insight into this process.

In 2015 the Mining Qualifications Authority (MQA) commissioned a study into the green skills needs within the mining value chain. However, it quickly became apparent that “there are significant differences in the value chains of different commodities (e.g. gold, diamonds, platinum, coal, limestone, iron ore), given the different ways in which these are mined, processed, beneficiated and used” (Rosenberg et al., 2015, p. 21). There was also different potential for greening these operations and skills. In order to allow for a more detailed and grounded assessment of green skills, coal mining was selected as the focus of the study. As the study notes: “To add value to the field, help us to clarify green skills needs, inform the MQA at a sufficiently specific level, and potentially serve as an example for future studies, the analysis would need to some extent to be applicable to mining in general, but mostly commodity-specific” (ibid., p. 21). Key considerations in selecting coal as a commodity included: the importance of coal as the primary energy source in the country; the scale of the impacts of this sub-sector on biodiversity, ecosystem services, tourism, agriculture and health; the concern over South Africa’s greenhouse gas emissions in the context of climate change and international commitments; the impact that a move out of the fossil fuel industry would have on jobs; and the emerging access to sustainability reporting by the larger coal mining companies.

The Chemical Industry Education and Training Authority (CHIETA) services nine sub-sectors namely: petroleum; base chemicals; fast moving consumer goods; explosive goods; speciality chemicals; surface coatings and glass. In seeking to develop a research methodology for occupationally directed green skills studies, it commissioned a study on the surface coating sub-sector and more specifically on one form of surface coating (of eleven), namely paint (Jenkin et al., 2016). Even a focus on the paint industry proved too broad and three sub-industries were identified for further consideration. These were decorative paints, industrial coatings for the automotive industry and industrial coatings for the marine industry. A table including economic, environmental, social, political, skills development potential and local firm representation was used to make this selection.

The Public Sector Education and Training Authority (PSETA), when commissioning a study (Ward et al., 2016) on the occupations and skills required for green supply chain management in the public sector, acknowledged that the focus on strategic commodities would help to focus and deepen the study. These commodities needed to be strategically important in terms of government procurement but also needed to give insights into different procurement processes and levels of authority required. A key consideration in terms of strategic importance was the relative size of government spend on particular goods. This resulted in an initial list of 11 categories of goods based on financial and statistical records. These goods were then weighted according to several criteria developed from a broad consideration of definitions of ‘green’, change drivers relevant to this definition and with reference to the Global Reporting Initiative (GRI) framework. The resulting matrix is included in the next section.

- ◆ The potential to reduce the environmental impact;
- ◆ The potential for the creation of green jobs or the need to support a just transition;
- ◆ The potential for technological change related to the sector, product or service;
- ◆ The ability of the sector (or organisations within the sector) to respond to change and competition.

Selecting a Focus Sub-sector, Product or Service

The following example is drawn from the PSETA study mentioned in Box 1. The identification of goods on which to focus the study needed to be both quick and defensible. It also needed to be based on the significance of the selected goods in terms of government spend. Due to the lack of detail regarding economic classification in the National Treasury and Stats SA data, it was necessary to supplement this data with more detailed data from other countries.

Based on these cross correlations, the following commodities were selected for consideration:

- ◆ Computers (specifically laptops and desktop personal computers)
- ◆ Food (this category was eliminated early on due to the huge variety and no clear categories)
- ◆ Vehicles (specifically cars used for the transport of personnel)
- ◆ Communication (mobile phones)
- ◆ Lighting (indoor)
- ◆ Stationery (specifically paper up to 170g)
- ◆ Cleaning products (all purpose cleaners)
- ◆ Furniture (this category was eliminated early on due to the variety and the difficulty of delineating a particular category)
- ◆ Apparel (uniforms and personal protective clothing)
- ◆ Paint
- ◆ Fuel (it was felt that transport fuel was a useful category but that this would be covered in the section on vehicles since the options in South Africa are still extremely limited)

The criteria for assessing the relevance of each of these commodities for this study were selected based on a broad consideration on the Political, Economic, Social, Technological, Environmental and Legal (PESTEL) factors that have an implication on the potential to 'green' a particular supply chain. Greening was understood as reducing carbon dioxide emissions; enhancing the efficiency in the use of resources; and being socially inclusive or more specifically creating jobs within South Africa. There are many issues with this definition but for the purpose of identifying commodities for focus, it was sufficient.

Within this broad definition and the PESTEL framework, several criteria were identified through reference to the international literature on Green Public Procurement. This resulted in an extremely long list of criteria that were then clustered and consolidated based on similarity. Once the clustering was complete, the list was compared to the Global Reporting Initiative (GRI) categories to provide a broad check that no key categories had been omitted.

This process resulted in 12 criteria:

Processes	Associated Green Competencies
Economic	<ul style="list-style-type: none"> ◆ Total spend by economic category (quantity of spend) ◆ Local procurement (potential to source locally) ◆ Demand and supply (the potential for government to influence the sector by its spend and the potential of the sector to increase supply based on government spend)
Environment	<ul style="list-style-type: none"> ◆ Opportunity to reduce negative environmental impact across the life cycle of the commodity ◆ Environmental impact of the commodity over its life cycle ◆ The existence of eco labels (e.g. ISO, FSC) that could inform procurement decisions
Technological	<ul style="list-style-type: none"> ◆ The realistic potential for innovation and competitive advantage in South Africa ◆ Feasibility (particularly in terms of bringing about change in a reasonable time frame)
Social	<ul style="list-style-type: none"> ◆ Job creation (potential to create new jobs) ◆ Opportunities for improving green skills (this tended to focus on short term considerations and the ability to develop skills in the near to middle future)
Political and legal	<ul style="list-style-type: none"> ◆ Existing legislation that creates enabling or compliance framework ◆ Level of risk that corruption or violence would undermine the greening component (e.g. introduction of public transport in the context of a high investment in the taxi industry)

These criteria were discussed amongst the four reviewers so that a relatively clear understanding was shared. A matrix was developed that mapped the commodities on one axis and the criteria on the other.

	Total Spend	Local Procurement	Demand and Supply	Reduced Env Impact	Environmental Impact	Eco Labels	Job Creation Potential	Green Skills Opportunities	Legislation	Risks (e.g. protest action)	Potential for Innovation	Feasibility of innovation	TOTAL
IT (laptops)	2	1	1	3	3	2	1	3	1	3	2	3	25
Food	2	3	3	3	2	3	3	1	2	2	1	3	28
Transport vehicles (cars)	3	3	3	1	3	1	2	2	2	3	2	2	27
Communications (mobile phones)	2	1	1	3	3	2	1	3	1	3	2	3	25
Lighting (internal)	2	1	2	3	3	3	1	2	1	3	2	3	26
Stationery (print paper up to 170g)	2	3	3	1	2	2	1	2	2	3	2	3	26
Cleaning products (all-purpose)	2	3	3	3	3	1	2	3	2	2	2	3	29
Furniture	Decided too much variation in category												
Apparel (uniforms)	2	1	3	2	2	3	3	2	2	3	1	1	25
Paint	2	3	3	2	2	2	3	3	2	1	2	3	28
Fuel (petrol/diesel)	Would actually be captured under cars since mainly a factor of fuel efficiency of cars												

The scoring was based on the collective experience of the four people involved in the process. The identification of commodities, criteria and scoring of the criteria was done over the period of one day.

There was one further consideration relevant to this research: to choose two commodities that would provide insight into different procurement processes. The two ends of the spectrum were commodities that tend to be high value items and require high level of authorisation at one end and low value items that are bought on an almost daily basis and require very low levels of authorisation. With this consideration in mind, the cleaning products (highest score) and cars (highest score in the high value items) were selected.

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Environmental Hotspot Analysis

This resource represents a variation of a widely used prioritisation method called ‘hotspotting’ or ‘hotspot analysis’. Hotspots are in this case not necessarily areas of trouble, but strategic leverage points in a system where most change can be affected – in this case, through attention to green skills development. Although Value Chain Analysis is useful for considering and mapping the full range of activities required from conception to end of use for a sub-sector, commodity, product or service, the proliferation of information can leave decision makers and skills analysts overwhelmed. ‘Hotspot analysis’ or ‘hotspotting’ is a method that allows for the rapid assimilation and analysis of a range of information sources including value chain analysis, life cycle based studies, expert opinion and stakeholder concerns (Barthel et al., 2014; ILO 2014a, 2014b). The criteria we have successfully used for identifying hotspots or leverage points in industry value webs or systems are: economic (physical trading volumes and/or economic value), environmental, social (including ethical) and political gains – where can these be best achieved? Where they overlap, may be a ‘hotspot’ for green skills development. This process of strategic analysis will filter and distil information to identify and prioritise among identified green skills for mining, thus “helping to provide focus in an era of information overload” (Barthel et al., 2014, p.12).

Hotspotting can thus be used to identify priority action areas related to economic, environmental, ethical, and social impacts or benefits. Environmental hotspotting brings a particular focus to the analysis and often highlights water use and pollution; greenhouse gas emissions, chemical toxicity and other resource use or waste processes within the value chain. The outputs from this analysis can then be used to identify potential solutions and prioritise actions around the most significant environmental responses required within a value chain. This in turn enables an identification of the kinds of occupations and skills that will be required to realise these solutions and actions.

As with the value chain analysis, it is important to clarify the scope of the hotspotting analysis and to identify the audiences that need to be considered. Much of the data gathered for the value chain analysis will inform the hotspotting analysis although more detail may be required to identify particular environmental impacts within the value chain. Further analysis and engagement with experts may also be required to support the identification and prioritisation of these impacts. In many instances, the interaction between the environmental, social and economic impacts has implications



Box 1

An Example of Environmental Hotspotting

In extended and complex value chains, environmental hotspotting is useful for identifying the priority areas for change and the occupations and skills required to enable and support this change. The following example is drawn from an occupationally directed study on paint (Jenkin et al., 2016). During the value chain analysis, it became apparent that there were significant environmental impacts at various stages in the paint value chain. This included: “impacts during the extraction and processing of input materials, and during manufacturing, which produces wastewater and sludge...; and health impacts on workers. During the end-use phase, there are also health impacts associated with applying paint, and some components of paint e.g. lead remains hazardous long after application. ... Unused or leftover paint that has to be disposed of, is classified as hazardous waste.”

Further analysis revealed that globally “10% of the environmental footprint of coatings is created during manufacture, with some 50% occurring upstream during the extraction and manufacturing of input materials, and 40% created downstream in application and disposal” (Mash, 2015 cited in Jenkin et al., 2016). The main environmental and health impacts associated with surface coatings were then summarised in an environmental hotspotting table that showed the level of impact (high [red], medium [orange] and low [yellow]). The table for decorative paints is shown below.

This representation of the environmental hotspots was then used in subsequent discussion and validation with key stakeholders during the site visits and interviews. During this process, it became apparent that in South Africa weaknesses in key support structures related to environmental compliance were resulting in higher environmental risk at the manufacturing and use phases. More specifically, the legislation controlling the use of lead in paint was not being well enforced, resulting in heightened impacts during manufacture, use and disposal of paints.

Based on these hotspotting insights, a more focused actor map was developed that identified three actor and occupational networks. These were: 1) the Safety, Health, Environment and Quality Network; 2) the Technical and laboratory (R&D) network related to manufacture; and 3) the Painters as the main users of the paint.

It must be noted that the mining and manufacture of input materials including lead and titanium fell outside of the scope of this study as they fall under the mandate of the Mining Quality Authority. However, by developing green skills in the technical and laboratory (R&D) and the environmental compliance officers, it would be possible to reduce or eliminate high impact input materials, thus reducing demand. Other studies with the MQA may in future enable a more direct engagement with the environmental hotspots related to the input materials.

Table 1: Environmental and health impacts associated with decorative paints (Jenkin et al., 2016)

Process stage	Input materials	Paint manufacture	Distribution	Retail	Users
Environmental impact	50%	10%	40%		
DECORATIVE					
Social impact	<ul style="list-style-type: none"> Lead 	<ul style="list-style-type: none"> VOCs from solvents (health) Methanol & lead 			<ul style="list-style-type: none"> VOCs from solvents (health)
Environmental impact	<ul style="list-style-type: none"> Titanium Dioxide (processing energy, air & water pollution) 	<ul style="list-style-type: none"> Solvents Water use 			<ul style="list-style-type: none"> Disposal to sewer Unused paint

for the identification of priority areas. In the paint sector, for example, it is the relationship between the disposal of paint into water systems (sewage or storm water systems or directly into rivers) along with the toxicity of heavy metals, particularly lead, that results in specific aspects of the manufacture, use and disposal of paint being considered important environmental hotspots. As the heavy metals are removed from paints, the disposal of paint into water systems may become less of an issue relative to other processes within the value chain.

Hotspotting thus supports the identification and prioritisation of actions. A range of methods from literature analysis to stakeholder engagement can be used to identify, validate and shortlist potential impact reduction opportunities. Once these priority impact reduction opportunities have been identified, it is important from a skills development perspective to identify the key actors (or networks of actors: see resource on Value Chain Analysis) who have the potential to have the greatest influence on these reduction opportunities. By identifying these actors and actor networks, it becomes possible to map the occupations and skills required to engage with and address hotspots identified. It must be stressed that the scope of the study and the intended audience will have an impact on which hotspots and related occupational and skills profiles are developed. By way of example, an occupational directed study on the paint sector in South Africa identified the sourcing of raw materials as the part of the supply chain in which the greatest environmental impact occurs. However, since the study was being produced for the Chemical Industries Education and Training Authority, a decision was made to focus on the technical research and development chemists and paint manufacturers rather than the mining operations which fell in a different education and training authority. The hotspotting highlighted the need for skills development that would support new ways of manufacturing paints that avoided input materials with high negative environmental impacts.

Conducting an Environmental Hotspot Analysis

Environmental hotspot analysis deepens and refines the focus of the value chain analysis. As you start the hotspot analysis, you should already have defined the scope and goals of both the broader study and the value chain analysis. You should also have an expanded value chain diagram identifying the discrete unit processes.

The next step in the analysis is to identify and quantify the input and output environmental loads involved in each unit process within the value chain. This involves the collection of data for physical inputs (raw materials and energy) and outputs (products and waste/ recyclable content). Depending on the level of detail required, this can be an extremely complex and time-consuming part of the analysis. In many instances however, standard industry data already exists and can be used to give a quick overview of key environmental and social risks. Some input categories that may be relevant include: energy (quantity and source); land use; water use; other resources (renewable, non-renewable, virgin material, recycled material). Output categories could include: emissions to air (e.g. greenhouse gas emissions, particulate matter, volatile organic carbons, etc.); emissions to water (e.g. phosphates and nitrates, toxic chemicals, heavy metals) and solid waste (e.g. biodegradable, non-biodegradable, hazardous). The following diagram provides a generic example of what the resultant input/ output inventory may look like using a basic flow chart.

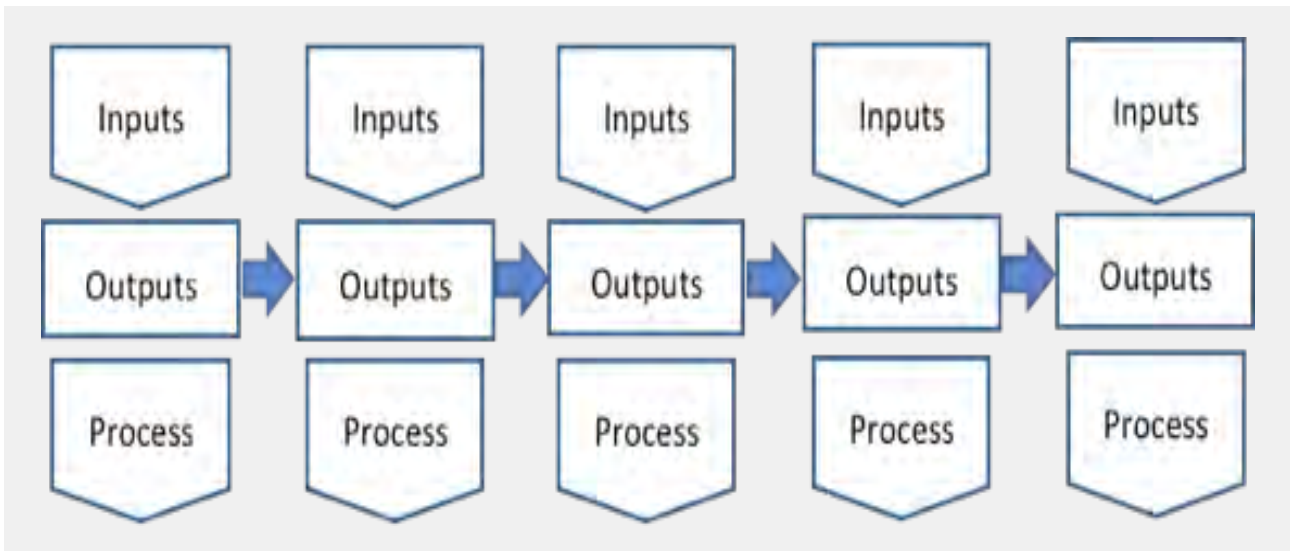


Figure 1: Basic flow chart of input/output inventory

Once the inputs and outputs have been identified and quantified in as much detail as required by the scope and purpose of the study, the next step is to assess the environmental impact across the value chain. This involves examining the potential and actual environmental effects of the environmental loadings identified in the inventory component. This may be classified simply as high, medium or low or it may require more specific categorisation such as global warming/eutrophication/human toxicity etc. and a value such as tons of CO₂ equivalent.

Environmental and social 'hotspots' along the paint value chain

Process stage	Input materials	Paint manufacture	Distribution	Retail	Users
DECORATIVE					
Social impact	• Lead	• VOCs from solvents (health) • Methanol & lead			• VOCs from solvents (health)
Environmental impact	• Titanium Dioxide (processing energy, air & water pollution)	• Solvents • Water use			• Disposal to sewer • Unused paint
AUTOMOTIVE					
Social impact	• Toxic metal pigments	• VOCs from solvents (health) • Methanol & lead			• VOCs from solvents (health)
Environmental impact	• Rare metal pigments	• Solvents			• On-site energy use • Disposal
MARINE					
Social impact		• VOCs from solvents (health) • Methanol & lead			• VOCs from solvents (health)
Environmental impact	• Metal pigments – copper • Biocides	• Solvents			• Toxic biocides (TBT) • Copper toxicity • Paint waste • Water pollution

Figure 2: Example of hotspotting from CHIETA surface coatings study (Jenkin et al., 2016)

Finally, as this source book is focused on occupations and skills, it is necessary to identify the actors and actor networks associated with each process and the related inputs and outputs. As with the value chain analysis, this would include both the core actors and the support or secondary actors. The following figure (Jenkin et al., 2016) shows a combined mapping of insights emerging from the environmental hotspotting and a high-level identification of core and support processes that will enable the actor mapping. Building on this high-level overview and the environmental hotspotting information that informs it, it is now possible to focus on particular value chain processes and the actors involved in these processes. In the example given, the environmental hotspots that were identified were the production and management of hazardous waste. These hotspots were exacerbated by the lack of enforcement of and compliance with legislation related to the inclusion of lead in paints. Three hotspots were thus identified, namely: the need for ongoing research and development to reduce the need for hazardous chemicals in paints; the management of paint during use and disposal; and environmental management and safety practices.

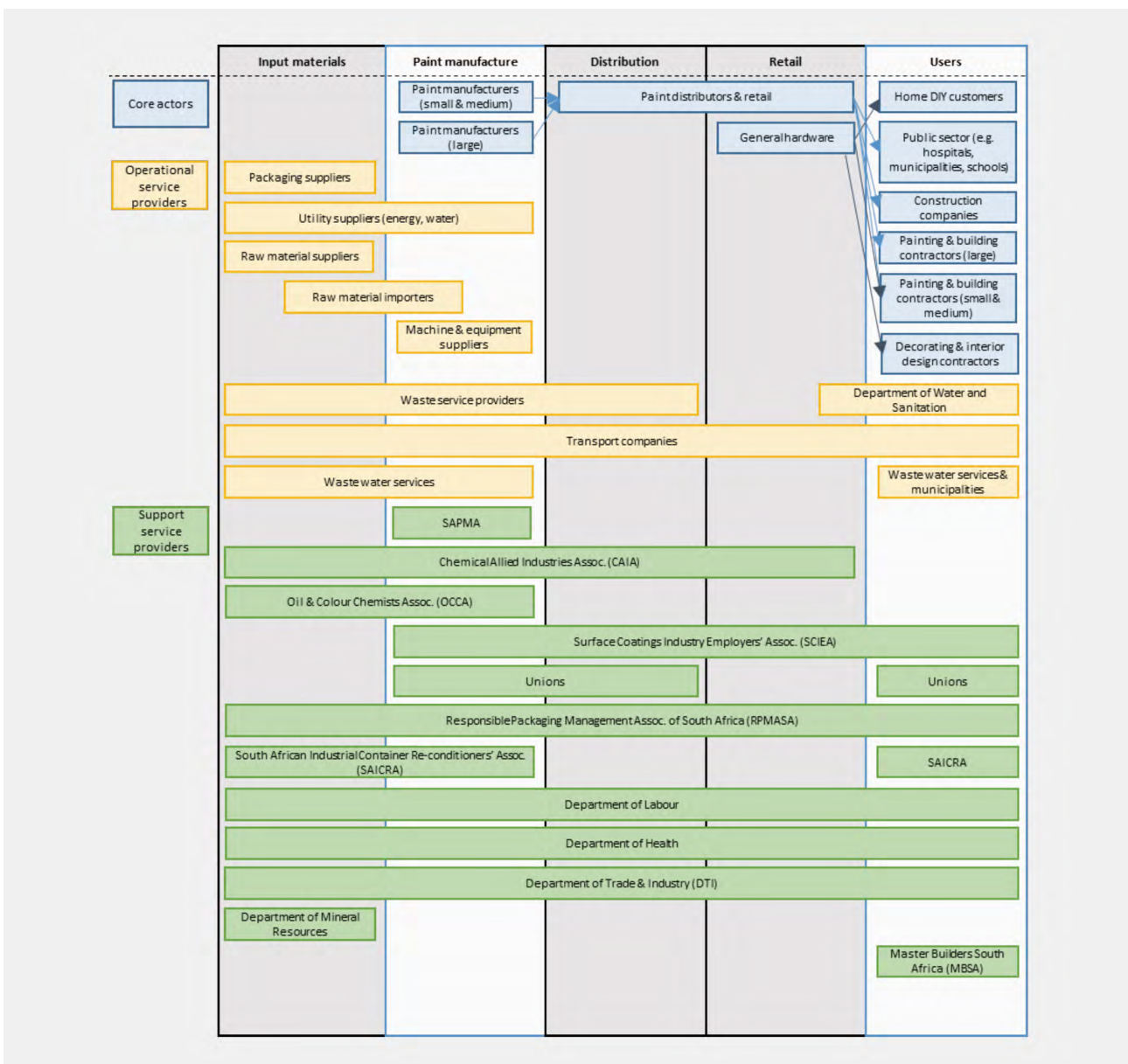


Figure 3: Main actors in the paint value chain, e.g. decorative (Jenkin et al., 2016)

As can be seen in the Value Chain resource on occupational mapping that includes actor and actor network identification, it may be necessary to develop a full mapping of all actors involved in the chain (important for identifying specific occupations for example) and a more generic mapping for inclusion on aggregated diagrams and the identification of generic skills and relationships. The environmental hotspot analysis helps to identify key areas requiring process changes and thus enables a more focused and strategic approach to the occupations and skills required for this change.

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Backcasting – Defining Actions from Envisioned Futures

Backcasting is a widely used approach in situations where there is a normative objective such as sustainability and fundamentally uncertain future events that influence this objective. To differentiate backcasting from other tools that are used in skills planning, it is useful to distinguish between three ways of thinking about the future. The first is based on ‘probable futures’ where studies seek to identify what is most likely to happen based on current trends. Forecasting studies that focus on trend monitoring and historical data analysis are a common approach for predicting probable futures.

The second approach is based on articulating ‘possible futures’ where different possibilities of what might happen are explored. Scenario studies are an example of this approach where possible futures are described along with the factors that may lead to their emergence. A third approach is deliberately normative and seeks to describe ‘preferable futures’. Backcasting is the best-known

tool within this approach as it seeks to collaboratively define a desirable future and identify the steps required to realise this future. The approach has been used in many different settings including energy planning, river basin management, transportation studies and the transformation of companies to create sustainable value. Backcasting does this by taking desirable (sustainable) futures or a range of sustainable futures as a starting point and then analysing their potential, their feasibility and possible ways of achieving them. By including a specific focus on the occupations and skills required for achieving the desired futures, backcasting provides a useful tool to support strategic, proactive and anticipatory skills planning.

Backcasting is particularly useful in contexts with the following characteristics:

- ◆ The problem to be studied is complex and there is a need for major change;
- ◆ The nature of the change required is highly contested although there may be some agreement at higher levels of principle;
- ◆ The dominant trends are part of the problem;
- ◆ Possible solutions are absent from current practices or are significantly marginalised;
- ◆ The time horizon is long enough to leave space for deliberate choice and change.



Box 1

Examples of Backcasting

Backcasting lends itself to use in a wide range of contexts as it tends to be relatively easy to implement, supports creativity and dialogue and can be adapted to suit the time and resources available. The following two examples draw on work in the local government and business sectors.

The impacts of rapid urbanisation, exacerbated by climate change, are placing significant strain on the resources and capacity of local government to address the demands for social development, environmental sustainability and economic growth. One response has been to explore the potential for Community Ecosystem-based Adaptation (CEBA) to involve local communities in protecting and restoring ecosystems to build resilience within cities. Using a backcasting approach, representatives from five cities in southern Africa developed principles, key action areas and indicators for success of CEBA initiatives in southern African urban contexts. These criteria were developed and mapped out using coloured cards on which key insights were captured and then positioned on a large wall at the workshop venue. Once the more generic principles, future visions and necessary actions had been developed collaboratively, each city group developed more specific visions and plans based on their unique contexts. A key part of this

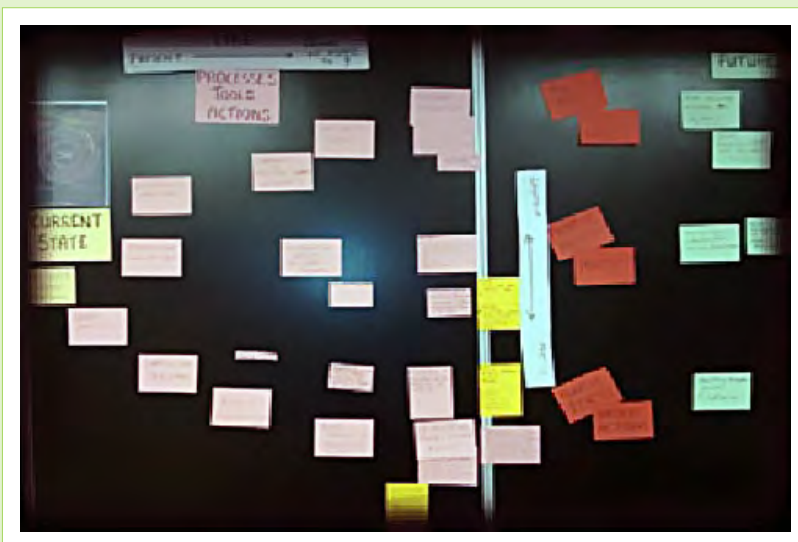


Figure 1: A backcasting workshop process

planning related to capacity development and particularly the occupations and skills that would be required to achieve the future visions. This in turn resulted in planning related to the curriculum development and institutional support that would be needed to build these skills.

The second example shows how a principle informed backcasting process gave Electrolux a significant competitive advantage over firms that responded incrementally to new legis-

lation on ozone-depleting chemicals. When chlorofluorocarbons (CFCs) were initially restricted by law, companies re-engineered their products and factories to accommodate hydrochlorofluorocarbons (HCFCs) instead. However, these chemicals were also problematic in that they are persistent compounds, are greenhouse gases and are toxic. They too were eventually phased out requiring industry to reactively change again. Electrolux, however, backcasting from a future frame given by the system condition principles developed by the Natural Step, developed a different strategy. Recognising that HCFC also had no long-term future, Electrolux set about finding alternative compounds that were biologically harmless. As a result, Electrolux was the first company to launch a whole family of freon-free refrigerators and freezers. The result was increased market shares in several important markets and a new overall business strategy that earned them wide acclaim and public support at the time. (Holmberg and Robért, 2000)

In the backcasting process, a range of stakeholders are brought together and through a process of research, reflection and discussion, identify a set of principles, the realisation of which would lead to a desirable future state. The participants envision their companies, sectors, societies, etc., acting in this desirable future thus developing a rich description of this future state, where the principles for success have been met. Based on these principles and desired future states and an understanding of the current situation, participants then plan what needs to be in place to achieve the desired futures. By ensuring that each activity provides a logical platform for the next, a detailed plan can be developed.

There is an old saying that the best way to predict the future is to create it and in a sense, this is what backcasting sets out to do. Once the collective desirable vision is developed, alternative paths to achieve it are proposed and scrutinised in terms of desirability, viability, advantages, disadvantages and challenges. It is at this point that forecasting can be used in conjunction with backcasting to refine the action steps required to achieve the desired future. Ultimately the outputs from a backcasting process are the development of strategic and proactive future visions and ways to achieve them that are discussed and agreed on among key stakeholders.

Conducting a Backcasting Process

Backcasting is normally done in four steps and involves bringing together a number of stakeholders in a workshop setting. It is useful to have a large working surface (such as a wall), lots of coloured card and marker pens. The process usually takes one to two days and can benefit from some preparatory reading or presentations particularly regarding the principles that could inform a sustainable society or green skills development.

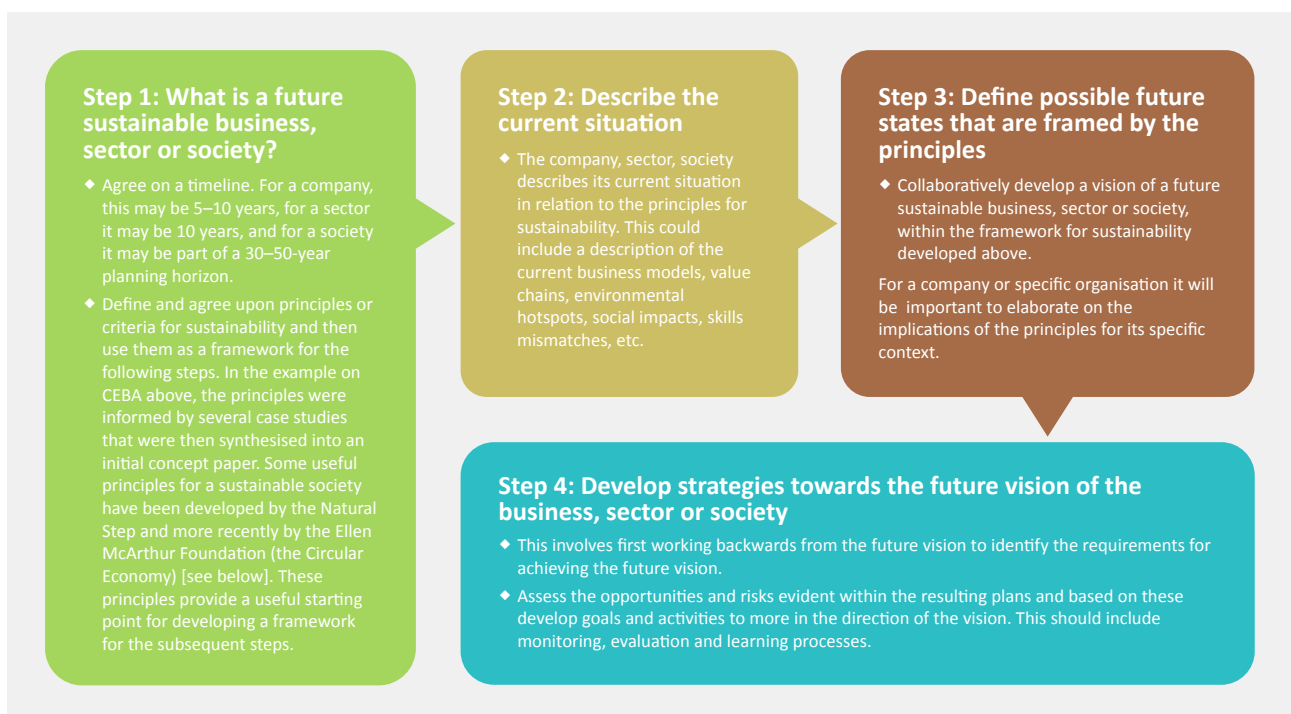


Figure 2: *The four steps in backcasting*

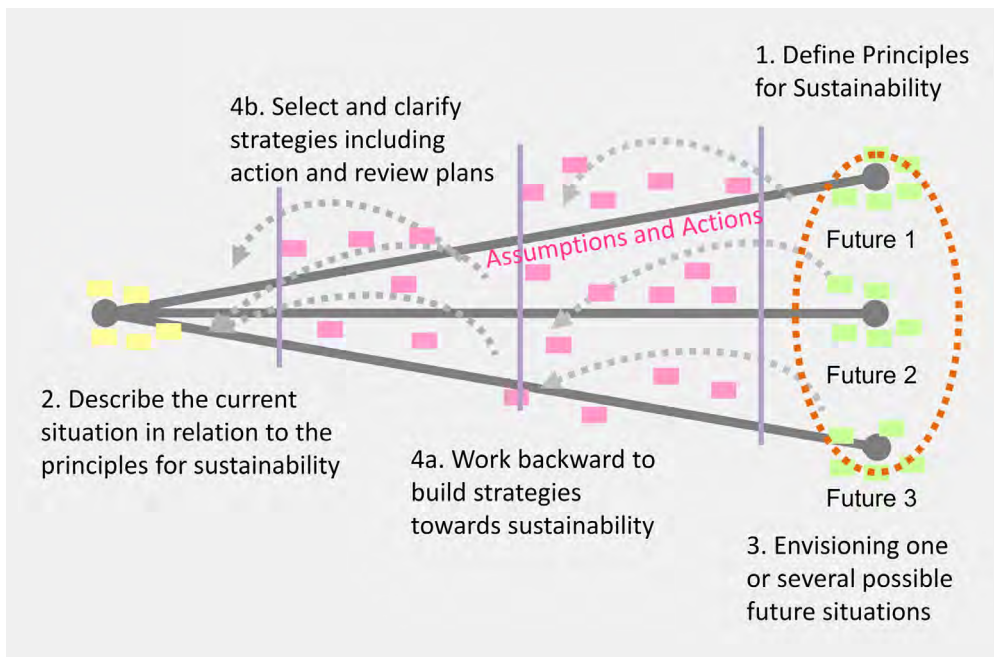





Figure 3:
The backcasting process


Some Principles that could Frame a Sustainability Focused Backcasting Process

The Natural Step is both a framework and an organisation that has since 1989 supported a deeper understanding of and commitment to sustainability. The Natural Step has identified four system conditions that fundamentally undermine our ability to live sustainably on this planet. “We are systematically digging so much stuff out of the Earth that nature can’t cope; systematically poisoning the system with polluting chemicals; and systematically burning, covering over, and generally laying waste to the living environment. In addition, we live in societies that do not give individuals a chance to lead a decent way of life.” These system conditions provide the principles that frame possible futures. As we consider possible business models, sector transformations and societal development paths, we need to be asking: Will this future increase concentrations of substances extracted from the Earth’s crust? And if it does, we should be looking very hard for alternatives.

In a sustainable society, nature is not subject to systematically increasing...

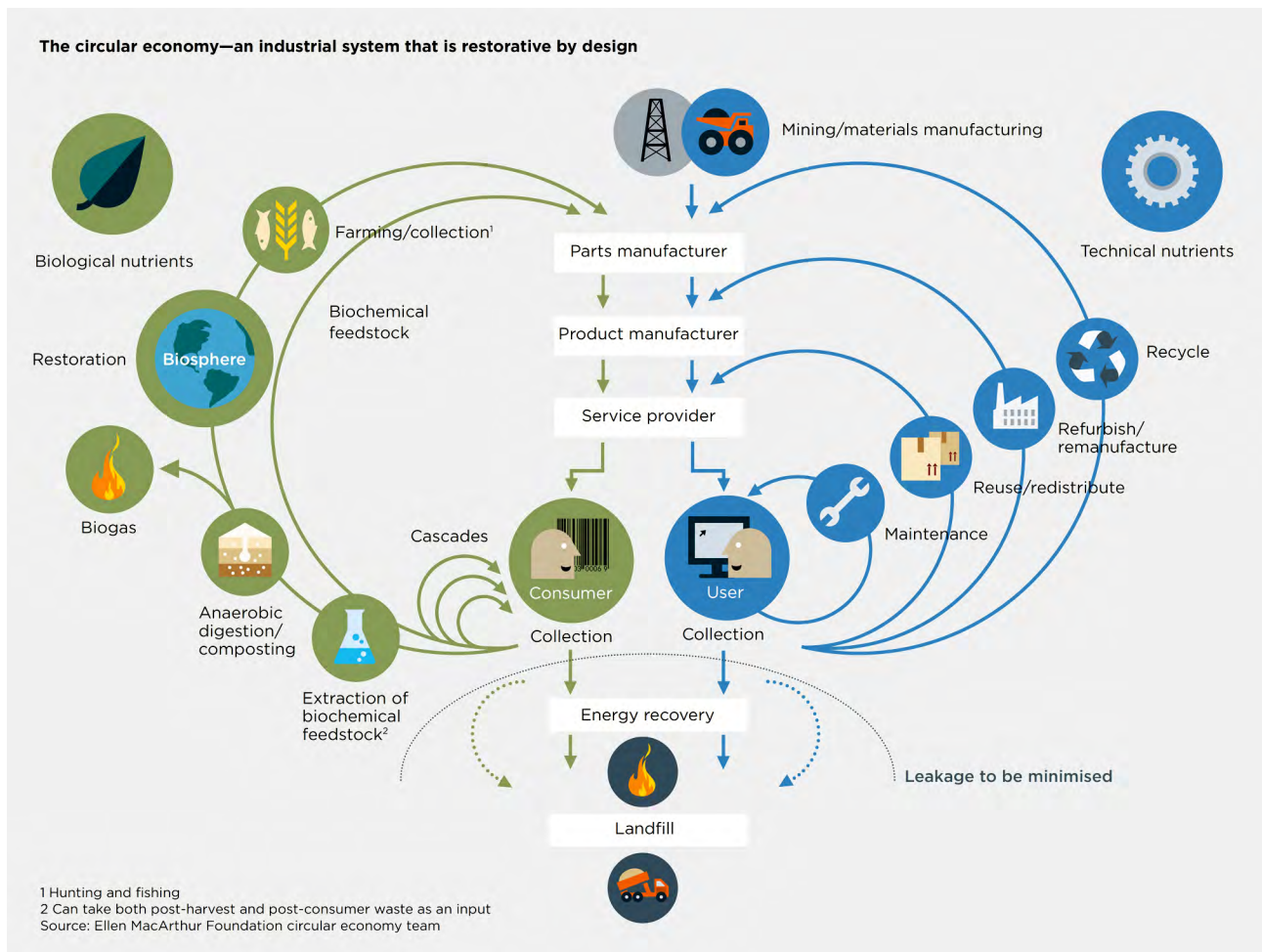
-  ...concentrations of substances extracted from the Earth’s crust,
-  ...concentrations of substances produced by society,
-  ...degradation by physical means,

and, in that society...

-  ...people are not subject to conditions that systematically undermine their capacity to meet their needs.

The concept of a circular economy has been around for many decades and includes a broad array of ideas including notions such as ‘cradle to cradle’, industrial symbiosis, industrial ecology and

biomimicry. At its core is the commitment to move beyond linear ‘take, make, dispose’ processes and develop cyclical systems where inefficiencies are minimised and processing materials, whether biological or technical, are fed back into systems powered by renewable energy. The Ellen MacArthur Foundation has recently popularised the concept by linking significant economic and business opportunities in the circular economy. By bringing together a number of complementary schools of thought and creating a coherent and visually accessible framework, the Ellen MacArthur Foundation has given the concept wide exposure and appeal. [The framework and principles associated with it currently appear to lack a social dimension although work by people like Alexandre Lemille is grappling with this issue.]



The Circular Economy rests on three principles each addressing several of the resource and system challenges that linear industrial economies face and that could inform a backcasting process. These are:

Principle 1: Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows.

Principle 2: Optimise resource yields by circulating products, components and materials at the highest utility at all times in both technical and biological cycles.

Principle 3: Foster system effectiveness by revealing and designing out negative externalities.

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Green Occupations and Green Skills Analysis

Interrogating the Organising Framework for Occupations (OFO) has raised some generic issues around representation and framing of environmental occupations which we need to engage with to enable better movement, progression and navigation within and between environmental occupations.

- ◆ Due to its 'newness' as well as the lack of a co-ordinated approach, there is very little available knowledge on the profile of environmental occupations and systemic integration of these into broad occupational frameworks. This has resulted in huge contextual variance in occupational titles, occupational tasks, entrance requirements and general sectoral knowledge of an occupation, which has created difficulty in finding a common language or reference framework for discussion on employment trends and statistics in the sector.
- ◆ Representations of environmental occupations are scattered and clear scaffolded pathways are not visible across levels of skill.
- ◆ Representations of socio-ecological occupations in OFO are poor – many environmentally linked occupations currently represented are scientists requiring a science learning pathway. Occupations linked to community conservation, social ecology, stewardship, rural development are not represented, thus restricting movement for students with a social sciences/arts pathway.
- ◆ Most entry points in terms of represented occupations are at professional levels, mostly requiring postgraduate qualifications. Greater representation of entry level environmental occupations to enable better access into the sector at artisan and technical skill levels needs to be explored. This would have implications for TVET and FET pathways to enable better artisan linked education and training opportunities.
- ◆ New fields of occupational practices are not well captured in the OFO, thus skills provisioning and training for these will be reactive, ad hoc and uncoordinated.

The notion of 'greening' the economy will require the identification of particular green jobs, occupations and skills. Assessing and anticipating these jobs, occupations and skills will require research relating to at least four different situations:



Core green occupations

Some existing occupations are already focused directly on green issues often with a high degree of specialisation. Some examples are environmental managers (134901) and air pollution analysts (213305). The primary research question for this group is how many are needed given different supply and demand considerations.

Changing occupations

Within some existing occupations, emerging environmental challenges and opportunities are resulting in a requirement for new skill sets that differ significantly from those required for more traditional work in these occupations. For example, the installation of solar water heaters (642602) overlaps with more traditional plumbing (642601) work but differs in the specifics of its core skills requirements. Research questions need to establish both the supply and demand of existing skills and qualitatively assess and anticipate the new skills requirements.

New skills needs across occupations

These are existing occupations that do not have a focus on environmental issues but require supplementary skills as environmental issues emerge or are acknowledged in a particular area of work. An example may be the incorporation of sustainability considerations (e.g. water or energy use) into the job of a facilities manager (143901) or sustainable investment considerations for an investment manager.

Newly emerging occupations

Here the requirement is for people with new skills in roles that amount to new occupations. This group is extremely difficult to deal with in existing skills planning frameworks since the occupations have not been defined and in many instances, even the skills are still emerging in response to new demands. The research for this group is largely qualitative as anticipatory approaches to skills planning seek to clarify what these occupations will look like in the near or medium term. Examples include carbon accounting, sustainability managers (121909), chief sustainability officers, alien species control officers, etc.

Box 1

An Example of Green Occupations and Green Skills Analysis

Several of the occupationally based green skills studies in sectors as diverse as the mining sector, the chemical sector and the public service sector have used value chain analysis as the basis for occupational and skills analysis. The example below is taken from a mining study and provides and emphasises the links within and between value chains. The table below shows a high-level breakdown between value chain processes, associated green competencies and broad occupational categories.

Table 1: *Green skills in the processes enabling coal mining (Rosenberg et al., 2015)*

Processes	Associated Green Competencies	Associated Occupations
Governance leadership and management	Ethical leadership, effectively setting a “green” direction and approach for the organisation, overseeing governance of environmental compliance, climate change and sustainability management, overseeing the implementation of environmental management plans	Company board members, CEOs, corporate managers, mine managers, environmental managers. Larger coal mining companies employ corporate level environmental sector.
Reporting	Knowledge of sustainability reporting requirements and national and international trends and standards for environmental justice	Corporate sustainability and climate change managers, environmental managers. Larger coal mining companies.

Within the occupational categories, specific occupations were then identified and linked to unique codes within the OFO. Based on this detailed analysis, recommendations were made regarding addressing scarce skills (many of which related to ‘dark green’ occupations such as environmental law and mine rehabilitation) or emerging skills needs within existing occupations from governing bodies to mine managers to mine workers.

Using the actors identified within the value chain analysis, the four categories outlined above and occupational information derived from the OFO, it is possible to develop a map of occupations and occupational families.

Conducting a Green Occupations and Green Skills Analysis

Understanding that occupations will undergo substantial changes in the transition to a green economy is critical. The ILO (Strietska-Illina, 2011) provides a framework for understanding the type of skilling intervention that will be required in the transition to green economy, shown in the table below.

Table 2: *Training needs for changing and emergent green occupations*

Degree of Skill Change	Occupational Change	Typical Skill Response
None	None or only quantitative	None or increased training in existing occupation
Low	Changing established occupation	On-the-job learning or short training courses
Medium	Changing or emerging occupation	Short courses or longer continuous training
High	New and emerging occupation	Initial training, university degree or longer continuous training

Source: Strietska-Illina, 2011

The green occupations and green skills analysis is intended to identify the key occupation and skills required in the core and support processes within a value chain. This involves listing all actors and then aggregating them into common categories, in this instance usually occupational groups, and identifying the main environmental issues and skills required to deal with these issues. This process results in a list of occupations and related skills requirements that can be used in different ways by different audiences. It must be stressed that the actor mapping will define the subsequent boundaries of occupational analysis, therefore in producing the actor map it is important to ensure that the scope is commensurate with the project's ability to generate meaningful insights into occupations and skills. This is helped significantly by the use of environmental hotspot analysis to identify priority areas of focus and related actors, occupations and skills.

The first step is to use value chain analysis to identify the main actors and their areas of operation. Building on the value chain analysis and the environmental hotspot analysis, the following section of a table that extends over almost four pages (listing approximately 50 occupations) is linked to the surface coating value chain.

Table 3: Surface coating value chain (Jenkin et al., 2016)

Value chain process stage	Process & business activities	Main environmental issues (greatest area of impact)	Suggested occupations for greening (code)
Paint manufacture	Technology development		
	R&D	<ul style="list-style-type: none"> Hazardous materials (env. & health) alternatives Water-based alternatives to raw materials 	R&D Manager 122301
			Chemical Engineering Technician 311601/ Chemical Engineering Technologist 314502/ Chemical Engineer 214501
			Analytical Chemist 211301
	Manufacturing & production		
Procurement & Supply Chain	<ul style="list-style-type: none"> Green Procurement Hazardous materials (ingredients) 	Procurement Manager 132401 Supply Chain Manager 132401	

The next step is to use the value chain and the environmental hotspot analysis along with interviews and site visits to identify key areas of focus in terms of actors, occupations and skills. These key areas of focus will usually be people who, working individually or as a network, have the potential to make a significant difference in terms of addressing environmental hotspots.

In the surface painting study, for example, it became apparent that it was important to focus on three ‘occupational networks’. These were: Safety, Health, Environment and Quality; Technical and Laboratory (R&D); and Painters and Contractors. The environmental or greening tasks that these clusters performed (or were increasingly required to perform) were then listed against a broad set of key occupations derived from the OFO.

Key Occupations in this Network	Core Green tasks for this Network
<ul style="list-style-type: none"> ◆ SHEQ Practitioner ◆ Sustainability Manager ◆ Environmental Officer ◆ EHO ◆ Health and Safety Manager or Officer 	<ul style="list-style-type: none"> ◆ Develop or execute strategies to address issues such as energy use, resource conservation, recycling, pollution reduction, waste elimination, transportation, education and building design. ◆ Drive lean management throughout the business and raise awareness accordingly. ◆ Application of and compliance with, environment, health and safety legislation and regulation e.g. ensuring workforce wear protective clothing and masks.

Key occupations are then examined in detail using the OFO, international equivalents such as the US based O*NET and alternative local equivalents such as competency tables developed within particular institutions or industry bodies. It is here that the categories of ‘dark green’, ‘light green’, ‘green tint’ and ‘new green’ are useful for highlighting emerging focus areas that may not yet be included in the OFO. More specifically, this examination of occupations and skills through the various green lenses should lead to a better understanding of whether new skills need to be added to existing occupations

that were already sensitive to environmental issues or whether a more fundamental engagement with sectors that were not currently incorporating green skills into particular occupations is required. A small section of the resulting table for the Environment(al) Officer from the surface coating study is presented below.

Occupation name: Environment(al) Officer			
OFO major group (code)	OFO sub-major group (code)	OFO unit group (code)	OFO occupation code
Professionals (2)	Physical, Mathematical and Engineering Science Professionals (21)	No unit group 2133	213302
Segment of the value chain	Skills band (high/intermediate/low)		Shade of green (dark/light/tint)
Manufacture	High or Intermediate		Dark
Occupation description and purpose	Studies and develops policies and plans for the control of factors which may produce pollution, imbalance or degradation of the environment.		
Greening the occupation recommendations	Field of knowledge	<ul style="list-style-type: none"> - Understands environmental legislation and standards e.g. SABS, and application thereof. - Understands the implications of not being compliant. Gets input from legal department regarding updates on compliance (includes national and local by-laws. - Needs to follow and apply environmental management systems (EMS), in line with ISO 14001:2004. Environmental Management Systems programme. - Has ability and understanding to interpret environmental initiatives and implement these in the business. - Waste management – map waste arisings and reasons, identify solutions for reduction along the supply chain. - Energy management and identification of solutions – where is energy being used, measure and identify solutions – lean manufacture, installation of renewable energy solutions e.g. solar panels, CHP. 	

Based on this review and the resulting tables, it should be possible to develop a number of conclusions and recommendations regarding key occupations and skills. In the case of ‘dark green’ occupations, this is most likely to be focused on the number of professionals required and additional skills that may be required that are not yet incorporated within the OFO. For ‘light green’ and ‘green tint’, recommendations are likely to focus on how particular existing occupations may need to link within networks and what skills would be required to support this. The most challenging recommendations are likely to be around those occupations that are emerging or may be required in the future. Here significant engagement may be required to lobby industry bodies and higher education institutions to name these occupations, ensure they are recognised on the OFO and articulate the skills required within this emerging occupation.

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Multi-Levelled and Mixed Method Approach to Understanding Green Skills

An International Labour Organisation (ILO, 2013) research brief on anticipating skills needs for the low carbon economy notes that it is possible to distinguish between four main levels of skills analysis. These are: the macroeconomic level; the sectoral level; the occupational and skills levels; and the training and education levels. At each of these levels, different methodologies may be appropriate, thus requiring research design decisions. Given the need for depth and (often) limited resources, most studies will focus on one or two levels. However, due to the connections between global and national environmental trends and the implications of these trends on sectors, occupations, skills and education, there is often a need to work across levels and integrate insights from different levels. The impact of climate change and the associated international and national commitments to reducing carbon dioxide emissions, or a national commitment to growing the green economy, or increasing frequencies of water shortages will all have an impact on sectors, occupations, skills and education. These impacts may be driven by consumer demand, new tax structures or disruptive technologies that offer new business opportunities. Even when working at a sector level, it is necessary to understand the broader macroeconomic context within which a particular sector and its extended supply chains are located. Methods such as forecasting or scenario planning informed by a careful consideration of political, economic, social, technological, environmental and legislative dimensions of a global, national or even sub-national setting could inform a macroeconomic level analysis.

Within a sector, more quantifiable data may be available thus supporting the use of more quantitative methods. The growth in employment in the renewable energy industries, the growth of industries providing services and goods for energy efficiency, or the loss of employment in coal powered energy productions could all be calculated based on national energy policies, strategies and projects. The shorter the time frames, the more certainty there would be in terms of numbers. As the time horizons extend beyond 2-4 years, discussions with role players may require more qualitative methods to supplement the quantitative methods.

In terms of occupations and skills, a research project may seek to quantify the number of a particular occupation that will be required given the macroeconomic and sectoral findings. Where these occupations are not well defined on the OFO or where the skills within an existing occupation may



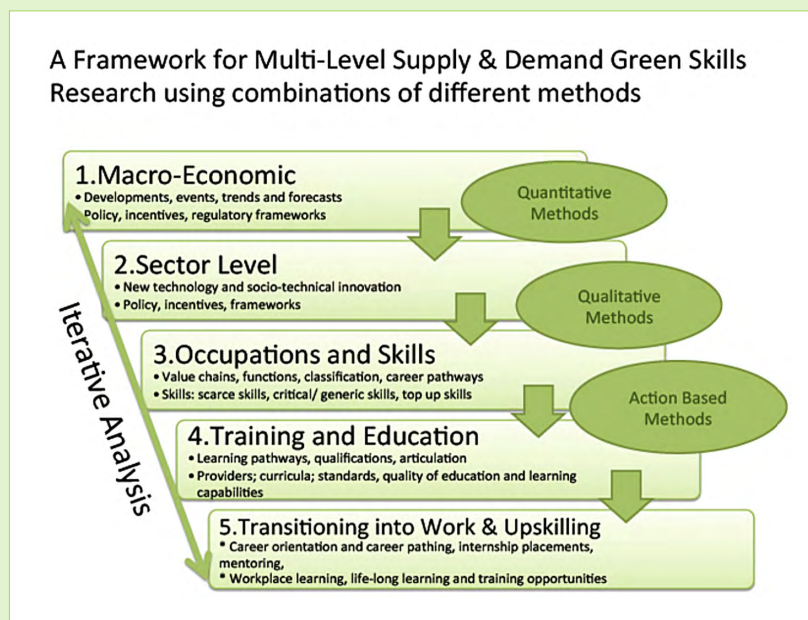
need updating due to emerging environmental issues, more qualitative research methods may be required. This more qualitative research may be important for identifying emerging occupations that need to be included in the occupational classifications and tracked in future data gathering exercises to provide more quantitative data for analysis.

The occupational and skills analysis will be needed to inform most studies on both the demand for and supply of training and education. Again, the research may be purely quantitative if the main research focus is on the numbers of particular graduates produced or required. However, it is more likely that the study will also require insights into the kinds of skills that will be needed and thus the kinds of educational opportunities that must to be developed. Similarly, research could focus on the number of graduates being employed over a particular period and/ or it may use a method such as tracer studies to develop a more nuanced picture of how graduates are integrated into a particular sector or into other opportunities within, for example, a broadly understood ‘green economy’.

Box 1

Example of Use

Numerous studies have highlighted that green skills are ‘hidden’ which makes them difficult to surface. Thus, an argument for a laminated or multi-levelled view is often necessary. The figure below illustrates the multi-levelled nature of how the sector studies within the Green Skills programme were framed. This further highlights that understanding green skills needs to be investigated on multiple levels to enable these ‘hidden’ skills to surface.



Research Methodology of a coal mining study (Rosenberg et al., 2015) notes:

“These data sources provided insight across levels in the system: from a macro-level analysis of broad social, policy and economic trends, and a meso-level focus on drivers in the coal industry, to a micro-level perspective on how environment-related work and associated training plays out in the on-the-ground context of one mine, and individual study and career paths. While most

green skills studies only focus on one or two of these levels, because of time and resource constraints (ILO, 2011b) observations in initial green skills research conducted by Rhodes University suggest that an analysis of the linkages and interplay between macro-, meso- and micro-levels are important for understanding the supply and demand of environmental skills, in sometimes fluid and fast-moving contexts.”

Navigating Multi-level and Multi-method Decisions

The research purpose and questions are key to deciding which levels will form the focus of the study and which methods may be appropriate. In general, the micro-level studies related to the current or near term will lend themselves more to quantitative research methods. However, as soon as the scope of the study expands either in terms of level or in terms of time, it is more likely that qualitative questions and qualitative methods will play a role in the study. Access to good quality qualitative data is also an important consideration and where this data is not easily available or will require significant resources to generate, it may be more useful to use qualitative methods. These variables mean that there is no universal methodological approach for skills anticipation. At best, various frameworks can be used to help us think through some of the options we have and implications of the decisions we make.

The CEDEFOP Volumes 1-6 on skills planning provide a useful orientation to a wide range of quantitative and qualitative methods. Volume 3, in particular, on sectoral studies provides a table of methods that includes a consideration of the pros and cons of the various methods and the relevance of these methods to sector level studies. A section of this table is reproduced below and you are advised to also look at volume 2 if working with longer time horizons, volume 5 for particular workplaces and volume 6 for tracer studies of graduates and learning pathways.

Approach	Advantage	Disadvantage	Use in sectoral context
Primary data collection			
Factual surveys directed at employers (or other groups such as households) containing questions about employment levels, pay, unfilled vacancies, for example	Direct 'user' or 'customer' involvement Focuses on how people behave, not what they say or perceive	Getting responses could be problematic Need large samples to get robust data, may be expensive	Most useful for sectoral approaches if the surveys are economy-wide and allow a breakdown by sector. Then they can provide comparisons across sectors and also reveal which sectors may compete for people with the same qualifications.
Survey of opinion directed at employers (or other groups) containing questions about skills deficiencies and skills gaps, for example	Direct 'user' or 'customer' involvement	May be subjective and inconsistent May focus too much on the marginal and ephemeral The respondents may not necessarily be knowledgeable about future skills needs	Can be both economy-wide as well as sector-specific. The sector-specific surveys can focus on more sector-specific problems and even selected occupations win the sector. However, they may lack information on the more general context.

Approach	Advantage	Disadvantage	Use in sectoral context
Interviews and related techniques	May be able to address problems and concerns more subtly and in greater depth	May be unrepresentative	Very useful for sectoral approach, especially to address 'key players' in the sector (main employers, main vocational institution)
Workshops	Useful mechanism for exchanging views	Can provide a partial view	At the sectoral level the participants, who use a common language and often share common interest, can be brought together relatively easily for workshops.
Other informal contacts	Useful mechanism for exchanging views	May be anecdotal and not grounded in reality	Informal contacts and networking are an important background for sectoral platforms where information can be shared.

Analysis

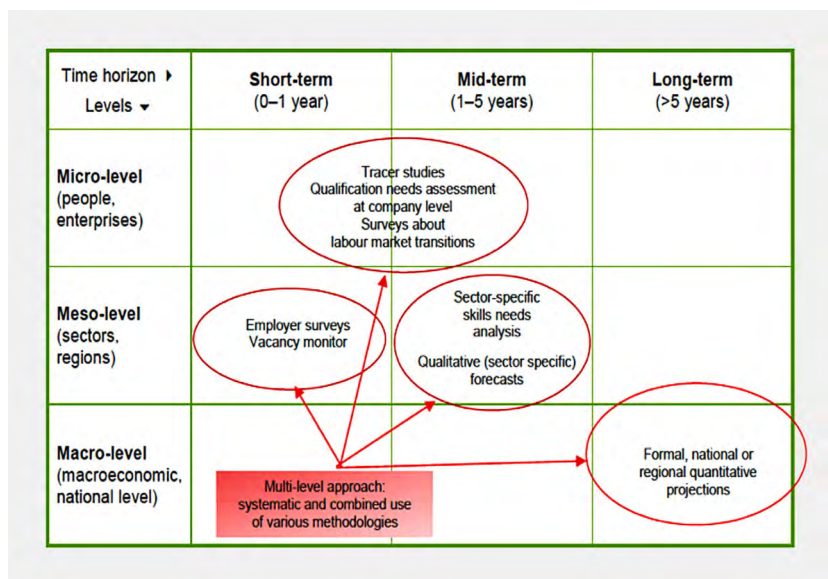
General synthesis and critical assessment of available evidence			Necessary for any analysis. Useful for analysis of drivers of change in the sector – new trends in technology, trends in international business and the context in which the sector operates
Formal, national-level projections based on a quantitative model Uses econometric techniques or computable general equilibrium (CGE) or similar models	Comprehensive Consistent Transparent and explicit Quantitative	Data-hungry Costly Not everything is quantifiable May give a false impression of precisions	Studies for specific sectors can gain the information for the model if these provide sufficient sectoral breakdown. Information from sectors obtained by other methods may also inform the model.
Partial projections based on quantitative models, for example focusing on individual sectors or occupations	Transparent and explicit Quantitative Targeted	Not everything is quantitative May give false impression of precisions Partial analysis may be biased	Sector-specific drivers of change and more appropriate detail of jobs classification may be captured better by these models, but interference with other sectors is missing.

Approach	Advantage	Disadvantage	Use in sectoral context
Other foresight methods			
Focus groups, round tables, Delphi-style methods	Holistic Direct 'user' or 'customer' involvement	Can be non-systematic Can be inconsistent Can be subjective	Often used at sectoral level, either in a situation where the data do not allow for quantitative modelling or to validate or interpret quantitative forecasts. Useful for identifying drivers, new trends in technologies and processes, emerging occupations or skills in the sector.
Scenario development analysis, encompasses many different forms	Holistic Direct 'user' or 'customer' involvement Focuses on uncertainty	Can be non-systematic Can be inconsistent Can be subjective	Very often used at sectoral level as the sector can define a reasonable scope of the scenario. The sector may also determine which people are institutions are relevant to the scenario development process.
Case studies of particular sectoral, occupational or regional groups and/or observatories (using both quantitative and qualitative evidence)	Holistic (for the sector) Strong on sectoral and other specifics	Partial Potentially biased Inconsistent across sectors	This group of methods includes use of different methods applied in the context of sectoral objectives. They may be purely sectoral or cross sectoral, e.g. aimed at one occupation across sectors.

Source: Cedefop, ETF and ILO (2016) Volume 3: 26-27 (Wilson et al., 2016)

A study on skills needs identification and matching in south eastern Europe (Kriechel, Mereuta & Monteleone, 2016) provides a useful multi-level framework for thinking through the methodological implications across levels and time.

Figure 1: Multi-level approach to skills anticipation (Source: Adapted from Feiler et al., 2012, in Kriechel et al., 2016)



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