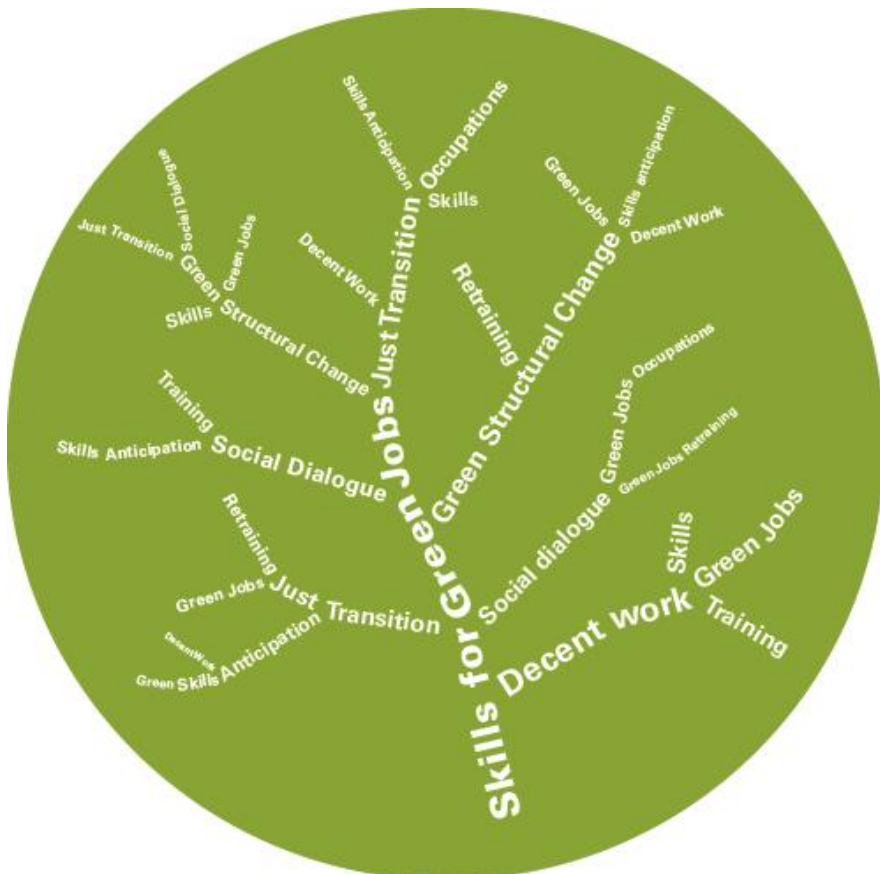International
Labour
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Anticipating skill needs for green jobs
A practical guide

Skills and Employability Branch
Employment Policy Department
ILO
Geneva

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Foreword

Climate change and environmental degradation have been recognized as global drivers of change. Along with technological change, globalization, demography and other drivers, they have a pronounced impact on changing employment and the demand for skills. Moving towards a greener economy is creating opportunities for the introduction of new clean technologies, green investments and jobs. Climate change and environmental degradation are constrained, however, by the shortage of human capital to deploy the technical solutions that are required. At the same time, both environmental change and policies and regulations targeting the greening of production processes have detrimental effects on certain economic sectors and can cause job losses. In addition, a skills mismatch on the labour market results in high costs for individuals, enterprises, industries, economies and societies. Skills mismatch contributes to unemployment, lower returns on investments into training, decreased productivity and lost investment and job creation opportunities. Given the lead time for the design and delivery of education and training, it is necessary today to have a good grasp of the skills demand of tomorrow. Identifying and providing right skills for new, existing and forthcoming jobs can smooth transitions to greener economies, help to tap into the vast employment potential and ensure that new opportunities benefit a broader share of society.

In this context, in 2008, the ILO, in partnership with the United Nations Environment Programme (UNEP), the International Trade Union Confederation (ITUC) and the International Organization of Employers (IOE), launched the Green Jobs Initiative. Subsequently, the ILO has implemented several research projects. The ILO project Skills for Green Jobs (2009–11) included background analyses of 21 countries and nearly 150 case studies (Strietska-Ilina et al. 2011). These resulted in a synthesis report on how, in the context of green structural transformation, countries deal with identifying and responding to requirements for new and emerging occupations, and new skills for well-established occupations. In 2010, the ILO concluded a joint management agreement with the European Commission on knowledge-sharing in the early identification of skill needs for the low-carbon economy. The project came up with important research outputs based on case studies, which covered over 30 countries globally. These concerned skills and occupational needs in two sectors – green building and renewable energy – and on methods of the identification of skill needs on the labour market in transition to the green economy (see ILO, 2011a, 2011b, 2011c).

The present guide builds on the previous research and practical application, and provides guidance on how to embark on the identification of current and anticipation of future skill needs for the green economy and green jobs. Intended primarily to assist researchers and analysts, the guide deals with qualitative and quantitative methodologies, data classifications and sources, research process and institutional arrangements. The recent Tripartite Meeting of Experts on Sustainable Development, Decent Work and Green Jobs (Geneva, 5–9 October 2015) agreed that "Governments, in consultation with social partners, should: … give high policy priority and allocate resources to the identification and anticipation of evolving skills needs and the review and alignment of occupational skills profiles" (ILO, 2015b). In an earlier discussion, the tripartite Committee on Sustainable Development of the International Labour Conference (ILC, 2013) concluded that sound labour market information and social dialogue were essential for the identification of current and future skills needs (ILC, 2013).

I would like to take the opportunity to thank the authors for producing this guide, expressing special acknowledgement to ILO skills specialists Con Gregg, who was the main author, and Olga Strietska-Ilina, who was a co-author and the team leader. I hope that the guide will make a useful contribution to making this process better comprehended and transparent.

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Acknowledgements

Abbreviations

Institutions

CBD	Convention on Biological Diversity
Cedefop	European Centre for the Development of Vocational Training (www.cedefop.europa.eu)
EGFSN	Expert Group on Future Skills Needs (http://www.skillsireland.ie/)
ETF	European Training Foundation
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation) (www.giz.de)
IEA	International Energy Agency (www.iea.org/)
ILO	International Labour Organization (www.ilo.org)
MSA	Manufacturing Skills Australia
OECD	Organisation for Economic Co-operation and Development (www.oecd.org)
PERI	Political Economy Research Institute, University of Massachusetts-Amherst (www.peri.umass.edu)
UNESCO	United Nations Educational, Scientific and Cultural Organization (www.unesco.org)
UNFCCC	United Nations Framework Convention on Climate Change
UNEP	United Nations Environment Programme
VATT	Valtion taloudellinen tutkimuskeskus (Finnish Government Institute for Economic Research) (www.vatt.fi/)

Other abbreviations used

CBD	Convention on Biological Diversity
CGE	Computable general equilibrium
CVT	Continuing vocational training
CVTS	Continuing Vocational Training Surveys
DACUM	developing a curriculum (approach to occupational analysis)
DHET	Department of Higher Education and Training (South Africa)
DySAM	dynamic social accounting matrix
E3ME	energy-environment-economy model of Europe
EDUCATE	Environmental Design in University Curricula and Architectural Training in Europe
GDP	gross domestic output
GEO	Global Environment Outlook

HCIS	high-carbon-intensive sectors
HE	Higher education
HRD	Human resources development
ILC	International Labour Conference
ISCED	International Standard Classification of Education
ISCO	International Standard Classification of Occupations
ISIC	International Standard Industrial Classification of All Economic Activities
KILM	Key Indicators of the Labour Market
Ktoe	thousand tons of oil equivalent
LCIS	low-carbon-intensive sectors
LEED	Leadership in Energy and Environmental Design
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne (Statistical classification of economic activities in the European Community)
NAICS	North American Industry Classification System
NQF	National Qualifications Framework (South Africa)
O*NET	Occupational Information Network (United States)
OFO	Organizing Framework for Occupations (South Africa)
PES	public employment service
PESTLE	political, economic, social, technological, legal, environmental (analytical framework)
POLA	Policy Analysis (Finland)
R&D	research and development
ROA	Research Centre for Education and the Labour Market (Maastricht University, Netherlands)
RSC	Regions for Sustainable Change
SAKERNAS	National Labour Force Survey (Indonesia)
SAM	social accounting matrix
SCADA	Supervisory Control and Data Acquisition (software systems, South Africa)
SMEs	small and medium-sized enterprises
SOC	standard occupational classifications
STED	skills for trade and economic diversification
TVET	technical and vocational education and training

Key terms used

apprenticeship: A system of training which usually combines on-the-job training and work experience with institution-based training. It can be regulated by law or by custom (ILO, 2006 – unpublished).

curriculum: A detailed description of the objectives, content, duration, expected outcomes, learning and training methods of an education or training programme (ILO, 2006).

continuing vocational training: Further vocational training, undertaken by those who have already completed basic or initial training, in order to supplement acquired knowledge or skills (ILO, 2013d).

core skills: Non-vocational, non-technical skills or competences that are needed to perform at work and in society. They apply to work generally, rather than being specific to an occupation or industry. Core employability skills include the ability to work with others and in teams; the ability to solve problems and use technology; communications skills; and learning-to-learn skills. Core skills are also called generic skills, key competences, key skills, portable skills, soft skills and transferable skills (ILO, 2006).

decent work: A term that sums up the aspirations of people in their working lives – their aspirations for opportunity and income; rights, voice and recognition; family stability and personal development; and fairness and gender equality. Ultimately these various dimensions of decent work underpin peace in communities and society. Decent work is captured in four strategic objectives: fundamental principles and rights at work and international labour standards; employment and income opportunities; social protection and social security; and social dialogue and tripartism (ILO, 1999).

delphi method: This is an expert survey implemented in two or more rounds where, in the second and later rounds of the survey, the results of the previous round are provided as feedback.

direct, indirect and induced jobs: Direct employment refers to the numbers employed in the activities studied. Indirect employment refers to employment among suppliers and elsewhere in the value chain as a consequence of the activities studied. Induced employment refers to employment in the wider economy that arises from spending by those employed directly and indirectly.

green economy or greening the economy: The process of reconfiguring businesses and infrastructure to deliver better returns on investments of natural, human and economic capital, while at the same time reducing greenhouse gas emissions, extracting and using fewer natural resources, creating less waste and reducing social disparities (UNEP). A number of related terms, such as "green growth" and "circular economy", largely refer to the same paradigm.

green jobs: Jobs that reduce the environmental impact of enterprises and economic sectors, ultimately to levels that are sustainable. This definition covers work in agriculture, industry, services and administration that contributes to preserving or restoring the quality of the environment while also meeting the criteria for decent work – adequate wages, safe conditions, workers' rights, social dialogue and social protection. It also covers activities related both to mitigation of and adaptation to climate change (UNEP et al., 2008).

green technology or clean technology: Technology that improves the resource or energy efficiency of production, ultimately to sustainable levels, reduces waste or increases the use of non-polluting, renewable resources (Strietska-Ilina et al., 2011).

informal economy: Refers to all economic activities by workers and economic units that are – in law or in practice – not covered or insufficiently covered by formal arrangements. Their activities are not included in the law, which means that they are operating outside the formal reach of the law; or they are not covered in practice, which means that – although they are operating within the formal reach of the law, the law is not applied or not enforced; or the law discourages compliance because it is inappropriate, burdensome, or imposes excessive costs (ILC, 2002).

initial training: Pre-employment training in the fundamentals of an occupation. It may qualify a learner for a job or provide the basis for specialization (ILO, 2006).

input-output table: A means of presenting a detailed analysis of the process of production and the use of goods and services (products) and the income generated in that production. They can be either in the form of supply and use tables or symmetric input-output tables). Supply and use tables are in the form of matrices that record how supplies of different kinds of goods and services originate from domestic industries and imports and how those supplies are allocated between various intermediate or final uses, including exports. Symmetric (input-output) tables are tables in which the same classifications or units (i.e., the same groups of products or industries) are used in both rows and columns (OECD, 2013b).

job: A set of tasks and duties carried out, or meant to be carried out, by one person for a particular employer, including self-employment (Greenwood, 2008).

low-carbon economy: An economy that produces minimal greenhouse gas emissions. Its fundamental aims are to achieve high energy efficiency, and to use clean and renewable energy via technological innovation, while maintaining the same levels of energy security, electricity supply and economic growth (adapted from RSC, 2011).

occupation: A grouping of jobs which have a repeating set of main tasks and duties across industries. For reasons of classification, occupations are grouped together into narrowly or broadly defined occupational groups on the basis of similarity in the type of work done (Greenwood, 2008).

sector skills council: A sectoral body typically made up of representatives of the main stakeholders interested in skills for the sector, including employers, workers' representatives, government ministries or agencies and providers of education and training to the sector, supported by a secretariat. Typical functions include skills anticipation, and also involvement in designing qualifications and in developing courses, coordinating collaboration between stakeholders, stimulating innovation in education and training, and sometimes an involvement in areas such as quality assurance and funding for education and training.

skill: Ability to carry out a manual or mental activity, acquired through learning and practice. The term "skills" is used as an overarching term for the knowledge, competence and experience needed to perform a specific task or job (adapted from ILO, 2006).

skills development: Understood in broad terms to mean basic education, initial training and lifelong learning (ILO, 2000).

skills for green jobs: Broadly defined "skills" (see the definition above) that are necessary for the successful performance of tasks for green jobs (see the definition above) and to make any job greener. That includes both core and technical skills and covers all types of occupations that contribute to the process of greening products, services and processes, not only in environmental activities but also in brown sectors.

skills gaps: A term to describe the qualitative mismatch between the supply of human resources and the requirements of the labour market. "Skills gaps" exist where existing workforce has inadequate skill types or levels to meet their business objectives; or where new entrants to the labour market are apparently trained and qualified for occupations but still lack a variety of the skills required (NSTF, 1998; Strietska-Ilina, 2008).

skill needs anticipation: Stands for any forward-looking diagnostics of skill needs expected on future labour markets performed by means of any type of method, be it quantitative or qualitative, including interaction, exchange and signalling between labour market actors.

skills shortage: An overarching term which stands for both skill gaps and labour shortage. Skills shortage is a genuine lack of adequately skilled individuals available in the accessible labour market with the type of skill being sought and which leads to a difficulty in recruitment (NSTF, 1998). A skills shortage characterizes the situation where employers are unable to recruit staff with the skills that they are looking for at the going rate of pay (EEO, 2001). This could result from basic lack of people (when unemployment levels are very low), significant geographical imbalances in supply (sufficient skilled people in the labour market but not easily accessible to available jobs), or a genuine shortfall in the number of appropriately skilled individuals – either at new entrant level, or for higher level skilled occupations (NSTF, 1998; Strietska-Ilina, 2008).

social accounting matrix (SAM): A means of presenting the national accounts in a matrix which elaborates the linkages between a supply and use table and institutional sector accounts. A typical focus of a SAM on the role of people in the economy may be reflected by, among other things, extra breakdowns of the household sector and a disaggregated representation of labour markets (i.e., distinguishing various categories of employed persons). (OECD, 2013a)

sustainable development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development includes three components – economic development, social development, and environmental protection – as interdependent and mutually reinforcing pillars (UN, 1987; UN, 2005).

technical and vocational education and training: Initial or continuing education and training provided by schools, training providers or enterprises that imparts the skills, knowledge and attitudes required for employment in a particular occupation, or group of related occupations, in any field of economic activity (adapted from ILO, 2013d).

expansion demand, replacement demand and total demand: Expansion demand measures the increase in the number of people employed in an occupation due to industry growth, or because of an increase in the importance of that occupation within its industry. Replacement demand measures demand which results from the net outflow of workers from an occupation due to retirement, migration or other

movements out of an occupation. The total demand for workers is the sum of expansion demand and replacement demand (US Department of Labor, 2013).

qualitative research: A method of enquiry employed to gather an in-depth understanding of processes and relationships and to answer the why and how of these. Typically, smaller but focused samples are sufficient, since the results do not claim to be statistically significant.

quantitative research: a type of research that is "explaining phenomena by collecting numerical data that are analysed using mathematically based methods (in particular statistics)". This type of research usually aims to answer the question "how many" – including "how many of which type will be required when and where?" (Creswell, 1994).

Introduction

Sustainable development has become a major policy issue for countries at all levels of development. One of the keys to making sustainable development policies successful in terms of environmental, social and economic outcomes is to ensure that the right skills are available when and where they are needed.

Sustainable development means doing things differently, and exactly what should be done differently depends on country-specific factors. Countries face different challenges and choose to respond in different ways. The present methodological guide focuses on understanding and measuring the skills implications of those challenges and response choices.

Transition to the green economy and sustainable development bring about economic restructuring and shifts in employment. New jobs and new job tasks require different skills. The key to inclusive and just transition is to help enterprises to adjust to change and to equip current and potential workforce with relevant skills in order to ensure that job losses are mitigated and those affected receive retraining. Anticipating skill needs therefore becomes critical.

Skills implications cannot be resolved overnight. Designing relevant training and putting a required number of people through this training takes time, sometimes a few years. The guide provides suggestions on how to conceptualize and conduct research to anticipate skill needs for existing and new forthcoming green jobs. It stops far short, however, of prescribing a specific method on how to meticulously calculate and plan the required workforce. Instead, the guide combines qualitative and quantitative methods for skill needs identification and briefly refers to employment projection models where linkages with qualitative approaches make sense.

Successfully identifying and anticipating the skills required for greening the economy and green jobs (hereinafter referred to as "skills for green jobs"[1]) often means that stakeholders must adapt their existing approach to skills strategies. Sustainable development drives new skills needs discontinuous with the past across a wide range of sectors and occupations. Even where a country already has well-functioning mechanisms for skills identification and anticipation, they will not always function well for green jobs. This is because transition to the green economy is a process where green jobs become a moving target, whereas related labour market information is scarce.

Providing the skills required to improve sustainability in an area of activity can create a need for a new occupation, or for a very distinctive new specialization or set of new skills within an existing occupation. Important skills required for an initiative to improve sustainability typically span a wide range of levels, from high policy, management and professional levels, through technician, associate professional, skilled craft, administrative, skilled agricultural and operative levels. In most cases, the greatest numbers required are at levels from operative to technician, but the availability of high-quality skills at higher

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[1]The term "skills for green jobs" is defined broadly as referring to all skills that are necessary for the successful performance of tasks for green jobs and to make any job greener. That includes both core and technical skills and covers all types of occupations that contribute to the process of greening products, services and processes, not only in environmental activities per se but also in brown sectors.

levels is typically also important to effective planning, leadership and implementation. A shift to a more sustainable economy may influence skills required for performing a particular occupation, even if the numbers of jobs in the occupation remain unchanged. Similarly, a shift to a greener economy may generate the increased demand for certain occupations without altering their skills composition.

Identifying current and anticipating future skills for green jobs requires the conduct of research and analysis. The range of related research questions is wide. Research may look at the whole economy, at particular sectors, occupations, or just at the specific skills required by a government or other stakeholders to implement specific initiatives. Its focus may be at national, supranational or subnational levels. It may look at skills requirements in terms of occupational categories or in terms of the technical and core skills required. It may quantify the skills required, or look mainly qualitatively at skills requirements and how these meet the needs of sustainable development, or indeed combine quantitative and qualitative analyses. It may look just at skills requirements, or also focus on sources of skills supply, such as the provision of education and training in relevant fields, drafting adequately skilled workers from elsewhere in the economy or through inward migration.

The variety of questions involved in research into skills for green jobs requires diversity in research approaches too. For this reason, the approaches that the present guide advocates represent more a menu of possible approaches than a single prescriptive methodology. The selection of a specific method will depend on research objectives and specific questions (see table 1.1).

The guide has been prepared primarily with the needs of ILO technical assistance in mind. In addition to providing technical assistance, it can also be used as a resource to support the transfer of knowledge on skills anticipation from the ILO to country-level institutions, and as a capacity-building tool. The guide has the following structure:

Sectiion 1: Identifying research question(s) and linking them to a methodology
- How many jobs? What skills and occupations are needed? Which training and education?
- Which methodologies (qualitative, quantitative, both) are appropriate to answer the research questions(s)?

Section 2: Defining and classifying green jobs
- How to define green jobs and green occupations and how to delimit a sector?

Section 3: Choosing data sources
- What data sources are appropriate, e.g. labour force surveys, enterprise surveys or interviews?

Section 4: A "whole economy" research approach
- Step by step guide to research skills needs in the overall economy

Section 5: A sector specific research approach
- Step by step guide on research aiming at skills anticipation at sector level

Section 6: Research Process
- Recommendations on how to undertake the research in an ILO technical assistance context

Section 7: Institutional arrangements for skills identification and anticipation
- Which institutional setting is appropriate to anticipate skills for sustainable development?

Section 1: Identifying the research questions

1.1   Introduction

It is important, when planning research into skills for green jobs, to be clear about the research questions to be answered. In some cases, defining the scope of the research may be straightforward. In other cases, it may require both significant consultation with stakeholders and significant consideration by researchers and by organizations commissioning research.

There is no single correct set of questions to answer on the issue of skills for green jobs. In practice, researchers address diverse questions shaped by policy priorities, institutional issues and limitations on data availability. Likewise, a study may be at national, supranational or subnational levels. It may address skills for green jobs across the economy as a whole or in one or more economic sectors.

1.2   Types of skills question

There are a number of major types of question that arise. Each of these questions may be posed at the level of the whole economy in the geographical area under consideration, or at the level of specific sectors.

The key types of skills-related questions are as follows.

- How many jobs are involved, now and into the future? This question is relevant to areas of job growth, areas of job loss, and areas where net changes in employment are likely to be minimal.

- What skills are required, now and into the future? Questions about skills can be quantitative, qualitative or both. Answers to quantitative questions about skills frequently use occupations as a good proxy for skills.

- What training and education is required, now and into the future? Again, questions can be quantitative, qualitative or both.

How many jobs are involved, now and into the future?

In general, this question is posed at up to three levels – direct employment, indirect employment and induced employment. Direct employment refers to the numbers employed in the activities studied. Indirect employment refers to employment among suppliers and elsewhere in the value chain as a consequence of the activities studied. Induced employment refers to employment in the wider economy that arises from spending by those employed directly and indirectly.

All three levels are relevant in cases where the main policy interest is in measuring the overall employment impact of the transition to the low-carbon economy, although the complexities and added effort involved in producing a well-founded estimate of induced employment may persuade policymakers that they can settle for measures of direct and indirect employment.

Table 1.1 Overview of major questions in research into skills for green jobs

		Some key headline questions	Whole economy	Sector
Jobs	Quantitative – direct	How many direct jobs now and in the future?		
	Quantitative – indirect	How many indirect jobs now and in the future?		
	Quantitative – induced	How many induced jobs now and in the future?		
Occupations and skills	Quantitative	How many people in each occupation? What is the resulting demand for skills?		
	Qualitative	What occupations? How should they be defined? Where are the boundaries between occupations? What skills and competences? How do these relate to occupations?		
Training and education	Quantitative	What is the existing stock of people with the right skills and training available to be recruited? What is the current flow of newly trained people available to be recruited? What flow will be needed in future to cover the new vacancies and to replace workers who leave the jobs? How many people who are affected by job losses will require retraining?		
	Qualitative	What sources of skills are available? What types of training and education are needed to meet the demand of green jobs and to improve employability of people who lose their jobs in the greening process? How can the skills be provided?		

If the questions that interest researchers are primarily about estimating job numbers, and do not also look at skills, occupations, training or education, then they should not use this guide. They should instead use the ILO practitioner's guide to assessing green jobs potential in developing countries (Jarvis et al., 2011) and the related policy brief on methodologies for assessing green jobs (ILO, 2013g). At the same time, the ILO is propagating the integrated approach between jobs and skills assessments. The discussion on how skills needs assessments could be included in green jobs assessment practices may be found in subsection 4b below.

What skills and occupations are required, now and into the future? How many people per occupation?

These questions have both quantitative and qualitative aspects, and for most purposes relating to the transition to the low-carbon economy, a good answer must respond to both. The right balance between the two varies, however. Figure 1.1 provides types of situations of changing occupational demand with examples.

Figure 1.1 Quantitative and qualitative questions on occupations and skills

Changing need for existing occupations
- For some areas of skills people in well-defined existing occupations are required, with or without some specialized knowledge relevant to implementing the green transition
- Examples may include increased demand for occupations in public transportation in the case of foreseen invesments in the sector as part of a greening economy measure
- The primary questions are quantitative – how many people will be in employment and how many new entrants will be in demand for the occupation?

Changing occupations
- For some areas, the requirement is for people who fit quite well into one or more existing occupational classifications, but who require a skill set that differs significantly from that of people doing more traditional work in those occupations.
- Examples include green plumbers and green electricians, whose skills set focus on installing technologies, such as solar water heating or solar photovoltaic systems, and skills in water and energy saving techniques.
- In these cases, both quantitative and qualitative questions are important

Newly emerging occupations
- Some skills areas require people with new sets of skills that amount to new occupations.
- Examples include energy management and carbon accounting. Another example is that of specialist solar water heating installers, whose skills set is focused on particular areas within plumbing, as well as more structural skills in areas such as roofing.
- In these cases, good qualitative research is highly important, although it is best if some effort is made to quantify the requirement too.

New skill needs across occupations
- In some areas of skill, there is a need for existing skills to be supplemented.
- Examples include the economics of sustainable transport for road engineers, carbon management for operations managers, or balancing heating systems for plumbers and heating engineers. Other examples include core skills that may be relevant across a wide range of occupations, such as environmental awareness and risk analysis of systems.
- In these cases, good qualitative research is key. If new skills requirements in the relevant area can be built into existing initial education and into existing systems of continuing education and training, there may never be a need at policy level to determine the numbers requiring skills development.

As it is challenging for a single piece of research to achieve the right balance of methods, it is important that researchers and commissioners of research explicitly consider what their priorities are at the research design stage.

The nature and scope of research are likely to be different depending on whether the focus is at the level of a sector or the whole economy. Research focused on the whole economy is unlikely to be capable of addressing each sector as deeply as in a typical skills sectoral study. Only the latter could bring detailed knowledge of specific skills and competences required on the labour market in a given sector.

At the same time, analysing the whole economy through sectoral perspectives, there is a risk of aggregating too different summands, and that the sum will not represent the total. This may result in missing or misinterpreting the skills requirements in certain segments of the economy, such as government and public administration. A combination of quantitative and qualitative research focused on the entire economy level might be more suitable in such case.

What training and education is required, now and into the future? How many people are trained or need to be trained?

Again, these questions have both quantitative and qualitative aspects, and the right balance between the two varies. The most important policy reason to identify skills is to trigger and inform responses through education and training.

The information needed from skills research varies depending on the institutional arrangements for course design and development. Where there are arrangements for the continuing development of courses in place (as, for example, in Denmark or Germany), it may only be necessary for skills research to provide broad guidance about the changes under way, what the emerging skills requirements are and how many are likely to be required. Where existing processes for course development are not as well developed as in those countries, there may be a need for skills research to provide very detailed guidance. At the level of technical and vocational education and training, this guidance is often undertaken in the context of initiatives to develop new qualifications, and in the context of systems to update existing qualifications.

Various parts of the education system should be taken into account, i.e., all levels of initial education and also continuing vocational training and other forms of adult education. The actions undertaken to meet the education and training needs vary from the development of completely new qualifications to introducing a short-term non-formal training programme for people in a specific occupation. When considering training needs, the researchers should look not only at the identified skill needs but also at the current skills needs of the workforce and population and at what can be done to link them better to the identified skill needs.

1.3 Matching skills research questions to strategies, visions and policy measures

Skills development strategies can only efficiently address labour market needs when they are linked to broader national or sectoral strategies (ILC, 2004; ILC, 2008). Earlier research by the ILO showed that skills policies and environmental policies are still often dealt with in isolation with a lack of coherency and coordination (Strietska et al., 2011). In order to be useful and meaningful, research into skills for green jobs has to be linked to specific strategies, and to the specific activities that will be required for those strategies to be successful.

Useful sector-level research in skills for green jobs is typically linked to some sort of strategy or vision for developing the sustainability and greening production practices of the sector into the future. In some cases, there is an existing plan or vision that the research can use as its starting point. In some cases, skills research is undertaken as part of the process of producing the plan.

It is important to understand that formulating a sectoral strategy for sustainability is beyond the scope of the present guide. The first task therefore would be to identify strategic documents, available or under preparation, which could become a useful framework and a starting point for a skills implications analysis. In some cases, however, there is no existing formulated plan or vision, and skills researchers have to produce a foresight (or a vision, an outline strategy) of what the future might look like as a preliminary step to working through the skills implications.

Even if there is no detailed strategy at the sectoral level, a country may have some more general strategy or vision for sustainable development (including strategies of adaptation, mitigation or resilience to climate change) at the national level that has some influence on different sectors. Similarly, a cross-

sectoral skills demand or that of the whole economy may be influenced by strategies and plans in each significant sector.

Examples of types of strategies that may drive a skill needs analysis include the following.

- Linking spending to skills demand: For example, a United States federal government stimulus spending package, the American Recovery and Reinvestment Act, directed funds towards a number of areas, including clean technology. The clean technology spending was split between many different projects in different sectors. To support and evaluate the initiative, the Political Economy Research Institute was engaged to estimate the number of jobs that would be created, the occupational categories in which they would be created, and the consequential training needs (ILO, 2011).

- Linking a major investment project to skills demand: For example, the Desertec Foundation is promoting the creation of large-scale solar energy projects in the Maghreb. The investment plan determines skills development requirements and subsequent training objectives.

- Linking market-based incentives to skills demand: For example, there have been initiatives in many countries to incentivize the retrofitting of homes and other buildings with energy-saving technologies such as wall insulation, roof insulation and heating controls, and in building, scaling renewable energy technologies such as solar thermal water heating. These initiatives typically have targets for the amount and types of activity that they will generate which can be used as the basis for projections of the quantity and type of skills that will be required. In practice, the volume of activity is hard to predict, so a set of scenarios based on the plan is usually more useful than a single prediction.

- Linking the planned transformation of an electricity or energy sector to skills demand: Many countries are undergoing transitions from fossil energy to renewable energy in electricity generation. While many of the individual investment decisions are made by private businesses, relevant ministries, regulators and grid operators often possess quite detailed and reliable profiles of planned future investments, both by public utilities and private operators. For example, Finland carried out an engineering study to model its energy system (the Policy Analysis – or POLA – model) for wider policy purposes. The Finnish Government Institute for Economic Research (VATT) has used this to model the skills impacts of change (ILO, 2011).

- Linking strategies based on adoption of standards or targets to skills demand: A key type of strategy used to improve sustainability across many sectors and countries is to use standards to drive improvements in practices. This may be through promoting the adoption of standards significantly stronger than the legal minimum (for example by adopting Marine Stewardship Council standards in fisheries), through making the legal minimum more demanding (for example through stronger requirements for insulation in

Box 1.1: Identifying and estimating green jobs in Indonesia

The study estimated the numbers of core environment-related jobs and green decent jobs in agriculture, foresty, energy, manufacturing, transport, construction and fisheries and in related subsectors.

The green jobs mapping study applies a mixed method approach that incorporates techniques such as the collection of qualitative data from key informants and focus group discussions, along with an analysis of quantitative data from the National Labour Force Survey (SAKERNAS). The methodology consisted of the following steps:

1. Understanding the structure of the economy and its links to employment as per the international standard classification of industry.

2. Each sector of the economy was then examined to determine the particular subsectors that are strongly integrated with the environment. In Indonesia it was determined that there were nine core sectors where green jobs were clustered, namely, agriculture, forestry, fisheries, mining and energy, manufacturing, construction, transport, tourism and waste.

3. Green subsectors that exist within these parent sectors were determined through a combination of focus group discussions with key focal points from each sector, together with a thorough literature review of national laws and regulations, voluntary standards and activities that are associated with each sector. Criteria for determining sustainable activities within an identified subsector were established.

4. The labour force survey was used to generate estimates for environmentally sustainable employment within each green subsector.

5. Estimating green jobs involved the introduction of criteria to provide insight on employment quality or what is known as "decent work". Focus group discussions with the ILO's constituents focused on adequate earnings, formality, safe working environment, access to social security, social dialogue and employers' and workers' representation in each green subsector. Estimates for green jobs were then derived using a combination of insights collected from focus group discussions and data from the labour force survey.

6. Finally, the programme targeted the development of a strategy on skills for green jobs that can fully reap the benefits of a greener economy.

Similar green job mapping studies have also been undertaken in Bangladesh, India (state of Gujarat), Malaysia, Mongolia, Nepal, the Philippines, Sri Lanka and Tunisia.

Source: ILO, 2013f

building regulations), through more effective enforcement of the legal minimum, or through a voluntary decision by a sector to adopt tougher standards for emissions reduction. The skills implications are typically a mix of retraining of the current workforce across a range of occupations, changes to initial education and training across a range of occupations, and specialist training for professionals who will lead the change and for assessors or inspectors who will ensure high-quality compliance.

- Linking enterprise development strategies to skills demand: For example, the Irish Government followed a strategy report on developing the green economy in Ireland (Forfás, 2009) with a study on the future skills needs of enterprise within the green economy in Ireland (EGFSN, 2010), focused on the skills required for enterprise development. The research approach taken was qualitative.

Not all the skills requirements that arise from improving sustainability follow from plans such as these. Some arise from market opportunities and cultural norms. Studying the skills implications of market-driven developments is potentially useful, but only a small minority of studies on skills for green jobs study them in detail.

This appears to be mainly because:

- Detailed sectoral skills studies are most often triggered by the need to ensure the availability of labour for specific initiatives.

- The changes in skills requirements are often part of a wider pattern of incremental change whose skills implications are handled mainly through decentralized arrangements for skills anticipation (such as contact between industry and providers of education and training) without a need for interventions based on policy-driven research.

- Data problems typically make the skills implications hard to study quantitatively without substantial new enterprise survey work.

Overall, therefore:

- Most frequently, sector-focused skills studies concerned with green jobs can take existing plans as the starting point for the analysis.

- The types of plans from which they start are diverse, and skills researchers have to be sensitive to their differences when designing their research approach.

- Where the research does not start from an existing plan, in some cases it may be necessary to produce a foresight (a vision, an outline strategy) acceptable to policymakers and other stakeholders.

- Where there is no existing plan, qualitative research into what experts, industry and other stakeholders believe is required is a feasible approach to research.

- Skills research is not always necessary. In some cases, particularly where changes in skills needs are incremental, stakeholders such as employers, workers' representatives and providers of training and education can manage change on a decentralized basis, including workplace learning arrangements.

1.4   Levels of analysis and scope of research

An important issue to address is the level and scope of the study.

Will the study be:

- at national level?
- at sector level?
- for a supranational grouping of countries?
- for a subnational area within a country?

Figure 1.2 Levels of analysis in skills research
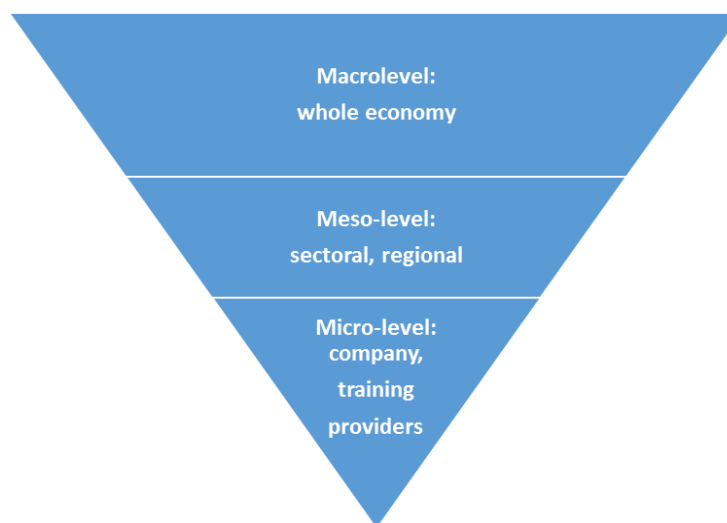
The scope of analysis involved in skills research is wide, ranging in level from researching and modelling the relationship between macroeconomic developments and macrolevel workforce requirements to understanding the practical training implications of developments arising from organizational or technological change in a particular narrow type of business.

The level (or levels) on which research focuses varies depending on the research questions posed, and on other factors that may include data availability and the resources available to the project.

Questions about the overall employment impact of the transition to the low-carbon economy require macroeconomic analysis to explore issues such as the impact of green stimulus spending, the impact of changes in relative prices arising from taxation of carbon, or the impact of energy-related subsidies or mandates. Questions about the employment impact of specific measures, whether at sector level or across the economy, also require analysis beyond the sector level to identify wider employment effects through the supply chains of businesses in the sector (indirect employment) and through the wider effects of consumer spending by those employed in businesses in the sector and in their supply chains (induced employment).

Most questions about skills anticipation in the transition to the low-carbon economy require significant research at sector level, although the focus and scope of the research vary depending on the question.

Figure 1.3 shows how the different components that may go into a skills-for-green-jobs model fit together. Most practical models will only use some of the components shown. Every economy is made up

of a number of sectors, in addition to consumers. The economy in figure 1.3 has n+m sectors. Of these, m sectors are partly green and n sectors have no specifically green component industries. Researchers have a choice as to how to treat partly green sectors. They can either split each one into a green synthetic sector and a non-green synthetic sector, or they can choose to analyse each as a whole. For example, researchers could choose to split the electricity sector into a green renewable sector and a non-green "rest-of" sector, or could decide to analyse the whole sector together. The whole-sector approach typically requires more detailed sector level analysis and modelling.

Interactions between sectors are modelled through some form of sectorally-based macroeconomic model. In general, researchers can choose between using an input-output model, a social accounting matrix model (SAM), a dynamic social accounting matrix model (DySAM) or a computable general equilibrium model. There is no single correct choice.

Figure 1.3   Overview of quantitative methodologies
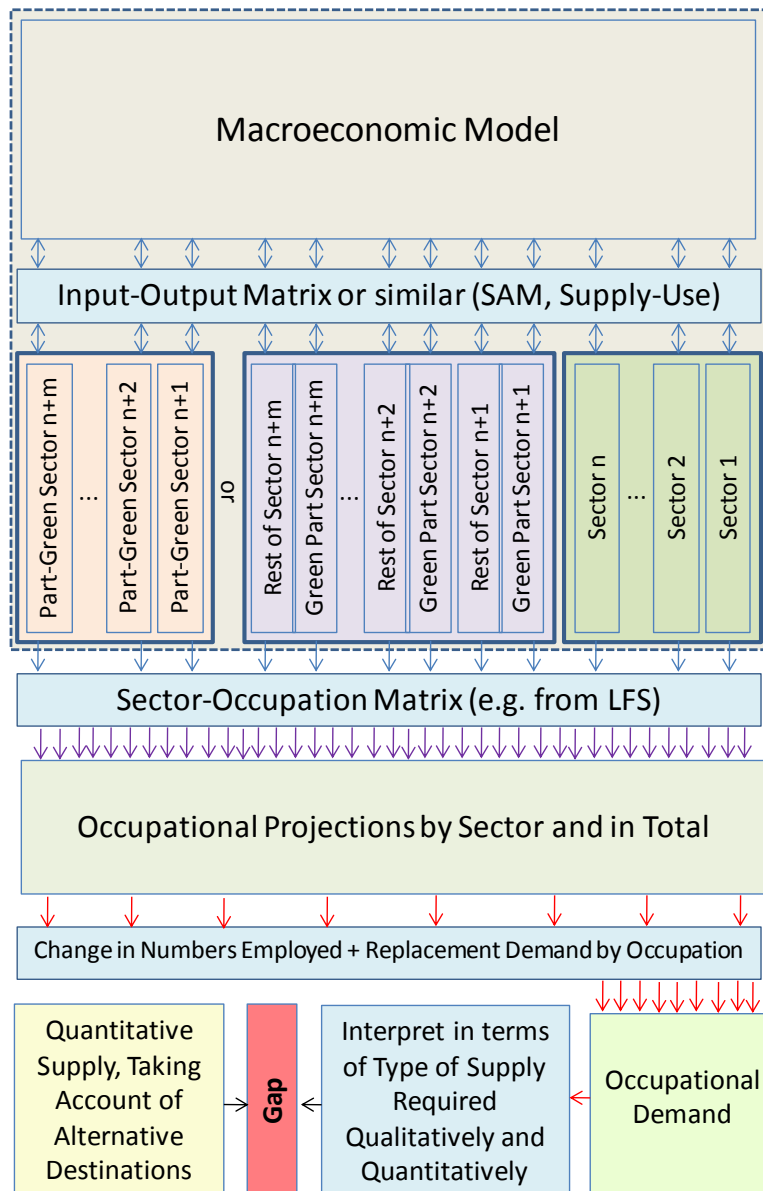
A macroeconomic model can be used to estimate numbers of jobs influenced by the green transition (see subsection 1.5.1), for a quantitative analysis of skills at the whole-economy level (see section 4) or as the background for a sector-based analysis to feed the sector study with quantitative information on the sector in the context of other sectors (see section 5).

1.5   Linking research questions to research methods

This subsection provides an overview of quantitative and qualitative methodologies suitable for research on skills anticipation for the low-carbon economy (see table 1.2). Not all these methodologies have to be used in every research project addressing a type of question; some depend on the level of analysis (whole economy or sector-specific), others are most useful under specific conditions (such as, for example, where statistical systems are weak and it is necessary to obtain data from alternative sources). Most research projects use a combination of different methods.

Research projects on skills anticipation for the transition to the low-carbon economy are usually interested in more than one type of research question. In most cases, where a type of methodology is listed under more than one question, one research activity can address several questions. For example, there is no need for more than one DySAM to address the "how many jobs" questions. In many cases, on the qualitative side, the same sources of informed opinion can be consulted for information and views on a range of types of research question.

Table 1.2 Skills research questions and appropriate types of methodology

		Main types of appropriate methodology	
Level of question	Type of question	Quantitative modelling	Qualitative
Jobs	Quantitative: How many direct jobs?	Models tailored to sector, scenarios DySAMs, computable general equilibrium (CGE) models, synthetic sectors	Scenarios, establishment surveys, informed opinion, case studies, sectoral studies, secondary research
	Quantitative: How many indirect jobs?	Input-output methods, input-output models, SAM and DySAM models, CGE models synthetic sectors	Establishment surveys, case studies, informed opinion, secondary research
	Quantitative: How many induced jobs?	Input-output methods, input-output models, SAM and DySAM models, CGE models	Informed opinion on labour market conditions
Occupations / skills	Qualitative: occupation questions		Informed opinion, consulting specialist knowledge, establishment surveys, case studies, content analysis of job adverts, occupational descriptions, secondary research

			including trends abroad
	Quantitative:– occupation questions	Sector-occupation matrices, trends	Case studies, establishment surveys, informed opinion
	Qualitative: skills questions		Consulting specialist knowledge, surveys on competences, informed opinion, secondary research including research of trends abroad
Training and Education	Qualitative: training and education questions		Informed opinion, consulting specialist knowledge, data on employability of graduates, analysis of current curricula
	Quantitative: training and education questions	Modelling future supply of graduates by type of education and training	Collecting or surveying for data on enrolments and graduates, tracer studies, trends of employability of graduates by type, informed opinion

Source: Adapted from ILO, 2011a

1.5.1 Answering quantitative questions about jobs

Direct jobs

Answering questions about the number of direct jobs now and into the future generally requires a combination of quantitative and qualitative approaches.

When approached at sector level, it is generally necessary to estimate current employment in the sector of interest. In countries with strong statistical systems, this is usually best approached in the first instance through using standard statistical sources such as labour force surveys and establishment surveys, while in countries with less well-developed statistical systems, particularly those that are developing and emerging, it is necessary to rely more on qualitative methods.

In almost all cases, projecting direct employment into the future at the sector level requires a heavy reliance on qualitative methods. Depending on the approach taken, quantitative modelling methods may also have a significant role. Future employment in green sectors cannot be modelled satisfactorily beyond a small number of years based only on continuing historical trends and relationships into the future. It is necessary to form a view on the future in terms of issues such as future demand, labour productivity, technological developments, effects of international competition, regulatory developments, labour costs, and the cost of energy and carbon, among others. Scenario methods have an important role to play in this, where projections look beyond a small number of years into the future. In some cases this may result in a single central scenario; in others, a baseline scenario and a scenario based on meeting decarbonization objectives may be described.

In countries where dynamic macroeconomic models (such as DySAM and CGE models) exist and are accessible to researchers, there is scope to model demand dynamically, taking account of prices and other interactions with other sectors of the economy. This is desirable where the objective is to take a whole-economy view; if the research question is just about the specific sector being modelled, however, researchers may reasonably decide that the benefits to doing this are outweighed by the disadvantages

of much greater model complexity. Suitable macroeconomic models exist for most developed countries, but will not always be accessible to researchers. They also exist for some developing countries; for example, the ILO commonly develops country DySAM models as part of the assistance that it provides to developing countries: recent examples include Indonesia, Malaysia and Mozambique.

Indirect jobs

Most practical research questions on skills for the transition to the low-carbon economy concern not just direct employment in the core sector or sectors under consideration, but also in sectors that sell to them, or in some cases buy from them. The standard approach to estimating a sector's impact on employment in other sectors is to use a model incorporating an input-output table for the economy, such as an input-output model, a SAM model or a CGE model. At its simplest, this is a purely quantitative approach which models the impact that increased activity in the sector of interest will have on other sectors based on the existing relationships between their activity encapsulated in an input-output table for the economy. Projections of future output in a sector studied in detail can be used to generate projections of related output in other sectors, which can be converted to projections of indirect employment.

In practice, however, qualitative analysis is required to inform the quantitative input-output analysis in most cases in the context of the transition to the low-carbon economy. Sectoral definitions of green sectors often do not match standard sector definitions, and new economic activities arise; it is necessary to use information from qualitative methods such as surveys, case studies or informed opinion to assess whether they can be treated as if their impact was the same as that of the broader sector of which they form a part, and, if not, what changes should be made if the analysis is to be plausible. Similar issues arise where input-output tables are out of date, where the relationships encapsulated in input-output tables are changing in a way that may be predictable, or where input-output tables are only available at a high level of sectoral aggregation. Similar qualitative methods are required to address these issues. As the issues are more common in developing economies than in developed economies, qualitative methods should often have a more prominent role in developing countries.

Input-output tables are published for all developed countries, and exist at some level of detail for most developing economies. The Organisation for Economic Co-operation and Development (OECD) regularly publishes input-output tables for a number of countries.2 In case of missing data for a particular country or region, input-output tables from another country in a similar social and economic condition can be used, for example, for its study in the region of Ontario, the Political Economy Research Institute used the national Canadian input-output tables (ILO, 2011a). As with direct jobs, however, even in the complete absence of standard statistical data from official sources, sectoral establishment surveys may be used in place of standard statistical sources, making it possible even for developing countries with weak statistical systems to quantify employment in green sectors.

Induced jobs

Estimating induced employment is seldom directly useful in anticipation of skills for the transition to the low-carbon economy. While some skill researchers do estimate induced employment, it occurs in such a diverse range of sectors and occupations that it is difficult to identify specific skills implications that could form the basis for a policy response.

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2 www.oecd.org/sti/inputoutput

The main reason for estimating induced employment is that it is useful in assessing the effects on employment. Researchers interested in estimating the impact of a policy initiative or a change in the economy only get a full picture if they take account of direct, indirect and induced employment.

Calculating induced employment is primarily a quantitative modelling exercise, although it may require some qualitative inputs on labour market conditions.

1.5.2 Answering questions about occupations and skills

Qualitative questions about occupations

Qualitative questions about occupations form an important part of skills research relating to the transition to the green economy. Questions about new occupations that are emerging, new specializations in existing occupations, and new skills and knowledge requirements becoming core to existing occupations are the focus of significant research. Much of this is about how occupations should be defined, and where boundaries should be drawn.

Research methods used to answer these questions are almost entirely qualitative. These broadly fall into three groups:

- methods such as interviews, focus groups, workshops and, potentially, Delphi methods designed to tap informed opinion and expert knowledge about occupations

- enterprise-focused survey and case-study methods designed to capture information about occupations and their skills content systematically

- content analysis of job advertisements or of responses to surveys that ask for textual descriptions of job tasks (although issues of confidentiality may limit access to the latter in the case of official surveys)

Many education and training systems have well-established processes in place to enable them to be responsive to new and changing skills needs. Skills researchers mostly need to get involved in research at this level, where there is a concern that providers may not be sufficiently responsive, may not be equipped to look sufficiently far ahead, or may need external direction or additional resources to respond.

Quantitative questions about occupations

To be useful for skills analysis, projections of employment must be disaggregated by some measure that may serve as a proxy for skill. The usual approach is to disaggregate by occupation. In principle, it is possible to disaggregate by level of educational attainment, but such data are usually used to add depth to an analysis mainly based on occupation.

Employment projections are converted to occupational employment projections for the sector through a sector-occupation matrix setting out the occupational composition of each sector modelled. This is usually based on an analysis of labour force survey data from the national statistical office.

Future employment by occupation can be estimated by applying the current occupational composition of the sector to future employment. It is possible to improve upon this by identifying stable trends in occupational composition from past labour force survey data, and using these to project future

occupational composition. Given projections of future employment by occupation, it is possible to project demand for additional people based on the projected change in numbers employed, and on a reasonable estimate of the number who will need to be replaced each year.

In practice, however, it is usually better to complement quantitative methods with qualitative methods.

Methods such as case studies and establishment surveys are required to identify the occupational composition of synthetic sectors that do not fit standard sector classifications, particularly where there is reason to conclude that the occupational profile of a green synthetic sector is different to that of the wider sector of which it forms a part.

Qualitative methods such as case studies and consulting with informed opinion have an important function in interpreting occupational projections. Some types of jobs important to the transition to the green economy are capable of being filled by people from more than one occupational background (for example, different types of technician or skilled manual occupations), and a good presentation of results from modelling should reflect this in addition to the raw numbers. In some cases, it may be desirable to model new occupations or specialized sub-occupations, and this requires investigation using qualitative methods.

In some countries, in particular developing countries, data on the occupational structure of sectors will not be available, or will only be available at a high level of aggregation, or will be out of date. In these cases, methods such as case studies or establishment surveys can be used to bridge the gap.

Quantitative analysis and the modelling of trends in the occupational composition of sectors benefit from a qualitative understanding of the changes and what drives them; this may give advance warning of changes in the trends. Methods including case studies and consulting expert opinion can be used.

Qualitative questions about skills and competences

Most questions about skills and competences are qualitative in nature, and have little or no connection with quantitative modelling. Appropriate methodologies depend on the depth of information required.

A description of the competences required for a type of job that is sufficiently detailed to guide the design of a course generally requires a systematic process of consulting people with specialist knowledge, in some cases supplemented by a detailed survey designed to gather detailed information about current competences and competence gaps. The process may be recursive, with a number of rounds of comments from experts, leading to improvements.

Research may be supplemented by content analysis of job descriptions and job advertisements. Occupational databases from other countries (such as the United States Occupational Information Network – O*NET[3]), used with caution and avoiding direct adoption, can provide a good background knowledge for further consultation with experts (see box 1.1).

A description of skills, competences and gaps sufficient to give an overview of important skills, of trends in competence requirements, and of major deficiencies can be accomplished by consulting expert opinion

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[3] http://www.onetonline.org/.

in a less rigorous way, whether through interviews, focus groups, workshops or other techniques, or through a combination of approaches.

> Box 1.1: Identifying green occupations in the building and tourism industries in Thailand based on analysis of skill standards from around the world
>
> The research into selected priority occupations in tourism and construction was conducted using three major research techniques:
>
> - review of published and unpublished materials
> - interviews with key informants – experts from the Department of Skills Development, Ministry of Labour, industry representatives from the construction and tourism industries
> - analysis of skills standards from around the world
>
> By analysing the skill gaps and needs of selected priority occupations, the research identified so-called "green competences" to transform these occupations into green jobs. Based on a review of the international experience, the research suggested a methodology for the creation of a taxonomy of potential green jobs that have emerged as a result of technological change, new environmental management processes designed to respond to climate change and new institutional regulatory frameworks and processes.
>
> Source: Esposto, 2015

1.5.3 Answering questions about training and education
Qualitative questions about training and education

Qualitative questions about education and training mostly require qualitative research methods. These questions are varied, and entail different research approaches depending on the question and on the country context.

Where there is a simple one-to-one relationship between a particular type of course and a particular type of job, this simplifies the investigation. In many cases, however, businesses recruiting for a particular type of job will accept people with different qualifications and from a range of backgrounds, and graduates from a particular education or training course will go to a range of different types of job in a variety of sectors.

The extent to which this happens varies between countries and between types of job. Added to which, employers for a new type of job frequently start by recruiting people from a range of backgrounds, but may later recruit mainly from specialist courses once these have been established. As many types of jobs relevant to the transition to the green economy are new in some respects, and may be changing quickly, the extent to which jobs and courses are tightly matched may be weaker than for longer established areas of activity.

Understanding these issues helps to identify what types of existing courses are most relevant to supplying the skills needs of the sector being researched. Key research approaches include consulting those with informed opinion (employers, workers' representatives and providers of education and training), and where possible cross-checking what they have to say against data on the employment of

graduates and tracer studies (first destination and longitudinal) and against survey evidence on the qualifications held by those employed in relevant occupations (which is typically available from labour force surveys).

Quantitative questions about training and education

Data on education and training may be obtained from sources of various types:

- Some data are compiled by international organizations such as OECD and the United Nations Educational, Scientific and Cultural Organization (UNESCO), typically using the international standard classification of education (ISCED) coding system. The statistical office of the European Union, Eurostat, prepares education statistics for the Union also based on the ISCED system. International organizations also compile data on continuing education and training and lifelong learning that may be relevant.

- Depending on the country, national education and training systems, national statistical offices, qualifications bodies and education and training observatories prepare national or institution-level statistics on the provision of education and training. In some cases, they follow ISCED coding systems. In many cases, however, they also prepare statistics using coding systems better adapted to the specific design of their own education and training systems, which may provide a more informative statistical description of provision, at the cost of less comparability with other countries.

- In many cases, behind national statistics there is a database of course-level statistics which may be accessible to researchers. This can be an invaluable resource, allowing researchers to compile statistics on the specific courses most relevant to the skills requirement that they are researching. The detailed information on specific courses required to do this is either available online or, failing that, may be obtained by contacting providers directly. The ability to do this is important for detailed research into the skills required for the transition to the low-carbon economy, as most standard coding systems do not go into enough detail to allow specific types of green jobs to be matched with specific courses.

- Even where no suitable statistics are compiled nationally, researchers are likely to be able to compile statistics by submitting enquiries to individual providers of education and training, or in some cases to groupings of providers. As these enquiries are most likely to be successful if well targeted, preliminary research with employers, workers' representatives and others familiar with the provision of the relevant education or training is generally required.

The future supply of graduates can be modelled for a period into the future by taking account of the current student and trainee population, and discounting for likely rates of non-completion. This can be an entirely quantitative exercise, based on historical non-completion rates, or it can also take account of qualitative information on factors that may change non-completion outcomes, such as retention initiatives, changes in labour market conditions or changes in staff–student ratios. Longer-term projections should take account of factors such as planned changes in the number of students admitted, expectations regarding the likely relative popularity of courses among potential applicants, any likely changes in funding arrangements and demographic changes in the size of the cohort of potential students.

When modelling supply, most skills researchers do not go beyond stating past, current and future numbers of graduates from relevant education and training courses. It is possible in principle, however, to make deductions to take account of graduates going to other destinations, and also to take account of complementary sources of skills that may have been researched in less detail, when estimating the supply of suitable graduates.

If the data on graduates are not available or are not of sufficient quality, an alternative approach is to focus on changes in stocks of population by the field of education and level attained and its changes over time. This information is available from the labour force survey in some countries. It usually does not allow a very detailed breakdown but enables identification of the main trends.

Section 2: Issues of definition and classification in green jobs

2.1 Introduction

There is no universally agreed definition of what a green job is. Translating any existing definitions into an operational definition that can be used for skills research is a complex matter. This section explores those complexities, and provides researchers with advice on how to apply the ILO definition in research. It provides two frameworks for skills research – one a general framework that can be used in skills research in any context, and the other a more detailed framework that highlights the complexities of quantitative research into skills for green jobs.

Research into green jobs faces complex issues of classification of sectors and occupations that arise because of a lack of direct correspondences between standard sectoral or occupational classifications, and the definitions of sectors or occupations in ways that distinguish between green and non-green jobs. This section also explores these issues, and gives advice to researchers on how to address them.

Although the term "green skills" is used widely outside the ILO context, there is little consistency in the meanings assigned to it. Sometimes it is used to refer to core skills such as environmental awareness, sometimes to technical skills relating directly to the environment, sometimes to skills in green technologies, sometimes to skills for green sectors or green processes. The term "skills for green jobs" is much broader, as it covers both core and technical skills for all types of green jobs. This is the term preferred here and in other ILO reports on skills for sustainability, to avoid the risk of ambiguity and confusion.

2.2 Defining green jobs

The ILO defines "green jobs" as follows.

> Green jobs are defined as jobs that reduce the environmental impact of enterprises and economic sectors, ultimately to levels that are sustainable (UNEP et al., 2008).

It elaborates on the definition as follows:

> This definition covers work in agriculture, industry, services and administration that contributes to preserving or restoring the quality of the environment while also meeting the criteria for decent work – adequate wages, safe conditions, workers' rights, social dialogue and social protection. It also covers activities related both to mitigation of and adaptation to climate change. This is a working definition. It implies in its inclusivity and breadth that every job can potentially become greener. As time goes on and the transition to a green economy intensifies, what is considered a green job today might not continue to be regarded so. The understanding of green jobs also varies from one country to another. Ultimately, countries will need to compose their own national definitions and set thresholds for practices considered green or non-green (UNEP et al., 2008, Strietska-Ilina et al., 2011).

While the definition and elaboration provide a very good qualitative description of what may be considered to be a green job, neither this definition nor other available definitions provide

comprehensive guidance as to how to count green jobs, and how to distinguish statistically between green and non-green jobs.

At the nineteenth International Conference of Labour Statisticians, participants adopted new guidelines for the statistical definitions of employment in environmental sectors (ILO, 2013h). In these guidelines, employment in environmental activities is defined as follows:

> Persons employed in the environmental sector comprise all persons who, during a set reference period, were employed ... in the production of environmental goods and services. In addition ... this includes workers whose duties involve making their establishment's production processes more environmentally friendly or more efficient in their use of natural resources (ILO, 2013h).

Green jobs are a subset of employment in environmental activities that meets the requirements of decent work. The relation between total employment, green activities and decent work is shown in figure 2.1.

Figure 2.1 Relationships between total employment, employment in environmental activities and decent work
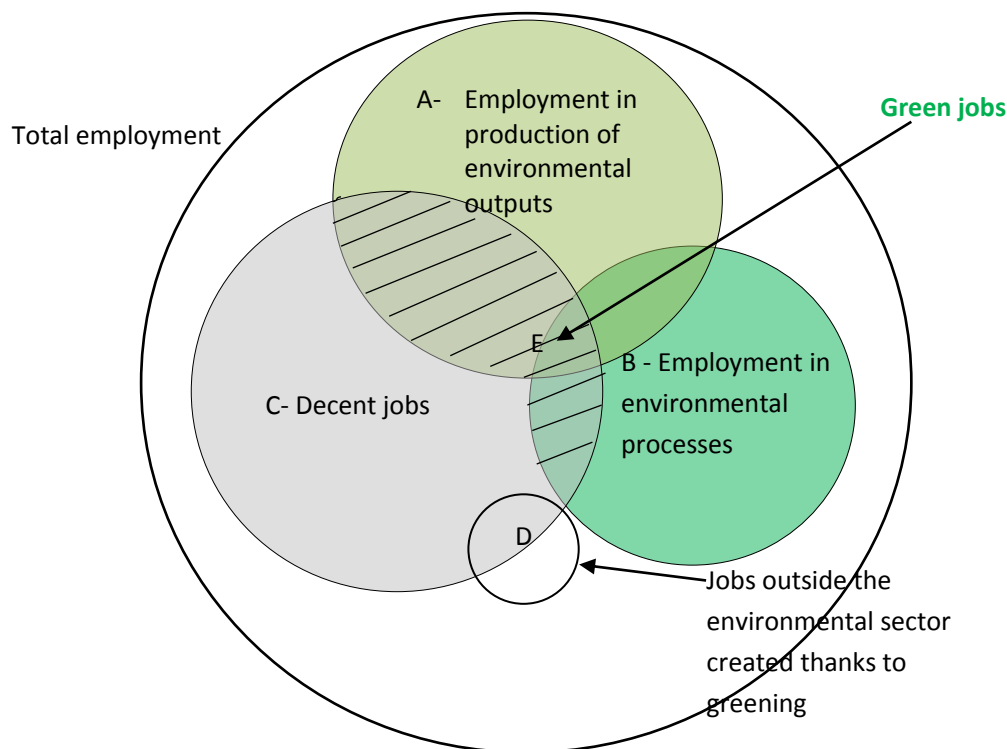
Source: ILO, 2013h

Green jobs are those jobs that either produce environmental outputs or are involved in environmental processes and meet the criteria of decent work at the same time ((A∪B)∩C).

There can however be other groups of jobs which do not meet all these criteria but are still created as a result of greening processes. From the perspective of the identification of skills for a sustainable economy, the researchers may be interested in analysing these jobs as well.

- **Total employment in environmental activities** (A∪B): this includes some jobs which do not meet the criteria of decent work. Researchers who work on skills related analyses may pose a question if the skills development of workers in these jobs or the application of some standards may help to improve the jobs in terms of their shift to decent work.

- **Employment thanks to greening** (A∪B∪D): in addition to work in environmental activities, this includes jobs which were created in other sectors thanks to greening. These can include jobs in sectors which sell products to environmental sectors (indirect jobs) and jobs which are created as a result of consumption by people in environmental sectors (induced jobs).

The decent work dimension of green jobs could be measured with the use of decent work indicators (see the ILO manual on decent work indicators: ILO, 2012b).

Since the statistical definition of green jobs now only comes into practice in data collection when researchers into green jobs wish to quantify the number of jobs involved, they may need to adopt an operational definition.

In the case of the approach recommended in the ILO practitioner's guide on assessing green jobs potential in developing countries (Jarvis et al., 2011), this means focusing on employment in distinctively green industries, either based on data from enterprise surveys in these industries, or starting from existing sectoral data (generally from national statistical agencies), and splitting the sectors into synthetic green and non-green parts based on sector-level research.

Input-output modelling techniques can then be used to estimate the number of additional jobs in other sectors that arise from selling to green sectors (indirect jobs) and as a consequence of consumer spending by those employed in the sectors (induced jobs). The guide also recommends estimating how many of the jobs counted comply with decent work criteria. Recognizing the prevalence of informal work in some relevant sectors in many developing countries, it sets out techniques for counting informal workers.

In addition to addressing green jobs, the practitioner's guide also provides guidance on identifying activities that will lose out with increasing sustainability, leading to employment losses. It also provides guidance on how to quantify the losses.

Skills research is typically interested in the occupations, skills and training needs of the core green industries whose employees are counted under the practitioner's guide approach. It is often also interested in skills and training of those indirectly employed by the sector – in other words those employed in sectors that supply the core green industries. For example, the part of the building construction sector involved in constructing buildings to high standards of sustainability, such as the United States Leadership in Energy and Environmental Design (LEED), requires specialist architectural and engineering services from the professional services sector and supplies of specialist building products and materials obtained from the manufacturing or wholesaling sectors. Where the skills of those indirectly employed in the other sectors are important to the core industry's capability to deliver improved sustainability, skills researchers will probably wish to investigate them.

Skills research may also be interested in the job losses that can be estimated using guidance in the practitioner's guide. It may tackle questions such as the occupational composition of job losses, the

potential for redeployment of workers in greener parts of the sector or elsewhere, and the specific skills and training that will be required to enable redeployment where it is feasible.

In addition to the green jobs, and the job losses, counted under the practitioner's guide approach, there are other groups of jobs, however, that skills researchers may need to research in order to address all the main skills implications of plans to improve sustainability. Some of these are green jobs in areas that are hard to measure quantitatively, but which can much more easily be researched qualitatively. Some are jobs that fall outside the ILO green job definition, but where new skill needs arise as their sector's operations become more sustainable.

The following are the main groups of jobs that could be addressed:

- Each core green industry typically forms just part of a wider sector (as defined by the country's sector classification system) that is not specifically green. Some jobs in the wider sector will be green, however, such as building services engineers in the construction sector who are concerned with maximizing energy efficiency, regardless of the sustainability of the buildings with which they are associated, or those mechanical engineers in manufacturing whose main concern is eliminating waste from production processes. Researching these jobs, the occupations of which they form a part, the specific skills that are needed, and the associated training and education needs means looking beyond the core green industries.

- In some cases, there will be a need for people whose jobs are not considered green to receive training in skills to enable changes that will improve sustainability. For example, a change to building regulations designed to improve energy efficiency creates a one-off change in skills requirements across a range of occupations in the construction sector, and a consequential requirement for training to meet this skills need. Researching these occupations, skills and training and education needs means looking beyond the core green industries.

- There are jobs across sectors that affect sustainability but will not be counted under the approach envisaged in the practitioner's guide. Some of these are in specific occupations such as environmental accounting, buildings management and green plumbing. Unfortunately, distinctively green occupations such as these are mostly not treated as separate occupations in standard systems of occupational classification, so statistics on numbers employed in these occupations are generally hard to gather.4 Many other jobs with impacts on sustainability cannot be analysed based just on their occupations, because only some members of the occupation do work relevant to sustainability. For example, mechanical engineers designing more energy-efficient consumer appliances cannot be distinguished in occupational statistics from those doing other types of work. People in public administration occupations concerned with forming policy on sustainability cannot be distinguished in occupational statistics from those with other roles. Where these skills are important to plans to improve sustainability, skills researchers are likely to wish to research them.

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[4] An exception is that some public employment services use classification systems much more detailed than ISCO to track skills, jobs and vacancies. In some cases these classification systems have included the main distinctively green occupations as separate occupations.

2.3   Issues of classification in green jobs

2.3.1   Broad options

In skills-related research on green jobs there is often a dilemma between using standard sectoral and occupational classifications and using specially devised classifications tailored to the needs of the research. The greater the degree to which sectoral and occupational classifications are tailored, the more original research is required and the more arduous the task of integrating findings with the outputs of other research.

There are essentially four options.

1. **Qualitative research only, open definitions**: If the research is qualitative only, researchers may choose to leave it to the stakeholders consulted in the course of the research how to define green sectors and occupations relevant to improving sustainability. This approach is most suited to research intended to produce an overview, or to scope out the area prior to undertaking further research. A key shortcoming is that stakeholders are likely to use inconsistent definitions. Another issue is that some respondents may focus on only the most explicitly green sectors and occupations, thereby potentially excluding industries, jobs and training activities that contribute to sustainability but do not have obvious references to sustainability in their names. As an example, while providing some guidance on definitions, the country studies for the joint ILO-European Centre for the Development of Vocational Training (Cede fop) Skills for Green Jobs project left many questions open, and left it to experts to define what was to be considered green in their country (see the annex to the present guide).

2. **Research based on definitions from researchers or other sources of non-standard classifications**: Researchers have the choice of defining sectors in ways that suit the topic of the research, and without regard for standard sectoral or occupational classifications. Elements of the value-chain analysis may also be implemented. A green building sector, for example, could be defined so as to include architectural and engineering professional services practices working in green building, and perhaps also green building advisory services and green building accreditation and inspection services. In standard systems of sector classification, these make up parts of several sectors. Within construction, this sector could be defined to include all building companies involved in the construction of exceptionally sustainable buildings, or could even be defined to include all businesses involved in building construction affected by regulations and customer demand that favour the more sustainable construction of buildings.

    Occupations can be classified using terminology common in the sector, rather than using categories from the country's standard system of sectoral classification. Where distinctively green occupations are emerging (such as installers of solar thermal water heating systems), they can easily be included among the occupations. Findings based on this approach can be more meaningful to industry stakeholders than research based on standard classifications.

    Non-standard systems of classification pose no distinctive difficulties for qualitative research, other than potential problems of comparability with other research that uses different classification systems. They pose greater issues for quantitative research – the data required for quantitative analysis have to be sourced from somewhere – typically from rather detailed sector-

level research. There may also be difficulties in fitting sector-level findings into a macroeconomic model.

An example of such research is a study on the skills requirements of the Irish wind energy sector, undertaken on behalf of the Irish Wind Energy Association, which included a survey to quantify skills requirements. The ILO reports on skills and occupational needs in renewable energy and in green building also took this approach, with detailed exploration of the occupations and skills required in these two areas (ILO, 2011b, 2011c).

3. **Research based on non-standard classifications within a sector, but with the boundaries of the sector defined based on standard classifications**: A common approach to sectoral skills analysis is to define the boundaries of the sector based on standard classifications, but to tailor the approach to classification within the sector in ways that suit the topic of the research, using industry and occupational descriptions familiar to stakeholders within the sector. This approach has most of the advantages of the preceding approach, but also enables the findings of the sectoral analysis to be fitted into a macroeconomic model based on standard sectoral classifications. By providing a point of reference in standard classifications, it also facilitates comparison with other research.

    A Hungarian study on the employment impacts of a large-scale deep building energy retrofit programme (Urge-Vorst et al., 2010) provides a good example. It models the proposed programme under a number of scenarios, sets each scenario within the construction sector, and places the construction sector scenarios within an input-output model.

4. **Research that maximizes use of standard classifications** – In general, it is not possible for research into skills for green jobs to use only standard classifications. Standard sectoral classifications do not generally distinguish between green and non-green activities, and standard occupational classifications do not distinguish meaningfully between green and non-green jobs, although exceptions exist (see, for example box 2.1). Information from sector-level research is required to distinguish between green and non-green parts of a standard sector classification and between green and non-green jobs within a wide range of occupations in sectors that are not specifically green. The level of sectoral and occupational detail available from surveys by national statistical agencies may be quite limited because of sampling limitations in labour force surveys, adding to the information that must be obtained from sector-level research.

    Maximizing the use of standard classifications means organizing the analysis by standard sectoral and occupational classifications to the extent possible, generally segregating standard sectors into green and non-green parts rather than studying standard sectors holistically. This is the approach to estimating employment impacts recommended in the ILO practitioner's guide to assessing green jobs potential in developing countries (Jarvis et al., 2011).

All four of these options to approaching classification can form the basis for high-quality research. Researchers should choose between them based on the research questions that they are most interested in answering, the characteristics of the sectors that are of interest, the availability of data, and the availability of resources for survey work and other primary research.

2.3.2   Standard systems of sectoral classification

Systems of sectoral classification vary between countries, but most of those now in use are based on the International Standard Industrial Classification of All Economic Activities (ISIC), often with some limited customization to meet national needs. The current ISIC standard was introduced in 2008, and is the fourth revision of the standard.

The most significant industry coding system not based on ISIC in use by some national statistical offices is the North American Industry Classification System (NAICS), used by the United States and Canada. The second revision of the General Industrial Classification of Economic Activities within the European Communities (NACE Rev. 2), the European Union's current standard, is almost identical to the fourth revision of ISIC – ISIC Rev. 4.

While most national systems for sectoral classification are based on ISIC, some are based on versions earlier than Rev. 4. Even where a system of classification is based on ISIC, it is important for researchers to refer to the actual national classification system in order to avoid errors in interpretation.

In order to provide researchers with an initial point of reference, table 2.1 shows the main equivalences between the eight sectors highlighted in the ILO report on working towards sustainable development (ILO, 2012a) and ISIC Rev. 4. It also highlights an illustrative sample of other sectors in which significant activities occur that may contribute to the sustainability of each of the eight sectors.

Only parts of each of these eight sectors will be distinctively green, so the quantitative modelling of green employment in each sector will require either splitting the sector between green and non-green synthetic sectors or, alternatively, analysing sustainability in the sector as a whole.

2.4   Defining and delimiting a sector

Deciding exactly how to define a sector for the purposes of research into skills for green jobs can take some effort, analysis and consideration. It is necessary for researchers to think through clearly what they are trying to achieve, and how this fits with feasible sector definitions.

As discussed earlier, most countries have well-established sector definitions, usually copied or adapted from ISIC. They are used by their national statistical offices in producing statistics, and may also be used for other policy and administrative purposes. Examples of sectors often important to the greening of an economy include forestry and logging (ISIC 02) and construction (ISIC 41). Unfortunately, however, most practical questions about skills for green jobs do not align with standard sector definitions.

Any standard sector may be viewed as having four main parts that are of interest to skills research – three concerned with skills within the sector and one concerned with skills in connected sectors.

Researchers should look closely at the structure of the system of sector classification in use in the country to be studied when deciding on which parts of the sector they should focus. They should also take account of data availability, and of the level of detail at which data are available. Where data are available only at a high level of sectoral aggregation they may not be of much practical use for purposes of sectoral analysis. Data sources are discussed later in the present guide.

When considering what sectors a study on skills for green jobs might address, it may be helpful to use as a checklist – and on an indicative basis only – the list of sectors covered by the ILO report on working

towards sustainable development (ILO, 2012a). If the researchers are not already familiar with the status of sustainability in these sectors, it will be important to undertake further investigation into each sector.

Figure 2.2 Four parts of the sector of interest to skills research

1. Core distinctively green parts

- In many cases, the sector has a core distinctively green part or parts. Examples include sustainable renewable energy within the energy sector, and both constructing new buildings to exceptionally high environmental standards and retrofitting existing buildings to improve their sustainability within the building sector. All jobs associated with the core parts of the sector are considered green under most definitions of green jobs. *The Practitioner's guide to assessing green jobs potential in developing countries* (Jarvis, A., Varma, A., Ram, J., 2011) focuses mainly on estimating the number of jobs in this category.
- Added this qualification because not all renewable energy is sustainable. It is up to individual projects to make this determination, but obvious candidates for exceptions include ethanol in the US, geothermal systems that are inefficient because of a poor resource or unsuitable technology, and poorly sited off-shore wind where the investment of energy in concrete, manufacturing and maintenance may be excessive in comparison with the yield.

2. Efforts to improve sustainability in non green parts

- Even in the parts of the sector that are not distinctively green, there will be efforts to improve sustainability. In manufacturing, for example, many firms are likely to have work under way to cut energy usage, reduce waste materials and eliminate harmful emissions. In the construction of buildings, for example, many countries are progressively introducing more demanding building regulations to reduce buildings' environmental impact. The employment impact of these efforts may be difficult to measure, and indeed the effect may just be to change the specific skills required rather than changing the numbers employed. Even though it may be difficult to analyse the employment effects quantitatively, the skills implications can be addressed qualitatively, using qualitative research methods. Researchers must decide whether to do this, or alternatively to just focus on the distinctively green core parts of the sector.

3. Skills located in complementary sectors

- Many improvements to the sustainability of a sector rely on other sections of the value chains of which its activities form a part. For example, initiatives to improve the sustainability of forestry depend not just on people employed directly in the forestry sector, but also on people employed in areas such as forestry services, community relations, forestry research institutes, forestry policymaking and policy advocacy, provision of transport, customers for forest products, and even law enforcement and security services. Researchers must decide whether to restrict their work to the sector under study, or to also look at skills important to improving sustainability that are located in complementary sectors.

4. Negative employment effects of improving sustainability

- In some cases, improving sustainability will have negative employment effects in part of the sector. For example, while increased use of sustainable energy resources will often increase employment in renewable energy sectors, it may result in job losses in areas such as coal-fired generation of electricity or refining of petroleum products. Employment losses may also arise from adaptation to climate change and to environmental degradation. Skills researchers should consider whether to study the scope for those losing employment to be redeployed within the sector or in other sectors, and what additional skills they would need for this to happen.

Table 2.1 lists the sectors covered in that report. In order to assist researchers in thinking through which parts of a sector should be covered, it provides examples of, first, distinctively green core parts of each sector; second, activities that may contribute to the greening of non-core parts; third, specialist links to other sectors; and, fourth, areas where jobs may be lost as sustainability is improved.

Table 2.1 Examples of four areas relevant to green jobs for eight sectors associated in particular with improving sustainability

	Examples of distinctively green core parts of the sector	Examples of activities that may contribute to greening other parts of the sector	Examples of links to other sectors	Examples of loss of jobs in parts of the sector due to climate change or environmental degradation
Agriculture	Growing biomass crops on land not required for food production while observing resource efficiency and other green principles	Adoption of drip irrigation	Improved storage and logistics systems to reduce food waste	Loss of crop or grazing lands to effects such as desertification, soil loss, soil salinization or depletion of soil nutrients
Forestry	Operating under sustainable forestry management principles	Replanting after harvesting	Forestry services (e.g. advice, harvesting)	Elimination of unsustainable harvesting
Fisheries	Operating under Marine Stewardship Council standards	Regulations to require the adoption of systems to reduce by-catch	Technologies for sustainable fisheries (e.g. minimizing damage to corals and the seabed)	Winding down unsustainable fisheries
Energy	Operation of wind turbines	Reducing emissions from generating stations	Sourcing biomass from agriculture or forestry sector for bioenergy	Closing coal-fired generating stations
Manufacturing	Manufacture of energy efficiency equipment	Regulations requiring improved efficiency in motor vehicles	Providers of energy efficiency services	Closing energy-inefficient cement manufacturers
Recycling	Recycling operations meeting high standards of environmental	Initiative to reduce the release of hazardous waste in recycling	Materials businesses (paper, glass, metals …)	Displacement of recycling workers in informal economy by

	protection (and of health and safety)			mechanized recycling
Buildings	Construction of buildings to exceptionally high standards such as the LEED system	Introduction of more demanding building standards	Training or reskilling building professionals, including energy auditors, energy consultants and architects, for sustainable building	Risk of loss of employment by construction workers who fail to learn new green building skills as they become part of the mainstream (e.g. through building regulations)
Transport	Urban transport systems	Impact of expanding railways on the use of bus networks	Construction of transport infrastructure	Reduced need for traditional mechanics as electric vehicles introduced

An activity that is considered to be distinctively green in one country will not necessarily be considered so in another.

For example:

- Where well-developed urban transport systems already exist, there may be no point in focusing on them as an opportunity for improving sustainability.

- If the quality of a renewable energy resource is poor within a country, or if it has a more sustainable competing use, investing in exploiting the resource to produce renewable energy may not improve sustainability. For example, the large-scale deployment of photovoltaic solar panels where solar power resources are poor (for example, because of frequent cloud cover and distance from the equator) may be less sustainable than other means of providing electricity.

Table 2.2 Equivalences between eight sectors highlighted in the ILO report on working towards sustainable development and ISIC Rev. 4

	Approximate equivalent in ISIC Rev. 4	Sample of other ISIC Rev. 4 sectors with significant activities relevant to sustainability in the core sector
Agriculture	01 – Crop and animal production, hunting and related service activities	52 – Warehousing and support activities for transport 841 – Administration of the State and the economic and social policy of the community
Forestry	02 – Forestry and logging	170 – Manufacture of paper and paper products 16 – Manufacture of wood and of products of wood and cork
Fisheries	03 – Fishing and aquaculture	102 – Processing and preserving of fish, crustaceans and molluscs 301 – Building of ships and boats
Energy	05 – Mining of coal and lignite 06 – Extraction of crude petroleum and natural gas 19 – Manufacture of coke and refined petroleum products 35 – Electricity, gas, steam and air conditioning supply	012 – Growing of perennial crops 271 – Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus 382 – Waste treatment and disposal 42 – Civil engineering 43 – Specialized construction activities 711 – Architectural and engineering activities and related technical consultancy
Manufacturing	Section: C – Manufacturing	E – Water supply; sewerage, waste management and remediation activities 72 – Scientific research and development
Recycling	383 – Materials recovery	381 – Waste collection 382 – Waste treatment and disposal
Buildings	41 – Construction of buildings, plus part of 43 – Specialized construction activities	68 – Real estate activities 711 – Architectural and engineering activities and related technical consultancy 841 – Administration of the State and the economic and social policy of the community
Transport	491 – Transport via railways 492 – Other land transport 50 – Water transport 51 – Air transport	29 – Manufacture of motor vehicles, trailers and semi-trailers 30 – Manufacture of other transport equipment 841 – Administration of the State and the economic and social policy of the community

Box 2.1: Comparing the share of low or skilled employment in high-carbon-intensive sectors (HCIS) versus low-carbon-intensive sectors (LCIS)

The ILO International Institute for Labour Studies compared the share of low-skilled employment in high-carbon-intensive sectors (HCIS) with that in low-carbon-intensive sectors (LCIS) in countries in the European Union. It found that in all but two countries studied the share of low skill employment in LCIS was lower than in the HCIS. As adjustment pressures arising from a green transition would mainly arise in the HCIS, the net impact might be to increase the average level of skill required in most economies in the European Union.

Source: International Institute for Labour Studies, 2011

2.4.3   Standard systems of occupational classification

Systems of occupational classification also vary between countries. Most are based on the International Standard for Classification of Occupations (ISCO), although frequently on an old version. The current version is the eighth – ISCO-08. In many cases, country-level classification systems have been significantly adapted from the original. Various different national systems of industrial classification are known as standard occupational classifications; the fact that they share a name does not guarantee that they are identical. Indeed, the Standard Occupational Classification system in use in the United States is quite different in structure from the ISCO.

ISCO-08 classifications range from a highly aggregated one-digit level to a detailed four-digit level. In some cases, countries have additional, more detailed, levels of classification that extend to five or six digits. Data may be coded at these more detailed levels, and available to researchers, even if they are not published at this level of detail.

Table 2.3 Structure of ISCO-08

3	Technicians and associate professionals
31	Science and engineering associate professionals
311	Physical and engineering science technicians
3111	Chemical and physical science technicians
3112	Civil engineering technicians
3113	Electrical engineering technicians
3114	Electronics engineering technicians
3115	Mechanical engineering technicians
3116	Chemical engineering technicians
3117	Mining and metallurgical technicians
3118	Draughtspersons
3119	Physical and engineering science technicians not elsewhere classified
312	Mining, manufacturing and construction supervisors
313	Process control technicians
314	Life science technicians and related associate professionals
315	Ship and aircraft controllers and technicians

Few occupations defined in the ISCO classification system are specifically associated with improving sustainability. Environmental professionals (2133) and refuse sorters (9612) are about the only

classifications that are specifically green, and even jobs in refuse sorting will not be green where the work produces damaging emissions or waste, or where it fails to comply with standards for decent work. Most green jobs are in occupations that also cover non-green jobs. For example, a mechanical engineering technician (3115) working in renewable energy or waste processing may be regarded as being in a green job, while a mechanical engineering technician with broadly similar skills working in manufacturing or a fossil-based energy industry is not, unless the job is focused primarily on process improvement.

The more detailed levels of classification in the ISCO system and other systems of occupational classification are of most use to researchers investigating specific skills needs, while the more highly aggregated levels of classification provide a much broader picture that lacks specific detail. Skills researchers should work at three-digit or finer levels of classification where the underlying survey sample is sufficiently large to generate reliable cross-tabulations against sectors meaningful to the research.

Table 2.2 illustrates the structure of ISCO-08, by showing all three-digit classifications within the two-digit science and engineering associate professionals (31) classification, and all four-digit classifications within the three-digit physical and engineering science technicians (311) classification. Many of the occupations listed here are important to sustainable economic activity. For example, civil engineering technicians may be involved in installation of preparatory works for wind turbines, while life sciences and chemical engineering technicians may be involved in operating bioenergy plants.

Box 2.2: Green occupations in South Africa

In South Africa the political will to move towards a green economy was expressed in 2011 in the Green Economy Accord and is associated with job creation, and also with new and changing skills demands. These skills demands are expected to be two-dimensional, as not only new green occupations will be required but also new skill sets within existing occupations.

The South African ISCO-8 based Organizing Framework for Occupations (OFO) introduces in its 2012 version a new category of occupations flagged as green. According to the OFO definition, green occupations are those that have as their direct purpose – based on nationally identified priorities and initiatives – reducing negative environmental impact and contributing to environmental, economic and social sensitive enterprises and economies.

As the OFO is used to collect and reflect labour market information on skills needs, the updated version is expected to enable the South African education and training authorities to better reflect skills demands in support for a green economy in their sector skills plans.

Source: DHET, 2012; OneWorld Sustainable Investments, 2010.

2.4.4 Choosing the level of detail to be used in sectoral and occupational classification systems

Researchers should put some effort into choosing the level of aggregation to use within sectoral and occupational classification systems. At its most straightforward, this is a matter of balancing the need for adequate detail with the need to avoid introducing unnecessary complexity.

The level of detail available in input-output tables varies from country to country. Where quantitative analysis requires a macroeconomic component, it is simplest to work with sectoral categories available in the standard tables.

When the researchers work mostly with the sample survey data and have access to the microdata, they can decide to combine different levels of detail in the classification depending on sample size, the structure of national economy and homogeneity of groups in the national context (for example, they can use the two-digit level for smaller occupational groups and the three-digit level for larger ones).

Section 3: Data and information sources

3.1 Introduction

This section provides an overview of the data sources that researchers into skills for green jobs are most likely to find useful. It addresses both sources of existing data and approaches to gathering new data.

Researchers should bear in mind the need to analyse the data by gender, age, disabilities and other cross-cutting criteria where relevant for the research objectives.

3.2 Labour force surveys

Labour force surveys are nationally representative household surveys which collect information on employment by industry, occupation, and typically also skill level as measured by level of qualification. Often, they are also representative at subnational levels, such as those of the province, state and metropolitan area.

Labour force surveys are a centrally important source of data for skills and labour market analysis that are undertaken regularly in most developed countries, and also at varying intervals in most emerging and developing economies. Despite their limitations, they are a cornerstone of quantitative analysis and the modelling of skills and labour markets, both for skills for green jobs and more generally.

Unlike enterprise surveys, labour force surveys collect data by focusing on the supply side of the labour market. In many cases, labour force surveys collect information on some aspects of enterprises, but this information will be reported based on the knowledge and perceptions of the workers in the enterprise (or another member of their household), as opposed to the owners, managers or employers.

Labour force surveys are sample surveys by statistical agencies, used to produce estimates of actual numbers. The unit of analysis is the job or the individual worker, not the enterprise. Given the existing structures of labour force surveys, it is generally impossible to identify individuals in jobs linked to green economic activities from the survey alone, since the standard industrial and occupational codes used in labour force surveys are usually not designed to identify green jobs. Some industrial and occupational categories, such as recycling activities, are easier to identify than others, such as the production of biomass.

In principle, existing labour force surveys could be modified or extended to gather information which could be used to identify these types of jobs. In practice, the need to ensure that labour force surveys continue to meet other needs would exclude the possibility of significant changes to the core of a labour force survey instrument that is in regular use. There are precedents, however, for specialist modules on high priority topics being added on a one-off basis to labour force surveys, and it would be possible, in principle, to do this to produce data on green jobs.

Much or all of the occupational data and data on employment by standard sector classification available to researchers are likely to be from labour force surveys.

Because these are sample surveys, sampling error is an important issue for smaller groups of employees. Sampling error for data on total employment by the two-digit ISIC classification (or equivalent) will usually be at an acceptable level. Sampling error for three or four-digit ISCO classification (or equivalent)

across the whole population will typically be acceptable, but may be excessive for occupations with smaller numbers of workers, depending on the absolute size of the sample and on the share of the population it covers. Sampling error for occupations within a specific sector is most often broadly acceptable at the one-digit ISCO level, but can pose problems at more detailed levels of resolution, particularly for occupations with smaller numbers. The national statistical office should be able to provide guidance on thresholds below which estimates of worker numbers should be regarded as unreliable.

In some cases, once researchers look at occupational data at the sector level and compare them with evidence from qualitative research it becomes apparent that there have been significant problems with the coding of the data at more detailed levels of coding. An occupation known to be important may not appear in the data, or an occupation known not to be present in significant numbers may appear to account for a significant share of employment. If researchers think they have observed this issue, they should confirm that their understanding of the classification system is correct, and particularly that they have not been misled by some difference between the national classification system and similar systems with which they may also be familiar.

If this does not resolve the issue, they may need to work at the one-digit occupational classification level, where errors are much less likely than at more detailed levels. Coding occupations at the one-digit level is easier to get right than at more detailed levels, and statistical offices might rationally place less emphasis on getting more detailed coding right because they only expect to publish results at the one-digit level.

Box 3.1: Pilot labour force module and establishment survey in Albania

In response to the growing demand for measurement of green jobs, the ILO developed and piloted guidelines (ILO, 2013h) concerning the statistical definition of employment in the environmental sector. A methodology for collecting statistics on a set of variables relevant to the existence and nature of green jobs was piloted in a number of countries, including Albania. Using the special labour force survey module on green jobs, two household members from each of the sampled households were interviewed in 2013. The survey of establishments was carried out among 300 establishments covering the whole country and excluding agriculture, forestry and fishing industries. The two surveys helped to test the proposed guidelines for measurement of green jobs, estimated the size of employment, and also addressed certain qualitative questions regarding skills mismatch in the environmental sector.

Source: Stoevska et al., 2014

Where existing labour force survey data are not capable of providing sufficient detail on occupations, it is possible to complement them with original research into the occupational composition of employment in the sector, using techniques such as enterprise surveys, consultation with experts or case studies. Some of this research may be required in any case to enable researchers to distinguish between green and non-green parts of sectors, to identify the occupational composition of firms in green sectors, and to identify green jobs in non-green sectors.

3.3   Input-output tables and other national accounts data

National accounts data are centrally important to any macroeconomic level analysis. Input-output models are based directly on input-output tables prepared along with national accounts. A supply-use matrix may be used as the basis for an input-output model instead.

Social accounting matrix models are derived from input-output tables, with additional variables, many of them derived from national accounts. Sectorally-based computable general equilibrium models also use input-output tables, and other national accounts data.

In addition to being used for modelling purposes, national accounts data can also be useful in less structured analysis, providing information on trends in overall economic activity and trends in investment and current spending by governments, businesses and households.

In addition to their uses in the modelling of interactions between economic sectors, input-output and supply-use tables can provide researchers with a qualitative understanding of supply dependencies between sectors and of the sectors in which indirect employment arising from business purchases by a green sector is likely to appear.

3.4   Enterprise surveys

Most countries with well-established statistical systems undertake large-scale surveys of business establishments, at least annually, either across all sectors, or split in some way, such as between industry and services. Many have more than one of these surveys, with a major enquiry requiring considerable detail and more frequent returns to be made on topics such as numbers employed and earnings.

In many cases, a threshold is set for the minimum size of businesses to be covered by a survey, often in terms of the number of employees.

In addition to large-scale business surveys, many countries run periodic sample surveys of establishments, either independently or in coordination with others countries. Many of the surveys run on cycles of more than a year. An example is the European Union's Continuing Vocational Training Survey (CVTS).

In addition, it is common for one-off business establishment and enterprise surveys to be undertaken for policy purposes, sometimes by the national statistical service, but more frequently by policy and research organizations.

This suggests four feasible approaches to surveying business establishments with questions relevant to skills for green jobs.

1.   Permanently adding a small number of questions to a regular large-scale enterprise survey. This could be as limited as two questions: one to identify whether the business establishment should be counted as green, and another to categorize what sort of green organization it is.

2.   Adding a more extensive module on green enterprise and green jobs to an existing large-scale survey on a one-off basis, or perhaps on a cycle of once every one, two or three years.

3.   Creating a new sample survey to be conducted periodically, perhaps every three years.

4.   Undertaking a one-off policy-focused sample survey, that can be repeated if circumstances warrant.

For most countries, the first of these would be more relevant to general green economy research than to skills research, as most large-scale enterprise surveys do not include extensive questions on skills and

occupations. Even so, generating accurate and fine-grained data on the green economy would make an important contribution to sectoral aspects of skills analysis.

From the perspective of a skills researcher, the second could be the most attractive, potentially generating detailed occupational and skills data linked to a fine-grained sectoral analysis. The biggest potential problem is that existing surveys generally have already struck a balance between the amount of information sought and the amount of effort required on the part of respondents to provide it. Adding a module may upset that balance, marking it much harder to obtain full responses, adding to the workload on businesses, and requiring greater effort from the surveying organization to obtain an acceptable level and quality of response. The greater the amount of additional information sought, the more the existing balance is likely to be upset.

The third, a new sample survey focused on green jobs, would also potentially be of great value to skills researchers. Its value could be broadened by also looking at other aspects of the green economy. While the sample nature of the survey will make the results less fine-grained than with a large-scale survey, this could, in principle, be balanced through sample design, with high sampling rates among sectors, or segments of sectors, that are of particular policy interest.

Box 3.2: Questions concerning environmental activities in the Cedefop employer survey on skill needs in Europe

The European Centre for the Development of Vocational Training (Cedefop) has developed and piloted in nine European Union member States an employer survey on skill needs in Europe. Evidence is collected from employers, who report on the change in importance of tasks and potential skill gaps for tasks increasing in importance. In the survey, employers also report on new (or emerging) tasks and the preparedness of the workforce for these tasks. Implementation practices in resource saving and anti-pollution tasks were surveyed among other generic skills. New processes and services necessitated by environmental awareness or standards and regulations were included under questions related to key trends that drive the change in the product innovation and adaptation strategies of employers.

Source: Cedefop, 2013

A key issue here is that a new survey such as this will require a substantial investment of resources by a statistical agency. Another consideration is whether such a survey will remain useful over time. It is possible that the survey might have to undergo significant redesign for each iteration, in order to keep up with the evolution of carbon-saving activities. It is also possible that policy interest in the area will decrease as progress towards the low-carbon economy becomes more routine, reducing the scope of current skills issues. These factors could make those responsible for prioritizing the work of statistical agencies more reluctant to build a survey such as this into their plans. The researchers should also consider the burden that they impose on enterprises by adding a new survey to the existing poll of enterprise surveys in the country. Too frequent questioning may negatively influence response rates and also the quality of responses.

The fourth, a one-off policy-focused survey undertaken by a policy or research organization has the advantage that undertaking it is largely just a matter of designing it, and paying a research organization to

do it, without any longer term implications for the country's statistical system. It may also be easier to include qualitative questions than with an official statistical enquiry. It has the disadvantages that the conduct of the work will not be as well tied into the country's statistical system, and may not be as comparable with official statistics as a survey undertaken by the national statistical organization. Depending on how it is resourced, it may be a relatively high-cost approach.

3.5   Interviews and other qualitative research methods

Most skills research requires a range of qualitative research techniques on a spectrum from structured interviews to focus groups and stakeholder workshops. Exactly what is required depends on the questions addressed by the research, on institutional and stakeholder issues, on the resources available, and on other methodological choices.

The main groups likely to be consulted through these qualitative techniques include:

- enterprises
- experts
- relevant government ministries and agencies
- workers' representative organizations
- employers' representative organizations
- providers of education and training
- Non-governmental organizations that include environmental initiatives

Key types of technique include:

- structured questionnaire surveys (by post, e-mail, on the web, etc.), or administered by an interviewer
- semi-structured surveys administered by an interviewer
- case studies (including case studies on the occupational composition of employment in a green sector for which official data on occupational composition are not available)
- focus groups
- workshops
- Delphi methods

The line between enterprise surveys and other qualitative research at enterprise level is unclear. In general, gathering information and views from enterprises using a structured questionnaire can be thought of as an enterprise survey, whether it is carried out by having the enterprise complete the questionnaire or by an interviewer following the questionnaire closely. Less structured approaches can also be useful, however, for deeper discussion of issues, featuring more open-ended questions in interviews or requests for submissions, or using focus group techniques that bring enterprises together to discuss issues in depth.

In addition to reflecting the ILO's tripartite governance, stakeholder workshops have an important function in validating findings with stakeholders, strengthening analysis, and building buy-in for the findings of the research. Stakeholder buy-in is critically important, as without it the findings of the research are much less likely to drive action.

3.6   Data on education and training

Data may be available from a range of sources, including the following.

- Ministries of education or labour or agencies of these ministries, such as funding bodies, qualifications bodies or quality assurance bodies

- Organizations of educational institutions

- Professional organizations, which may assemble statistics on the programmes that will provide their stream of future members

- Industry organizations, which may assemble statistics on the programmes that provide their members with key skills, and whose members may employ trainees such as apprentices and may get involved in other courses through providing work placements and guest lecturers. In some cases, employers collaborate with external education or training providers to provide courses for employees that fit into the mainstream framework of education and training, and industry representative organizations may be a good source of data on this.

- Employee organizations, particularly those that specialize in specific areas of skill, which may assemble statistics on the programmes that will provide their stream of future members, and which may have trainees such as apprentices within their membership. In many cases, worker organizations are themselves significant providers of education and training, whether continuing education and training for their members or initial education and training for those entering employment in their area of specialization.

- Agencies responsible for promoting inward investment or enterprise development often collect statistics from courses in subjects that provide skills of interest to potential investors, and to indigenous enterprises with growth potential

- If the country has a well-established skills anticipation system, one of the responsibilities of the system is typically to produce data on skills supply, including data on the flow of graduates from courses disaggregated by discipline and level of qualification.

- It is also possible to survey relevant providers of education and training to obtain data, although a survey of significant scale would most likely only be feasible if the research is particularly well resourced, and if it is possible to insist that relevant education and providers cooperate. To be reliable, surveys on student and graduate numbers generally require that the whole population be surveyed, with a response rate close to 100 per cent.

3.7 Other official sources

Existing planning work on sustainable development may have already produced useful statistics. It may even have already done a good job on profiling the sector statistically. Any existing statistics on the core sector will be particularly helpful in enabling the researchers to bridge the gap between the sector of interest to the research and the sector or sectors in the standard system of sectoral classification of which the core and extended sectors form a part.

Other existing sector-focused research may also be available. The sector may have been researched for other purposes by industry representative organizations, by researchers on behalf of international development organization, by academic researchers, by private sector market researchers or by government ministries or agencies. Again, data from these sources may be useful in bridging the gap

between the sector as defined for the research, and the sector or sectors with which they overlap in the standard system of sectoral classification.

Relevant data may be available from government ministries, such as those responsible for labour, education, industry, energy or environmental issues, or from their agencies.

For many green sectors, there may be official data series available that are specifically relevant to the sector. What is important will vary. It is not possible to be comprehensive here, but the following are examples of the sort of relevant data that may be available:

- time series on the area of forest under sustainable and non-sustainable management
- statistics on the stock of existing buildings by age, purpose and quality, as background information on the volume of work that may be involved in retrofitting for greater sustainability.
- projections of future building requirements by purpose
- statistics on energy consumption; statistics on energy production by technology
- statistics on waste by source and type; statistics on waste recovery – recycling, reuse, energy recovery
- statistics on international trade in relevant products

Section 4: Undertaking a whole-economy overview of skills for green jobs

4.1   Types of whole-economy overview

Three broad types of approach to undertaking whole-economy overviews of skills for green jobs have been seen.

These are:

- qualitative overviews of green jobs across the economy as a whole

- quantitative macroeconomic analysis that covers skills for green jobs across the whole economy without substantial sector level research

- research that covers the whole economy by addressing all the main sectors individually, either qualitatively or through a combination of qualitative and quantitative approaches

Subsections 4.2–4.4 below focus on the first option – qualitative approaches. Section 4.5 and the subsequent subsections focus on the second option – quantitative analysis.

The third option may be addressed using sectoral approaches described in section 5 below. Examples include two studies from Ireland. The first is a qualitiative study on the future skills needs of enterprise within the green economy (EGFSN, 2010), which researched the skills required to implement a green economy strategy for enterprise development. The second is a study on the skills required to implement a so-called "green New Deal" strategy (Comhar SDC, 2010). It used a combination of quantitative and qualitative approaches for some sectors, and qualitative approaches alone for others.

4.2   Introduction to qualitative whole-economy overviews

The approach described here is designed to provide an overview of a country's (or several countries') current position on skills and training for green jobs, and on the future skills needs and training requirements. It is designed to be carried out through consulting with stakeholders and experts, and by drawing on existing research and policy documents.

The approach is based on that used for country studies undertaken for the major ILO-Cedefop Skills for Green Jobs research project. Existing country studies and a global synthesis report may be found on the project's website (see ILO, 2013b).

This approach is suited to research at country level, and also at the level of a supranational grouping of countries or at a subnational level. The text refers only to country-level analysis in order to avoid repetition, but it should be read as also being relevant at these other levels.

4.3   Questions in qualitative research

The main aim of the analyses is to provide a general whole-economy overview of skills needed for the transition to a more sustainable economy. Key topics to be addressed include:

- identifying the main greening shifts in the economy that have already had significant labour market impacts, or are expected to have significant impacts

- identifying the main sectors where labour market impacts are under way or expected, and broadly what those impacts will be

- identifying and anticipating major developments in skills needs, focusing on broad themes and on both specific sectors and key occupations

- identifying major existing and emerging gaps between skill supply and skills needs that should be addressed

- identifying existing response policies and programmes

- identifying effective delivery mechanisms that could be used to address existing and emerging gaps

- identifying existing institutional arrangements for identification and anticipation of skills needs, and options for ways of developing these areas

- identifying key areas of uncertainty that might benefit from further research, including at the sector level: this should conclude with recommendations for action and recommendations for further research.
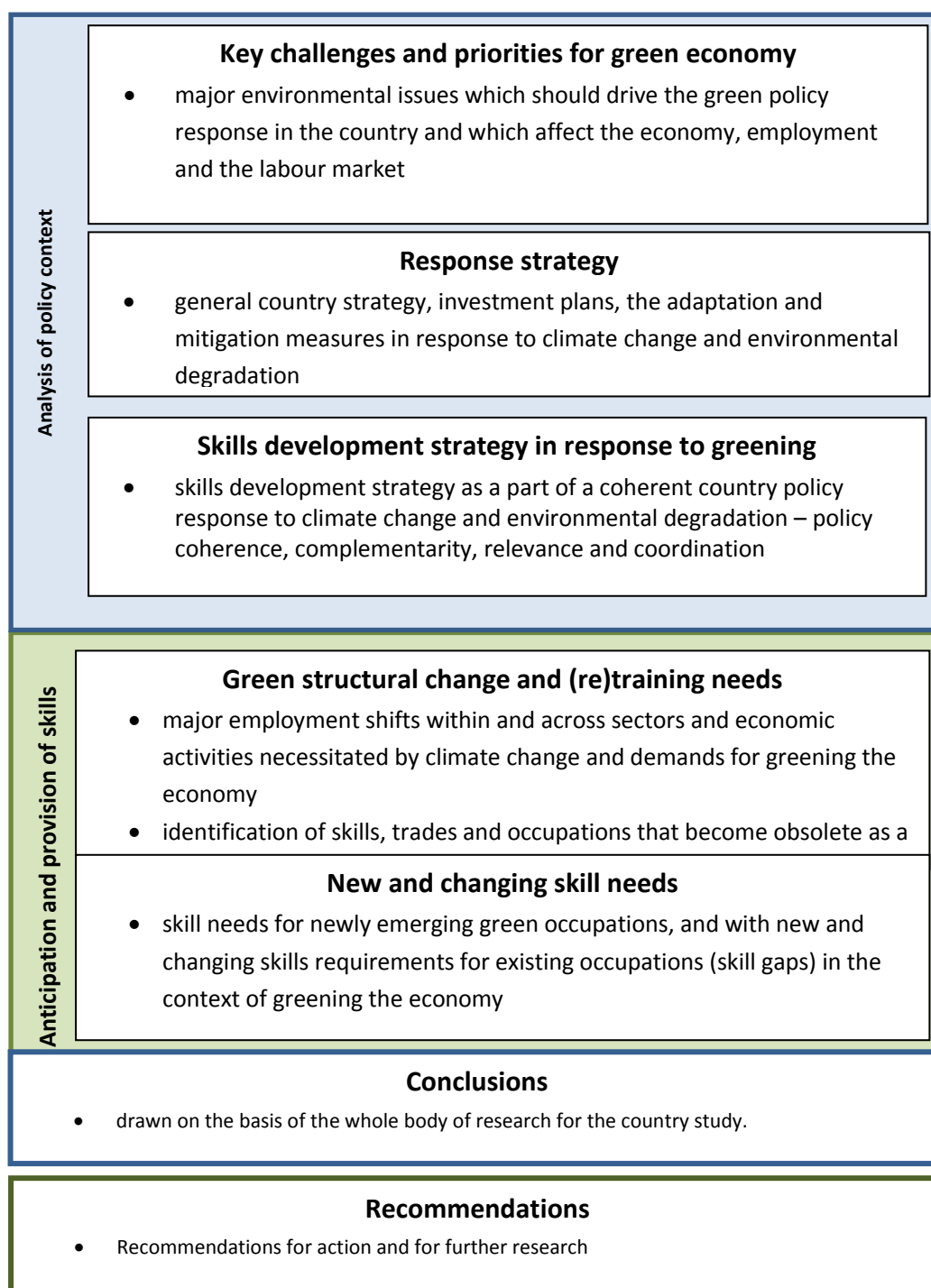
It is advisable that the overview should also provide some recommendations on actions and further research. The research approach described in this section deliberately takes a high-level perspective, and relies largely on what is already known by stakeholders. In some areas the conclusions reached will be sufficient to guide actionable recommendations. In other areas, the recommendations will mainly be concerned with identifying areas where more work is required, and how the additional work should be approached.

Key areas where recommendations can be considered include the following:

- recommendations on skills policy for environmentally sustainable economies

- recommendations on education and training for green jobs, which may cover initial technical and vocational education and training, continuing education and training, training in the workplace, training for unemployed, and university level provision, and may cover public or private provision

- recommendations on sources of skills for green jobs other than education and training, which may, for example, include other sectors or inward migration

- recommendations on institutional arrangements for further research into skills for green jobs

The structure of the analyses leading to these conclusions and recommendations is presented in brief in figure 4.1. More detailed guidance, setting out a possible structure of the national report and examples of important research questions under each heading, is provided in the annex to the present guide.

Figure 4.1:   Structure of a qualitative whole-economy overview

Analysis of policy context

Key challenges and priorities for green economy

- major environmental issues which should drive the green policy response in the country and which affect the economy, employment and the labour market

Response strategy

- general country strategy, investment plans, the adaptation and mitigation measures in response to climate change and environmental degradation

Skills development strategy in response to greening

- skills development strategy as a part of a coherent country policy response to climate change and environmental degradation – policy coherence, complementarity, relevance and coordination

Anticipation and provision of skills

Green structural change and (re)training needs

- major employment shifts within and across sectors and economic activities necessitated by climate change and demands for greening the economy
- identification of skills, trades and occupations that become obsolete as a

New and changing skill needs

- skill needs for newly emerging green occupations, and with new and changing skills requirements for existing occupations (skill gaps) in the context of greening the economy

Conclusions

- drawn on the basis of the whole body of research for the country study.

Recommendations

- Recommendations for action and for further research

4.4 Methods used for the qualitative whole-economy approach

The main methods used in a qualitative whole-economy overview include desk research and different forms of consultation with stakeholders, as follows:

- *International comparison of key indicators*: this can be used to identify key priorities and challenges for green economy in the country. Some useful resources that cover many relevant indicators include:

  - Global Environment Outlook: http://geodata.grid.unep.ch/results.php

  - International Energy Agency: http://www.iea.org/countries/

  - United Nations Framework Convention on Climate Change: http://unfccc.int/ghg_data/ghg_data_unfccc/items/4146.php

- *Analysis of policy and research documents*: this should cover national level documents from:

  - government ministries and agencies

  - employers' and workers' representative organizations

  - other stakeholders including providers of education and training, professional organizations and NGOs

  - academic research

- *Case studies*: researchers may find it useful to undertake case studies:

  - on identification of training and retraining needs, and of training provision developed in response as a part of their research

  - from the country or from other countries relevant for challenges and priorities in the country

- *Consultations with stakeholders and experts*: these may take various forms, including:

  - combination of structured surveys, whether written (via the web, by email, by post) or by phone and semi-structured face-to-face interviews.

  - focus groups

  - Delphi methods

  - in-depth interviewing of trendsetting companies

  - exploratory workshops and seminars

Stakeholder workshops are useful for disseminating and testing preliminary findings, for developing recommendations capable of being implemented in practice, and for building stakeholder acceptance, buy-in and commitment to implementation.

A consultation with any individual stakeholder may cover any or all of the topics addressed by the approach set out here. Considering the burden on stakeholders, it is important to plan the topics and forms of the consultations with different stakeholders in order to balance the needs:

o to cover in total all the research questions of the analyses

o to get more opinions on the same topic from various stakeholders to be able to draw a conclusion

o to question the stakeholders on topics which are relevant for them and use their language

4.5 Introduction to quantitative research into skills for green jobs across the whole economy

A small number of significant research projects have studied skills for green jobs across the whole economy, using exclusively macroeconomic methodologies. It is not feasible to give detailed guidance on the methodologies here, but a brief discussion is presented to provide researchers with an introduction. The last subsection provides more technical guidance through the process of quantitative skills for green jobs assessment using social accounting matrices, which could be applicable in developing countries. It is not the only option, however, and before applying it the researcher may find it useful to see a brief introduction into other quantitative approaches to skills for green jobs assessment.

One of the main barriers to research of this sort for most countries is a lack of statistics on green jobs that can be linked to macroeconomic analysis. Countries that prepare green jobs statistics based on the definition eventually agreed should be able to link these to macroeconomic models to provide better macroanalysis than is feasible at present without primary research.

Pending the availability of green jobs data, the need to rely on standard sectoral classifications, and on labour force survey data organized by standard sectoral classification, makes it difficult for whole-economy macroeconomic approaches to model changes within standard sectoral classifications that have significant real-world skills implications. In such circumstances and because the green jobs agenda is a moving target, significant qualitative inputs to quantitative modelling may be useful. Such inputs may include enterprise surveys, expert observations or the application of estimates from other countries, regions or sectors in a similar economic and policy context.

Box 4.1: PERI Green Prosperity study

In preparing its Green Prosperity analysis, the Political Economy Research Institute (PERI) at the University of Massachusetts-Amherst developed a methodology to form a bridge between the data from input-output tables to relatively detailed statistics available through surveys conducted by the United States Bureau of Labor Statistics. The analysis explored the differences between the employment that would arise from an investment in clean energy and that arising from an equal investment in fossil fuel energy. PERI used data on workers currently employed in the industries where their characteristics determined the types of occupations and the credential requirements of these occupations. The analysis of data on the education and training requirements for each occupation from the Occupational Outlook Handbook of the United States Department of Labor. This handbook identifies the "most significant source of post-secondary education or training" for each occupation on the basis of analyses of qualitative and quantitative information. Categorizing potential employment this way can be used to identify potential general skills gaps. In particular, it is possible to see the general skills demands, defined by workers' educational credentials, that will arise from increased investment in green activities.

Source: ILO, 2011a

One of the issues of which researchers should be aware in general, but in particular in a quantitative whole-economy approach, is that the process of greening the economy is an important – but not the only – determinant of changing skill needs. The other determinants are, for example, technological development, the globalization of the economy and trends in the international division of labour, demographic changes, changes in lifestyles and consumption patterns, among others.

When analysing skills for green jobs, researchers model how greening the economy influences skill needs. At the same time, other determinants of change, policies and regulations also influence the same occupations in different ways. There is no single quantitative model which can calculate all these in their full complexity. That is one of the reasons why the quantitative information on future demand for occupations and qualifications should not be taken simply at its face value to produce a precise workforce plan.

Box 4.2: E3ME

The energy-environment-economy model of Europe (E3ME) developed by the United Kingdom consultancy Cambridge Econometrics combines the economy and labour markets with Europe's energy systems and related greenhouse gas emissions. Detailed sectoral disaggregation allows projections of employment by occupation, using labour force survey occupational data. It has been used to produce Cedefop's medium-term projections of skills demand in the European Union.

As the model includes variables relating to energy and environment, it can be used to model the impact of environmental and energy policies on employment.

Recently Cambridge Econometrics has also modelled the effects of the investment of carbon tax in tertiary education (all subjects or selected subjects), by combining macroeconomic modelling with microlevel assessment of the returns to education. The data for the United Kingdom clearly demonstrated a positive impact of carbon tax investment in tertiary education on GDP and the labour market (decrease of unemployment) over the longer term (2030).

Source: Cedefop, 2012; Pollitt et al., 2014

4.6 Identifying skills for green jobs using accounting matrices

This subsection proposes a methodology for analysing skills for green jobs using the accounting matrices. Elements of this approach were applied, for example, in the ILO project in Malaysia (see box 4.3).

The models use data from the national accounts to project how macro-changes (public policies, external shocks, rising demand) influence production in different sectors and the whole economy, including the labour market. Depending on the data availability, the accounting matrices may be static (IO, SAM) or they may use time series and be dynamic (DySAM).

Employment satellite accounts[5] with detailed labour market information are combined with the accounting matrices in order to perform labour market analysis of exogenous shocks to the economy.

Employment multipliers, derived by combining employment satellite accounts with accounting matrices, show the expected numbers of jobs (direct, indirect, and induced) in different sectors and occupations in the target year or years as a result of an economic shock. So far, employment satellite accounts attached to accounting matrices lack the following information necessary for the assessment of skills for green jobs:

1. Occupational structure and qualifications and skills required for these jobs

2. The standard classifications do not provide us with information on green parts of the sectors and their occupational and skills composition.

These issues can be tackled by the methodology proposed below that consists of two modules. Module A is stocktaking data analysis, while module B may include a qualitative survey to cover the identified gaps and to bring additional data on skills demand. How these parts will be combined in the research process depends on the context in which the analysis is realized.

It is unlikely that the skills researchers would be fully responsible for the general development of the employment model. This guide therefore does not describe the general methodology of models, rather it focuses on how the skills component can be integrated into them. For more information on how DySAM models are used in modelling future employment in general and future green employment in particular, see Alarcón et al., 2011. A report compiled for the ILO in 2010 by the United Kingdom firm GHK Consulting shows how they have been applied for estimating green jobs in Bangladesh (GHK, 2010).

There are in general two possible scenarios for integrating skills assessment into green jobs assessment. If skills identification is to be realized together with the green jobs assessment, researchers may find it useful to follow scenario 1. If the skills assessment is added after the green jobs assessment has been realized, the researchers will have to apply scenario 2.

In addition to this two or three-step whole-economy exercise the researchers may want to add an additional step and examine some issues in more detail by looking at specific sectors. A methodology for this is described in section 5.

Module A: Inclusion of skills proxy variables in the accounting matrices analysis

The starting point of module A is number of jobs by sector. The researcher should look for additional data related to skills to enrich the matrices.

In the employment satellite account, data are generally available in a disaggregated form, by level of educational attainment, occupational classification, and demographic characteristics. It should be kept in

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[5] Satellite accounts are a component of the national accounts which provides a framework linked to the central accounts and which enables attention to be focused on a certain field or aspect of economic and social life in the context of national accounts. Common examples are satellite accounts for the environment, or tourism, or unpaid household work (OECD, 2013b). The employment satellite account, that enables a breakdown of employment by various characteristics, may be available in some countries.

mind, however, that the employment satellite accounts will not often have such highly disaggregated data, and the researchers will need to prepare the required breakdown from the original data source

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Box: 4.3: Integrating skills analysis in the green jobs assessment in Malaysia

Following the success of Cyberjaya and Putrajaya – its two planned green cities – Malaysia has taken the initiative to establish green townships in the southern state of Malacca. The ILO has been instrumental in producing a green dynamic social accounting matrix (DySAM) for Malaysia, in which some sectors of the national economy are subdivided into "green" – or environmentally friendly – and "brown" – or environmentally unfriendly – subsectors. In this box we focus on only one example -– the Malaysian construction sector and its four subsectors: residential construction, non-residential construction, civil engineering, and special trade works. Based on earlier policy implementation experience, previous analyses that mapped green jobs used assumptions on the construction sector to distinguish green and brown segments.

Cost estimates received from the Malacca authorities for the green township policy intervention helped to produce three distinct scenarios that simulate the economy-wide changes to the following three external injections:

- green sector injections: a total of 229.37 million Malaysian ringgits are spent on the green sectors
- brown sector injections: a total of 340.93 million Malaysian ringgits are spent on the brown sectors
- hybrid sector injections: a total of 455 million Malaysian ringgits are spent on the hybrid sectors

The spending can be seen as a form of fiscal stimulus by the government in the form of tax reduction, procurement of green equipment, and other measures.

Combining the employment multipliers with the 2011 Malaysian occupation level data yields some interesting results. As an effect of the green sector injections, more than 5,000 jobs are created in the green segment of the sector; whereas the brown sector injections create just over 2,000 jobs. The occupational composition of the newly created jobs in the case of the green scenario is mostly among craft and related trade workers, in contrast to the brown scenario, in which most jobs are created under the occupation of elementary workers. The ISCO group of crafts and related trade workers fall under a medium skill level that requires the completion of upper secondary schooling, in contrast to the skill level of elementary workers that requires the completion of only primary schooling. Hence, there is an upward movement in the skill level affecting a large portion of the workforce in the case of green injections in the sector.

In addition, a survey among employers in selected sectors, including construction, was implemented with the subsequent discussion by a focus group of stakeholders. The qualitative inputs confirm the growing demand for medium-skilled rather than low-skilled workers. They also show that the age structure of the workforce in the sector may assume higher replacement demand for workers in a relatively near future. The main skill gaps identified among craft and related trade workers was team working and technical skills, such as use of materials, machine, equipment and tools.

Source: ILO Green Jobs Malaysia project.

(such as the labour force survey). An analysis of the consistency of data from national accounts with data from the labour force survey is highly advisable in that case.

The researcher should focus on the following data in particular:

- Levels of educational attainment: three main levels derived from the International Standard Classification of Education (ISCED-1997 or 2011) or from a national classification which should be compatible with ISCED:

    - low level of educational attainment (ISCED 0–2),
    - medium level (ISCED 3–4)
    - high level (ISCED 5+).

- ISCOs (ISCO-08) or the national standard occupational classification (SOC). A three-digit level is desirable for any meaningful information on skills, but even two or one-digit levels would be useful for further cross-tabulation. ISCO is a good skills proxy because it it is linked to the field of specialisation and a theoretical level of education corresponding to the nature of the skills required to carry out the tasks and duties of the job. There are four skill levels in ISCO.6

- Demographic data: in addition to the data usually collected and analysed in DySAM (for example, urban or rural; formal or informal; gender) it is necessary to add the category of age in age group brackets which would include older workers. This is especially important with regard to the eventuality of calculating replacement demand (see subsection 5.7.3 for an explanation of replacement demand).

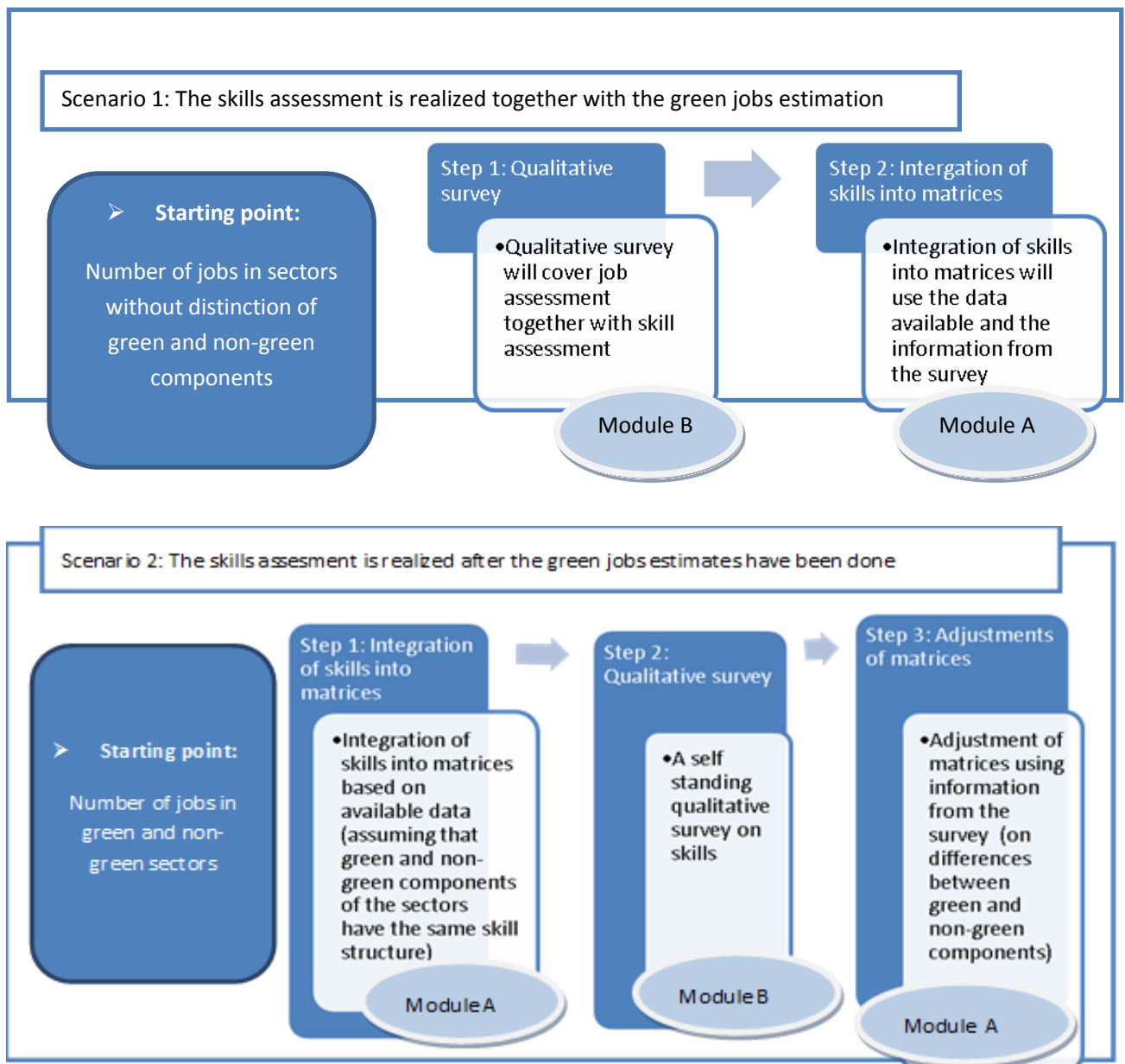- Wage statistics by ISIC and ISCO (if available).

The data should be incorporated into matrices or satellite accounts which would allow the researchers to use the model to translate employment by sectors into employment structure by occupation, level of education, age and any combination thereof. The following matrices provide useful information to help the researchers analyse the impact on the demand for skills:

- cross-tabulation between ISIC and ISCO (or SOC)

- cross-tabulation between ISIC and ISCED

- three-way cross-tabulation ISIC, ISCO and ISCED at a high level of aggregation

- cross-tabulation of ISIC and ISCO with demographic data (e.g. by gender or age group)

The two-way matrices can be produced at any ISCO and ISIC digit levels as far as the data allow. The three-way matrices should be produced at a higher level of aggregation. The specific breakdowns depend on data availability in the country and also on the country context (for example, whether it is important to distinguish between rural and urban populations).

Figure 4.2 Two scenarios for the implementation of skills analyses into green jobs assessment

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6 For more on ISCO-08 skill levels, see ILO, 2012c.

Scenario 1: The skills assessment is realized together with the green jobs estimation

Starting point:

Number of jobs in sectors without distinction of green and non-green components

Step 1: Qualitative survey

- Qualitative survey will cover job assessment together with skill assessment

Module B

Step 2: Intergation of skills into matrices

- Integration of skills into matrices will use the data available and the information from the survey

Module A

Scenario 2: The skills assesment is realized after the green jobs estimates have been done

Starting point:

Number of jobs in green and non-green sectors

Step 1: Integration of skills into matrices

- Integration of skills into matrices based on available data (assuming that green and non-green components of the sectors have the same skill structure)

Module A

Step 2: Qualitative survey

- A self standing qualitative survey on skills

Module B

Step 3: Adjustments of matrices

- Adjustment of matrices using information from the survey (on differences between green and non-green components)

Module A

Wage data could eventually be added to the analysis. From the skills perspective it is interesting to see wage dynamics per occupation. Where the rate of wage growth is higher than average, it might be an indication of skills shortage. But wage data have to be analysed in a comprehensive manner, together with other data to see the broader picture. In addition, wage statistics are rarely sufficiently detailed or reliable, so it is often hard to add them to the analysis.

Module B: Additional empirical data collection

Module B deals with the problem of assessing the importance of the green components of sectors (such as organic farming as a component of agriculture) and their occupational and skills composition. This can be accomplished by administering a qualitative sample survey to general businesses or even just to green businesses. It would also be possible to use alternative qualitative small-scale methods, such as interviewing associations or a smaller number of enterprises which have been qualitatively identified as green.

In scenario 1 the module is aimed at estimating the importance of the green components of the sectors, and also their occupational and skills structure.

In scenario 2 the skills assessment comes after the green jobs estimates have been made. The estimates of the importance of the green sectors have already been made in earlier stages (by surveys and structured interviews and also with the use of value-chain analyses). The empirical collection will in this case focus only on skills structure.

In scenario 1, questions should be asked to estimate the importance of the green components, such as:

- What percentage of enterprises produce green products and apply green processes?

- What is the proportion of green products and processes in these enterprises and how many jobs are involved?

In both scenarios 1 and 2, questions must also be asked which relate to occupational aspects and green jobs skills. The simplest solution would be to define the proportion of green jobs in the sector and assume that occupational aspects, skills and other characteristics are the same as for non-green jobs (labour force survey data could be used for this purpose). This, however, would be a very rough assumption and likely to be wrong. We need to understand whether the green components of sectors demand the same, higher or lower levels of skills as compared to those demanded by non-green jobs in the same sector. It is therefore desirable to include questions which would address:

- occupational composition (one-digit) of the green and non-green components

- or level of educational attainment of the workforce in both green and non-green components

The qualitative sample survey or other forms of data collection could also be used to reach an understanding of some of the principal questions related to skills gaps and shortages, such as:

- Do green establishments experience recruitment difficulties?

- If so, do they result from skills deficiencies or poor working conditions or wages?

- In which occupations do they encounter hiring difficulties due to lack of skills?

- Which generic (core) and technical skills does their current workforce lack that prevents them implementing the principal tasks of their jobs?

- We could perhaps ask whether the latter are related to green products or production processes

- Another option would be to ask whether establishments provide training to their workforce and, if so, in which fields (this information would be another skills proxy) and whether the workplace training on offer is related to the green, or greening, product or production process

Section 5: Sector-level research into skills for green jobs

5.1 Introduction

This section provides an overview of how to approach skills expectations for green jobs at the sector level. The approach outlined describes how the analysis can be undertaken for a single sector. In many cases, however, the policy context for the research demands that multiple sectors be addressed at the same time. Where this is necessary, researchers can undertake a full analysis of each sector if they have sufficient time or resources.

As an alternative, provided that this is consistent with the purpose of the work, they may decide to narrow the scope of the issues to be explored in each sector, to simplify parts of the analysis, or to rely on a narrower evidence base for each sector. In some cases, they may find that sectors initially thought of as separate have enough in common that they can be amalgamated for analytical purposes, particularly if they decide on a simplified approach to analysis. Figure 5.1 provides an overview of the process of sector analysis.

Figure 5.1 Overview of sector analysis process
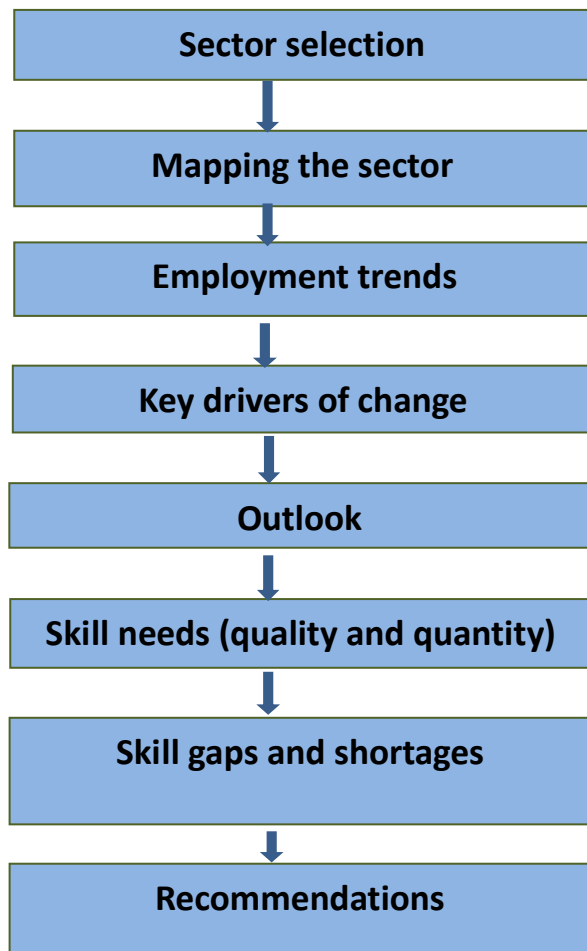
5.2   Sector selection

The decision to undertake a sector-level skills analysis most often comes out of an existing process of environmental planning or visioning that identifies a need for analysis of one or more specific sectors..

The following are hypothetical scenarios that might lead to a sector-level skills analysis:

- Planners working on a major series of concentrated solar power installations in an emerging economy realize that a substantial supply of specialist skills will be required in planning, site preparation, installation, operations and maintenance. They realize that many of these skills will not be available locally. In order to ensure that the skills are available, to maximize the local economic benefits of the installations, and to minimize the need for expensive expatriate labour, they decide to plan ahead to identify what skills are required, which of these skills it will be feasible to supply locally, and how to go about developing the skills so that they are available when required.

- A government has decided to make sustainability a policy priority for the future. It has undertaken a review of the scope to limit or cut carbon emissions, to prevent unnecessary environmental damage, and to preserve the value of environmental services. It has reviewed its own policies, looking at its existing environmental programmes, and at the broader environmental effects of its policies. It has identified priority areas for action. As part of the review process, it has undertaken high-level research into skills issues for green jobs along the lines described in section 4 of the present guide. It is necessary, however, for planning to move beyond the whole-economy level, and to focus on specific opportunities to improve sustainability. This brings the planning process to the sector level. As sector-level planning progresses, it becomes apparent that the plans will give rise to significant skills identification and anticipation issues across a number of sectors. The government decides to undertake skills research in these sectors, so that it can plan to ensure that skills will be available as required.

- Under a collaborative venture between the government, local communities, development agencies and environmental non-governmental organizations, there are plans to launch a major sustainable forestry initiative. The initiative will involve communities in forest management. There will be an inspection regime to assure compliance with standards, and to ensure the integrity of forest products supply chains. Timber-harvesting practices will comply with sustainability standards. New forest-based enterprises in areas such as tourism will bring additional value to the community. The partners in the collaborative venture realize that this will create a wide range of new skill needs, and decide that they must plan how to provide for these.

- A ministry of the environment looks ahead and realizes that its country can both achieve substantial economic benefits and greatly improve prospects for the country's carbon footprint by promoting energy efficiency. It decides on a three-pronged approach: first, that building regulations should require demanding levels of energy efficiency for new permanent buildings, through insulation and other passive techniques; second, that construction of new public buildings should progressively move to LEED (or equivalent) standards; third, that householders and owners of existing buildings should be encouraged to improve comfort and energy efficiency through the use of retrofitting technologies such as roof insulation and solar thermal water

heating systems. Each part of this approach will require new skills from the architects, engineers and construction workers involved, together with new skills in buildings inspection and quality control. The ministry decides that it needs a plan to ensure that these skills are available when required.

- A government undertakes an economic stimulus initiative, with some of the funds going to programmes targeted at improving sustainability. For example, funding might go into building energy efficiency, manufacturing energy efficiency, bioenergy and public transport. The government will wish to estimate how many additional jobs will be created (and for how long they will last), and will wish to ensure that the skills required are available so as to maximize the employment impact and ensure that the programmes are delivered efficiently and to a high standard. This will require sector-level research and if several sectors are to be covered, there may be a need for researchers to prioritize between sectors, based on criteria such as the expected expenditure in each sector and the perceived risks of non-performance.

- Industry skills councils in Australia are instrumental in identifying and responding to retraining needs. The councils foster close relationships between business enterprises, industry organizations, and the education and training system. Typically, they conduct annual environmental scans, which document industry-wide trends and concerns regarding the retraining requirements of the workforce. For example, Manufacturing Skills Australia (MSA) has recognized that the introduction of a carbon-pricing mechanism will have a strong impact on the manufacturing industry. Through a process of industry research that involved manufacturing enterprises, industry organizations and educators, MSA has developed units of competence relating to sustainable manufacturing, which embody skills to be accredited and incorporated within the national qualifications framework (Strietska-Ilina et al., 2011).

- A government prepares an energy strategy for the country which, in addition to other aspects (international energy prices, dependency on energy imports, technologies and other factors) should cover the component of human resources for the energy sector. The sectoral analyses in this case focus on green as well as non-green areas of the sector, but greening the energy sector is one of the key pillars of the strategy.

Where researchers have to choose one or more sectors for themselves without reference to an existing plan or vision, it is suggested that they use the list of sectors covered by the ILO report on working towards sustainable development (ILO, 2012a) as a checklist, and do a preliminary assessment as to how significant each of these areas is for the country concerned. These sectors have been listed earlier in table 2.1, but researchers will find the full sector analyses in that report useful in helping them to identify important areas, and in helping them to choose between those areas.

Criteria that researchers should consider using in cases when they have to choose between sectors include the following:

- sectors where a significant amount of planning has already been done, and skills planning is one of the main missing pieces in the overall plan

- sectors favoured by stakeholders, particularly where they are prepared to collaborate in the research, and take ownership of the findings and recommendations

- sectors with the greatest potential impact on sustainability

- sectors with the greatest potential for a positive impact in the labour market, whether through improving employment opportunities or making progress on the decent work agenda

- sectors that show the greatest potential for improving living standards through such channels as improving comfort in the home, improving access to clean water and safe food, improving air quality, reducing the cost of meeting basic needs and improving public safety

5.3   Mapping the sector

5.3.1   Mapping a sector's boundaries

The first step in mapping a sector is to map the boundaries. Existing plans and visions will, in most cases, have set out a view as to what is contained in the sector but, as noted earlier, this will seldom match standard sectoral classifications. Such existing work may also turn out to be less clear about what is included once an interest is taken in determining precisely where the boundaries fall.

Figure 5.2 Mapping the sector's boundaries

Sectors of economy according to a standard classification system
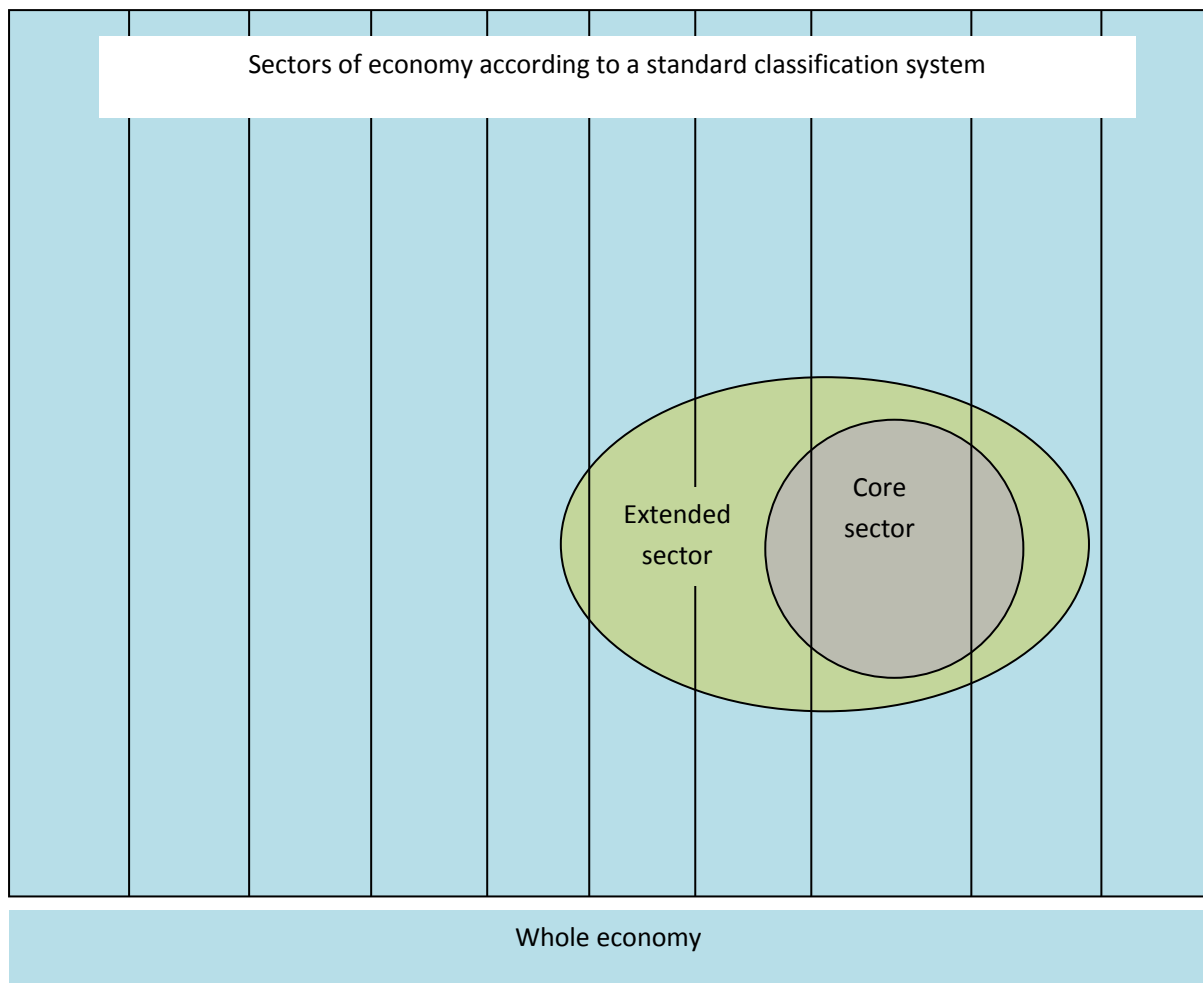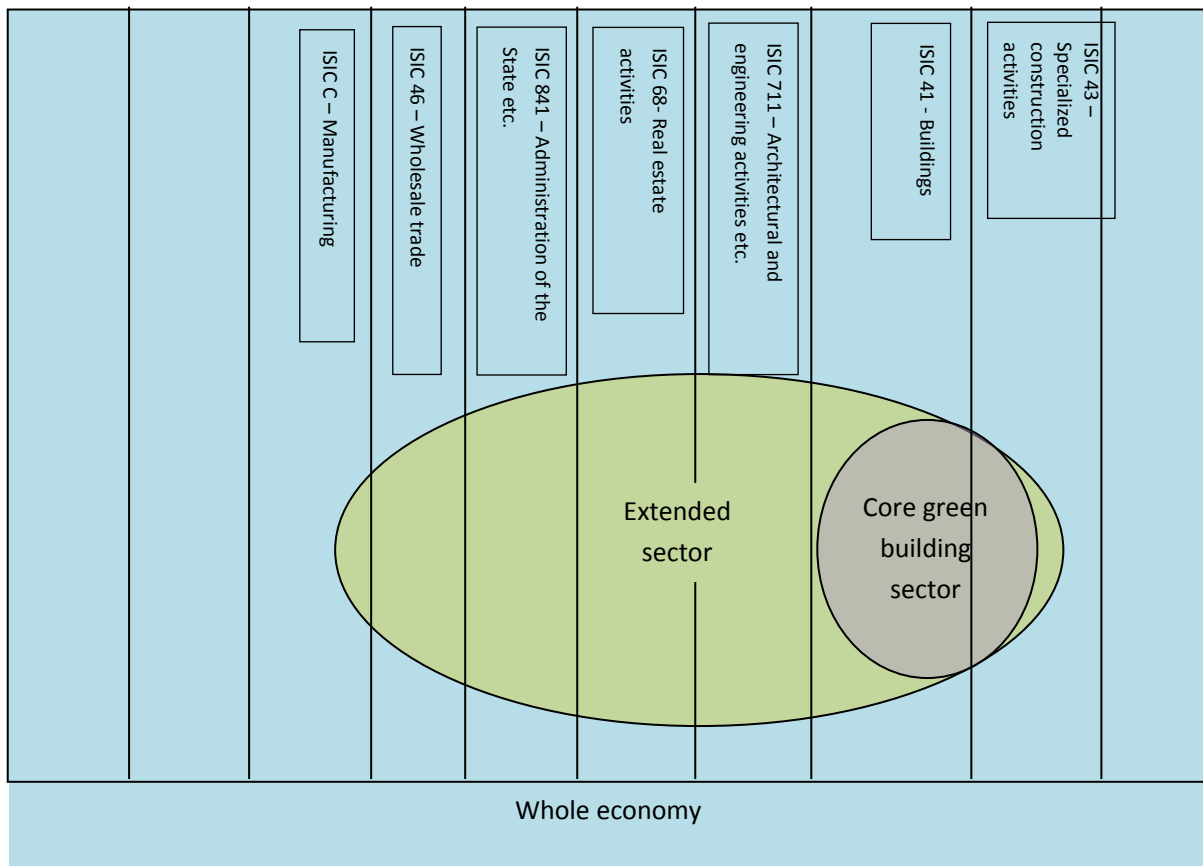
Extended sector

Core sector

Whole economy

Figure 5.2 may be helpful to researchers trying to define the boundaries. The large rectangle around the boundary represents the whole of the economy. The vertical sections within it represent the sectors into

which it is divided by the country's standard system of sectoral classification. The circles represent a core green sector that emerges unambiguously from existing plans. This is embedded in an extended sector that takes account of specialist activities beyond the core sector that contribute to the core sector's success. Examples might include suppliers to the core sector with specialist capabilities, suppliers of complementary products and services, policymakers, research institutes and even local community groupings.

The core sector may be spread across more than one standard sectoral classification although in most cases it will only account for parts of the classifications with which it overlaps. The extended sector will typically be spread across more sectors – with a substantial presence in some and a small but potentially important presence in others.

Figure 5.3 shows an example of how the framework can be applied to green building.

Figure 5.3 Mapping the green building sector's boundaries

The sector's boundaries can be mapped by:

- describing the activities that fit into the core sector
- describing the activities that fit into the extended sector
- cross-referencing both sets of activities against standard sectoral definitions
- revisiting the descriptions of activities in the core and extended sectors to see if it is possible to draw boundaries in a way that fits better with standard sectoral definitions

Making a distinction between core and extended sectors can be useful to researchers by helping them to prioritize their efforts. For example, in cases where research questions require a good quantitative analysis, it may be sufficient to carry this out at a detailed level for the core sector alone, while addressing both core and extended sectors qualitatively. If it is still necessary to address employment effects in the extended sector, this can then be achieved through estimating indirect employment using an input-output or other macroeconomic model, rather than through a detailed analysis of the extended sector.

The core sector in terms of delivering green building projects is the construction sector. In ISIC terms, almost all of this activity fits into ISIC 41 – Buildings, and ISIC 43 – Specialized construction activities.

Core green building activities consist of the construction of buildings to high standards of sustainability, and retrofitting existing buildings with technologies such as insulation or solar water heating to improve their carbon impact.

It is also, however, important to look at the wider construction sector in ISIC 41 and 43 and not just at businesses specializing in these core activities. In many countries, significant numbers of firms undertake both core green projects and projects that are not specifically green. In addition, much of the process of greening construction comes from improving the sustainability of mainstream building, through mechanisms such as strengthening building standards. It is therefore useful to look at the implications of green building for skills in the wider construction sector.

In addition to activities in ISIC 41 and 43, there is also an extended sector, made up of activities in related sectors that contribute to green building, as described below:

- Professional services firms in areas such as architecture, engineering and surveying, and specialized providers of advice on energy efficiency, all make a major contribution. These are classified within ISIC 711.

- ISIC 68 covers a range of types of activity relating to real estate, such as property management, and buying, selling and renting of property. Decisions by businesses in these sectors may have a major impact on investment in green building, and on operating buildings sustainably.

- The adoption of green building practices is influenced heavily, in many countries, by decisions made by government and public administration (ISIC 841) on promoting and encouraging green building, on introducing regulatory and legal obligations to build "green", and on inspection and enforcement to ensure compliance.

- In some countries, those entities within the wholesale trade (ISIC 46) that distribute building materials and technologies have a significant role in giving building firms access to the technologies required for green building.

- Where materials and products for green building are produced within the country that uses them, they will be sourced from manufacturing businesses that form part of ISIC C – Mining and quarrying. Relevant products can appear in a variety of subclassifications within this broad manufacturing classification, from insulating panels in ISIC 23 – Manufacture of other non-metallic mineral products, to building energy management systems in ISIC 26 –Manufacture of computer, electronic and optical products.

5.3.2 Key economic statistics, sustainability indicators and sector composition

Having mapped the sector's boundaries, the next step is to profile the sector statistically. Researchers should use the data to construct a coherent description of how the sector has developed, and characterize its current state.

The types of sector-level data likely to be useful in any sector include the following, where available:

- time series in tabular and chart form, which are useful for analysis, and for presentation in the report; charts or tables of employment, output or any of the other indicators mentioned above

- national economic statistics, such as GDP, along with estimated share of GDP accounted for by the sector

- gross output or sales from the sector, with disaggregation by important subsectors where available

- Product composition of output or sales if available, ideally distinguishing between green and non-green products, and how this differs from other similar or competing countries

- domestic sales versus exports if the sector is involved in exporting

- Input-output or supply-use tables

Researchers should also focus on other types of economic data that are relevant to the development of the specific green sector under study. For example, data on the value of the sector's capital stock per employee, and on value added per employee, will provide useful information on capital intensity and labour intensity, when compared with the same indicators for other sectors.

When going through this stage of the work, researchers are likely to find that they wish to use both data on the core sector, to the extent that they are available, and data from official statistical sources on the wider sector (or group of sectors) based on standard sectoral classifications, of which the core sector forms a part.

In addition to looking at economic and product-related indicators, researchers should also look at environmental and sustainability indicators relevant to the sector. Examples of such indicators include the following:

- CO_2 emissions (lifecycle and operating)
- other GHG and air emissions
- water usage
- raw (virgin) material usage and use of recycled materials
- energy usage
- energy efficiency and other resource efficiency
- waste generation and treatment – hazardous and non-hazardous
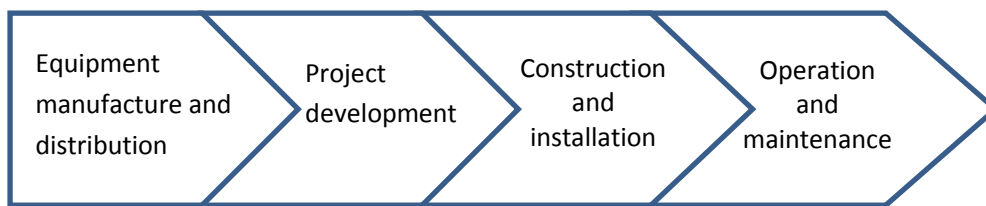- carbon storage and sequestration
- health impacts

In addition to describing the sector using the available statistics, researchers should also describe the sector qualitatively, with support from quantitative indicators where available, covering issues such as the following:

- what is done by firms in the core green sector and extended sector

- ensuring that there is sufficient background on how the sector improves sustainability and how its technologies work in order to allow the skills researchers themselves and the users of their research to understand the benefits that the sector provides and to underpin an understanding of the roles of the sector's main occupations

- what contribution the sector makes in improving sustainability and providing decent work

A diagram mapping out the sector's value chain can be useful in explaining the main supply linkages to other sectors and within the sector, both in terms of products and services. As an illustration of this, figure 5.4 shows a slightly simplified version of the renewable energy value chain used in the ILO report on skills and occupational needs in renewable energy (ILO, 2011b).

Figure 5.4 Renewable energy value chain

| Equipment manufacture and distribution | Project development | Construction and installation | Operation and maintenance |

5.4   Employment trends

The purpose of reviewing employment trends is to profile the sector's workforce as it is now, and to identify trends in its development. As with economic data, time series in tabular and chart form are useful for analysis, and for presentation in the report, ideally over a period of about 10 years. Types of sector-level data likely to be useful with regard to any sector include the following, where available:

- employment (total employment in the sector; share of employment in the country; annual percentage employment growth rate)

- employment turnover

- Labour productivity – output per unit of labour input (persons engaged or hours worked) (ILO, 2013a)

- occupational composition of employment

- gender and age composition of employment

- labour costs and pay

In some cases, the complexity of data may be such that presentation of data for a single year is justified – for example, when presenting an employment cross-tabulation by sector and occupation. Even in cases such as this, it is desirable to analyse trends over time, and summarize the results in the report on the research.

Different measures of employment may be available that could include full-time employment, part-time employment, contract employment and informal employment. The ILO multifunctional research tool Key Indicators of the Labour Market (KILM) provides useful guidance on measuring these (ILO, 2013a).

For skills analysis purposes, it is usually sufficient to take a labour force survey measure of employment as the benchmark, allowing for adjustments for informal employment where there is concern that this has not been adequately identified through the survey.

Depending on data availability and on the issues found to be important for the sector, other types of sector-level data that are frequently useful include:

- disaggregation of employment between small, medium and large businesses

- workforce turnover rates per annum

- age composition of workforce

- educational composition of workforce, and how this varies by occupation and by size of business

- job vacancies

The types of source that are relevant overlap to a great extent with those linked to key economic statistics. Two particular types of source will, however, play a particularly important role: labour force hoousehold surveys and standard establishment surveys.

Labour force household survey data will be a key source of data on the occupational and gender composition of employment, and potentially also on the qualifications and age profiles of workers. These data, however, will only be available for standard sectoral classifications, and not for core green sectors. As noted earlier, survey sample sizes and other issues can limit the amount of occupational detail available from this source.

In most cases, it will be necessary to undertake primary research into the sector. This is needed for the collection of qualitative information, but it will often also be the only practical means of collecting key employment-related statistics specifically associated with the core green part of the sector. In the absence of any other source, a survey should be conducted to quantify the numbers employed. In most cases, some kind of research, whether in the form of a survey, case study, consultation with experts, or some other qualitative approach, will be required to identify the core green sector's occupational composition at a detailed level. This can take account of how occupations are categorized by employers and workers in the sector, and does not have to be restricted to using standard occupational classifications.

In some countries standard establishment surveys can provide information on volumes and structures of employment, but coverage of informal employment can be problematical. Access to the establishment survey microdata enables the researchers to regroup the companies with a view to better identifying the green part of the sector. This reclassification can be based on a very detailed level of sectoral classification, which is often collected in the survey but not published. The sample size has to be considered in the process.

Data on job vacancies can provide useful insights into the severity of any particular skills shortages identified by employers. Researchers should, however, take account of the limitations that typically affect data on vacancies. Sources, for example, generally do not measure all vacancies – any individual source typically measures fewer than half of all vacancies and they tend to concentrate on identifying lower level skills. Difficulties in filling posts can be a result of working conditions rather than non-availability of skills.

5.5   Key drivers of change

The key drivers of change for a sector are the major factors shaping change in that sector. Analysis of the drivers of change is almost invariably an important part of any forward-looking sectoral skills study. Most green economic sectors are undergoing rapid technological and economic change that is closely linked to the politics of sustainability, making those sectors particularly subject to rapid and often fragmented processes of change, and less likely to change incrementally.

The global synthesis report on skills for green jobs (Strietska-Ilina et al., 2011) found four broadly applicable drivers of change in current use. These were:

- changes in the natural or built environments
- policy and regulation
- technology and innovation
- markets for green industries and new consumer habits

The discussion of drivers of change in this synthesis report is a useful resource for researchers. Other drivers may include demographic changes, trends in international markets and international division of labour or changes in lifestyles and consumption.

Researchers will usually find that their green sector's drivers of change have already been studied, whether as part of an existing planning or vision-based process for the sector in their country, as part of a study for the same sector in a similar country, or as part of an international study on their sector. Existing analyses such as these form a very good starting point for skills researchers.

Projections of future skills needs will be rooted in the analysis of drivers of change, often based on a complex balancing of factors. In order to perform their task well, researchers must have a good understanding of these drivers, and how they are likely to interact with each other in the specific conditions present in the sector. They should develop and elaborate their own list of drivers in order to achieve this depth of understanding. Moreover, any analysis of existing drivers of change will have been shaped by the conditions under which it was developed, so researchers will often be able to produce a new analysis that fits the sector under study better than any existing analysis. Even where the skills research builds on an existing plan that includes a solid analysis of key drivers of change, it may be best to rework the analysis to confirm its validity, to ensure that the researchers understand it thoroughly, and to allow them to adapt it in a way that better reflects factors relevant to skills and to the labour market.

A useful tool for researchers working on drivers of change is the so-called "PESTLE" framework for attitudes to the business environment, a concept that is familiar to business studies students7. This framework sets out the following six broad areas to be considered when analysing the business environment:

- political
- economic
- social
- technological
- legal

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7 This framework, or a variation on it (PEST, PESTEL, STEEP, …), can be found in most basic college texts on business strategy.

- environmental

For illustrative purposes, table 5.1 summarizes the key drivers of change found for the global renewable energy sector and for green building in the ILO reports on skills and occupational needs in renewable energy (ILO, 2011b) and in green building (ILO, 2011b). The reports include a more extensive discussion of each driver of change. Each of the drivers fits into one or more of the PESTLE categories.

Table 5.1 Drivers of change from ILO reports on skills and occupational needs in renewable energy and green building

Drivers of change in renewable energy report	Drivers of change in green building report
Climate change and the need for lower carbon emissions	Need for lower carbon emissions from buildings to respond to threat of climate change
Increasing demand for energy	Broader issues of sustainability such as the need to conserve water or to limit construction waste
Meeting the particular energy needs of developing countries – for example by providing off-grid electricity	High energy prices and benefits to energy security of lower energy consumption
Threat of higher fossil energy prices making renewable energy more cost effective	Environmental awareness among individual consumers
Interventions by governments to promote renewable energy through market-based mechanisms such as price floors (renewable energy feed-in tariff – REFIT – schemes) or subsidies	Improvements in comfort from improved insulation
Other types of government interventions to promote renewable energy, such as investing in modernizing electricity grids	Green building as a source of employment creation in economic crisis
Technological developments and productivity improvement making renewable energy more cost effective	Population growth, urbanization and improving living standards as a driver of new building activity
Domestically produced renewable energy as a source of energy security	Opportunities for enterprises to manufacture green building products, or to provide green building services
Economic opportunities for businesses in renewable energy	Quality of building stock
Lower barriers to entry into energy markets	

Source: ILO 2011b, 2011c

Each of these ILO reports is based on the study of a wide range of developed and emerging countries. There was a particular focus in this research on the low-carbon aspects of sustainability. Drivers of change for other green sectors might have a greater focus on other aspects of sustainability.

There are certain issues specific to the sustainability agenda that researchers should take into account when working on drivers of change, such as the following:

- Government interventions play a particularly important role in shaping developments in green sectors, whether through laws and regulations, through official encouragement, through supporting the development of new capabilities, or through rebalancing economic incentives in favour of sustainability, using mechanisms such as subsidies, carbon pricing, taxes on unsustainable activity, or the guaranteeing of prices in regulated markets. Outcomes obviously vary depending on the effectiveness of these measures and on the strength and durability of the Government's commitment to pursuing them, although it is true that the outcomes are moderated by technological and market developments outside government control.

- It is important that researchers should be conscious of the economics underpinning the adoption of environmental technologies:

    o Some will be successful, even without government intervention, because they make economic sense to businesses and households.

    o Many will be unsuccessful because they are not as good as competing (green) solutions to the same problem, or will only be successful in niche areas where they have an advantage.

    o Some will be successful because governments use regulation to insist on their use, believing that the social benefits will outweigh the costs.

    o Some will be successful because governments intervene to tilt the economics of the market in their favour, to compensate for the fact that less green solutions to the same problem are able to externalize their costs to society.

    o Many will be unsuccessful because the extra costs they impose in comparison with less green competing solutions are too high for governments to be prepared to tilt the market enough to make them successful.

- It is also important that researchers should be conscious that the economics of environmental technologies are not a constant and should bear in mind the following.

    o The cost of competing non-green technologies can change, as with, for example, the cost of oil or gas.

    o The cost of green technology can change. In many areas, there are substantial and experienced economies working progressively to make green technologies more competitive with established non-green technologies. In some cases, this has the potential to bring the cost of the green technology below the cost of competing technologies, even without government intervention.

- In some cases, the viability of a green activity depends on the quality of resources available at that geographic location. Solar energy technologies, for example, are most viable at lower latitudes with little cloud cover. Sustainable forestry depends on the availability of suitable forests or land suitable for forestry use.

- Researchers should be conscious that the sector has to juggle a balance between, on the one hand, refitting existing operations, infrastructure or buildings with green technologies and, on

the other hand ensuring that there is a potential for new operations to adopt green technologies from the start. It is usually much less costly to implement green technologies from the beginning than to start with conventional technologies and replace them with green technologies later. This marks an important distinction between developed countries which find it costly to upgrade the sustainability of their legacy equipment, buildings and infrastructure, and emerging and developing countries for which the incremental cost of installing green technologies over conventional non-green technologies can be small.

- Consumer behaviour can be an important issue here. The adoption of green technologies by consumers is influenced by issues of cost and benefit – both actual and perceived. It is also influenced by the personal responsibility that many consumers feel to support sustainability. Adoption of many of the practical changes required for sustainability depends on decisions taken by consumers, and on what governments and other stakeholders do to influence their decisions.

- Most drivers of change that influence skills for green jobs do not stand alone but are related to and interact with other drivers of change.

5.6   Outlook

5.6.1   Purpose of the outlook stage

The outlook stage of the analysis concerns the drawing up of one or more scenarios showing the future development of total employment in the sector. Researchers may also wish to make estimates regarding future indirect employment associated with the sector. At this stage both qualitative and quantitative information are used to develop the scenarios: the output is in the form of quantitative employment scenarios, supported by a qualitative description of what will happen under each.

If the research questions are all qualitative, researchers can approach this stage accordingly, and not have to construct quantitative projections for employment (see table 1.2 for an overview of skills research questions and appropriate types of methodology).

Alternatively, the outlook may be developed by means of an interactive foresight process in which the sectoral stakeholders develop a shared vision of the future or of future scenarios. They can then have a discussion on which version of the future is the most desirable, what would be needed to achieve it and how to meet the related demand for skills development. More information on the foresight approach can be found in the Cedefop-ETF-ILO guide on developing skills foresights Kriechel et al., 2016).

5.6.2   Descriptive scenarios

The outlook stage should start with the creation of one or more descriptive scenarios for how the sector will develop. How researchers should go about doing this depends on:

- whether the research is intended to build on other planning and vision work for the sector, and, if so,

- how firm a view of the future emerges from this existing work, and how reliable stakeholders and the skills researchers consider the analysis to be.

In many cases, it will be possible either to develop one or more scenarios from other planning and vision work, or at least to base the scenarios closely on such work. Depending on the existing plan and the context, this can be as simple as adopting a single scenario that assumes the plan is implemented successfully, or alternatively it can involve setting out a number of scenarios based on different projections of the future – whether based on different approaches to implementation of the plan, different market responses to the plan, or different developments in the wider environment. Building on existing scenarios not only lessens the amount of effort which has to be invested in the skills study but also brings value added by enabling future linking of strategies and analyses and the possibility of applying joint actions.

For example, plans for new installations of wind energy capacity would form a good starting point for anticipating the needs of future wind energy skills. Box 5.2 provides an example of this based in South Africa.

If there is no existing plan on which the scenarios can be based, it becomes necessary to propose an outline on future development. While it is not possible to give a comprehensive picture of the content of scenarios for green sectors, the following are some generic examples that may be helpful to researchers:

- A new standard will be introduced, applicable to all or part of the sector, which will improve the sector's sustainability through changed practices and changed technologies. It may boost activity

by making the sector's outputs more marketable; it may lessen activity by reducing the exploitation of resources to sustainable levels; it may create opportunities for complementary economic activity; it may generate significant activity in inspection and enforcement, and it may provide advice on ways to ensure compliance with the standard.

- A certain amount of new renewable energy capacity will be installed, using a specific technology and over a specific timescale. It will generate activity in planning and design, construction and installation, and operations and maintenance. If the technology is a crop-based bioenergy technology, it will also generate activity in agriculture or forestry.

- Some existing infrastructure (buildings, machinery, power generation, transport, water supply and other elements) will be retrofitted with a new technology that improves sustainability (reduces wasted energy, conserves water, reduces emissions and other effects). The total amount of work to be done will be based on the amount of infrastructure that can be upgraded, the proportion that will be upgraded, the pace at which upgrading will progress, and the amount of work involved in upgrading. Different scenarios may be based on varying assumptions about the amount that will be upgraded and the pace at which upgrading will progress. Depending on the mechanism used to encourage adoption of the new technology, this may generate significant activity in inspection and enforcement, and in providing advice on compliance.

- An industry manufacturing green technologies will start to develop, supplying its products to domestic and export markets. Through innovation, cost efficiency, closeness to the market or some other source of competitive advantage, it will grow rapidly for a number of years, and will then maintain its share of global markets once the product-market matures.

- The Government, a donor or some other source of funding will provide money to encourage the adoption of a green technology. The amount of funding available is a known quantity, as is the timescale over which it is planned that the funding be applied. The incentive envisaged per unit is also known, giving an indication of the total number of units that will be installed if the programme proceeds as planned. If the typical volume of work required per installation is known, it would be possible to estimate the number of person-years of work involved. If the volume of installations is, as expected, be fairly constant, estimation of the numbers to be employed should be quite straightforward.

5.6.3 Turning descriptive scenarios into quantitative scenarios

The process of developing a quantitative projection of skills needs starts out with a projection of employment in the sector. These employment projections are then disaggregated by occupation to produce projections of future employment by occupation. If desired, these occupational employment projections can then be used to produce projections of demand for new workers by occupation.

The first step in turning descriptive scenarios into quantitative scenarios is to decide on what sort of model will be used to generate employment projections. This should be shaped by the kind of questions that researchers are seeking to answer, and by the choices they have made about sectoral boundaries.

Not every study will contain a quantitative analysis, as quantitative findings are just not useful to every study. It can also be the case that the amount of effort required is disproportionate to the benefits, and that qualitative findings alone will be sufficient.

The available choices are summarized in figure 5.5.

Figure 5.5 General approaches available for modelling employment in green sectors

		Approach to embedding sector in wider economy			
		Quantitative analysis not linked explicitly to wider economy	Based on primary research rather than modelling	Input-output or Social Accounting Matrix Model	Dynamic models, such as Computable General Equilibrium or Dynamic Social Accounting Matrix Models
Boundaries on sector for modelling purposes	Subset or subsets of green sector				
	Green sector				
	Wide sector that includes green				

One choice to make related to the level at which the sector is to be analysed, namely:

- Will the analysis only address a subset of the green sector? Perhaps all that is required is to project the employment effects of a specific initiative. For example, the objective might be to project the employment impact of introducing electricity generation based on gas from anaerobic digestion of waste. Or it might be to project employment arising from a government programme to support the installation of roof or attic insulation.

- Will the analysis seek to project employment across the whole of a green sector (or core green sector), as defined when mapping the sector's boundaries?

- Will the analysis address the whole sector within which the green sector is embedded, so as to take account of interactions between green and non-green areas of the sector?

The last of these approaches is often adopted for more sophisticated studies of electricity sectors, or of whole energy sectors. In the case of electricity it is, for example, relevant to take account of the fact that adding sources of variable power (such as wind or solar) to an electricity grid increases the need for peaking power (such as gas turbine or hydro) to provide coverage in times of low variable output, and has other impacts on the need for base load power (such as from coal, nuclear or geothermal), on the

electricity grid infrastructure required, and on electricity pricing. As a consequence, some of the more sophisticated projects projecting employment in renewable energy are directly based on engineering studies dealing with the whole electricity sector or even the whole energy sector. Even those that focus narrowly on renewable energy must take account of the constraints on deployment imposed by policy and economics that are ultimately based on engineering considerations.

Researchers will usually wish to embed the model of employment in the sector in a wider quantitative and qualitative context. At the very least, researchers will wish to identify the main areas of employment in other sectors that are associated with the core sector's activities. It is possible to identify these through qualitative research approaches. As an alternative to modelling, this employment can be quantified through an enterprise survey targeting firms that supply the core sector. The enterprise survey can include questions about skills, occupation and training that will assist with subsequent stages of the sectoral analysis.

The most straightforward quantitative approach to modelling the relationship between employment in the sector itself and in other related sectors is input-output modelling. Social accounting matrix modelling is broadly similar, but includes more economic variables. It is not difficult, with these types of model, to estimate the employment impacts that changes in one sector will have on another. These models have the benefit of being fairly easy to understand, so that their workings and outputs can be explained to policy-making audiences. Nevertheless they have the disadvantage of being static – they do not model changes in relationships over time, and they do not take account of shortages and price effects.

The most work-intensive option is to insert the sector-level analysis into a macroeconomic model based on a dynamic modelling approach to the whole economy that takes account of factors such as energy flows, price effects and constraints on supply. Models such as these can be more realistic, in that they capture more of the operation of the system. On the other hand, their greater complexity means that much more work has to done by researchers, and it can be more difficult to communicate the logic of these models' outputs to policymakers. Taking a dynamic modelling approach will typically only be feasible if the researchers have access to an existing CGE or DySAM model of the economy that can be adapted for the purposes of their research, and if they have a sufficient understanding of the model to be able to adapt it. This is partly to do with the amount of effort and expertise required to work with dynamic macroeconomic models, but also because the challenges in validating such models mean that it is preferable to start with a model that has already been shown to work well for the economy.

It is beyond the scope of this guide to give detailed advice on how to turn descriptive scenarios for green sectors into quantitative scenarios. The general approach is to interpret the descriptive scenario using a projection on some measure of activity, and then to translate that activity projection into an employment projection based on a logical quantitative relationship between the activity and the amount of labour required to carry it out. Researchers should look to other sources for guidance on the technicalities of input-output, SAM, DySAM and CGE modelling, including the ILO guide on assessing green jobs potential in developing countries (Jarvis et al., 2011), which takes an approach based on input-output modelling.

Skills researchers by themselves are unlikely to be able to undertake detailed engineering modelling of sectors, and will have to rely either on existing models of a sector, or on collaborating with experts in such modelling. Detailed engineering modelling of a sector would, however, normally be carried out for other planning purposes, and skills researchers would typically be just one group of many users for such a model.

Simpler approaches to quantification of the scenarios are also possible at sectoral level. Here are some practical examples:

- In the case of renewable energy, a scenario can be expressed quantitatively in terms of the technology being installed, the peak power output it is capable of producing, typically measured in MW or GW, and the energy produced per annum, most often measured in GWh, TWh or sometimes in ktoe in this context.8 Employment associated with construction and installation is generally related to capacity. Employment associated with operation and maintenance may be related more closely to capacity or to energy output per annum, depending on the renewable technology. In the case of bio-energy, employment associated with providing and processing biomass is most closely related to energy output per annum.

  There have been many studies of the relationship between these capacity and output measures and employment for renewable technologies. Rutovitz and Atherton provides a useful review of the findings of studies undertaken up to that date (Rutovitz et al., 2009). Modelling employment on the basis of relationships like these taken from the literature does provide a useful means of producing first estimates of the employment likely to be associated with renewable energy, but it is preferable, in addition, to investigate the specific employment requirements associated with the technologies that will be installed, and to bear in mind that newer versions of technologies can be less labour intensive.

- In the case of an initiative to promote the retrofitting of homes with energy efficiency technologies, a scenario can be drawn up in terms of the number and type or size of homes that will have a range of different energy efficiency technologies installed. Examples might include external wall insulation, internal wall insulation, roof or attic insulation, heating and air-conditioning controls, and solar thermal heating. The scenario would be developed using information on the condition of the housing stock and would also specify the pace at which the work should be undertaken.

  Employment can then be estimated either directly, based on survey or case study data on the labour input associated with each installation, or indirectly, via survey or case study data on the cost of each installation, including the proportion of the share of the cost that goes to labour, and the average labour costs in the construction sector.

  In the case of a green stimulus initiative, the number of people employed in an area where spending takes place can be modelled with reference to the amount of public money spent over the period, the amount of funding from other sources (such as businesses and households) leveraged by public money, the proportion of the total expenditure that goes on labour, and the average labour costs for the sector. The number of jobs is best expressed in job-years.

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8 MW (megawatts) and GW are measures of power at a specific time. MWh, GWh (megawatt hours) and TWh (terawatt hours) are measure of energy. 1 tera = 1,000 giga. 1 giga = 1,000 mega. A 10 MW plant operating at full capacity for 24 hours would produce 240 MWh of energy. Operating at an average of half capacity for a year, it would produce about 44,000 MWh of energy, or 44GWh. Energy is alternatively measured in ktoe (thousand tons of oil equivalent): 1 ktoe = 11.63GWh.

While projecting employment levels in a green sector, researchers should also ascertain the patterns of employment likely to be associated with that employment. The following are some patterns that might be identified:

- In some cases, jobs will be stable, with most employees able to work for many years if they wish. For example, jobs involved in the supply of biomass to a generating station or biofuel plant may be fairly stable for as long as the plant is in operation.

- In other cases, for example in project work associated installing various types of green technology, even if many jobs are of limited duration, workers may be able to work fairly continuously in the same area, provided that the rate of investment is stable. If the rate of investment is volatile, employment will be unstable too. For example, if the rate at which new wind energy capacity is installed can be kept fairly constant, workers involved in site development and installation may have fairly stable work, despite moving regularly from one project to the next.

- In other cases where employment is of limited duration, there may not be a clear labour market boundary between green and non-green segments, so green jobs may regularly be filled by workers from a non-green background. For example, there may be a regular flow of construction workers between green and non-green building.

5.7 Skills demand

The skills stage of the sectoral analysis is about identifying and anticipating the sector's future skills needs in both qualitative and quantitative terms. It first looks at current and future demand for skills (subsection 5.7) and then at the skills shortage as a result of the imbalance between the supply of skills and the demand for them. (subsection 5.8.)

5.7.1 Current skills demand

The research starts with evidence regarding the sector's current skills profile, in terms of its occupational composition and the distinctive skills required by the various occupations. In theory, the occupational composition of the sector will already have been addressed adequately in connection with the profiling of employment in the sector. In practice, it will often be necessary to revisit the matter at this stage, in order to ensure the reliability and detailed quality of the data on which the occupational composition of employment in the model is based and to see to it that the categories used are relevant to the sector and distinction made between the green and non-green areas of the sector.

It is, therefore, useful to review the main sources of the available data, and the issues that may arise therefrom.

Key sources of evidence that may contribute to the occupational profile include:

- Occupational data on the sector, or related sectors, drawn from labour force surveys: while core and extended green sectors defined by researchers will usually not fit in with standard sectoral classifications, data on the wider sector or sectors of which a green sector forms a part can also provide an important reference point. In some cases, occupational profiles within the green sector may not be very different from the wider standard sector classification of which it forms a part.

- Primary research can also be used to produce a profile of the sector's occupational composition if, as is likely, the information available from labour force survey data is insufficiently detailed. This can be carried out through an enterprise survey (a sample survey is sufficient for this purpose), or even through a representative set of case studies. A possible alternative approach is to draw on expert knowledge, but asking questions of the firms that are active in the sector is more likely to produce accurate information.

  When profiling the occupational composition of a sector through primary research, it is usually preferable to employ the occupational titles in use in the sector itself, rather than using generic titles from standard occupational classifications. The questions will be more relevant to the firms canvassed, and it will be possible to focus on occupations that are important to the sector but that do not appear as distinct occupations in standard classifications. Researchers can obtain advice from experts or stakeholders as to which occupational classifications it would be best to use.

- Occupational profiles of the sector may, in some cases, be found within the work of other researchers. The occupational profile of the same sector at a similar stage of development in a similar country could, in principle, be used effectively, provided that the stakeholders agree that there is an adequate level of similarity to the sector being researched.

It is also useful to carry out research into the specific work performed by each of the most significant occupations in the sector, to examine the distinctive technologies they install or use, and look at the way in which work within the sector is organized. All of these factors have an important influence on the skills required.

For example, wind turbine technicians doing on-site maintenance might be classified as mechanical engineering technicians under a standard system of classification (3115 under ISCO-08), but will also require skills and knowledge in electrical engineering and electronic control systems, along with specific knowledge of wind turbine technologies. Some knowledge of structural engineering may also be useful. They will work for much of the time in small teams or alone on work that requires good record keeping, adherence to procedures and the ability to show initiative, which will influence the personal qualities and core skills required. To the extent that there are specializations within the job, the small team environment will favour a high degree of cross-skilling.

The extent of the research into the necessary skills requirements can vary, depending on the purpose of the research. For many purposes a high level overview is sufficient, whereas more depth of research (similar to the outline for wind turbine technicians above) is needed to provide broad policy guidance to education and training systems. Much more depth of research would be required to form the basis for the design of a course.

Higher level overviews can be obtained by consulting with a small number of industry experts through workshops or interviews. Very detailed investigative work, however, undertaken from scratch, would require extensive research across a range of firms into the specific tasks carried out by workers in the occupation, and the skills that they need to use. This could be done through an enterprise survey or a DACUM-like occupational analysis (DACUM, 2013). In many cases, however, existing occupational profiles will be available from other countries, and it may be more practical to adapt these than to create entirely new profiles.

When undertaking qualitative research into demand for skills, researchers should generally look beyond the core green sector. Most research questions will also call for an examination of skills requirements in the extended green sector, particularly those that will help the core sector to operate more effectively, to grow, and to attain its full sustainability potential..

For many research questions, it will also be relevant to take into account the demand for skills within the wider non-green sector(s) of which the core and extended green sectors form a part. At the very least this helps researchers understand to what degree skills are transferrable between related green and non-green sectors, and the extent to which these sectors draw on a common pool of labour.

5.7.2   Future skills demand – qualitative

In addition to describing the types of skill required in the present, it is also important that researchers should look at the future to foresee likely qualitative changes in skills requirements; this can be addressed in part through interviews with firms in the sector and with other stakeholders.

It should also be addressed through consideration of the implications of identifiable trends, at the very least taking account of the following issues, within the context of the drivers of change referred to above. Such consideration could include:

- Looking at similar businesses in other countries where the same sector is more advanced. Are there patterns that the sector being researched is likely to follow? What are the skills implications?

- Looking at probable changes in technology that will have an impact on the demand for skills, whether in terms of increasing unit labour productivity (producing more using the same number of people) or changing the skills required in development, production, installation, operation, maintenance or provision of advice. What are the skills implications?

- Looking at likely changes in work organization that may have an impact on skills. While it may be possible to identify changes, such as systematization of work, that will reduce technical skills requirements and scope for initiative, many changes result in a need for stronger core skills in fields such as communication, teamwork, computer use and problem solving. Automation changes the skills content of operative level work, with manual skills among operators and assemblers often being replaced by basic skills in managing and documenting the production process, and in basic machine maintenance. It also tends to increase the need for technicians to do set-ups and higher level maintenance.

5.7.3   Future skills demand – quantitative

Quantitative modelling of skills demand has already been discussed in sections 1 and 4 above. The sector analyses often use quantitative information from the whole-economy model which enables the sectoral breakdown.

Occupational employment projections

Employment projections are converted to occupational employment projections for the sector through a sector-occupation matrix setting out the occupational composition of each sector modelled. This is based on the occupational data for the sectors already used in the analysis of current skill needs. If existing trends or the qualitative analysis of skills point towards future changes in the occupational composition

of the sector, researchers should add a time dimension to the matrix, incorporating assumptions about future changes in occupational composition.

Researchers may wish to prepare occupational projections for each employment scenario they have undertaken.

The employment projections may have been prepared in a way that divides the sector into a number of constituent subsectors. If there are separate analyses of occupational composition for each, the occupational projections can be made at subsector level.

It is important for researchers not to place too much emphasis on the projections. Even if events turn out approximately as projected under a scenario, the actual numbers employed per occupation will most likely vary from the projections, possibly significantly in specific years. Therefore any report on such research should be qualified by a certain amount of caution. Researchers should avoid giving the misleading impression that the quantitative findings are flawless: to avoid this impression the findings could be presented in graphical form or in the form of a more qualitative indicator; they could be summarized over a number of years, and a warning could be included against over-reliance on detail.

Occupational demand projections

It is possible to develop estimates of the demand for workers according to each occupation for which employment in the sector is projected. It is usually best to focus these projections on a limited number of occupations in which significant numbers will be required, rather than attempting to cover all occupations in a sector individually in a detailed manner. Occupations that are similar in nature could be grouped together to help achieve this.

Estimates of occupational demand are made up of two components: growth-related demand based on changes in the numbers employed in the sector (expansion demand), and replacement demand based on assumptions about the proportion of those employed who will need to be replaced due to retirement, change of occupation, moving to a different sector or for other related reasons:

- Growth-related demand is calculated arithmetically, based on the projected change in employment levels from one year to the next.

- Replacement demand may be addressed either through relatively simple or more complex methods. Using more simple methods, it is most often calculated as the numbers employed in the current year divided by the numbers employed in the previous year. More complex methods include cohort component methods and longitudinal flow models.

It is possible, in principle, to identify the rate at which workers in the sector have had to be replaced in the past using survey data. Some labour force surveys ask for information about the sector of employment and occupation of each person in their sample relating not just to the time of the survey but also to the previous year. An enterprise survey conducted as part of the research can ask about employee turnover, and also about the proportion of recruits that came from the same sector. (Employee turnover is higher than the sector's replacement rate because workers circulating between employers within the same sector do not have to be replaced by the sector as a whole.)

In practice, however, it is often necessary to make an informed estimate based on information gained from interviews about what is happening in the labour market. It is necessary to take account of the following, at the very least, when making this assessment:

- If the sector is growing, there may be significant numbers of people leaving an occupation to further their careers.

- In the case of certain occupations there may be a significant flow out of the sector's workforce to other sectors or to emigration.

- For sectors with a substantial female workforce, it is important to understand whether significant numbers of women leave the workforce upon marriage or upon starting a family, and to look at the pattern of their subsequent return to the workforce.

- Depending on the age profile of the workforce, significant numbers may be lost to retirement. Where the work is physically demanding, many workers may leave long before the formal retirement age, or step back to a less demanding role, because they can no longer perform effectively. The age composition of the green part of the sector can differ significantly from the non-green part, as the green part tends to introduce new technology and innovative processes which attract a younger workforce.

Replacement rates most often lie in the range of between 2 and 5 per cent of the previous year's employment, but can rise substantially higher where skills and training requirements are low, employment relationships are weak or significant numbers are approaching retirement age.

Researchers should be aware that actual replacement rates can vary considerably over time, depending on labour market conditions. Where confidence in the sector among workers is high and competing opportunities are limited, replacement rates tend to be low. Where confidence weakens and good alternative opportunities emerge, replacement rates can increase substantially.

5.8   Skills gaps and shortages

5.8.1   Introduction

There are two main types of skills shortage, which may exist separately or in combination:

1. A quantitative skills shortage, under which the number of workers available with broadly suitable skills is insufficient;

2. A qualitative gap under which the number of people available may be sufficient, but their skills are deficient relative to what is needed.

5.8.2   Quantitative labour shortage[9]

Labour market evidence of skills shortage

[9] This section was prepared with the use of the ILO pratical guide on skills for trade and export diversification (STED) (Gregg et al., 2012).

The first step in the quantitative analysis of skills shortage is to look at the labour market evidence about the development in recent years of the balance between supply and demand, and how it stands now.

In skills analysis and in anticipating the balance between supply and demand for an occupation or a type of skill, it is often difficult to bring the supply data in line with demand estimates. Observation of actual labour market conditions provides indispensable insights into what the actual supply-demand balance is, and how it has developed.

If there is a high level of vacancies, if pay is increasing faster than for other types of occupation in the economy, and if there is a rapid labour turnover, with many workers moving between employers in the sector, then demand probably exceeds supply. If there is a low level of vacancies, if suitably qualified people are unemployed or taking up work outside their area of expertise, if pay is depressed, and if voluntary labour turnover is low, then supply probably exceeds demand.

Figure 5.6: Signals of imbalances in the labour market

Demand exceeds supply
- elevated vacancy levels
- pay increasing faster than for other types of occupations in the economy
- high labour turnover - many workers moving between employers in the sector

Supply exceeds demand
- low vacancy levels
- suitably qualified people unemployed or take up job outside their area
- depresses pay
- low voluntary labour turnover
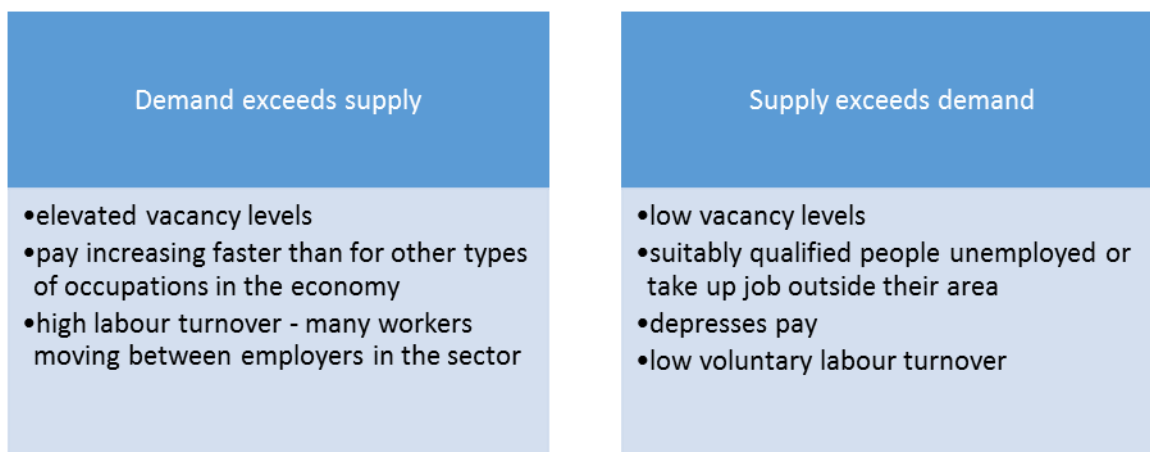
In the event that some indicators point towards an excess of supply over demand and others point in the opposite direction, then matters may be more complex. If employers complain about difficulty in finding sufficient numbers of workers, but other evidence suggests that there are plenty of workers available who simply do not want to work in the sector, the problem may lie with the image of the sector, with poor working conditions, or with levels of pay that are not competitive with other sectors of the same economy, rather than with a straightforward shortage of supply. The solution could be to improve working conditions, to improve productivity so as to allow improvements in pay or to develop new sources of workers, rather than endeavouring to increase the supply from existing sources.

New sources of workers could include conversion courses for people who have some of the required skills, new initial training courses designed to be attractive to people from non-traditional backgrounds, and recruiting from other countries.

Sources of labour for the sector

Before looking in detail at whatever data on the sources of key skills are readily available, it is important to check what sources of labour the sector actually uses for its main occupations.

The answer for an occupation may be straightforward – that the sector only recruits graduates[10] from a number of specific courses or other training programmes, such as apprenticeships, and will take almost anyone from these courses. This is most common where an occupation is regulated, and only people with a specific qualification, linked to a specific set of courses or other training programmes, are permitted to do the work. It may also come about through collaboration between a sector's employers and those who provide training courses that are very closely tailored to the sector's needs.

More broadly, the sector may recruit graduates with a particular type of qualification from any provider of education and training in the country. In many cases, employers who hire on this basis look at the course provider or the grades obtained when making their choice. Some firms will be less demanding than others; nevertheless, not all graduates of these courses will be judged to be sufficiently well skilled to form an effective part of the workforce.

There are, however, other possibilities. For specific types of job, employers may:

- recruit people whose qualifications are not linked to the specific job, and train them in the specific skills needed

- recruit people whose qualifications are broadly relevant, and give them specific training and experience

- provide training for existing employees, or sponsor them to do external training

- recruit people with the skills required from another sector

- recruit inward migrants with the required skills.

- recruit people from outside the existing workforce or from among the underemployed

Estimates of the available supply of labour should be based on the sources that are actually used by the sector, and the sources that could feasibly be used in the judgement of employers and other stakeholders, not on whatever data happen to be most conveniently available.

It is important that researchers should not assume that a sector will necessarily make use of a supply of people qualified to work in an occupation.

Quantification and projection of different types of jobs vary in their complexity. While there are more examples covering graduates and unemployed in the quantitative supply models, only very well

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[10] The terms *graduate* is used here in the sense of a person who has qualified from any substantial programme of education or training, including both technical and vocation education and training, and university-level courses, and including apprenticeships and other formal programmes of learning that take place partially or wholly in the workplace.

Figure 5.7: Quantification and projections of different sources of labour for the sector

From education and training

Where the key sources of new skills supply are programmes of education and training, data on the flow of graduates from these programmes provide important insights into skills supply. A number of **types of data on students and graduates** are of interest.

 - *Graduate data* – historical time series data on the number of graduates from relevant courses

 - *Student data* – historical time series data on the number of students, trainees and apprentices in the system, ideally disaggregated by the stage of the programme (by year of course in the case of higher education).

 - *New entrant data* – historical data on the number of students, trainees and apprentices taking up places. These are not necessarily the same as data on the number of first years – depending on the course and country, significant numbers of new students may leave before the reference date when students are counted, and some students may repeat first year.

 - *First destination data* – historical data on where students have gone after graduation, in terms of the split between employment versus further study versus unemployment versus other destinations, and in terms of information about the industries and occupations to which those in employment go.

In most cases, *it will be sufficient to quote graduate data* to demonstrate how many graduates are available. Where courses are of more than a year or two in duration, it can also be worthwhile to quote trends in student or new entrant numbers to demonstrate how the graduate pipeline is developing.

Researchers should anticipate that in most cases only some of these types of data will be available, that they *will not necessarily be available for all relevant parts of the country's education and training systems*, and that systems of classification by subject and level of study (and qualification) will not necessarily suit the requirements of their research. They should be prepared for much of the student, trainee, apprentice and graduate data that they would ideally like to use in their analysis and present in their report to be unavailable from existing sources, and should plan to work with what they can get.

From under-utilized pools of labour

The earlier discussion of sources of labour highlighted a number of types of source that fall broadly into an "underutilized pools of labour" category. In many cases, *these pools are in general so obviously large relative to demand* that there is no great need to quantify them. This might, for example, be the case in some countries when the relevant pool of people is "young unemployed", "family members of subsistence farmers" or "home-makers interested in entering the paid economy".

In other cases, there may be a need to be more specific, e.g. to be able to identify not only the total supply but also the supply with adequate broadly suitable skills. If it is practicable to quantify these numbers, it will typically either be through obtaining information from a *public employment service (PES)* or from analysing *detailed data from a labour force survey*.

The relevant population might, for example be:

 - *Unemployed people with a specific qualification* or who were in a specific occupation – may be available from the PES or labour force survey

 - *Unemployed people with at least a specific level of education* – may be available from the PES or labour force survey

 - *People in a specific occupation working part time* who say they are underemployed – may be available from a labour force survey

From existing pool of labour

Drawing from the existing pool of fully utilized labour means drawing on groups who are already fully employed, whether within the sector itself or from another sector. The scope for **recruiting workers employed by another sector** depends both on how many workers with the required skills are employed in other sectors and on how easy it will be to achieve a net gain in numbers from seeking to recruit them.

While mobility between businesses in the sector does not add to the supply, **upskilling people already employed** in the sector does do so. Estimating the potential supply is primarily about estimating the number of people suitable for upgrading – perhaps based on occupational data – and the proportion of these who can practically be upskilled.

It may be possible to quantify numbers employed in other sectors from *labour force survey data*. It will usually be difficult to quantify analytically how many can be recruited. *Interview evidence* from firms or employment services may provide reasonable estimates, however. *An analytical look at regional allocation of these sectors, wage levels and* working conditions can provide further information input for the estimates. Building a quantitative model which would take them into account would be a very demanding exercise but qualified qualitative estimates may be applicable.

From inward migration

It is generally difficult to quantify with any precision how many people with a skill it will be possible to attract as inward migrants. Most often, the **relevant questions to ask** are whether there is a significant population of internationally mobile skilled labour available, whether the country and the sector are attractive to that population, whether regulations on inward migration will facilitate recruiting from the population, and whether they will come to the country on their own initiative or will only come if recruited actively. Based on the answers to these questions, it is possible to assess in broad terms what the constraints will be on recruiting inward migrants.

The key data sources include the ministry or agency responsible for controlling or recording inward migration and the international literature on flows of skilled workers for specific sectors.

developed models explicitly work on transitions of labour supply between sectors[11] and inward migration is always very challenging to quantify and project.

In a sectoral study it is always necessary to keep in mind that the supply as a whole is not always available for the sector of interest. The sector has to compete with other sectors of the economy and may even face competition from other countries in attracting a qualified labour force. Allocation of the labour force depends on various circumstances such as wage levels and differences, labour conditions, legislative regulations and spatial considerations. Quantitative data (and possibly projection models for some parts of the labour supply) always need to be combined with qualitative assumptions and estimates of what supply will be available for a particular sector.

Comparison of quantitative measures of supply with demand projections

Quantitative analysis of supply gaps must take account of the diversity of the available sources of supply, and of the actual requirements represented by quantitative projections of demand. A descriptive approach to comparing the volume of demand and supply is usually preferable to simply calculating the difference between their quantitative projections. In most cases, estimates both of supply and demand require careful interpretation to avoid problems with comparability. A simple supply-demand balance should be regarded as only indicative, and it can be misleading if not interpreted with care. For this reason, they should be used to inform apparently less precise indicators or descriptions of trends, and should not normally be published.

It is helpful to root comparisons of future supply and demand in current labour market conditions. If the modelled balance between supply and demand for the current year is consistent with qualitative evidence on labour market conditions, then this provides evidence that the balance produced by the model is approximately correct. If not, it provides information useful for either calibrating the model to give a more accurate reflection of reality, or contributing to a sound interpretation of the model's projections.

5.8.2   Qualitative supply gaps
Analysing future qualitative supply involves addressing two questions:

- What existing qualitative skills gaps (deficiencies) are there that must be tackled just to satisfy current skills needs?

- What qualitative changes in skills needs are emerging?

Current skills deficiencies

Information on the qualitative gap between the skills available and the skills that the sector needs is best gained through consultation with employers, although the views of workers' representatives, providers of education and training, and employment agencies are also relevant and can assist researchers in reaching well balanced conclusions.

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[11] For example the model prepared by the Netherlands Research Centre for Education and the Labour Market (ROA) has a module on substitution which assumes that people may be demanded by sectors and occupation not directly linked to their education.

Key groups of workers to ask about include:

- existing employees
- experienced people available to be recruited into the labour market
- new graduates of education and training courses and apprenticeships

It is relevant to ask about deficiencies at all occupational levels, ranging from unskilled workers, operatives, and assemblers right through to senior management.

Experience shows that senior managers may be overly generous in rating the skills of their own occupational group; as management skills are an important determinant of business effectiveness, independent assessment of such skills is therefore particularly valuable.

Box 5.1: Core skills for green jobs

The global synthesis report on skills for green jobs identified the following principal core skills necessary for green jobs:

- strategic and leadership skills to enable policy-makers and business executives to set the right incentives and create conditions conducive to cleaner production, cleaner transport etc.
- adaptability and transferability skills to enable workers to learn and apply the new technologies and processes required to green their jobs
- environmental awareness and willingness to learn about sustainable development
- coordination, management and business skills to facilitate holistic and interdisciplinary approaches incorporating economic, social and ecological objectives
- systems and risk analysis skills to assess, interpret and understand both the need for change and the specific measures required
- entrepreneurial skills to seize the opportunities relating to low-carbon technologies;
- innovation skills to identify opportunities and create new strategies to respond to green challenges
- communication and negotiation skills to discuss conflicting interests in complex contexts
- marketing skills to promote greener products and services
- consulting skills to advise consumers about green solutions and to spread the use of green technologies
- networking, information technology and language skills to enable performance in global markets

Source: Strietska-Ilina et al., 2011

When asking about the skills and job readiness of new graduates of education and training courses, researchers should be aware that there is often a tension between employers wanting employees who can be fully productive from the moment that they are recruited, and providers of education and training wanting to make sure that their graduates have a grounding in disciplines suited to all employers, and are prepared to continue the learning process throughout their careers. While assertions by employers that providers of education and training do not respond adequately to their skills needs are often well founded, researchers cannot assume that this will always be the case. By comparing detailed information from several employers and from within the broader sector the researcher can decide whether the same skills gap is identified by different employers or whether it is specific to particular firms or related to very narrow sectors.

When asking about skills deficiencies, it is important for researchers to take account of at least three different types of skill:

- general technical skills and knowledge associated with the occupation
- specific technological and firm-specific skills required for the job
- core, or generic skills required to perform effectively, including those listed in box 5.1.

Emerging qualitative skills gaps

In addition to investigating current skills deficiencies, researchers should also investigate emerging and future qualitative gaps in skills. In the assessment of future skills needs, researchers will already have addressed future qualitative skills needs. Reviewing these will reveal potential gaps that need to be addressed.

Box 5.2: For full three-year wind service technician training	
Phase: operation and maintenance	
Skills level: technician	
Qualification levels and occupational profiles	As for entrance to other technician training courses. NQF 3, 4. Suitable for OFO classifications 311301, 311401, 311501, 311905, leading to classification as 215104 (wind energy technologist) or 313105 (wind energy technician)
Quantities	100 people per year
Duration	3 years
Outline syllabus	As for electro-mechanical or mechatronic technician training, but including: wind turbine awareness safety: working at heights, use of cranes and hoists, electrical mast and tower climbing, rescue mechanical and hydraulic service, testing, fault-finding and repair techniques appropriate to the wind industry. electrical service, testing, fault-finding and repair techniques appropriate to the wind industry. control and instrumentation service, testing, fault-finding and repair techniques appropriate to the wind industry, including wind farm SCADA. safe operation of medium-voltage electrical switchgear
Suitable providers	Institutions: colleges. May have some involvement with or provision from wind turbine manufacturers.

Source: GL Garrad Hassan, 2012

One example is a study conducted on behalf of the South African-German Energy Programme that assesses training and skills needs for the wind industry in South Africa (GL Garrad Hassan, 2012). This study undertakes a scenario- based employment projection with middle, high and low estimates (jobs in

operation and maintenance, installation and manufacturing estimated per year until 2030) and links those estimates to skills levels (skilled workers, technicians, engineers) that will be needed for different phases of wind energy projects (project development phase; construction and installation phase; operation and maintenance phase; wind turbine and component manufacture). Based on the South African Organizing Framework for Occupations (OFO) the study provides an analysis of the training and skills that will be required by the wind energy sector in South Africa. Training courses are outlined, the number of people to be trained is estimated and training providers are recommended for the future provision of training. An example of a training course analysis is provided in box 5.2.

5.9   Recommendations

5.9.1   Scope of recommendations

Key questions that, in all likelihood, researchers will wish to answer are:

- How can existing and anticipated future critical skills shortages and gaps be avoided?

- How can existing training and education institutions better meet demand?

- What other sources of skills supply can be used?

- How can skills demand be better anticipated in the future?

- How can enterprises improve the skills of their workforce?

Based on these questions, a skills research project may propose specific recommendations for the government, education and training institutions and enterprises, and potentially for other stakeholders that may include industry and employer organizations, employee organizations and professional organizations.

Deciding which recommendations should be directed at which implementing organizations is a question which depends on the institutional arrangements of each country, and on the practicalities of implementation. For example, in some circumstances a recommendation for the provision of a particular type of course might easily be implemented by an education or training institution, needing only advice from industry bodies, while under other circumstances it might also require funding and permission from a government ministry or agency.

General classes of recommendations include:

- recommendations that a particular type of learning programme be put in place, modified or expanded to meet skills needs

- recommendations about changing institutional arrangements to improve the operation of the labour market in areas, which may include:
    - o   skills anticipation
    - o   public and private employment services
    - o   incentive systems (taxes, subsidies and other measures) for skill formation, trade and innovation

- capacity-building initiatives such as train-the-trainer programmes to improve the capability of education and training institutions, employers and others to provide for skills needs

- improving coherence among trade, industry, enterprise, investment, labour market and skills policies;

- dialogue between social partners

- how to implement the recommendations

5.9.2 Linking analysis of skills requirements to recommendations on learning programmes

Most recommendations are likely to follow from the analysis of skills gaps. These will have come from:

- existing and anticipated shortages in the quantity of skills available

- existing and emerging qualitative gaps in the supply of skills

The process of forming recommendations essentially consists in identifying the practical actions that can be taken to respond to each of the gaps deemed to be important.

In some cases, it may be preferable to set out more than one potentially viable option, and leave it to stakeholders to choose between them.

For each type of skill required, it is necessary to answer the following questions:

- Who should be targeted in order to obtain this type of skill for the sector?

  - Groups not yet in the labour force, such as school leavers, graduates of training courses, college graduates?

  - Specific occupations already employed in the sector? Which occupations, and what profile of people within the occupations?

  - Skilled workers employed in other sectors? What occupations and which sectors?

  - Groups outside the formal labour force? Which groups?

  - Skilled workers from other countries?

- What sort of interventions should be used?

  - College-based initial education or training courses? Higher education or technical, vocation or training level, and what level of qualification within these? Full time, part time or some form of flexible or distance learning?

  - Apprenticeships? Other combinations of practice-based and classroom-based learning?

  - Continued education and training, whether at an institution or attached to the workplace? Classroom-based? Laboratory-based? Workplace-based? E-Learning or blended learning approaches? Some combination of the above?

- Mentoring or team-leading? Learning from peers, whether within the firm or through meetings of professional groups, informal networks or other structures? Self-directed approaches to learning, such as use of e-learning materials, texts, manuals or web-based material?

When thinking about the types of intervention that can be taken, it is worth revisiting questions about the sources of labour used by, and available to, the sector. These were considered earlier in section 5.8.2.

- What types of institution should lead, design and deliver the interventions?

  - Established public technical, vocation and training institutions?

  - Universities or other higher education institutions?

  - Training centres (including centres of excellence), employer organizations, employee representative organizations or those which are established on a bipartite or tripartite basis?

  - Private providers of training?

  - Other institutions associated with the sector, such as professional groups, employer or employee organizations (outside the training centre context), development agencies, regulators, research centres, public-private partnerships, sector skills councils?

  - Technical assistance projects in collaboration with stakeholders?

- Who should pay for, or co-fund, the intervention? Development and start-up costs, ongoing cost of provision and cost of participants' time are all relevant, and may be met by different stakeholders, or combinations of stakeholders.

  - Existing framework of provision, with well established precedents as to how costs are allocated? Or should a new framework be created, or an existing framework modified?

  - Employers or employer organizations?

  - Individuals or worker organizations?

  - Government – directly or indirectly?

  - International funding initiative?

  - Some combination of the above?

In some cases, it will make sense to comment on the wider institutional context, and suggest various modifications to institutional arrangements that may be required for the necessary changes to be made to the sector and in order to make the system more responsive to skills issues that may arise in the future.

5.9.3 Recommendations on implementation

Researchers should consider including recommendations on implementation.

- In many cases, it will be appropriate to propose that an existing stakeholder grouping should take responsibility for prioritizing recommendations for implementation, and for driving implementation forward. In other cases, it will be appropriate to propose that a stakeholder group should be established for this purpose, and that one or more specific stakeholders should take a lead in ensuring that the group is formed and operates effectively.

- In some cases, it will be possible to require specific organizations to undertake specific actions.

- In some cases, it will only be possible to suggest broad groupings of stakeholders, such as employers and their organizations, government and its ministries and agencies, workers' representative organizations, universities, public providers of technical or vocational education and training, other training providers, regulators and others.

- In general, it is important that implementation of the conclusions and recommendations of skills anticipation should be reviewed and evaluated. It will often be helpful for a report to recommend this.

Section 6: Research process

6.1   Introduction

The research process described here is one undertaken in the context of ILO technical assistance for constituents in a country or supranational grouping of countries, whether the focus of the work is at national, supranational or subnational level.

6.2   Carrying out research

A research project on the identification and anticipation of skills for sustainable development would use different methods, which include:

- desk research

- statistical analysis

- field research through structured or semi-structured interviews with stakeholders and experts (in most cases)

- questionnaire-based enterprise surveys conducted by post or e-mail, posted on the web, or administered by research support staff over the phone (in some cases as part of sector-level research)

- economic modelling (where quantitative findings are required)

- focus groups

- stakeholder workshops

- interactive foresight sessions with stakeholders

It is beyond the scope of the present guide to examine in detail the general methodology of each of these methods and the various options regarding their application in the context of skills for green jobs. The researchers may, however, find it useful to look at other ILO publications on skills for green jobs which show how such methods are applied in various countries (see box 6.1) and could also consider other ILO tools on skills needs anticipation (see ILO, 2015a).

The resources that the research is likely to draw on include:

- The ILO country office, regional office or subregional office, for a range of roles

- Local consultants for field research and enterprise survey work

- Local or international consultants (depending on capability) for economic modelling work

- Possible technical backstopping from ILO Head Office where resources are available

Box 6.1: ILO publications in the field of skills for green jobs

The ILO has produced a number of publications on skills for green jobs, of which the following make reference to least developed countries:

The 2011 study Skills for Green Jobs – a Global View examines the experiences of developed and developing countries in adjusting their training provision to meet the new demand for a greener economy. It is based on 21 country studies and includes the following least developed countries: Bangladesh, Mali and Uganda.

The studies, both also of 2011, Skills and Occupational Needs in Renewable Energy and Occupational Needs in Green Building bring together the findings from 33 countries, including Ethiopia, Nepal, Uganda and Zambia. Their preparation was prompted by a joint management agreement between the European Commission and the ILO on knowledge-sharing in the early identification of skill needs.

The 2011 policy brief Greening the Global Economy: the Skills Challenge draws the attention of policy-makers and social partners in both developed and developing countries to the role of skills development in facilitating the transition to a greener economy and grasping the employment opportunities that the transition entails.

The 2013 policy brief Greening the Economies of Least Developed Countries: The Role of Skills and Training draws the attention of policy-makers and social partners in least developed countries to the role of skills development in facilitating the building of greener economies

6.3   Local partners and ownership of the process and findings

Two key factors in the facilitation of access to information and increasing the probability that the recommendations will be implemented are: the participation of local partners; ensuring that stakeholders have ownership of the results.

The strong relationship that the ILO enjoys with labour ministries, unions, and employers' organizations facilitates access to well-positioned partners. These partners should be systematically involved in the process from the beginning, including helping to decide on the scope of the work and the types of question to be addressed. Where research is to be undertaken at sector level, they should be involved in the choice of sector.

In some cases, tripartite institutions for social dialogue on skills already exist as natural counterparts in a country. In other cases, research to identify current and future skills needs will bring the relevant stakeholders in a sector together for the first time, thus laying a foundation for social dialogue on skills and enabling better policy coherence.

An important aspect of promoting ownership and advancing the implementation of recommendations from the research is to align it with existing strategic planning on sustainable development. Green jobs and skills researchers usually build their analysis on existing plans, where they find credible plans for sustainable development that have buy-in from the main stakeholders. This also means paying close attention to ongoing processes for strategy formulation and implementation and – where feasible – aligning the research and its recommendations to such initiatives.

6.4   Three paths for follow-up and implementation

The process of identifying current and future skills needs for green jobs contributes to improvements on the ground by raising awareness and stimulating dialogue on skills development among stakeholders. Many of the recommendations, however, are likely to have a perspective that goes beyond immediate one-off change. Planning should therefore include provisions for follow-up activities to support implementation. These can vary in scope and set-up and are not necessarily restricted to purely skills related activities.

The decision on how best to set them up will be very dependent on country-specific circumstances, the resources that are available and work that is currently being carried out by the ILO and other organizations. Generally, one or more of the following paths can be pursued for follow-up and implementation:

- If the skills research is undertaken as a stand-alone project, resources can be factored in to support follow-up activities with a short or medium-term perspective. This could involve the provision of funding and technical assistance for the development of new curricula or other specific forms of support for training institutions that have been identified as crucial to the process. It could also include the identification and funding of training programmes or the training of trainers to address specific needs that have been identified as priorities. If a longer timeframe is envisaged, this could also include support for the establishment of a national or sector-level institution for skills anticipation and skills policy advice.

- The methodology can be used for capacity-building and providing support to existing institutions to advance skills anticipation and education planning. In this case, the focus would be on enabling the relevant local institutions to undertake work, independently and on an ongoing basis, in the field of skills identification and anticipation.

- Research into skills for green jobs can be embedded into broader technical assistance projects in the areas of skills, sustainable development, sectoral and private sector development, employment promotion and enterprise development. The analytical results would inform follow-up work through established ILO methodologies in areas such as technical and vocational training reform, dialogue on trade and employment, skills anticipation, labour market information systems, the promotion of life-long learning, youth employment and enterprise development.

These paths do not limit the application of the methodologies described in this document to ILO projects; integration into multi-agency projects could also be a viable path. In particular, they could add a skills and employment perspective to sustainability-related assistance projects. Within the logic of such multi-agency projects where each agency contributes according to its specific technical expertise, research into skills for green jobs can make a strong contribution through bringing the ILO experience with skills development into a holistic strategic approach to sustainable development.

Section 7: Institutional arrangements for skills identification and anticipation for sustainable development

7.1   Institutional approaches to skills identification and anticipation

Successful institutional approaches to skills identification and anticipation generally bring together representatives of the main stakeholders with interests in skills for the sector, including employers, workers' representatives, government ministries and agencies and providers of education and training to the sector. For these approaches to be effective, they require the support of a secretariat capable of undertaking or managing skills research, and responsible for managing the skills anticipation agenda on a day-to-day basis, while the stakeholder representatives advise and provide governance for the process.

Institutions for skills anticipation take a number of different forms in countries where the concept is well developed. Some, mostly larger, countries have established systems of sector skills councils. A sector skills council is typically made up of representatives of the main stakeholders interested in skills for the sector, including employers, workers' representatives, government ministries or agencies and providers of education and training to the sector, supported by a secretariat. Typical functions include skills anticipation, and also involvement in designing qualifications and in developing courses, coordinating collaboration between stakeholders, stimulating innovation in education and training, and sometimes participating in areas such as quality assurance and funding for education and training.

Countries with well-established sector skills councils include Australia and the United Kingdom; Bangladesh is in the process of developing a system of sector skills councils. Countries with sector skills councils have also established national-level councils to coordinate and integrate the work of the different sector-level councils, and to take responsibility for cross-sector initiatives.

In many cases, skills for green jobs are addressed by existing sector skills councils. In Australia, for example, skills for green jobs are dealt with through several sector skills councils which also act in collaboration, and other stakeholders also participate through the Green Skills Agreement.

In some cases, specialist sector skills councils are established for green sectors. The Republic of Korea, for example, has established sector councils for human resource development in renewable energy and green finance. In other countries the functions of sector skills councils are disseminated across a range of institutions, mainly at sector level. Many of these have established skills and employment observatories to undertake work on skills anticipation which can be linked up with the work of stakeholders and of other institutions, many of which are existing sector-level institutions.

In this regard, France has established 11 sectoral committees ("comités de filières") representing the sectors considered most promising in terms of green economy jobs creation. These sectors are: agriculture and forest industries; automotive industry; biodiversity and ecosystem services; the building sector; electromechanics; electric construction and networks; fuel and green chemistry; renewable energies; sea trades; transport; tourism; water; sanitation; waste and air. The role of the committees was to carry out a quantitative and qualitative analysis of each sector's needs in terms of training,

employment policy and skills needed. They were also commissioned to propose specific measures adapted to each trade, such as the overhaul of qualification standards.

Some, mainly smaller, countries have established a single central skills anticipation institution at national level, incorporating representatives of social partners and other stakeholders. Ireland, for example, set up an Expert Group on Future Skills Needs, which undertook a study and made recommendations on the skills needs of the green economy, ranging across several sectors (EGFSN, 2010).

In cases where very strong sector-level institutions are already in existence, which bring together the main stakeholders, there may be no need for separate institutions for skills anticipation. In Germany, for example, the occupation of chimney sweep has evolved to the degree that its members can now inspect buildings for energy efficiency, and many of them have taken courses in providing advice on improving the energy efficiency of existing buildings.

7.2   Institutional approaches to skills anticipation for sustainable development

In its review of institutional arrangements for skills anticipation, the ILO report on the comparative analysis of methods of identification of skill needs on the labour market in the transition to the low-carbon economy (ILO, 2011a) found significant patterns.

Most of the key policy work undertaken at the country level on skills anticipation for a low-carbon economy is carried out within institutional arrangements that are already in existence. Countries that use sectoral skills councils (many of them anglophone) still use the same bodies. Countries that use thematic observatories (in particular francophone countries and Spain) still use those observatories. Countries with decentralized arrangements supplemented with research commissioned by ministries, such as Germany, still use largely similar arrangements. In the United States, the key policy work undertaken for skills anticipation purposes fits into a wider scheme of work carried out by the Bureau of Labor Statistics and O*NET. In Ireland, where skills anticipation research is undertaken by a group that was set up to advise the Government, key research has been undertaken by that group.

Social dialogue is a key feature of established skills anticipation arrangements in many countries. Governments, employers, workers' representatives and providers of education and training all have capabilities and knowledge that are useful in skills anticipation. Bringing them together has a positive effect both on the quality of analysis and on the effective implementation of proposed actions and skills policies based on the research.

One distinctive feature of skills anticipation for the transition to a low-carbon economy is that the issues, and often the skills requirements associated with specific developments, cut across established sectoral boundaries. In countries where skills anticipation is usually conducted at the sectoral level, based on well-established sectoral definitions, there is evidence of cross-cutting arrangements being put in place (for example in Australia and the United Kingdom) to ensure that low-carbon economy skills issues are addressed in a coordinated way.

In countries where sectoral definitions in skills anticipation are more flexible, this is reflected in anticipation arrangements that do not match traditional sectoral boundaries, as in the Republic of Korea, with its sectoral skills councils in green finance and new renewable energy, and in France, with its national observatory of green jobs and trades.

A considerable share of efforts to adapt education and training to the skills requirements associated with the transition to a low-carbon economy is taking place through the normal operation of mechanisms to update education and training, and to fill skills needs identified through consultation between education and training providers, employers and workers' representatives. Organizations such as qualifications bodies and professional bodies are making their usual contribution to this process. Examples include: additional training in modern heating controls and the installation of photovoltaic solar panels for apprentice electricians; the decision made by one provider of electrical and mechanical technician training to organize training for wind turbine technicians in response to a request from wind farm developers.

In some cases there is a degree of international coordination, through international groups of professional organizations or providers of technical and professional education and training12.

A substantial amount of research work on skills-related issues has been undertaken independently of established skills anticipation arrangements by employer organizations, labour organizations, subnational governments and civil society organizations, and also by ministries and public agencies with enterprise development or low-carbon transition responsibilities. While this research has made an important contribution to broader policy on the transition to a low-carbon economy, the contribution to skills anticipation has been more limited.

Key contributions relevant to skills anticipation include the following:

- Some of the research has looked at the expected employment impact of specific policy proposals, or of scenarios for the future based on attaining specific policy objectives. This sort of analysis does much to clarify the feasibility of the proposal, and helps with planning for implementation, in particular in cases where the analysis goes beyond looking at employment impacts to looking at specific skills requirements. As skills availability is a key enabler (and potentially a key barrier) to implementation, this sort of analysis forms a very useful part of the planning process.

- Other parts of the research have looked at the likely impact that the transition to a low-carbon economy might have on employment quality, and on possible losses and gains in employment. These issues are relevant to skills anticipation.

7.3   Conclusions on institutional approaches to skills identification and anticipation

A country, or group of countries, or subnational entity that wishes to undertake research on skills identification and anticipation for sustainable development has a wide choice of options on institutional approaches. If there is already a well-established institutional approach to skills anticipation in place, there is no reason why it should not continue to be used when looking at skills for sustainable development, subject to the following two qualifications:

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12 In the case of architecture, for example, the European Commission has contributed to this pursuant to the EDUCATE (Environmental Design in University Curricula and Architectural Training in Europe) action under Intelligent Energy Europe. EDUCATE supported a study on the state of the art and developing a framework for curriculum development in environmental sustainability in architecture courses.

- Where existing approaches are sectorally based, there may be a need to tweak institutional arrangements to ensure that issues that straddle standard sectoral boundaries are addressed adequately.

- In many cases, research projects on skills anticipation for sustainable development follow on from existing planning processes on sustainable development, and it will often be useful to have an institutional link between the existing planning processes and the work on skills anticipation.

If there is still no established approach to skills identification and anticipation within a given country, then engagement in research work in the area could provide a good opportunity for knowledge-building among ILO constituents and other stakeholders. What the constituents learn from their involvement with research on skills identification and anticipation for sustainable development might also contribute to shaping ideas as to the form that institutional arrangements for a national system of skills identification and anticipation might adopt.

References

Alarcón, J.; Ernst, C.; Khondker, B.; Sharma, P. D. 2011. Dynamic social accounting matrix (DySAM): concept, methodology and simulation outcomes: the case of Indonesia and Mozambique. Employment working paper, No.88 (Geneva, ILO).

Cedefop. 2012. Skills supply and demand in Europe. Methodological framework. Research paper No.25 (Luxembourg, European Centre for the Development of Vocational Training – Cedefop).

—. 2013. Piloting a European employer survey on skill needs Illustrative findings (Luxembourg, Publications Office of the European Union, file:///C:/Users/Marcin/Downloads/5536_en%20(1).pdf).

Comhar SDC. 2010. Skills and training for a Green New Deal (Dublin, Comhar Sustainable Development Council).

Creswell, J.W. 1994. Research design: qualitative and quantitative approaches (London: SAGE Publications).

DACUM. 2013. DACUM archive and resource website – on-line resource for occupational analysis (www.dacum.org).

DHET. 2012. Guidelines: organising framework for occupations (OFO) 2012 (Department of Higher Education and Training, Republic of South Africa, http://www.dhet.gov.za/Publications/OFO%20Guideline%20-%202012.pdf).

EEO. 2001. Labour shortages and skill gaps. European Employment Observatory, spring review, 2001 (Birmingham, EEO Secretariat).

EGFSN. 2010. Future skills needs of enterprise within the green economy in Ireland (Dublin, Forfás).

Esposto, A. S. 2015 (forthcoming). Skills needs of emerging green jobs in the building and tourism industries in Thailand. Prepared for the ILO DWT (Bangkok, ILO).

Forfás. 2009. Developing the green economy in Ireland. Report of the High-Level Group on Green Enterprise (Dublin, Forfás).

GHK. 2010. Estimating green jobs in Bangladesh. Report prepared by GHK for the International Labour Organization (London, GHK).

GL Garrad Hassan. 2012. Training and skills needs for the wind industry in South Africa. (Pretoria, GIZ).

Greenwood, A. M. 2008. Updating the International Standard Classification of Occupations, ISCO-08 (Geneva, ILO Bureau of Statistics).

Gregg, C.; Jansen, M.; Von Uexkull, E. 2012. Skills for trade and export diversification (STED): A Practical guide (Geneva, ILO).

ILC. 2002. Resolution on Decent Work and the Informal Economy, Resolution and conclusions concerning decent work and the informal economy, International Labour Conference, 90th session, Geneva, 2002 (http://www.ilo.org/public/english/standards/relm/ilc/ilc90/pdf/pr-25res.pdf).

—. 2004. Recommendation concerning Human Resources Development: Education, Training and Lifelong Learning, International Labour Conference, 92nd session, Geneva, 2004.

—. 2008. Conclusions on skills for improved productivity, employment growth and development, International Labour Conference, 97th session, Geneva, 2008.

—. 2013. Achieving Decent Work, Green Jobs and Sustainable Development. Committee on Sustainable Development, Conclusions, International Labour Conference, 102nd session, Geneva, 2013.

ILO. 1999. Decent Work, Report of the Director-General, International Labour Conference, 87th Session, Geneva, 1999.

—. 2000. Conclusions concerning human resources training and development, International Labour Conference, 88th session, Geneva, 2000.

—. 2006. Glossary of key terms on learning and training for work (Geneva, ILO – unpublished).

—. 2011a. Comparative analysis of methods of identification of skill needs on the labour market in the transition to the low carbon economy (Geneva, ILO).

—. 2011b. Skills and occupational needs in renewable energy (Geneva, ILO).

—. 2011c. Skills and occupational needs in green building (Geneva, ILO).

—. 2012a. Working towards sustainable development: opportunities for decent work and social inclusion in a green economy (Geneva, ILO).

—. 2012b. Decent work indicators: concepts and definitions: ILO manual (Geneva, ILO).

—. 2012c. International Standard Classification of Occupations: structure, group definitions and correspondence tables, ISCO-08. Volume 1 (Geneva, ILO, http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_172572.pdf).

—. 2013a. Key Indicators of the Labour Market (KILM) (Geneva, ILO, www.ilo.org/kilm).

—. 2013b. Skills for Green Jobs (Geneva, ILO, http://www.ilo.org/skills/projects/WCMS_115959/lang--en/index.htm).

—. 2013c (forthcoming). LDCs brief: Greening economies of least developed countries, the role of skills and training (Geneva, ILO)

—. 2013d. ILO Thesaurus (http://www.ilo.org/thesaurus/)

—. 2013e. Green jobs becoming a reality. Progress and outlook 2013 (Geneva, ILO).

—. 2013f. Identifying and estimating green jobs in Indonesia (Geneva, ILO).

—. 2013g. Methodologies for assessing green jobs. Policy brief (Geneva, ILO).

—. 2013h. Proposals for the statistical definition and measurement of green jobs, Room document 5, 19th International Conference of Labour Statisticians, Geneva, 2–11 October 2013.

—. 2015a. Guidance note: Anticipating and matching skills and jobs (Geneva, ILO)015

—. 2015b. Outcome of the Tripartite Meeting of Experts on Sustainable Development, Decent Work and Green Jobs. Governing Body, 325th Session, Geneva, 2015.

International Institute for Labour Studies. 2011. Towards a greener economy: the social dimension (Geneva, ILO).

Jarvis, A.; Varma, A.; Ram, J. 2011. Assessing green jobs potential in developing countries. A practitioner's guide (Geneva, ILO).

Kriechel, B.; Wilson, R.A.; Bakule, M.; Czesana, V.; Havlickova, V.; Rasovec, T. 2016 (forthcoming). Guide to skills anticipation and matching – volume 2: Developing skills foresights, scenarios and forecasts (Luxembourg, Cedefop, ETF and ILO).

NSTF. 1998. Towards a national skills agenda. First report of the national skills task force (Sheffield, Department for Education and Employment, United Kingdom).

OECD. 2013a. Glossary of statistical terms (http://stats.oecd.org/glossary/index.htm)

—. 2013b. Input-output tables (www.oecd.org/sti/inputoutput)

OneWorld Sustainable Investments. 2010. Skills for green jobs in South Africa, background country study (Geneva, ILO Skills and Employability Department, http://www.ilo.org/wcmsp5/groups/public/@ed_emp/@ifp_skills/documents/publication/wcms_142475.pdf)

Pollin, R.; Garrett-Peltier, H. 2009. Building the green economy: employment effects of green energy investments for Ontario (Amherst, Political Economy Research Institute, University of Massachusetts).

Pollitt, H.; Alexandri, E.; Lee, T.; Na, S.; Barker, T.; Chewpreecha, U. 2014. Using carbon tax revenues to invest in human capital, presentation at the 5th Global Conference on Environmental Taxation, Pavia, September 2014.

RSC. 2011. "Tackling climate change by shifting to a low-carbon economy", in: Building a low carbon economy: A handbook for European regions, online version, Regions for Sustainable Change (http://www.rscproject.org/indicators/index.php?page=tackling-climate-change-by-shifting-to-a-low-carbon-economy).

Rutovitz, J.; Atherton, A. 2009. Energy sector jobs to 2030: a global analysis, prepared for Greenpeace International by the Institute for Sustainable Futures (Sydney, University of Technology)

Stoevska, S.; Elezi, P.; Muraku, E. 2014. Report on the pilot project towards developing statistical tools for measuring employment in the environmental sector and generating statistics on green jobs. (Geneva, ILO, http://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/presentation/wcms_329511.pdf)

Strietska-Ilina, O. 2008. "Skills shortages", in: Modernising vocational education and training in Europe: background report, fourth report on vocational education and training research in Europe (Luxembourg, Cedefop)

Strietska-Ilina, O.; Hofmann, C.; Haro, M.D.; Jeon, S. 2011. Skills for green jobs: a global view. Synthesis report based on 21 country studies (Geneva, ILO and Cedefop).

UN. 1987. Report of the World Commission on Environment and Development: Our Common Future, document A/42/427, Annex (New York, United Nations).

—. 2005. 2005 World Summit Outcome, General Assembly resolution 60/1, adopted on 16 September 2005 (New York, United Nations).

UNEP, ILO, IOE, ITUC. 2008. Green jobs: Towards decent work in a sustainable, low-carbon world (Geneva, UNEP, ILO, IOE, ITUC).

United States Department of Labor. 2013. O*NET Online (http://www.onetonline.org/).

Urge-Vorsatz, D., et al. 2010. Employment impacts of a large-scale deep building energy retrofit programme in Hungary (Budapest, Centre for Climate Change and Sustainable Energy Policy, and The Hague, European Climate Foundation).

Annex: Suggested structure for the qualitative whole-economy country report on skills for green jobs

Reproduced below is the template for the qualitative whole-economy overview which was used for country studies undertaken for the major ILO-Cedefop Skills for Green Jobs research project. Existing country studies and a global synthesis report may be found at http://www.ilo.org/skills/projects/WCMS_115959/lang--en/index.htm (ILO, 2013b). Since then, the template has served several other countries in the own preparation of their own national studies on skills for green jobs and has proved to be useful.

Abstract

Executive summary

Introduction

Describe briefly the objectives of the study, specific methods used to conduct the research, institutions and experts consulted, difficulties faced and research limitations to take into account, etc.

2. Policy context

2.1 Key challenges and priorities for the green economy

This subsection should provide very concise contextual information which should serve as a starting point for further analysis. It should point out major climate change and environmental issues which should drive the green policy response in your country and which affect the economy, employment and the labour market.

Describe briefly the main challenges and priorities of the country for mitigating and adapting to climate change and in response to environmental degradation. Provide concise information on how the country's green economy is developing. You may build your analysis on a limited number of key indicators relevant to your country, such as:

- numbers and trends on ecological footprint (see GEO),
- energy production per capita and per GDP (see IEA),
- electricity consumption per capita and per GDP (see IEA),
- composition of energy use/production,
- waste production per capita (see GEO),
- CO_2 per capita (see UNFCCC or IEA),
- rate of land degradation/agricultural soil degradation/desertification,
- rate of deforestation,
- R&D related to energy and to renewable energy (see IEA),
- share of R&D budget/expenditures (public/private) on environment-related issues, new technologies and innovations in relation to the overall R&D budget/expenditure,
- use of fresh water per capita and per GDP,
- programmes in place for the protection of biodiversity (CBD), etc.

Some useful resources:

- GEO: http://geodata.grid.unep.ch/results.php
- IEA: http://www.iea.org/countries/
- UNFCCC: http://unfccc.int/ghg_data/ghg_data_unfccc/items/4146.php

2.2 The response strategy

2.2.1 General environmental strategy

This subsection should briefly outline the general country strategy, the adaptation and mitigation measures in response to climate change and environmental degradation, referring to key strategic, political and programming documents of the country.

What are the strategic development responses of the country to prevent environmental degradation and to contain and adapt to climate change and the global call for greening economies? Do these strategies have skills implications and do they include a skills development component?

2.2.2 Green response to the current economic crisis

This section should briefly outline the greening components of the country strategy in response to the current economic crisis.

Does the country's response to the current economic crisis include greening economic practices and does it target greening investments and stimuli, such as greener infrastructure and renewable energies? Which skills implications does this convey?

Does the crisis response strategy include a skills development component?

2.3 The skills development strategy in response to greening

This section deals with the skills development strategy as a part of a coherent country policy response to climate change and environmental degradation. It focuses on policy coherence, complementarity, relevance and coordination.

How and whether skills response strategies are incorporated into a larger greening policy agenda? Is there a coherent national strategy/policy targeting the skill needs for greening the economy? What is the main driver for the national HRD strategy in the provision of skills for green jobs – market adaptation or greening policy agenda, i.e. is the national HRD strategy market-driven or environmental policy-driven? What is the role of skills identification in the strategy development?

In the context of greening the economy are skills development policies and strategies coordinated with and linked to industrial, trade, technology, macroeconomic and environmental policies? If so, how: what kind of coordinating mechanisms are in place (e.g. Inter-ministerial coordination, labour market intelligence/information system, local feed-back mechanisms between employers and training system; value chains; clusters and industry networks) and how do they work?

What is the role of social dialogue in skills development for greener economies?

What are the biggest institutional roadblocks that hamper skills development for a transition to green economies?

Which level and types of education and training are considered crucial in promoting green skills among the population: compulsory level education, initial secondary general type of education, initial technical and vocational education and training (TVET), continuing vocational training (CVT), higher education (HE)? What is the role of business management education and training in promoting sustainable entrepreneurship? How important are generic skills such as leadership, communication, problem solving etc., in the skills provision for green jobs? Does the education and training system follow a strategy to "mainstream" sustainability and environment protection issues within the education and training system?

3. Anticipation and provision of skills

3.1 Green structural change and (re)training needs

This section and all its subsections deal with (re)training needs which derive from

- major employment shifts within and across sectors, and economic activities due to climate change and demands for greening the economy i.e. green structural change (e.g. in construction, agriculture, in energy), and

- identification of skills, trades and occupations that become obsolete as a result of green structural changes on the labour market (e.g. in fisheries, in coal mining, oil and gas production).

3.1.1 Green restructuring and its impact on the labour market

This subsection deals with employment shifts and trends due to green structural change. It will identify sectors and economic activities with major employment growth potential and will identify trades and related skills in declining sectors/economic activities.

Identify sectors/economic activities with major employment growth potential for green jobs most relevant for the economy of the country of your study (consult Annex 1 for a general guidance).

Identify trades and related skills in declining sectors/economic activities that will or have become obsolete in the context of environmental degradation, climate change or environmental policies (e.g. in fisheries, in coal mining, oil and gas production). What is the origin of the decline – why does demand for these trades and skills decline? Is the change driven by policy, by technology implementation, by innovation, or by environmental pressure?

Analyse current and estimated future employment shifts and trends due to the green structural change. While assessing employment potential, take into account direct and indirect employment, disaggregate by occupation, trade and sector, economic activity. Wherever possible, provide quantified trends analysis.

3.1.2 Identification of (re)training needs

This subsection deals with (re)training needs based on identification of major employment shifts (current and anticipated) and the green structural change as outlined in the previous subsection. It also covers approaches and tools for identification of (re)training needs.

Outline current and future (re)training needs due to major employment shifts and green structural changes as analyzed in the previous subsection. How have these (re)training needs been identified? Which methods and approaches to skills anticipation and assessment were used?

Explain both quantitative and qualitative approaches and levels of identification, i.e. national, sectoral, subnational, company, training provider etc. Specify methodology, explain modelling, provide tools – e.g. questionnaires etc. Specify whether the methodology sought to identify the immediate skill needs or the mid- or long-term needs? Does it address particular target groups (youth, women, rural population etc.)?

Explain which institutions / systems were in charge of skill needs identification (e.g. LMIS, specific research and/or data collection institutions, departments of ministries, subnational or sectoral bodies etc.)

3.1.3 Skills response

This subsection analyses effectiveness and organisation of the skills response (retraining, TVET) to meet the challenge of the green economic restructuring paying specific attention to active labour market policy measures, planning of initial and continuing training, institutional frameworks, systemic provisions, delivery channels, ad hoc versus anticipated skills responses, and skills response by different actors and providers.

Are there special skills development programmes to cushion the effects (displaced workers, need for skills upgrading, etc.)? What are their delivery/provision channels? How are these programmes funded? Since when and for how long are these programmes in place?

How many people have been trained and in which fields? How many have found a job or could be kept in their old job?

3.1.4 Case studies

Please provide illustrative case studies on retraining as part of active labour market policy measures for the workers who became redundant as a result of green structural change on the labour market. You could also select retraining as part of green crisis response. Please try to follow the above structure of section 3.1 and its subsections.

3.2 New and changing skills needs

The section and its subsequent subsections deal with skill needs for newly emerging green occupations, and with new and changing skills requirements for existing occupations (skill gaps) in the context of greening the economy. In the skill needs identification and analysis and in the case studies it is necessary to distinguish between skills needed for (i) reactive and remedial environmental measures, and (ii) pro-active measures.

3.2.1 New green occupations

This subsection deals with green occupations which emerge newly as a result of adaptation to climate change and mitigation of its negative impacts. Such occupations are new on the labour market meaning that the actual change has occurred recently or is occurring now, no matter whether such occupations have already been listed in the national catalogue of occupations or may be considered for the inclusion

in the catalogue in future. These could be new as well as 'hybrid' occupations (e.g. agricultural meteorologist, solarteur, bioenergy technicians, energy assessors, green accountants).

Where are these new green occupations concentrated? Which sectors, companies (SMEs vs larger companies, rural vs urban, national vs foreign/multinational), subnational areas, etc. If possible, provide an estimate of the volume (absolute and relative) of the workforce involved in such occupations now and how this is expected to change in future.

What is the role of technological change and innovation for new occupations demands? What are qualifications and levels of educational attainment expected?

Which new green occupations are most demanded in the country in terms of greening the economy?

In the analysis consider which existing occupations and qualifications could supply the workforce for new green occupations. Which technical and generic skills and competences are required? Discuss gender composition of new green occupations and implications.

If the list of new occupations is available, please provide the list in the Annex. If occupational profiles are available – please provide in the Annex.

3.2.2 Greening existing occupations

This subsection deals with new types of skills, competences and skill gaps which need to be incorporated into existing occupational profiles (i.e. greening existing occupations e.g. advisory services in craft and retail, green procurement, new skills for improved energy efficiency and lifecycle analysis). In order to delimit the analysis and for the benefit of a better focus it is advised to address skills gaps among key occupations in the major economic sectors with the highest greening potential in the country.

Which existing occupations tend to become greener? What is the outlook for the future – which occupations are expected to become greener? Which sectors and companies (SMEs vs larger companies, rural vs urban, national vs foreign/multinational) are they concentrated in? Which workers tend to acquire the green collar – blue or white collar workers? Which qualifications and levels of educational attainment are expected? Are skills levels expected higher, the same or lower? What is the role of technological change and innovation for new skills demands? Which technical and generic skills and competences are required? Discuss gender composition and implications.

Where are the greatest skills gaps in the country in terms of greening the economy? Shortage in the supply of which skills and qualifications is responsible for the labour market bottleneck in greening the economy? If possible, provide an estimate of the volume (absolute and relative) of the shortage workforce now and how this is expected to change in future.

If the list of new occupations is available, please provide the list in the Annex. If profiles are available – please provide in the Annex.

3.2.3 Identification of skill needs

This subsection deals with methods, approaches, systems and institutional responsibilities in identification of current and future skill needs for the green-jobs labour market.

How are new occupations and new skills requirements are identified? Please describe methods in detail, provide description of assessment and modelling methods and related diagrams, questionnaires and other tools used in the Annex. Identify which methods and approaches to skills anticipation and assessment are in use to ensure the skills provision correspondence to current and future labour market demand for green workers both quantitatively and qualitatively and at different levels, i.e. national, sectoral, subnational, company, training provider.

Explain which institutions/systems were in charge of skill needs identification (e.g. LMIS, specific research and/or data collection institutions, departments of ministries, subnational or sectoral bodies etc). Do labour market information systems take green jobs into account? If yes, how?

What are systemic and institutional arrangements for early identification of skills needs and for the transfer of the findings into occupational profiles, curriculum design and education and training provision for new green occupations? What are institutional roles and responsibilities? Which actors are involved? What is the role of government (e.g. Ministry of Labour, Ministry of Education, interministerial bodies), businesses and social partners in the process?

3.2.4 Skills response

This subsection analyses effectiveness and organisation of the skills response in relation to the challenge of greening the economy with a specific attention to planning of initial and continuing training, institutional frameworks, systemic provisions, delivery channels, ad hoc versus anticipated skills responses, and skills response by different actors and providers.

How does the education and training system react to the identified skills needs? Have new courses/ occupational standards been developed? In which fields of studies? How do education and training providers deal with curriculum development?

What are the main channels of current response in skills provision: initial TVET, CVT, training measures within active labour market policy implementation, on-the-job training or other forms of training supported by enterprises, etc. Who provides the skills required? Do mainly businesses organize skills upgrading courses or do private/public training providers also offer courses for these skills? In which fields of training?

Given the estimate of future training needs, is the education and training capacity to meet the needs sufficient? Do companies find training offer satisfactory for their needs to upgrade/prepare the workforce for the green production processes, services and products?

What are the mechanisms applied to respond to these new skill needs? Are feed-back mechanisms between business and the education and training systems in place? How do they work? How are future changes in skills requirements communicated and translated into timely supply of relevant skills?

Who are the actors involved? (Ministries, labour market observatories, skills councils, business associations, etc.)

How effective is the skills development response? How many people have been trained? How many have found a job? Are businesses satisfied with the education/ training programs available?

3.2.5 Case studies on new green occupations

Please provide illustrative case studies on new green occupations respecting the following structure:

- Select an example of a new green occupation

- Describe the origin and the situation of the occupation (sector, type of companies, subnational area, number of the current workforce involved into this occupation and its composition by age, gender and qualification/level of educational attainment, estimate of future growth in the demand for this occupation etc.)

- Analyse skill gaps for the new occupation

- Describe how and by whom the need was identified (method, institutional responsibilities, information flows etc.)

- Analyse provision of skills and the potential of the education and training system for skills provision for this occupation (which curricula and training programmes could be adopted?)

- Analyse the skills policy response to the situation (specify the policy/legal framework and level of decision making). Assess adequacy of the policy response.

- Describe the skills provision in response to the identified need. Assess the effectiveness of the process.

3.2.6 Case studies on greening existing occupations

Please provide illustrative case studies on greening existing occupations respecting the following criteria for the selection of occupations:

- greening potential in terms of reducing greenhouse gas emission or non-renewable resources;

- contribution to adaptive capacity of communities;

- skills development record;

- contribution to national economy and as source of employment.

Please follow the following structure for each case study:

- Select an example of an existing occupation which typically undergoes 'greening' in reaction to the demands of economy

- Describe the origin and the situation of greening this occupation (Is this a massive process? Does greening concern a large proportion of existing occupations? What is the role of technological change and innovation? What are sectors, types of companies, subnational areas? Specify where possible the number of the current workforce already performing a greener version of this occupation, its composition by age, gender and qualification/level of educational attainment; estimate the volume of the workforce expected to transit into a greener version of this occupation in the coming years etc.)

- Analyze skill gaps for greening the occupation

- Describe how and by whom the need was identified (method, institutional responsibilities, information flows etc.)

- Analyse provision of skills and the potential of the education and training system for skills provision for greening this occupation (which curricula and training programmes could be adopted?)

- Analyse the skills policy response to the situation (specify the policy/legal framework and level of decision making). Assess adequacy of the policy response.

- Describe the skills provision in response to the identified need. Assess the effectiveness of the process.

4. Conclusions

The conclusions should be drawn on the basis of the whole body of research for the country study, i.e. literature review, data analysis, empirical research including interviewing, focus groups, case studies etc.

Main 'greening' shifts in economies and labour markets

4.2 Skills implications and development

4.2.1 Anticipation and identification of skill needs

4.2.2 Response policies and programmes

4.2.3 Effective delivery mechanisms

5. Recommendations

5.1 Policy recommendations

5.2 Recommendations for education and training

5.3 Recommendations for further research and data collection