



International
Labour
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Geneva

Assessing green jobs potential in developing countries

A PRACTITIONER'S GUIDE

Andrew Jarvis
Adarsh Varma
Justin Ram

Assessing green jobs potential
in developing countries

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INTERNATIONAL LABOUR OFFICE • GENEVA

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Foreword

The model of growth and development pursued in the last decades has not delivered the inclusive growth and sustainable development aspired to by people around the world. The recent global economic and financial crisis has thrown into stark relief the inadequate capacity to create sufficient numbers of decent and productive jobs. At the same time, the unsustainably high environmental cost of a business-as-usual model and the threat of climate change reversing the progress made on poverty reduction are becoming ever clearer and more urgent. Sustainable development which not only balances but builds on the synergies between economic growth, social inclusion and preservation of the environment is not only possible; it is becoming an imperative. The Global Jobs Pact adopted by the representatives of government and of the employers' and workers' organizations of over 180 member States at the International Labour Conference in 2009 therefore calls for a transition to a sustainable, low-carbon economy.

This transition will have profound effects on modes of production and consumption, on enterprises and workers, on employment and incomes. It offers many opportunities for the creation of green and decent jobs and for inclusive, low-carbon growth. Managing the transition successfully and seizing the opportunities for job creation and social development will require coherent policies based on a good understanding of the interrelationships between environmental factors and policies on the one hand and labour markets on the other.

The design of integrated and coherent policies and programmes is a challenge in all countries. In the developing world, the challenge is even greater because relevant information is scarce and the tools for analysing the linkages are often inadequate. The present guide aims to help fill this gap. It has been developed

Foreword

with GHK Consulting as part of the global Green Jobs Programme of the ILO on the basis of a pilot study in Bangladesh in 2010. That study is published separately and is due to be updated regularly as countries employ it for their own green jobs initiatives.

The methodology presented in this manual is tailored to the particular needs of developing nations worldwide. The guide is user-friendly and practical and will serve analysis and planning in the growing number of countries interested in green jobs. It will also be a key ingredient for capacity building to enable ILO constituents to actively engage in related policy development.

This product is one of the deliverables under the Green Jobs Initiative and regional outcomes and as such is an illustration of exemplary collaboration between several ILO departments and field offices in support of the pooling of technical and financial resources in order to provide a first-class service to our constituents.

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Acronyms and abbreviations

ADB	Asian Development Bank
APC	air pollution control
CER	certified emissions reduction
CNG	compressed natural gas
EEI	eco-efficiency indicators
EU	European Union
GDP	gross domestic product
GHG	greenhouse gas
GNI	gross national income
GTBR	green tax and budget reform
ICLS	International Conference of Labour Statisticians
ILO	International Labour Office/Organization
I-O	input–output
IOE	International Organisation of Employers
ITUC	International Trade Union Confederation
LEED	Leadership in Energy and Environmental Design
LFS	labour force survey

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MW	megawatt
NGO	non-governmental organization
OECD	Organisation for Economic Co-operation and Development
PEM	private environmental management
R&D	research and development
RCSG	soil and groundwater remediation
SAM	social accounting matrix
SCP	sustainable consumption and production
SMEs	small and medium-sized enterprises
SMP	sustainable master planning
SNA	System of National Accounts
SOC	Standard Occupational Classification
SWM	solid waste management and recycling
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCCC	United Nations Framework Convention on Climate Change
WWT	wastewater treatment
ZEV	zero emission vehicle

PART I

CONCEPTS, DEFINITIONS
AND FRAMEWORK

Introduction

1

1.1 Purpose

This book provides guidance on how to estimate the actual and potential level of economic activity and number of jobs related to the environment in a developing country context. It is intended to be generic in its application (i.e. relevant to a wide range of countries) and therefore flexible enough to accommodate different sets of economic and environmental conditions.

The guide has been developed as part of an ILO-funded project led by GHK that mapped green employment in Bangladesh. That study will be published as the first of a series of papers, each looking at a different country. These country studies should be seen as companions to this guide. They give detailed information on how methods set out here have been applied. A researcher who is considering a study for her or his country should therefore consult the country studies as well as this document.

The project process involves agreeing a detailed working definition of “green jobs”, and quantification of the direct and indirect employment linked to green growth (e.g. through input–output (I-O) coefficients and modelling). It is intended that further testing and development through application in other countries will help to improve the depth and breadth of the guidance over time.

1.2 Context

The guide supports the Green Jobs Initiative,¹ a joint initiative by the United Nations Environment Programme (UNEP), the International Labour Organization (ILO), the International Organisation of Employers (IOE) and the International Trade Union Confederation (ITUC). The Initiative was launched to assess, analyse and promote the creation of decent jobs as a consequence of environmental policies. It supports a concerted effort by governments, employers and trade unions to promote environmentally sustainable jobs and development in a climate-challenged world. Work under the Green Jobs Initiative so far has focused on collecting evidence and different examples of green job creation. A ILO/UNEP/ITUC/IOE study in 2008² explained the impact of the emerging green economy on the world of work. The evidence base presented in that study is concentrated in relatively few countries. Research on this topic in developing countries in general is scant. But the study made great strides in stimulating the debate on defining, understanding and quantifying green jobs. Most importantly it highlighted differences in methodologies, definitions and estimates between countries that make it very challenging to compare the links between the environment, the economy and jobs worldwide.

Green jobs assessments in the developing world³ may produce results that do not necessarily correspond to those observed in OECD countries. Even where environment-related jobs can be counted, labour market impacts such as skills, productivity and mobility and quality of jobs will differ by country. This is true regardless of whether the drivers and mechanisms behind the transformation to a green economy in both developed and developing countries are the same. There are differences between developing countries⁴ and developed countries⁵ in the structure of the economy, and in environmental standards and working conditions.

¹ Under the UNEP/ILO definition, green jobs are considered decent. In other words, they include the two dimensions of decent work and environmental sustainability. This is discussed in more detail in Chapters 2 and 3.

² UNEP et al.: *Green jobs: Towards decent work in a sustainable, low-carbon economy* (Geneva, 2008).

³ For the purposes of this study we use the World Bank country classification based on its GNI per capita. Every economy is classified as low-income, middle-income (subdivided into lower-middle and upper-middle), or high-income. Bangladesh is classified as a low-income country.

⁴ For example, Bangladesh, where the share of agriculture and other primary sectors in the economy is very high.

⁵ For example, OECD countries, where there is a high share of services and a comparatively small primary sector.

The ILO has also established a global programme on green jobs.⁶ The programme outlines the labour and social rationale for the transformation to an environmentally sustainable, low carbon and climate resilient economy. The ILO programme of activities reflects a broad scope for green jobs that encompasses environmentally sustainable development, a low carbon future and the need to adapt to climate change. The low carbon transition and climate change adaptation are priority areas for development of tools for use in diagnosing labour market impacts and informing policy. The ILO Green Jobs Programme also sets out the requirements for enterprises and labour markets to contribute to meeting pressing social and environmental challenges and establishes how the ILO should set up and implement its global programme through partnerships.

Box 1.1 What are “green jobs”?

The term “green job” is used in this guide to refer to jobs which are sustained by economic activities that are more environmentally sustainable than the conventional alternative *and which also* offer working conditions that meet accepted standards of decent work. Just how environmentally friendly those activities need to be to “qualify” as green jobs, and the issues around conditions of decent work, are discussed in more detail in the next chapter. The guide also takes explicit account of the significant role of the informal economy in many developing countries.

1.3 Using the guide

1.3.1 Purpose, process and outputs

This guide is intended for use by individuals and organizations⁷ who wish to examine the links between environment and employment in a developing country context. In particular it provides a step by step guide to estimating “green” employment and a way into understanding how that employment can be increased through attention to environmental or social and employment policies. The process involves:

- understanding and identifying the drivers of green job creation;
- mapping the size and structure of the national economy;

⁶ Available at: http://www.ilo.org/wcms5/groups/public/@ed_emp/@ed.ent/documents/publication/wcms_158729.pdf

⁷ These may include government officials, national and international development institutes, non-governmental organizations (NGOs) and international agencies such as the United Nations (UN), the ILO or the Asian Development Bank (ADB).

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- estimating the scale of *total environment-related employment*⁸ (whether or not these are decent jobs or the activities are environmentally sustainable);
- identifying “*core*” *environment-related employment*, i.e. jobs sustained by activities that are more environmentally sustainable as defined by compliance with relevant standards and other performance indicators (whether or not these provide decent work);
- estimating, as far as the available data allow, the number of those jobs that provide decent work conditions and thus, through their environmental performance and social/economic attributes, can be considered “*green jobs*” under the ILO definition;
- estimating the scale of *indirect and induced employment* associated with those “*core*” environment-related jobs and (where possible) green jobs;⁹
- examining what might be done to turn environment-related jobs that are not “*decent*” by ILO standards, because of deficiencies in working conditions (occupational health and safety, skills), into “*green*” jobs – i.e. those that exceed minimum acceptable levels of environmental *and* social performance.

The application of the guide in a particular developing country will provide the following outputs:

- a quantitative estimate of total environment-related employment;
- a quantitative estimate of the number of “*core*” environment-related jobs sustained by economic activities that directly or indirectly improve the environmental sustainability of the economy, according to defined criteria or performance thresholds;
- a “*map*” of the “*quality*” of that core environment-related employment by reference to agreed conditions of decent work and, where data permit, a quantitative estimate of green jobs that satisfy both environmental criteria and decent work criteria according to the ILO/UNEP definition;
- quantitative estimates of indirect/induced jobs sustained by these core environmental sectors and the “*green*” activities, generated via development of a set of new input–output coefficients and modification of national input–output tables;
- a modelling tool that can aid policy-making by showing the employment impacts of alternative “*What if?*” scenarios and strategies, including identifying potential winning and losing sectors.

⁸ This estimate should be broader than “*core*” environment-based sectors; for example, energy efficiency in public administration, sustainable urban planning, green buildings and retrofitting of existing building stock.

⁹ Both numbers may be of interest to policy-makers, as the difference between the two numbers then provides a clear target for jobs upgrade. It is not straightforward to estimate decent jobs within “*core*” environment-related jobs. This is discussed in more detail in Task 3.

Development of new input–output (I–O) coefficients for green sectors is fundamental for assessing the net impact of existing green jobs and for exploring the future impacts of green growth. However, creating new input–output coefficients is not straightforward. This guide provides a range of methods that could be used to develop these coefficients, depending on available time and resources and green job related policy priorities, objectives and constraints. An important prerequisite of using this guide is the availability of good quality and up-to-date national input–output tables in electronic format.

The input–output coefficients can also be used for other forms of modelling, such as dynamic social accounting matrices (SAMs) and SAM-based computable general equilibrium models. This guide suggests ways of addressing a bottleneck that exists in assessments of green jobs using input–output tables (i.e. adjusting I–O coefficients) which other researchers may wish to address in due course with other modelling methods.

It is worth noting that the method set out here can be used to generate useful information for policy-makers and others even if the models or skills required for the final modelling stage are not available. The early stages will provide a picture of the distribution and character of the country’s “green economy”, and the employment that it sustains. Readers should not, therefore, be discouraged by the technical nature of the discussion of the process of modelling indirect employment.

1.4 Assumed knowledge and level of effort

A project based on use of this guide would benefit from access to a multi-disciplinary team that offers together skills and experience in research, data and policy interpretation, stakeholder consultation and input–output modelling. This document assumes basic literacy in accessing, manipulating and interpreting economic data, but does not require expert knowledge of labour markets or environment–economy linkages. The later stages, in which the user is estimating the indirect and induced employment associated with green jobs, require knowledge of and familiarity with input–output tables and their use in economic analysis.

The effort level required will likely vary according to the level of detail and accuracy required, how much information is available in published sources and the size of the country. As a point of reference, completing the Bangladesh assessment (research and analysis, excluding report-writing time) took around 45 person-days of effort – 15 days in research, 15 days in fieldwork and 15 days in modelling and analysis. More resources would allow tighter definition of the results, opportunities and issues.

1.4.1 Data requirements

Information requirements and sources are discussed in more detail later in this document, but use of the guide will typically require access to:

- national statistical accounts;
- national labour force surveys;
- market studies and market data;
- statements of public policy, strategy and investment;
- research reports on environmental, employment and social issues; and
- national input–output (I-O) tables or social accounting matrices (SAMs).

National labour force surveys are particularly important for the purposes of this assessment. They are a useful resource for identification of direct environmental related jobs as well as for analysing the quality of the jobs.

Desk research and analysis may need to be complemented by interviews and consultations.

1.4.2 Improving the guide: Your role in building it

This guide is intended to be a living document. The ILO and GHK would like to see it developed and improved over time, building from experience with its application in different countries. The various tasks in the guide contain a menu of options for undertaking those tasks. These options can be improved and/or new options added from applying this guide in various countries.

1.5 Structure

This guide is structured as follows:

- In Part I, Chapter 2 lists some of the key concepts, definitions and rules as a reference guide to estimating green jobs, while Chapter 3 explains the analytical framework adopted in a developing country context.
- Part II provides a task-by-task guide to estimating green jobs including “what if” scenarios to aid policy-makers.

Using the guide: Key definitions, rules and concepts

Initiatives and investments in renewable energy, greater energy efficiency and more environmentally sustainable business models are increasing. The result has been increased demand for information about the employment impacts and opportunities of the “greening” of the economy.

A literature review of green job estimates shows that uniform definitions for a green job and related green concepts are not available. Instead, concepts are commonly defined in relation to the specific issues being studied. Numerous studies have estimated the scale of environment-related employment, with results that reflect the variation in their scope and assumptions. For example, green job estimates for the European Union (EU) range from 2.4 to 36.4 million (year 2000 figures)¹⁰ depending on the nature and coverage of the estimates.

In this context, it is fundamentally important for those involved in any such exercise to reach agreement on the key definitions, rules and concepts before undertaking an assessment, in particular:

- the definition of green jobs to be adopted, including “what counts” as environmentally sustainable and as decent work;
- how to handle the informal economy within the analysis, and the implications of that decision for the estimation of green jobs; and
- the forms of economic analysis and the tools to be used for measuring green employment.

¹⁰ European Commission, Directorate-General for Employment: *Employment in Europe 2009* (Luxembourg, 2009), chapter on “Climate change and labour market outcomes”. Available at: <http://ec.europa.eu/social/>.

2.1 The concept of green jobs

As used here, the green job concept has social as well as environmental aspects. For our purposes green jobs comply with the pillars of decent work (as defined by the ILO) *and* are provided by economic activities that contribute to reduced environmental impact. *Green jobs are thus both environmentally sound and also “decent” in social terms.*

Box 2.1 The UNEP/ILO concept of green jobs

Green jobs can be generically defined as the direct employment created in different sectors of the economy and through related activities, which reduces the environmental impact of those sectors and activities, and ultimately brings it down to sustainable levels. This includes “decent” jobs that help to reduce consumption of energy and raw materials, de-carbonize the economy, protect and restore ecosystems and biodiversity and minimize the production of waste and pollution.

Ultimately, given the broad scope of the green jobs concept, individual countries and organizations such as the ILO and the United Nations Environment Programme (UNEP) have to determine the appropriate boundary for green jobs within the economic sectors being analysed. Data limitations may make it difficult to define boundaries between environment-related and other employment, and when conditions of decent work are met. The environmental and social dimensions of green jobs which affect these boundaries are discussed in more detail below. Task 3 provides a screening tool that helps in identifying which environment-related jobs meet prescribed conditions of decent work and thus qualify as “green” for the purposes of this process.

2.1.1 Environmental dimension of green jobs

There are a large number of links between the environment and economy, and thus many sources of green employment

For a modern economy, even in the least developed countries, a complete mapping of links between the environment and economy is a major challenge given the many positive and negative feedback loops that would need to be examined.

This guide focuses on the main connections. It considers economic activities directly dependent on natural resources as production inputs (e.g. farming, fishing and forestry) through to economic activities where the linkages are indirect and diffuse (e.g. via fuel and power, or the effects of ambient air quality on community health).

The range of green job profiles thus defined is broad. It stretches from highly skilled research and development or management functions through technical and skilled levels to relatively low-skilled roles. In developed economies, environment-related jobs tend to be concentrated in sectors/activities directly linked to decarbonizing energy supply and improving energy efficiency, pollution control and eco-friendly services. Examples of those sectors that hold the promise of the green jobs of the future include:

- delivering improvements in energy and resource efficiency, particularly in the building sector (new and existing built stock), but also industry and transport;
- renewable energy (including biofuels and renewable technologies);
- sustainable mobility (i.e. mass transportation);
- waste management and recycling of raw materials;
- eco-industries related to pollution control (air, water, waste, site decontamination, noise); and
- “eco-friendly” services (conservation, ecotourism, etc.).

In developing economies other sectors may be at least as important, in particular:

- those involving the sustainable use of natural resources, including agriculture, forestry and fisheries; and
- activities relating to adaptation to climate change.

Setting the environmental performance level that must be exceeded for an activity to be regarded as “green” for the purposes of such studies is something that needs to be done on a case-by-case basis

The key challenge is to develop a practical interpretation of environmental sustainability for each of the main sectors that can be agreed upon and supported by the main stakeholders, including policy-makers. The process of defining this is likely to draw on national policies and priorities as well as international benchmarks.

Most countries now have an established body of environmental law, but the level and enforcement of the performance standards and environmental protection that such legislation provides differ widely around the world. Legal standards change over time, as do the expectations of consumers and global supply chains. Leading-edge practice in one country may be yesterday’s technology in a second country, and an interesting but inappropriate technology in a third.

Determination of “what matters” in the context of projects using this guide will also reflect national environmental priorities. These vary by country and over time.

The cross-cutting nature of climate mitigation and adaptation policies means that all sectors of the economy will be impacted by the enactment of national

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voluntary medium-term emissions reduction targets, with important impacts on job creation and job transformation. At the same time, policy-makers are likely to follow sector-based approaches to achieve climate mitigation and adaptation targets; the development of an analytical framework that would help in understanding the sectors that would stand to gain and lose from any policy intervention would contribute to their ability to do so.

2.1.2 Social dimension of green jobs (the “decent work” criterion)

The green job definition used here encompasses more than just the extent to which a particular job contributes to a more environmentally sustainable economy. It also captures a measure of job quality. Effectively, a job may be associated with an economic activity that is more environmentally sustainable than the norm or which contributes to such improvement in other sectors, but it cannot be considered a “green job” if it does not meet conditions of decent work (see box 2.2).

The decent work definition is built upon a set of social and labour rights and obligations. The eight basic Conventions of the ILO, which are recognized as defining the various aspects of socially responsible production, also apply to green jobs.¹¹ Indicators and criteria have been developed and endorsed at the international level through adoption of the ILO labour standards which are relevant to the further characterization of the social and labour dimension of green jobs (see box 2.2).

Many jobs would not be considered decent. This is due to a number of factors. The so-called “green sectors” in developing countries include sectors where achieving decent work conditions remains a challenge. Examples of “green but not decent jobs” include low-wage jobs installing solar panels, and jobs in shipbreaking or electronic waste recycling where occupational safety is inadequate or child labour is used. In many instances, these sectors are defined by their informal nature, hardship and occupational and health hazards.

Measuring decent work in developing countries is challenging but possible through a broad-brush approach

The evolution of decent work can be measured by assessing predetermined benchmarks in a particular country and monitoring their progress over time. Decent work can be disaggregated into ten main elements for measurement purposes, as shown box 2.3. A mix of qualitative and quantitative data will be required to measure each of these indicators.

¹¹ Available at: http://actrav.ilo.org/english/about/about_fundamentals.html.

Decent work indicators for Asia and the Pacific: A guidebook for policy-makers and researchers (ILO, 2008)¹² provides details on the different types of decent work indicators and methodology and measurement of the less easily quantifiable dimensions of decent work. Task 3 below provides more details on screening environment-related jobs using decent work indicators.

Box 2.2 The ILO definition of decent work

Decent work has been defined by ILO representatives of governments and employers' and workers' organizations in over 180 countries as: "opportunities for women and men to obtain decent and productive work in conditions of freedom, equity, security and human dignity, in which women and men have access on equal terms". Decent work combines adequate income from productive work with social security, respect for worker and social rights and the opportunity to voice and defend interests collectively.

Decent work is relative and country-specific because countries differ socially and economically. None can aim for the same absolute conditions of work. Each country must set its own targets for decent work.

The following integrated agenda of policies and measures across four mutually reinforcing areas is required to achieve decent work goals:

1. Respect for and protection of basic human rights at work
2. Promotion and creation of opportunities for full productive and remunerative employment
3. Broad social protection
4. Sustained social dialogue among social partners: workers, employers and private business, and government.

A universal social "floor" applies to all countries, and includes respect for the following basic human rights:

- Freedom of association and the effective recognition of collective bargaining rights
- Elimination of all forms of forced or compulsory labour
- Effective abolition of child labour and the right of children to learn and develop rather than work
- Elimination of discrimination in respect of employment and occupation.

Gaps between people's decent work aspirations and reality exist everywhere. The challenge is to reduce these gaps. Progress towards decent work should be the central goal of all economic and social policies and strategies.

Sources: ILO: *Decent work*, Report of the Director-General, International Labour Conference, 87th Session, Geneva, 1999; ILO: *Reducing the decent work deficit: A global challenge*, Report of the Director-General, International Labour Conference, 89th Session, Geneva, 2001.

¹² Available at: http://www.ilo.org/asia/whatwedo/publications/lang--en/docName--WCMS_099163/index.htm.

Box 2.3 Decent work can be assessed and measured using ten broad indicators

1. **Employment opportunities:** All persons (women and men) who want work should be able to find work, and the decision to work should be voluntary, in accordance with the minimum age of access to employment.
2. **Unforced paid work:** Work should be freely chosen and not forced on individuals. Certain forms of work are completely unacceptable (e.g. bonded labour, slave labour and child labour). Workers should have the freedom to join workers' organizations.
3. **Adequate earnings and productive work:** Workers must have acceptable livelihoods including remuneration for all work carried out. Remuneration – especially in the case of wage workers – should correspond to a fair and living wage. Equal pay should be ensured for work of equal value.
4. **Fair and equal treatment in employment:** Fair and equitable treatment and opportunity at work and in access to work (coinciding with absence of discrimination or harassment on grounds of sex, national origin, race and age) should be ensured.
5. **Decent working hours:** Working time arrangements concerning daily and weekly working hours, regular and overtime work, and breaks and rest periods should reflect fair and acceptable practices, and be compatible with social and family life. Work intensity leading to excessive hours threatens physical and mental health, and interferes with the balance between work and family.
6. **Fair balance of work and family life:** Workers with family responsibilities (those with young children or elderly and sick family to care for) should be able to exercise their right to engage in work if they wish to, without being subject to discrimination. Family responsibilities fall most heavily on women.
7. **Safe work environment:** The physical work environment should avoid extreme conditions (heat, dust, noise, workload, etc.) and ensure a safe working environment with appropriate prevention of work-related accidents, injuries and occupational diseases.
8. **Stability and security of work:** This recognizes workers' needs to limit insecurity associated with the possible loss of work and livelihood.
9. **Social protection:** Work conditions should be conducive to safeguarding health, pensions and livelihoods, and should provide adequate financial and other protection in the event of work-related injuries or health-related contingencies.
10. **Social dialogue and workplace relations:** Workers should be treated with respect at work, and should be able to voice concerns and participate in decision-making about working conditions. Workers' freedom to organize and collectively represent their interests is an essential ingredient of ensuring dignity.

Source: ILO: *Globalization and decent work: A report for the Decent Work Pilot Programme in Bangladesh* (Dhaka, 2004).

2.2 The informal economy and implications for estimating green jobs

All countries contain an “informal” economy, a label which essentially describes economic activities conducted outside the labour-market regulatory framework. This sector is significantly more prominent in developing economies than in developed economies. It is important to understand the size and nature of the informal economy in developing countries as it is significant in terms of GDP share and number of workers. The formal/informal nature of work typically has important implications for job quality as well.

2.2.1 Defining the informal economy

The definition¹³ of the informal economy adopted in the System of National Accounts in 1993 stated that it:

may be broadly characterised as consisting of units engaged in the production of goods and services with the primary objective of generating employment and incomes to the persons concerned. These units typically operate at a low level of organisation, with little or no division between labour and capital as factors of production and on a small scale. Labour relations where they exist are based mostly on casual employment, kinship of personal and social relations rather than contractual arrangements with formal guarantees.

Informal enterprises were defined as private, unincorporated and unregistered entities employing no more than a defined number of persons (varying by country) and engaging in exchange-related activity.¹⁴ A decade later this definition was expanded¹⁵ to emphasize jobs rather than enterprises, so as to cover informal jobs outside informal enterprises. This includes, for example, casual labour and non-documented work that are often a feature of formal enterprises. This broader concept was termed “informal employment”. Subsequent labour market surveys have shifted attention towards capturing informal employment, but a significant proportion of existing data refers to the older notion of the informal economy. According to the Seventeenth International Conference of Labour Statisticians:

¹³ Resolution of the Fifteenth International Conference of Labour Statisticians (ICLS), January 1993, and adopted in the System of National Accounts (SNA 93).

¹⁴ Ibid.

¹⁵ Seventeenth International Conference of Labour Statisticians (ICLS), December 2003.

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Employees are considered to have informal jobs if their employment relationship is, in law or in practice, not subject to labour legislation, income taxation, social protection or entitlement to certain employment benefits (advance notice of dismissal, severances of pay, paid annual or sick leave, etc.).

Note that this definition is made at the job level and not at the individual level because a person can simultaneously have two or more jobs.

Informal employment can be classified into:

- *informal self-employment* – which includes self-employment in informal enterprises, own-account workers in informal enterprises, unpaid family workers, and members of informal producers' cooperatives;¹⁶ and
- *informal wage employment* – which includes employees without formal contracts, worker benefits or social protection, who are employed either in formal or informal enterprises.

2.2.2 Methods for estimating the informal economy

A number of methods have been used in the literature to estimate the size of the informal economy. Among the most commonly used methods are:¹⁷

- *Micro measures.* These are based on household-level data, labour market surveys, tax data and other individual-centric estimates. A recent paper by Maligalig et al. (2009),¹⁸ which presents estimates of informal employment in Bangladesh, exemplifies this method. The paper uses data sourced from the Bangladesh Labour Force (BLS) Survey, 2005–06.
- *Macro “indicator” variables.* These measures use an indicator or variable, such as currency demand,¹⁹ to track the size and progress of the informal economy. This is because informal activity is likely to be financed by cash transactions in an attempt to evade official detection. Excessive currency demand estimates over time should control for other possible determinants of such demand and money-flow velocities, and account for various drivers of the decision to take up informal employment. Such estimates will yield a figure describing informality as a proportion of GDP.

¹⁶ M. Chen, J. Vanek and J. Heintz: “Informality, gender and poverty: A global picture”, in *Economic and Political Weekly* (27 May 2006), pp. 2131–2139.

¹⁷ See F. Schneider and D. Enste: “Shadow economies: Size, causes and consequence”, in *Journal of Economic Literature* (2000), Vol. 38, No. 1, pp. 77–114; G. Georgiou: *Measuring the size of the informal economy: A critical review*, Working Paper 2007–1 (Central Bank of Cyprus, 2007).

¹⁸ D. Maligalig, S. Cuevas and A. Rosario: *Informal employment in Bangladesh*, ADB Economics Working Paper Series, No. 155 (Asian Development Bank, 2009).

¹⁹ P. Cagan: “The demand for currency relative to the total money supply”, in *Journal of Political Economy* (1958), Vol. 66, No. 3, pp. 302–328.

- *Econometric modelling techniques*.²⁰ These model multiple causes and indicators of informality to arrive at more reliable estimates.

The advantages and disadvantages of these three methods are given in table 2.1.

Table 2.1 Methods to estimate the size of the informal economy

Method	Advantages	Disadvantages
Micro measures	<p>Greater degree of detail</p> <p>Emphasize individual-centric aspects of informality</p> <p>Convenient as data compiled by governmental authorities and publicly available</p>	<p>Potential for response biases</p> <p>Non-random sampling possible</p> <p>Differences in survey design – non-comparable across countries and times</p>
Macro-based “indicator” variables	<p>Based on publicly available macro data – easy to estimate and track, less time-consuming</p> <p>Avoid sampling and other bias problems and are comparable across countries and over time</p>	<p>Omit several potentially important macro variables by focusing on one indicator – vulnerable to estimation bias</p> <p>Several assumptions questionable (e.g. assuming monetary/electricity-to-GDP elasticities to be identical across countries)</p>
Sophisticated econometric model-based techniques	<p>Seek to allow for multiple indicators and multiple causes of informal employment</p> <p>Permit dynamic analysis of informal employment/wage trends</p>	<p>Complex methods – feasibility of acquiring necessary data can be questionable</p> <p>Theoretical foundations often ad hoc or weak and subject to criticism</p>

²⁰ See for instance D. Giles: “Measuring the hidden economy: Implications for econometric modelling”, in *The Economic Journal* (1999), Vol. 109, No. 456, pp. 370–380.

2.2.3 Size of the informal economy

The informal economy is significant in terms of GDP share in developing countries. In the late 1990s, the ILO estimated that informal activities accounted for 25 to 50 per cent of GDP in most developing countries. The informal economy accounted for a majority of the total non-agricultural workforces of several countries across Asia, Africa and Latin America in the 1990s (table 2.2). The share of informal jobs is even greater if agriculture is taken into consideration.²¹ In India, for instance, the informal economy accounts for 90 per cent of total agricultural employment.²² In Bangladesh nearly 99 per cent of all agricultural jobs²³ and nearly 80 per cent of all jobs are in the informal economy.

2.2.4 Informal employment and decent work

A defining characteristic of informal employment (both self-employment and wage employment) is the inherent lack of security owing to the absence of contracts, employee benefits or social protection, and lower average wages in general.²⁴ Non-agricultural employment in the informal economy is highest in sub-Saharan Africa, followed by Asia (see table 2.2). Some of the other main social features of informal employment are as follows:

- Employers in the informal economy earn more by remaining informal because they do not pay taxes or observe minimum wage laws. Consequently, wage workers, unpaid workers and others receive far fewer benefits and lower wages.
- Rural areas tend to have greater proportions of informal workers.
- Women, as a rule, outnumber men in informal employment, so much so that the informal economy is often said to have a “woman’s face”.²⁵

²¹ It is not, however, straightforward to estimate the informal economy’s share of the agricultural workforce. As the Fifteenth ICLS (1993) left it to the discretion of individual countries to decide on the inclusion of agricultural and domestic activities in computing informal-economy statistics, estimates of informal workforces in agriculture are not available across several countries.

²² M. Chen, R. Jhabvala and F. Lund: *Supporting workers in the informal economy: A policy framework*, Working Paper on the Informal Economy, Employment Sector (Geneva, ILO, 2002).

²³ Maligalig, Cuevas and Rosario, op. cit.

²⁴ M. Carr and M. Chen: *Globalization, social exclusion and work: With special reference to informal employment and gender*, Working Paper No. 20, Policy Integration Department, World Commission on the Social Dimension of Globalization (Geneva, ILO, 2004), p. 37.

²⁵ R. Palmer: *Skills and productivity in the informal economy*, Working Paper No. 5, Skills and Employment Department, Employment Sector (Geneva, ILO, 2008).

Table 2.2 Informal economy employment as a percentage of the non-agricultural workforce, by region, 1985–1999

Country/region	Informal employment (%)		
	1985–89	1990–94	1995–99
North Africa	38.8¹	43.4²	n.a.
Sub-Saharan Africa (excluding South Africa during the 1990s)	68.1¹	74.8²	n.a.
Burkina Faso	70.0	77.0	n.a.
Chad	n.a.	74.2	95.2
Kenya	61.4	70.1	71.6
Mauritania	80.0	n.a.	n.a.
Latin America	52.3¹	56.9²	n.a.
Argentina	n.a.	47.5	53.3
Brazil	52.0	60.0	60.0 ³
Paraguay	61.4	n.a.	65.5
Asia	53.0¹	63.0²	n.a.
India	76.2	73.7	83.4
Indonesia	39.2	n.a.	77.9
Thailand	57.4	51.4	51.5

Notes: ¹ Overall figure for the 1980s. ² Overall figure for the 1990s. ³ The percentage for Brazil was estimated to have declined to 51 per cent over the period 2000–2007. n.a. = not available.

Sources: J. Charnes: *Informal sector, poverty and gender: A review of empirical evidence*, background paper (2000) for World Bank: *World Development Report 2001* (Washington, DC, 2001); OECD: *Is informal normal? Towards more and better jobs in developing countries* (Paris, 2009).

2.3 Methods used to estimate environment-related employment

The research literature provides both qualitative and quantitative methods for estimating environment-related employment.²⁶ Qualitative methods mainly involve business survey approaches, while quantitative methods mainly use input–output modelling or green economy satellite accounts.

2.3.1 Business surveys

Two approaches to surveying environment-related jobs are:²⁷

- *the industry approach* – which counts the number of employees at firms that produce green products or services; and
- *the occupational approach* – which uses occupation classification to count the number of employees at all types of firms with work activities that contribute to the greening of the economy.

The industry approach is akin to the industry-output side of green production, while the occupational approach is akin to the industry-input side of green production. That is, irrespective of a firm’s output, the number of environment-related jobs counted is based on whether the occupational activities of the job make production greener.²⁸

2.3.2 Input–output analysis

Input–output analysis is an empirical tool designed to analyse sector interdependencies. An input–output table describes the flow of goods and services through an economy in monetary units for a given time period, usually a year. Table 2.3 represents a simplified version of an input–output table.

²⁶ See European Commission: *Employment in Europe 2009* (Luxembourg, 2009), Chapter 3, Statistical Annex: “Climate change and labour market outcomes”, for a summary of findings from the literature on estimated employment effects of climate change related policy measures and description of the methods used. Available at: <http://ec.europa.eu/social/main.jsp?catId=119&langId=en>.

²⁷ T. Slaper and R. Krause: “The green economy: What does green mean?”, in *Indiana Business Review* (Fall, 2009), Vol. 84, No. 3. Available at: <http://www.ibrc.indiana.edu/IBR/2009/fall/article3.html>.

²⁸ Ibid.

Table 2.3 Simplified example of an input–output (I-O) table

		Purchasing sectors					
Selling sectors	Industry sectors	Agriculture	Food and beverages	Land transport	...	Final demand	Total output
	Agriculture	1 323	2 290	6		1 911	6 467
	Food and beverages	333	1 390	17		8 074	11 670
	Land transport	34	261	480		5 794	10 775
	...						
	Primary inputs (labour)						
Total input							

The *rows* in an I-O table show that the total output of an industry sector is consumed either by other sectors (i.e. to intermediate demand) or to final demand (e.g. to household consumption). Thus, we can see the extent to which a particular sector sells its goods and services to other sectors and to final demand.²⁹ The *columns* show the share of inputs a sector uses to produce its final output. The columns refer to the share of production inputs, while the rows show the distribution of goods and services.

The basic input–output model measures how much additional output is needed from each sector in response to a unit increase in final demand. In other words, if consumers buy an additional unit of a good, what are the consequences for the different industry sectors? By answering this question, input–output models provide the link between production and use. They show how a change in consumption (including households and governments) may affect production in different sectors and the relationships between consumers of goods and services.

The input–output modelling approach can be used to estimate the effects on employment resulting from an increase in final demand for the product or service in a given green industry. For example, one can estimate the number of jobs directly created in the sustainable construction industry for each US\$1 million worth of spending on construction. One can also estimate the jobs that are indirectly created in other industries through the US\$1 million in spending on construction – industries such as lumber and hardware. Overall, the input–output model can estimate the economy-wide employment results from a given level of spending.³⁰

²⁹ Final demand includes spending by households and governments, intermediate sales to other industries, as well as net exports.

³⁰ See methodology section in Political Economy Research Institute (PERI): *The economic benefits of investing in clean energy* (Washington, DC, Center for American Progress, 2009).

Box 2.4 Estimating environment-related jobs with input–output modelling: Some challenges

Estimating environment-related jobs with input–output modelling requires the creation of new “green” sectors by splitting standard sectors within the model and mapping certain green activities across its industrial sectors. A common challenge in such analysis is the lack of Input–output data for either the green subsector or the green activity that cuts across several sectors in the I–O table. This guide outlines a range of options in light of different resource, time and information constraints for dealing with this issue (see table T4.3 in Task 4.2).

Table 2.4 details the pros and cons of using business surveys and input–output modelling. In practice, a combination of the two can be used to estimate environment-related jobs. Business surveys can also be used for collecting technical information for I–O modelling and are discussed in more detail in Task 4.2.

Surveys are best suited to estimation of direct environment-related jobs. These estimates can be complemented by use of the multipliers from an I–O table to estimate indirect and induced jobs (see next section for more details on indirect and induced effects). Surveys are also a good way of obtaining information in order to split and map sectors and activities into their green components.

2.3.3 Multipliers: Direct, indirect and induced impacts

Studies³¹ have found positive net national economic benefits from a shift to more environmentally sustainable activities due to the longer and more diversified supply chains and higher labour intensity of the alternative technologies involved.³² The net benefit of the substitution should also take into consideration the budget effect,³³

³¹ R. Pollin et al.: *Green recovery: A program to create good jobs and start building a low-carbon economy* (Washington, DC, Center for American Progress, 2008); R. Pollin and J. Wicks-Lim: *Job opportunities for the green economy: A state-by-state picture of occupations that gain from green investments* (Amherst, University of Massachusetts, Political Economy Research Institute, 2008); US Conference of Mayors: *Current and potential green jobs in the U.S. economy* (Global Insight, 2008); American Solar Energy Society: *Renewable energy and energy efficiency: Economic drivers for the 21st century* (Management Information Services, Inc., 2007).

³² The University of California Berkeley’s Renewable and Appropriate Energy Laboratory found that renewable energy technologies create more jobs per average megawatt of power generated and per dollar invested than coal or natural gas. The Center for American Progress (2008) report (Pollin et al., op. cit.) states that a US\$100 billion investment in clean energy and efficiency would result in two million new jobs, whereas similar investment in old energy would only create around 540,000 jobs.

³³ The budget effect is discussed in more detail in Task 5.

Table 2.4 Estimating environment-related jobs: Pros and cons of business surveys and Input–output modelling

	Pros	Cons
Business surveys	<p>Better suited for estimating direct environment-related jobs, especially if the green activity cuts across a number of different sectors.</p> <p>When estimating employment in the green economy, the job is the unit of observation. Jobs exist within business establishments (i.e. the industry), and can be classified according to the product or service produced, the type of work performed (i.e. the occupation), as well as by geography. Therefore, a business survey is likely the best method to estimate and track trends in green jobs.</p>	<p>Interpretation of what constitutes a green job is partially left up to the survey respondent.</p> <p>Can be expensive and time-consuming (planning, designing questionnaire, sampling and analysis). Requires sophisticated occupational classification systems. Emerging green occupations are mostly without a Standard Occupational Classification (SOC) code.</p> <p>Industry codes are often not specific enough to separate the core green firms from those that are green-related in a secondary or tertiary sense.</p>
Input–output modelling	<p>Able to estimate economy-wide results including indirect and induced impacts and their interaction with the environment. For example, changes in agricultural product sales will have immediate (direct) effects on the food and beverages industry, but also less immediate (indirect) effects on the transportation industry, and any other industries that provide inputs to the food and beverages industry.</p> <p>Shows economic links between various industrial sectors, government and households.</p> <p>Provides a good snapshot of the economy and potential for green jobs to aid future policy design.</p> <p>Less expensive and time-consuming.</p>	<p>Assumes “constant coefficients for production”, which means that the ratio of outputs to inputs is constant regardless of the scale of production or the time period. This eliminates the possibility that inputs may be substituted for each other, either because of technological progress or because of changes in factor prices.</p> <p>Risk of double counting</p> <p>Risk of double counting as many green jobs reflect shifts of workers from one industry to another or upskilling, rather than an infusion of new economic activity.</p>

which results from the difference in price between the conventional and sustainable product or activity. If sustainable technologies are relatively more expensive, then the higher cost burden would fall on consumers. Cost-effective green activities that have a negligible or even positive budget effect would have a higher net positive employment effect.

The ripple effects³⁴ of spending on environment-related activities can be estimated using multipliers. Multipliers are measures of the way in which an increase in activity by one firm will lead to an increase in activity by other related firms. For example, the contractor for a new building buys concrete, the concrete subcontractor buys new tyres for its trucks, all the firms' workers spend their wages on food or consumer goods, and so forth.

Multipliers are estimated by indirect means, using input–output tables. They are calculated by using the estimates for direct, indirect and induced effects, which are also estimated from I-O tables. The three effects are defined below:

1. *Direct effect* – defined as an increase in demand for the goods produced by any sector leading to an increase in the output of goods from that sector.
2. *Indirect effect* – as producers increase their outputs in any sector, their suppliers will also see an increase in demand for their goods, and so on. The shock of the increase in final demand for that good then ripples through the supply chain.
3. *Induced effect* – as a result of these supply chain effects, the level of income in the economy will increase, and a portion of this income will be spent on other goods and services, leading to further increases in demand. This is termed an induced income effect.

The ratio of the sum of direct, indirect and induced effects to the direct effect is called the Type II output multiplier (induced effect). A Type I output multiplier excludes the induced effects (i.e. it represents the ratio of the sum of direct and indirect effects to direct effects alone). Multipliers can also be derived for employment and income (table 2.5).

Type II multipliers require data on household expenditures and incomes by industry, and these may not necessarily be provided in I-O tables. Hence, total estimates of green jobs are dependent on the capability of the I-O models, both in terms of the different types of data required as well as the ability to split sectors and map certain green activities across industrial sectors in an I-O table. This creates an additional layer of complexity when thinking about the creation of new industries in the I-O tables.

³⁴ See <http://faculty.washington.edu/krumme/207/inputoutput.html>.

Finally, apart from these direct employment effects, indirect knock-on effects may also ripple through via price, wage and income effects and affect employment in the rest of the economy.³⁵

Table 2.5 Definitions of Type II output, income and employment multipliers and effects

Output multiplier	Output multiplier for an industry is the ratio of direct, indirect and induced output effects to the direct change in output resulting from a unit increase in industry final demand.
Income multiplier	Measured as the ratio of direct, indirect and induced income change resulting from a unit increase in industry final demand.
Employment multiplier	The ratio of direct, indirect and induced employment change to the direct employment change generated as a result of changes in final demand.
Income effect	The direct, indirect and induced income effect generated as a result of a unit change in final demand.
Employment effect	The direct, indirect and induced employment effect generated as a result of a unit change in final demand.

³⁵ UNEP et al., op. cit.; GHK, Cambridge Econometrics and Institute for European Environmental Policy: *Links between the environment, economy and jobs* (Luxembourg, European Commission, Directorate-General for Environment, 2007).

The analytical framework for estimating green employment in developing countries

3.1 The environmental agenda and green jobs in developing countries

International debate on global environmental issues has evolved over the last two decades since the adoption of the 1992 Rio Conventions on desertification, climate change and biodiversity.³⁶ More favourable conditions are being created for the development of an enlarged “environmental economy”, and the emergence of new economic sectors and services. In response, demand for jobs with new qualifications and skills has increased and other jobs have evolved. The green jobs concept highlights labour market shifts that are directly dependent on various aspects of environmental management and low carbon development, as well as climate change adaptation in accordance with the definition given by the United Nations Framework Convention on Climate Change (UNFCCC).

A growing literature suggests that millions of green jobs already exist. The economic restructuring due to green growth will lead to changes in prices, in international trade and in the output of countries, and therefore in employment. These effects have been the subject of a number of studies seeking to quantify the net employment effects. Results show that net effects on jobs are modest but the economic structural shift can be quite substantial. Essentially, the number and

³⁶ The Rio Conventions are the three United Nations Conventions opened for signature during the United Nations Conference on Environment and Development (also known as The Earth Summit), 3–14 June 1992, in Rio de Janeiro, Brazil: The UN Convention on Biological Diversity, the UN Framework Convention on Climate Change, and the UN Convention to Combat Desertification. Available at: <http://www.rioconventions.org/>.

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nature of jobs will change as the relative importance of sectors changes, with some expanding, others contracting, and others remaining stable but with changes in processes and products.

But this transition has been documented mostly in industrialized countries. Research on developing countries is comparatively scarce. Alongside the growing need to assess the contribution of these sectors and activities to national economies, methodologies and analytical tools that integrate the complex interactions between the socio-economic and environmental fields are also required. Indeed, there is demand for a comprehensive analytical framework that can better assist policy-making in this fast-evolving field, including in developing countries.

Green growth can create new and additional employment demand. This is the case, for example, when jobs in renewable energy replace those depending on fossil fuels, or when new jobs are created by expenditure on adaptation activities. In developing countries, which tend to have unutilized or underutilized labour, this provides opportunities to raise total employment.

3.2 Addressing the particular needs of developing countries

As discussed in Chapter 2, definitions relating to green growth and the environmental economy used in the research literature tend to be derived from analysis in developed countries. The standard definition of eco-industries, for instance, is based on the concept of conservation and pollution control reflected in the OECD guidelines.³⁷ Such definitions are not necessarily appropriate to the developing country context where priorities and issues differ from those in OECD countries.

The appropriate scope and definition of “core” environment-related economic activity, and interpretation of the green jobs concept, will differ from country to country. Countries have different environmental standards and have ratified different ILO labour standards.

Any analytical framework developed to benefit developing countries requires a thorough understanding of local socio-economic conditions and national priorities in the area of environmental management. Important points of differentiation include the following:

- *The structure of the economy* – factors relevant to the green jobs agenda in a developing country context include:

³⁷ OECD/Eurostat: *The environmental goods and services industry: Manual for data collection and analysis* (Paris, 1999).

- the importance of the *agriculture* and/or *natural resource management* sectors;
- the scale of activities relating to climate change adaptation and disaster risk reduction; and
- the framing of emissions reduction efforts in terms of “*low carbon development pathways*” rather than the carbon mitigation strategies referred to in industrialized economies (the challenge in developing countries with low per capita emissions is to find a low-GHG development trajectory, whereas in the OECD the primary challenge is to achieve economic development whilst substantially cutting *existing* emission levels).
- *The environmental priorities* – in developing countries these are likely to include urban air quality, municipal waste management, freshwater shortages, water pollution and poor sanitation, coastal management, deforestation and unsustainable land cultivation. Climate-mediated environmental impacts may be significant: climate change is predicted to have a severe effect on many developing countries, especially heavily populated mega-deltas and small island States.
- *The impact of regulations and policies* – policy signals in developing countries to reduce environmental impacts and to increase energy and resource efficiency are either lacking, or are not as stringent, compared to developed countries. Differences also exist in terms of awareness, enforcement standards and legal frameworks for environmental protection and job quality.
- *The focus on job quality* – poverty reduction, dependence on informal employment, more limited safeguards on workers’ rights and workplace safety, and limited social protection mean that the need to create green jobs in developing countries is great but may not be considered the absolute priority, considering the dire need for jobs in general. This suggests that efforts must be invested in demonstrating the short-term and longer term benefits of environmentally sustainable labour market policies.
- *The quality of information systems and relative balance of the formal and informal economy* – developed countries typically have stronger information and monitoring systems on which to base analysis, and registered employment in the formal economy is dominant. In many developing countries there is extensive employment in the informal economy, including jobs in sectors of key interest in this particular context.

Developing estimates and mapping green employment often requires decision-making on a case-by-case basis. Boundaries must be defined and clarified in each instance. Defining the analytical framework will therefore require explicit choices.

3.3 Green growth can contribute to tackling national environmental, economic and social challenges

Green growth can play an important role in tackling key environmental, economic and social challenges (table 3.1), but there is no single solution that all countries can adopt to address all these issues. Priorities and capacities for supporting green jobs differ from country to country. Some countries may focus on green job creation in sectors that produce goods and services for domestic consumption. Others might wish to upgrade low-paying jobs, or create new jobs to increase total employment. Still others may focus particularly on small and medium-sized companies. Finally, countries will also differ on their environmental and social priorities, including the perception of acceptable working standards and conditions.

Table 3.1 Examples of typical economic, environmental and social issues with linkages to green growth revealed by a strategic scan

Economic issues	Environmental issues	Social issues
Economic resilience	Climate variability impacts – e.g. flooding, windstorms and droughts	Inclusion of marginal social groups
Increasing productivity	Air pollution – e.g. vehicular and industrial emissions	Public health, quality of work, decent work
Absorbing a growing workforce into the national labour market	Sanitation, waste management in urban areas, forest logging	Poverty reduction
Productivity – energy efficiency across sectors	GHGs emission reduction	Just transition for workers and enterprises
Productivity – energy conservation in buildings	GHGs emission reduction	Sustainable job creation
Rural economic development (forestry, agriculture)	Sustainable natural resource management, GHG capture capacity, biodiversity, land use management, food production	Employment, income, decent work
Urban planning	GHGs emission reduction	Employment, decent work
Productivity – resource efficiency	Waste management and recycling, pollution control	Decent work, livelihood diversification
Creating new markets (domestic and international)	Organic farming, sustainable logging, energy-efficient manufacturing, eco-tourism	Employment, income generation

Links between environmental improvement and economic development are increasingly recognized in the developing world. Political and economic decision-makers in developing countries are realizing that the long-standing paradigm of “grow now, clean up later” is problematic, given its high social and environmental costs – even in the short term. National and international policy initiatives promote national, local and enterprise-level shifts to a model of green growth and clean development. Green growth can have far-reaching implications for economic and social development, for production and consumption patterns, and therefore for employment, incomes and poverty reduction.

Links can be identified through:

- case studies that highlight environmental performance improvements in small enterprises (e.g. increased energy efficiency);
- sectoral initiatives that promote responsible business practices related to both the environment and labour and social issues (e.g. the Grameen Bank in Bangladesh);
- understanding labour market implications of transitions within and across sectors; and
- considering “co-benefits” of climate adaptation measures in developing countries, which provide environmental benefits and can also alleviate poverty by safeguarding subsistence livelihoods.

Green growth requires the support of domestic policies and regulations governing employment, environmental protection, public finances, trade and health and safety. Governments are beginning to clarify their green growth positions (see box 3.1) and developing criteria to determine what qualifies as green employment. Government initiatives thus establish the framework within which industry, NGOs, businesses and services develop green jobs and, as appropriate, benefit from government support to do so.

Green growth can provide economic (e.g. productivity, incomes, etc.), environmental (e.g. resource and energy efficiency) and social (e.g. better job quality) benefits (figure 3.1). The scale of these benefits greatly depends on how individual governments are able to develop programmes or support private enterprises to boost the development of a greener economy. There is a high potential for green jobs creation, as well as the greening of existing sectors and their jobs, within supply chains that are based on small and medium-sized companies. These represent 90 per cent of the industrial base in most developing countries.³⁸

³⁸ See UNCTAD, at: <http://samadhanfoundation.com/improving-the-competitive-strength-of-smes-through-business-development-services>.

Box 3.1 The main pillars of green growth

In order for the transition to a green economy to be successful, the right enabling environment must be created. The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) has recognized that this requires a multi-pronged approach, and has subsequently highlighted six pillars to enable green growth. Given the numerous links between them, these six aspects are best implemented in tandem for a transition towards a greener economy:

- greening business and markets;
- sustainable consumption and production (demand-side management);
- green tax and budget reform;
- sustainable infrastructure;
- investment in natural capital;
- eco-efficiency indicators.

“**Greening**” businesses and the relevant markets should be a key priority, for instance, through improvements in energy efficiency and resource use, given that businesses play such a key role in the economy. Indeed, by recognizing green growth as a business opportunity, businesses can become the agents of change.

However, whilst this concept of “greening” is important on a business level, the concept must also be adapted to the wider economy, by moving beyond products and individual businesses to also encompass infrastructure and services. This broader application of the concept of **sustainable consumption and production** requires a shift away from traditional supply-side economic development planning to a focus on the demand side to improve society’s efficiency of consumption. By decoupling economic growth from environmental degradation, we can begin to operate within the Earth’s natural limits. This is achieved by “getting more from less”, at a rate at which replenishment and restoration is possible. However, this requires a conducive regulatory environment and new markets created by the public sector.

One key mechanism to do so is through **green tax and budget reform** (GTBR), which entails two complementary tools that should be implemented in coordination to maximize effectiveness. The first, green taxation, involves shifting the tax burden onto environmentally relevant activities and products. Green subsidy reform, the second component, consists of gradually eliminating counterproductive subsidies that favour unsustainable development, and redirecting fiscal funds towards areas that support green growth and poverty reduction. Through GTBR a price signal is sent to consumers that more correctly reflects the real cost of production. However, GTBR has the potential to be regressive, so the appropriate steps must be taken. Additionally, educating citizens, in both the public and the private sectors, is crucial for garnering support. Nonetheless, the benefits are far-reaching. Applying GTBR can reduce poverty, improve resource productivity, international competitiveness and environmental quality, and create jobs. For instance, revenue from green taxes can be used to finance sustainable infrastructure projects that can increase green jobs.

Indeed, **sustainable infrastructure** is essential for green growth, in that the available infrastructure provides the foundation for economic and social development. Without careful planning, infrastructure can lock countries into unsustainable production and consumption patterns that may prove difficult to reverse. In order to avoid this, decision-makers can consider “sustainable master planning” (SMP), which involves communities in enhancing infrastructure services and the local ecology. Alongside supportive vocational training and employment policies, SMP is a primary vehicle in moving towards green growth. A further key component for sustainable infrastructure is greening buildings, whose construction and use is notoriously energy-intensive. Employment in the building and construction sector often makes up a large percentage of the labour market. Accordingly, eco-efficient construction practices can encourage linkages with green businesses that offer environmentally friendly products and services.

However, green growth will require not just investment in sustainable physical infrastructure, but also **investment in “green infrastructure”**. Natural capital underpins human well-being and socio-economic progress. It is the stock of natural ecosystems that yields the flow of valuable

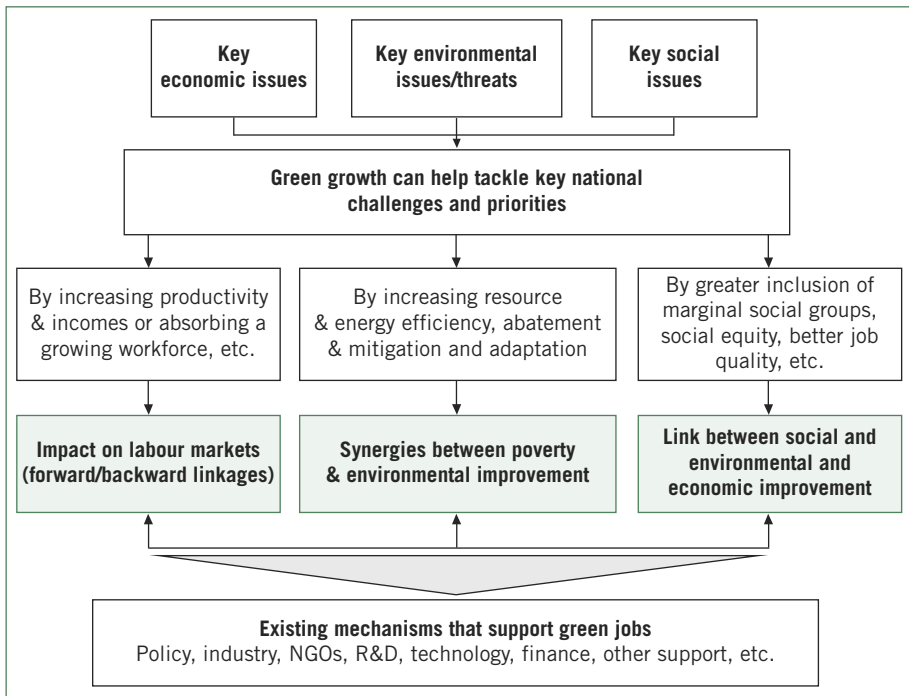
ecosystem goods or services that the economy depends upon. Investments in natural capital can take many forms. For instance, payments for ecosystem services (PES) allows multiple stakeholders to invest in the sustainable management of environmental systems that support their economy and society.

The last pillar of green growth identified by UNESCAP is the need to develop and use **eco-efficiency indicators** (EEI). EEIs will allow for a better understanding of the linkages between economic activity, resource usage and environmental impacts by measuring how the environment is used for economic activity and how it is affected by economic activity. EEIs can then be used to measure and compare the eco-efficiency of economic growth of different countries and to identify policy measures to improve this.

Source: UNESCAP, at: <http://www.greengrowth.org/>.

Green growth is relevant to environmental, economic and social policies (figure 3.1). Investments in adaptation to climate change offer significant employment and income opportunities in areas such as extending coastal defences, reinforcing buildings and infrastructure. These measures also help to safeguard livelihoods of the rural poor who live in areas subject to extreme climate impacts. Income and food security are especially precarious for the large numbers of rural poor in developing countries whose subsistence depends on agriculture.

Figure 3.1 Green growth can help tackle key national challenges with significant interlinked benefits



Assessing green jobs potential in developing countries

The focus on green jobs (which encompasses decent work) can help to address job quality and other social concerns in developing countries. Promoting the transition from general environment-related employment to employment that meets the decent work definition is an important objective under the green jobs agenda in a developing countries context.

The promotion of green jobs is achieved by:

- promoting employment in environmentally sustainable economic sectors;
- enhancing decent work in existing environment-related sectors by turning existing jobs into green jobs; and
- reducing the environmental impacts of traditional sectors.

Examples of the kinds of employment transitions that developing countries can make include:

- introduction of controlled and sanitary waste management services and enhancement of decent work in the informal waste management sector;
- introducing energy-efficient cooking stoves, solar water heaters and solar panel systems in place of unsustainably harvested firewood, creating jobs in the manufacture and servicing of such equipment and reducing the burden of firewood collection;
- building and servicing biogas plants to provide eco-friendly and economical fuel for lighting and cooking, in place of kerosene;
- building and servicing composting plants to convert waste into natural fertilizers that can replace the costly urea-based or petroleum-based fertilizers that can pollute groundwater reserves, and that can replenish the organic matter content of soils;
- small-scale generation/decentralized power grids based on renewable energy technologies or industrial co-generation, rather than on large oil- or coal-based power plants and centralized, inefficient and loss-making electricity grids;
- labour-intensive, environmentally sustainable and climate-resilient infrastructure;
- low-carbon public transport schemes; and
- sustainable natural management, such as forestry.

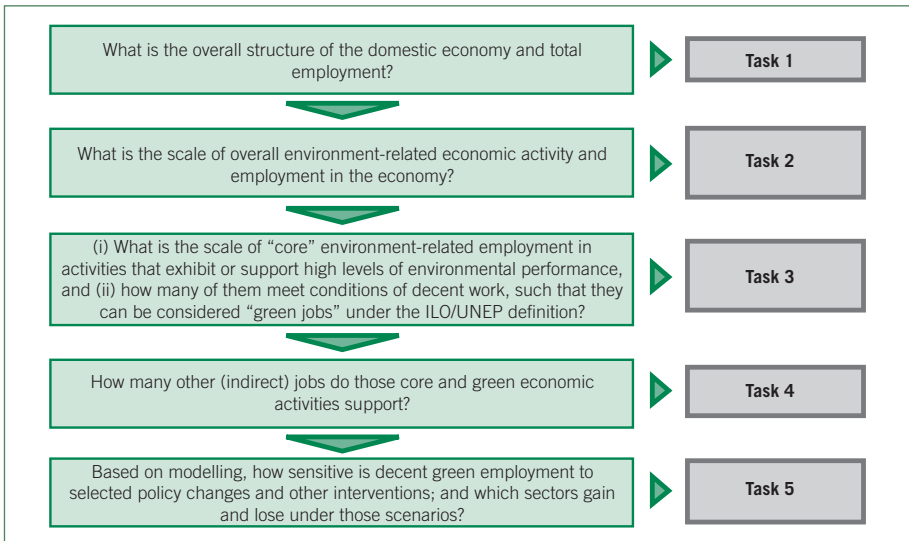
PART II

FIVE TASKS

Approaching the five tasks

Part II of this guide sets out a step-by-step process for estimating green employment and determining its relationship to the wider economy.

The proposed approach involves answering a sequence of questions, as shown below. In answering these questions you will develop estimates of environment-related employment, “core” environment-related and green jobs,³⁹ and an understanding of their relationship to the economy and to national development objectives.



³⁹ Green jobs should be defined only according to the ILO/UNEP definition, which requires that all jobs meet the requirement for decent work.

Assessing green jobs potential in developing countries

Tasks 1–4 take a stepwise approach to developing a robust quantitative estimate of green employment. This estimate will be accompanied by a qualitative analysis that both contextualizes the numerical data and explains any uncertainties associated with the estimate. It will also shed light on where the informal nature of economic activity and deficiencies in working conditions are impeding the creation of green jobs.

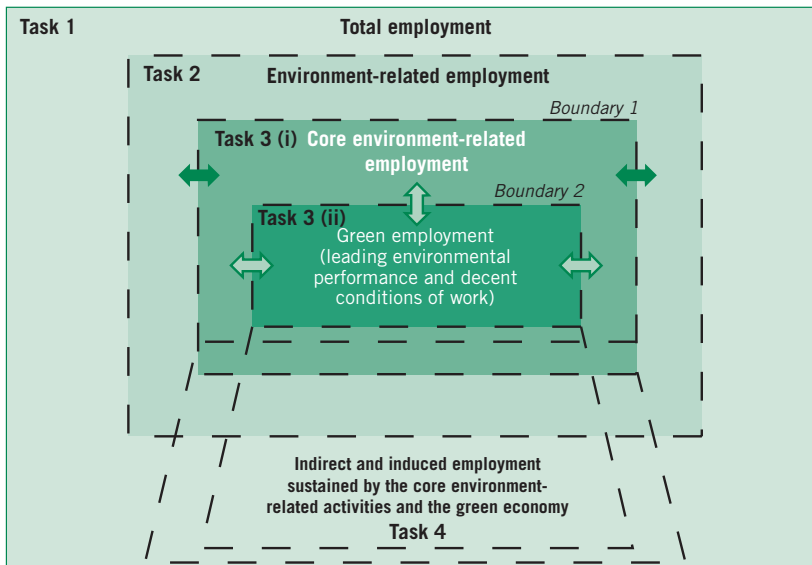
Such an approach will, at a minimum, allow a preliminary assessment of core environment-related employment and of green jobs, clearly outlining assumptions and limitations. Recommendations are left open to decision-makers.

Tasks 1–4 will also establish:

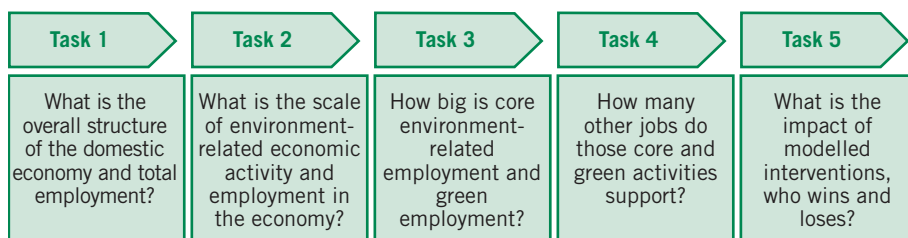
- realistic objectives for estimating green jobs; and
- relevant methods and tools to do so.

Tasks 1–4 present you with questions for which there are no objectively right or wrong answers, only choices. In particular, there are appropriate choices to be made in defining the boundaries of core environment-related employment and then, more importantly, of green jobs, as shown in the figure below. The results at tasks 3 and 4 are influenced by the boundary definitions in a process that requires professional judgement.

The description of each task provides advice on how to approach those choices, but these will vary from case to case and country to country.



Finally, Task 5 involves testing different policy scenarios, which will provide an opportunity to examine the economic impacts of potential policy changes or other interventions to promote green jobs, including identification of which sectors are likely to “win” or “lose” under the scenarios modelled.



Detailed task breakdown

Task 1 – Review the overall structure of the economy and employment

Task 2 – Estimate environment-related employment

Task 2.1 Identify economic sectors and activities that have strong links to the environment

Task 2.2 Research and write up sector profiles

Task 3 – Estimate core environment-related jobs and green jobs

Task 3.1 Estimate core environment-related employment by reference to agreed environmental standards and performance indicators

Task 3.2 Screen core environment-related jobs to estimate green jobs

Task 4 – Estimate direct, indirect and induced employment

Task 4.1 Assemble direct core environment-related job and/or green job estimates from Task 3

Task 4.2 Incorporate new industries in the I-O tables or SAMs

Task 4.3 Calculate multiplier effects

Task 5 – Identify “what if” scenarios

Task 1

Review the overall structure of the economy and employment

Task 1	Task 2	Task 3	Task 4	Task 5
What is the overall structure of the domestic economy and total employment?	What is the scale of environment-related economic activity and employment in the economy?	How big is core environment-related employment and green employment?	How many other jobs do those core and green activities support?	What is the impact of modelled interventions, who wins and loses?

Objective

The objective of this task is to research and prepare a profile of the economic and employment structure of the national economy.

Method

Prepare a basic profile of the structure of the economy and of employment. Table T1.1 provides a simple template for this, outlining the key environment–economy links for each sector.

Assessing green jobs potential in developing countries

Issues to consider

An important consideration is that data on registered jobs in the formal economy provide only a partial picture of total employment. The analysis needs to cover both formal employment and jobs in the informal economy (table T1.2), including subsistence farmers and informal workers. In Bangladesh, for example, nearly 88 per cent of all jobs are supported by an informal economy that accounts for 64 per cent of national GDP.

Outputs

The task write-up should include a brief overview that includes data and discussion on the following:

- total jobs/livelihoods maintained in the economy;
- profiles of the different economic sectors (e.g. GDP and employment share, GDP growth rate);
- a short description of the role and importance of primary sectors (agriculture, energy, etc.) relative to industrial sectors and service sectors; and
- share of informal activity in the total economy, preferably by sector (table T1.2).

Useful sources

Useful sources for this information include:

- national statistical office;
- World Bank economic indicators; and
- other development partners, e.g. Asian Development Bank.

Task 1: Review the overall structure of the economy and employment

Table T1.1 Template for the basic economic profile, by sector

Sector	Economic profile			Environmental—economic links			
	Share of jobs (%)	Share of GDP (%)	GDP growth rate (%)	Resource use	Mgmt./mitigation	Periphery activities	Environmental quality (including adaptation)
Agriculture and forestry				Water, land, minerals, soil Organic farming	Mining, energy sector pollution control & waste management		Organic farming, sustainable forestry, rehabilitation of quarries, reforestation, etc.
Fishing				Sustainable fisheries			
Mining and quarrying							
Industry (manufacturing)				Water, minerals and raw materials for industrial production Biofuels	Industrial pollution control & waste management Wastewater treatment Recycling	Energy efficiency (cement, steel, etc.), waste management, green products and services	
Electricity, gas and water				Fossil fuels, renewable sources	Smart grids, smart meters, energy from waste		
Construction				Sustainable materials	Energy-saving materials, eco-construction		Flood and coastal defences
Wholesale and retail					Transport logistics and efficiency	Green products and services	
Hotels and restaurants				Tourism-related use of water			
Transport, storage and communications				Transport-related use of water, air and land			
Financial intermediation				Microfinance	Microfinance	Green-focused banking	
Real estate, renting and other business activities						Consulting, advice and planning	
Public administration and defence					Waste and resource management Land management & nature protection		Environmentally related tourism, natural risk management (adaptation)
Education							
Health and social work							
Community social and personal services					Waste and resource management/nature protection		Environmentally related tourism, natural risk management (adaptation)

Assessing green jobs potential in developing countries

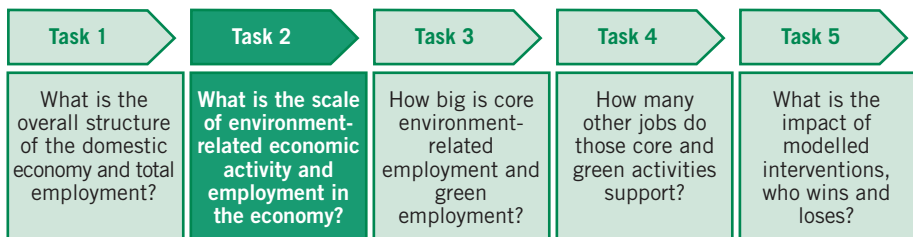
Table T1.2 Example of the mapping of formal and informal employment by sector, worker distribution and GDP share by industry: The case of Bangladesh

Industry	Type of worker				Total share of GDP (%)	Share of GDP (%)	
	Formal		Informal			Formal	Informal
	Jobs (mil)	Percentage of total formal jobs	Jobs (mil)	Percentage of total informal jobs			
Agriculture, hunting and forestry	0.09	1.5	21.59	52.0	16.6	1.0	15.7
Fishing	0.04	0.7	1.05	2.5	4.7	0.7	4.0
Mining and quarrying	0.01	0.1	0.05	0.1	1.2	0.8	0.4
Manufacturing	1.55	26.7	3.67	8.8	17.6	12.6	5.0
Electricity, gas and water supply	0.05	0.8	0.03	0.1	1.6	1.6	0.0
Construction	0.08	1.4	1.44	3.5	9.2	2.8	6.4
Wholesale and retail trade, repairs, etc.	0.77	13.2	6.34	15.3	14.2	1.4	12.4
Hotels and restaurants	0.10	1.7	0.61	1.5	0.7	0.5	0.2
Transport, storage and communications	0.43	7.4	3.54	8.5	9.9	7.4	2.5
Financial intermediation	0.41	7.1	0.10	0.2	1.7	1.7	0.0
Real estate, renting and other business activities	0.07	1.2	0.17	0.4	7.6	0.5	7.2
Public administration and defence, social security	0.71	12.3	0.17	0.4	2.8	2.8	0.0
Education	1.03	17.7	0.28	0.7	2.5	2.1	0.5
Health and social work	0.22	3.8	0.14	0.3	2.3	2.0	0.3
Other community, social and personal services	0.25	4.3	1.60	3.9	7.1	0.7	6.4
Private households with employed persons	0.01	0.1	0.76	1.8	n.a.	n.a.	n.a.
Total	5.82	100	41.54	100	100.0	36.9	63.6

Note: n.a. = not available.
Source: Malgalig, Cuevas and Rosario, op. cit. (2009), p. 62.

Task 2

Estimate environment-related employment



Objectives

The objectives of this task are to:

- identify parts of the economy directly or indirectly related to the environment;
- prepare sector profiles that explain the structure of these sectors and what sustains the activities concerned; and in so doing
- highlight the importance of these activities to the economy.

Method

Task 2.1 Identify economic sectors and activities that have strong links to the environment

Chapter 2 discussed the main linkages between the environment and economy. A complete mapping of links is a major challenge and should be undertaken depending on time and resources available.

Assessing green jobs potential in developing countries

The purposes of this task are to:

- develop a structure which focuses on the main connections between the environment and the economy; and
- use the basic sector data compiled in Task 1 to map the economic sectors and activities across the main environment–economy linkages (box T2.1).

Environment–economy linkages defy easy classification. As improved environmental performance is designed into products and processes it is increasingly difficult, and less and less useful, to attempt to draw boundaries between different types of environmental manufacturing and service sectors. This makes screening for environment–economy linkages more difficult.

Questions that may be helpful prompts to the process are:

- Does the economic sector or activity make direct use of *natural resources* (e.g. farming, fishing, forestry, energy generation, water supply)?
- Does the economic sector or activity support better *environmental management* through, for instance:
 - the management of land or water for production of environmental goods and services;
 - the reduction of pollution and management of waste (e.g. pollution control equipment, wastewater treatment services, recycling, remanufacturing);
 - the more efficient use of energy and of natural resources (e.g. energy management services); and
 - by providing products and services that have a significantly lower environmental impact than alternative options (e.g. mass transit, electric vehicles, fuel-efficient stoves)?
- Is the sector concerned with managing and mitigating *natural environmental risks* on people and the economy, including building resilience to such impacts through adaptation to the effects of climate change?
- Does the economic sector or activity have a high degree of *dependence on good environmental quality* (e.g. eco-tourism)?

If the answer is “yes” to any of the above criteria, then these activities and sectors should be further examined in terms of their environmental performance to identify and estimate the number of “decent green jobs” within them (see Chapter 2 for a more detailed discussion of these issues). Economic activities for which the answer to each of these questions is “no” are not of interest and can be disregarded.

It does not matter if activities are picked up by more than one of the above questions; the key issue is to “interrogate” the economic data so as to identify the significant linkages. Box T2.1 provides further elaboration of the types of linkages that can be considered.

Box T2.1 Environment–economy linkages: A sample typology

1. Use of natural resources

There are three types of environment–economy linkage under this definition of environment-related economic activities:

- Natural resource-based activities – non-renewable natural resources. These activities are based on the use of non-renewable resources such as fossil fuels, metals and minerals.
- Natural resource-based activities – renewable resources. Activities include agriculture, timber, fisheries, renewables, water supply and biodiversity-based resources for pharmaceuticals (natural drugs).
- Ecologically sustainable production. This is a subset of the above natural resource-based activities and includes organic farming, sustainable forestry and renewable energy.

2. Activities concerned with direct or indirect management of the environment and reduction of environmental impacts

There are three types of environment–economy links under this definition of environment-related economic activities:

- Pollution control and management activities, usually defined by the levels of expenditure made on the goods and services produced (e.g. solid waste management and recycling (SWM), wastewater treatment (WWT) and air pollution control (APC)).
- Natural resource management and activities intended to support delivery of environmental goods and services, again usually measured by levels of expenditure.
- Green(er) products and services – this definition encompasses products with eco-labels, sustainable construction such as zero carbon residential and commercial developments (includes passive houses/buildings and heat/energy saving and management), zero emission vehicles (ZEVs), ethical banking and investment funds, energy management, and extending into products and services that have a significantly lower environmental impact than alternative options (e.g. mass transit).

3. Activities concerned with management of environmental risks and adaptation to climate change

Management, and mitigation, of natural environmental risks – including insurance services to safeguard against natural disasters (avalanches, droughts, floods, fire, coastal erosion, earthquakes and tsunamis), additional expenditure on environmental (especially flood) protection of immovable assets and costs of rebuilding after the occurrence of natural disasters.

4. Activities dependent on high environmental quality

Environmental quality affects economic activities such as tourism and recreation, and provides cultural identity and health benefits.

Assessing green jobs potential in developing countries

The sectors and activities that emerge from this screening exercise are likely to include, among others:

- agriculture, forestry and fisheries;
- waste and resource management;
- energy production and distribution;
- climate adaptation activities (e.g. construction, infrastructure and land-related sectors);
- resource and energy efficiency services;
- green construction/energy and water efficiency in buildings;
- transportation (e.g. manufacture of vehicles/equipment; urban transit schemes); and
- eco-tourism.

The sectors and activities identified above should be categorized according to the key environment–economy linkages. Some activities might cut across a number of sectors (e.g. adaptation activities and natural resource management).

Task 2.2 Research and write up sector profiles

The next step is to create “sector profiles”. These are tables or short summaries describing the scale and structure of each of the priority sectors identified in Task 2.1. Box T2.2 provides a suggested outline structure for a sector profile. The scope of the sector profile can be broad but should be clearly defined. The focus for each profile should be to understand the sector substructure. This is important for the next stage of analysis. An example of sector substructure is analysing urban “waste picker” activity within the waste and resource management sector.

Box T2.2 Illustrative sector profile structure

1. Economic structures

- Jobs / Outputs / Incomes / Economic drivers (competitiveness, trade, etc.)

2. Environment–economy linkages (primary and secondary)

3. Sector-related problems (environment/climate/social)

4. Subset of core green activity or selected environment-related and socially sustainable activity

- Number of jobs / Skills and training / Quality of jobs

5. Identified sustainable/green structural change

- Opportunity / Potential / Beneficiaries

6. Reforms and investment

- Policy (domestic and international) / R&D and technology (industrial and academic)

7. Links with adaptation activities (if any)

8. Barriers

- Institutional / Market / Regulatory

Outputs

The concise summaries should provide data and discussion on:

- national environmental, economic and social challenges in the context of green growth;
- links between green growth, environmental improvements and social benefits;
- balance between national and international policy programmes that support the development of environment-related jobs;
- environment-related economic activities by linkage type (see table T2.1);
- an analysis of the structure of these activities by sector and initial estimates of environment-related employment; and
- key sources and contacts for further consultation.

Sector profiles should provide an initial attempt to identify and define environment-related jobs. Examples of relevant data and information for the sector profiles are provided in table T2.1.

Assessing green jobs potential in developing countries

Table T2.1 Examples of relevant data and information for sector profiles

Indicators	Description
National economic priorities	The main priorities driving environment-related jobs such as: stimulating productivity, upskilling the workforce, upgrading low-paying jobs, boosting jobs in SMEs, recognizing the potential of environment-related jobs for development and poverty reduction.
Economic drivers and policy	<p>Key economic drivers including market and economic policy drivers such as: competitiveness, productivity, poverty alleviation, skills, new markets, enterprise and industrial policies.</p> <p>These should encourage sustainable industries and therefore green jobs including: taxes and subsidies; environmental stipulations under trade agreements; and overall consumer willingness to pay for environment-related services and goods.</p>
Economic indicators for green activity	<p>Growth rate of green activity, share of sector activity, nature of demand in rural and urban areas, existing and potential market value, etc.</p> <p>Informal nature of the green activity impacting on green definitional and data issues.</p> <p>Any unique economic system affecting demand and supply of green activity (e.g. microfinance).</p> <p>Labour market profile - wage rates, gender profile, skills profile, skills gaps, etc.</p>
Impact on labour markets	<p>Put green jobs into perspective and consider the share of total jobs.</p> <p>Recognize the forward linkages of greening economic activity.</p> <p>Account for the interactions between new job creation, substitution, destruction and transformation.</p> <p>Consider the effects resulting from indirect and induced employment.</p>
Environment and social policy (domestic and international)	<p>Key environmental and social laws and policies incentivizing environment-related economic activities such as those for climate adaptation, energy (renewables), forestry and biodiversity.</p> <p>Environmental and social indicators such as: poverty ratio, CO₂ emissions, share of agricultural land and mortality rate.</p>

Table T2.1 Examples of relevant data and information for sector profiles (*Continued*)

Indicators	Description
Social	<p>Collect data on job quality and acceptable working standards for environment-related employment. Refer to indicators in Chapter 2.</p> <p>Accessibility of environment-related jobs to rural poor – this is a key issue in developing countries, where the overwhelming share of the population is still rural.</p>
Technical	<p>Technology and products/processes – suitability of technology/process to rural or urban areas, level of market access and marketing arrangements and private-sector involvement.</p> <p>Assistance and training programmes – technical assistance availability (qualified staff) and appropriate training provision. Skills development, through training programmes/workshops for building knowledge and its dissemination, is a key requirement for most green jobs.</p> <p>Regulatory and institutional framework – suitability of laws and regulations concerning green jobs and identifying gaps in regulatory and institutional frameworks.</p>

Note: Table not exhaustive.

Useful sources

Key economic, environmental and social issues and priorities should be identified using national and international published sources. These can be supplemented by interviews with government officials and industry experts.

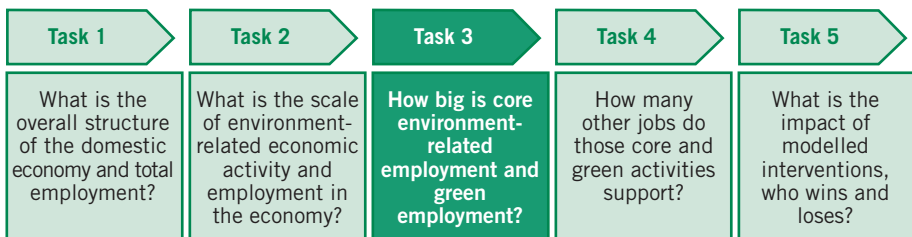
Some of the main reference reports include:

- national economic reviews;
- national labour force surveys and labour market reports;
- UN and World Bank economic reviews and labour statistics;
- UNEP *State of the Environment* Reports; and
- national climate change mitigation and adaptation strategies and key reports and indicators from external supporting agencies (e.g. UNDP, World Bank).

Annex 1 provides details of other sources.

Task 3

Estimate core environment-related jobs and green jobs



Objectives

The objectives of this task are to:

- generate an estimate of the number of core environment-related jobs in the economy, i.e. *jobs sustained by activities that meet the threshold levels of environmental sustainability as defined by compliance with standards and other performance indicators* agreed in the study process;
- then, to the extent possible with available data, identify those jobs which fulfil agreed conditions for decent work and which therefore constitute green jobs under the ILO/UNEP definition by screening on economic and social parameters;
- provide qualitative information that will help the reader interpret estimates of both core environment-related employment and green employment and, in particular, any uncertainties;
- where decent work conditions are not met, highlight the changes required to turn those core environment-related jobs into green jobs.

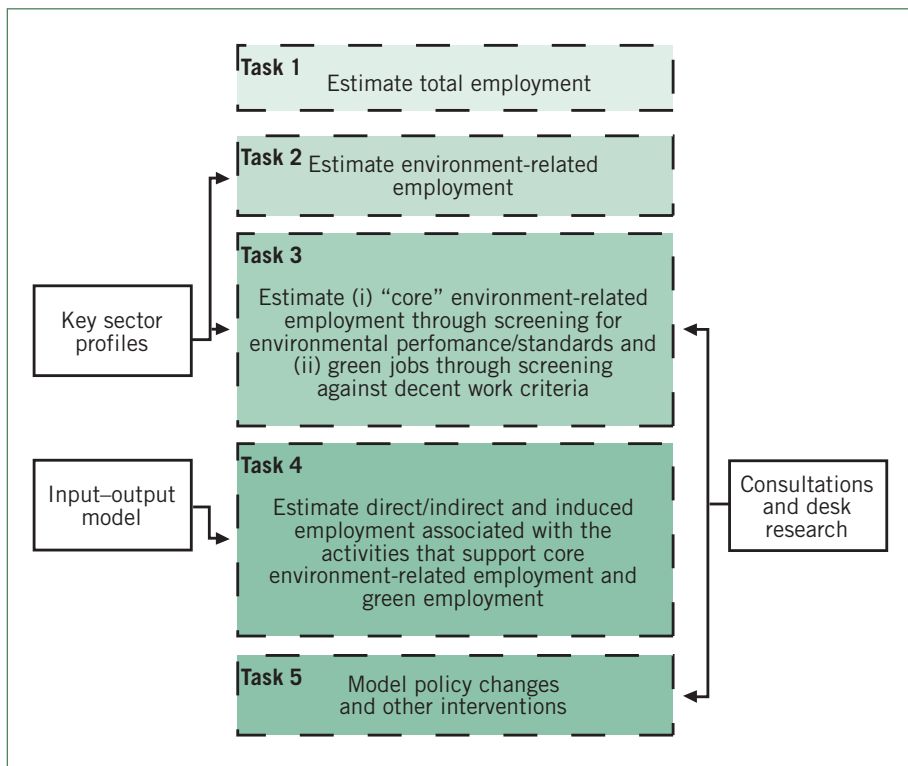
Method

The purpose of this task is to move from the list of broad environment-related employment generated in Task 2, to identify the core environment-related employment within each sector and then screen these activities to identify those that provide decent conditions of work and thus can be considered green jobs for present purposes. Task 3 draws on data analysis and consultations, as shown in figure T3.1.

The main challenges are:

- gathering information detailed enough to support robust analysis; and
- evaluating the sector information in order to separate out core environment-related employment from other environment-related employment.

Figure T3.1 Consultations as well as desk research required



Task 3: Estimate core environment-related jobs and green jobs

The method involves:

- (i) analysing the sector profiles prepared in Task 2, using consultations as needed to fill data gaps, improve quality and provide details of core environment-related green activities, in order to generate quantitative estimates of employment to the extent possible (a strategy for capturing data or information by which to estimate the number of jobs involved will be needed to compensate for gaps in official information); and
- (ii) screening core environment-related employment against economic/social parameters to arrive at an estimate of green jobs.

Task 3.1 Estimate core environment-related employment by reference to agreed environmental standards and performance indicators

The first step is to identify the economic activities that support core environment-related employment

As discussed in Chapter 2 (section 2.1.1), the analyst must define the boundary for environmental performance appropriate to the country being analysed. The lack of internationally agreed standards (or uniformity of standards) on key environmental performance indicators introduces subjectivity to interpreting and defining green activities. Environmental performance indicators may not be easy to statistically interpret. Leading-edge environmental management and technologies in one country may be established practice in another.

The economic activities of interest (and the related jobs) can be identified in two ways:

- *Activities that help to “green” existing sectors* – for example, sustainable agriculture within the broader agriculture sector or sustainable forestry within the broader forestry sector.
- *Green activities that cut across a number of different sectors* – for example, metal waste recycling, which requires inputs from manufacturing, professional services, transport and other services. (The share of inputs from different sectors will depend on the type of waste and technology for recycling and re-use.) Some green activities, such as sustainable construction and sustainable transport, could easily overlap. This introduces a level of complexity when using input–output tables to estimate the indirect effect of green jobs. This aspect is discussed in more detail in Task 4.

Table T3.1 illustrates how environmental performance indicators can be mapped across sectors.

Assessing green jobs potential in developing countries

Table T3.1 Mapping environmental performance indicators

		Indicators of environmental performance			
Primary sector	Core environment-related activity	Resource efficiency	Energy efficiency	Abatement & mitigation	Adaptation resilience
Agriculture	Organic	Pesticide-free	Limited energy use	Higher carbon sequestration	
	Sericulture Water-efficient agriculture				New production techniques
Energy supply	Biomass	Renewable source compared to fossil fuel	Higher efficiency than kerosene stoves	Reduced GHGs	
	Hydropower				

Note: The table shows an example of how environmental performance indicators can be mapped for sustainable agriculture and renewable sources of energy.

Figure T3.2 provides an example of the mapping generated by this process, using the case of Bangladesh. Table T3.2 categorizes these activities according to the extent to which they impact on existing sectors. They may be contained within a subset of a single sector or cut across two or more sectors.

Useful environmental performance indicators cover:

- Resource efficiency – resource use per unit of output;
- energy efficiency – energy consumption per unit of output;
- abatement and mitigation – efficacy in reducing waste and emissions released into the environment; and
- adaptation and resilience – where the economy has adapted to environmental risks including disease prevention and has improved or protected ecosystem services.

Figure T3.2 Identifying core environment-related activities from the literature: The example of Bangladesh

<p>Clean energy</p> <p>Power generation</p> <ul style="list-style-type: none"> • Solar photovoltaic (15 MW, 200,000 household installations) • Wind (2 MW, 20 wind monitoring stations) • Biomass & biogas: potential for 4 million biogas plants • Hydropower: possible sites from 10 kW to 5 MW; potential for micro-hydro power generation • Other clean power generation: bio-fuels, gasohol, geothermal, river current, wave and tidal energy – yet to be explored • Nuclear: plan for a 1,100 MW nuclear power plant by 2015 (IAEA approval in 2007) 	<p>Water</p> <ul style="list-style-type: none"> • Wastewater treatment in Dhaka 1/3 of effluents untreated; 30% of Dhaka's population covered by a sewerage system (the only one in the country); 30% of the population uses conventional septic tanks and another 15% uses bucket and pit latrines • Safe water access: 74% of population • Sanitation coverage of population 2% in 1980–81, 35% in 1995, 39% in 2004 • Distribution and management: very poor cost recovery ~43% of water non-billed (leakage and illegal connections) – tariffs do not recover operation and maintenance costs at all • Water efficiency: system losses reduced from 54% in 2002 to 35% in 2005 	<p>Environmental resource management (I)</p> <p>Water</p> <ul style="list-style-type: none"> • Wastewater treatment in Dhaka 1/3 of effluents untreated; 30% of Dhaka's population covered by a sewerage system (the only one in the country); 30% of the population uses conventional septic tanks and another 15% uses bucket and pit latrines • Safe water access: 74% of population • Sanitation coverage of population 2% in 1980–81, 35% in 1995, 39% in 2004 • Distribution and management: very poor cost recovery ~43% of water non-billed (leakage and illegal connections) – tariffs do not recover operation and maintenance costs at all • Water efficiency: system losses reduced from 54% in 2002 to 35% in 2005 	<p>Environmental resource management (II)</p> <p>Agriculture</p> <ul style="list-style-type: none"> • Irrigation innovation: very important; 4m ha of rivers, canals, ponds and reservoirs • Clean pesticides: huge use x 3.5 between 1973 and 2006 • Sustainable fisheries: huge potential – shrimp farms: 1 million employees, 6% of exports • Seeds: important potential – 12,000 nurseries currently • Timberland and forestry: ongoing deforestation – forest area only 9.8% of total land area: Government plans to increase it to 20% by 2015 • Organic farming: large potential – currently less than 0.5% of agriculture jobs 	<p>Energy and material efficiency</p> <p>Advanced materials</p> <ul style="list-style-type: none"> • Advanced coatings • Lightweight substitutes • Solvents and biodegradables <p>Building efficiency: largely undeveloped</p> <ul style="list-style-type: none"> • Building management • Heating & cooling systems • Lighting systems • Insulation • Microgeneration/micro CHP: potential for cogeneration in sugar factories, as well as textile spinning mill and “natural” fertilizers/compost factories 	<p>Environmental services</p> <p>Manufacturing services</p> <p>Huge potential: manufacturing 41% of the electricity and low energy efficiency</p>
<p>Cleantech infrastructure: largely undeveloped</p> <ul style="list-style-type: none"> • Infrastructure management • Supply chain management 	<p>Waste management</p> <ul style="list-style-type: none"> • Recycling: 50% + waste uncollected – inorganic waste (20%) extensively recycled by the informal sector in an unhygienic way • Toxin management: very poor; hospital waste (4% of total in Dhaka) landfilled • Energy from waste: 4ml. biogas plants potential • Land remediation: large potential for biofertilizers 	<p>Land management and protection</p> <ul style="list-style-type: none"> • Land conservation: urgent to prevent deforestation • Environmental restoration: quality of soil deteriorated due to agrochemicals, unplanned land use, deforestation, indiscriminate disposal of hazardous wastes • Sea defences: NAPA-planned • Carbon sequestration: huge potential through reforestation and regenerative agriculture 	<p>Power grid efficiency: largely undeveloped – grid-based electricity network difficult to build because Bangladesh is a delta with more than 400 rivers. Large potential for off-grid generation; smart grids; smart metering, etc.</p>	<p>Energy-intensive industries present in Bangladesh</p> <ul style="list-style-type: none"> • Extractive industries • Steel • Cement • Bricks: very polluting and energy-intensive; specific issue of energy efficiency in the brick industry: over 4,000 brick kilns. Each fixed chimney kiln consumes 20 to 27 tons of coal per 100,000 bricks 	<p>Business services</p> <ul style="list-style-type: none"> • Green focused banking • Microfinance: very developed – Grameen Bank: 7.95 million total borrowers, and 97% of those are women (Dec. 09)
<p>Power storage technology: largely undeveloped</p>	<p>Transport and sustainable biofuels</p> <ul style="list-style-type: none"> • Low carbon transportation • Biodiesel, ethanol, CNG: 13% of motor vehicles are run by CNG – potential: only 4% of gas production used for CNG-fuelled vehicles 	<p>Materials management</p> <ul style="list-style-type: none"> • Recycling: important in the informal economy (approx. 20% of the waste) • De-materialization • Durability and reparability of products 	<p>Cleaner production and diversification</p>	<p>Manufacturing</p> <ul style="list-style-type: none"> • Textiles: 76% of total export revenue 	

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Table T3.3 Core environment-related activities as identified in Task 3

	“Core” environment-related activities	Description
Greening of existing sectors	Sustainable agriculture	Organic farming, water-efficient farming
	Sustainable forestry, prevention of deforestation	Certified forestry, agro-forestry, sustainable forestry management and halting deforestation
	Renewable energy	Solar, wind, biomass/biogas, tidal, etc.
	Sustainable construction	Recycled materials, flood resilience, improved insulation
	Sustainable transport	Public mass transport, as opposed to individual road transport, hybrid vehicles, or green fuels
Green activities cross-cutting two or more sectors	Air pollution control, noise and vibration control	Production of equipment, technology or specific materials; design and operation of systems; provision of other services for the treatment and/or removal of exhaust gases and particulate matter from both stationary and mobile sources
	Recycling of materials (3Rs)	Recycling of metal and non-metal waste, plastic waste recycling, lead acid battery recycling
	Energy and resource efficiency	Measures to increase energy and resource efficiency in manufacturing (e.g. cement, steel, chemicals, etc.)
	Environment-related tourism	Any activity that designs, constructs, installs, manages or provides other services for tourism that involves protection and management of natural and cultural heritage, or education and interpretation of the natural environment, and that does not damage or degrade the natural environment
	Private environmental management (PEM)	Environmental consulting, planning, carbon audits, etc.
	Soil and groundwater remediation	Production of equipment, technology or specific materials; design and operation of systems; provision of other services to reduce the quantity of polluting materials in soil and water, including surface water, groundwater and sea water
	Wastewater treatment	Production of equipment, technology or specific materials; design and operation of systems, plants and sites; provision of other services for the collection, treatment, handling, transport, reuse and management of waste water, cooling water and sewage
	Conservation and nature protection	Includes the administration, training, information and education activities to conserve or maintain the natural environment and, in particular, the protection and rehabilitation of plant and animal species, ecosystems and habitats, and natural and semi-natural landscapes
	Climate adaptation	Coastal, agricultural and fisheries management. Risk management for extreme climate-related events

Task 3: Estimate core environment-related jobs and green jobs

Primary industry sector

Agriculture

Forestry

Energy and utilities

Construction, professional services

Transport, agriculture and forestry

Electrical engineering and instruments, professional services

Manufacturing, recycling, public administration

Manufacturing, professional services

Hotels and catering, transport, retail

Professional services, financial intermediation

Manufacturing, public administration and social services

Water, public administration and social services, manufacturing

Forestry, agriculture, public administration and social services, education and communication

Agriculture, forestry, water, transport, construction, public administration

Various methods are available to the analyst for estimating core environment-related employment

Table T3.3 outlines methods that can be used to estimate the number of jobs in the core activities of interest. Both bottom-up methods (1, 2 and 3) and top-down methods (4 and 5) can be used. Methods 1, 4 and 5 are particularly relevant for estimating jobs related to the greening of existing sectors, while methods 1, 2 and 3 are relevant for estimating jobs related to activities that cut across a number of different sectors.

Methods involving direct contact with businesses can also be used to collect technical information for input–output modelling and for quality of jobs (e.g. working standards, wages and skills). Hence, it is important that the business surveys are properly planned and designed to ensure that survey costs are minimized. The complementarity between using business surveys to estimate direct employment and collect information on quality of jobs and technical coefficients is discussed in more detail in Task 4.2.

Once all core environment-related jobs are identified, the next step is to identify labour market interactions for green activities, distinguishing between new job creation, substitution and transformation. The analyst should explain how the environmental performance of the green activity was determined and clearly outline how environmental performance relates to the three labour market interactions below. This step should:

1. Compare green activity with other activity when green jobs replace (*substitute for*) other jobs. For example, explain why sustainable farming is more resource-efficient than conventional farming, or the differences in supply chain for biomass gasification as an energy source compared to coal or gas.
2. Provide reasons why certain *new* jobs created can be considered *sustainable* green jobs. For example, these may include new jobs created in climate adaptation-related activities or jobs in green-focused banking and microfinance.
3. Describe how jobs related to certain other activities are being *transformed* into green job activities, clearly identifying the differences. For example, more energy-efficient manufacturing practices (e.g. industrial co-generation) or new and sustainable forms of waste management.

The last column in table T3.4 describes the three labour market interactions related to green activities.

A clear understanding of the three labour market interactions is important for estimating the indirect and induced impacts of core environment-related jobs or of green jobs using input–output models. These labour market interactions for green activities are relevant to the interpretation of multiplier effects. New environment-related jobs indicate additional economic benefits; whereas substitution and transformation of existing jobs suggest net benefits or costs. The multiplier effects of green jobs are discussed in more detail in Task 4.3.

Table T3.3 Methods for estimating direct employment in core environment-related activities

Methods	Description	Advantages	Disadvantages
1. Case studies and sector-specific national and international studies	For example, sector-specific studies such as <i>Green job assessment in agriculture and forestry sector of Bangladesh</i> (ILO, 2009) ¹	<p>More accurate definition and estimates of particular green activities</p> <p>Reliable estimates based on agreed project specifications and undertaken by experts</p>	<p>Time-consuming and expensive</p> <p>Could be subject to a sample and thus result in narrow estimates</p>
2. Business surveys	Jobs exist within business establishments (i.e. industry), and can be classified according to the product or service produced, the type of work performed (i.e. occupation), as well as by geography. Therefore, a business survey is likely the best method to estimate and track trends in environment-related jobs	More accurate estimates based on primary data	<p>Time-consuming and expensive (designing, planning, data collection and analysis)</p> <p>Requires a detailed industrial and occupational classification</p> <p>Estimates will be sensitive to the judgement of the survey respondent</p>
3. Coefficients for job estimates per unit of green activity (see box T3.1)	For example, in Bangladesh composting 14,000 tonnes per day of urban municipal waste can create 14,000 green jobs (i.e. 1 job per tonne of waste composted). A new generator recovering landfill methane gas generating 4.5 MW of electricity can create 250 new jobs (i.e. 56 jobs per MW). The coefficients can be used to extrapolate jobs at national level if the total value or share of the green activity is available. For example, the ratio of jobs per MW of renewable energy generated can be applied to the share of renewable energy to estimate green jobs (see box T3.2)	<p>Can provide broad job estimates</p> <p>Less time-consuming and expensive</p>	<p>Job estimates will be limited to the size and type of activity and can result in biases. Requires the analyst to make a number of assumptions</p> <p>Industry-wide estimate will depend on value or share of green activity to extrapolate the job estimates per unit of green activity</p>

Table T3.3 Methods for estimating direct employment in core environment-related activities (Continued)

Methods	Description	Advantages	Disadvantages
4. Sector-based targets or standards (e.g. CO ₂ per tonne of output of steel or g/km of CO ₂ emissions for cars) set by national authorities can be used to estimate the share of sector employment for achieving these targets	For example, workers assembling hybrid cars or cars with less than 120 g/km of CO ₂ emissions can be considered green jobs (see box T3.3)	Data relatively easier to obtain A recognizable and easier to understand definition of green jobs Less time-consuming and expensive	Standards could differ from country to country Standards may be subject to change and jobs associated with achieving these standards may be transitional
5. Estimates of value or output of green activity and labour-output ratios	For example, jobs related to investment in adaptation activities can be estimated by using sectoral ratios between output and employment of the recipient sectors. It is important to obtain the share of investment by sector to provide direct employment effects. The output-employment ratios should be adjusted if the green activity cuts across a number of sectors (see box T3.2)	Can provide broad sector-level job estimates Less time-consuming and expensive	Risk of double counting job numbers Assumes no change in productivity of environment-related job Share of investment by sector is not easy to obtain and requires assumptions or expert judgement

Note: ¹ Available at: http://www.ilo.org/wcmsp5/groups/public/-asia/-ro-bangkok/-ilo-dhaka/documents/publication/wcms_106515.pdf.

Task 3: Estimate core environment-related jobs and green jobs

Box T3.1 Research required to estimate coefficients for job estimates per unit of core environmental activity

Some further research is likely to be required to characterize green sectors in each country. A selection of well-defined indicators for green activity will be required to estimate the corresponding job estimates using labour-intensity ratios for each sector. A template for undertaking such an exercise with examples of typical labour coefficients per unit of green activity and possible sources is given in the table below.

Sector	Country	Labour intensity	Unit of measure	Possible source
Wind	United States	4,300 jobs per MW installed	Electricity production by wind (GWh)	International Energy Agency (2006)
Wind	Europe	On average 15.1 jobs are created in the EU per new megawatt (MW) (manufacturing) and 0.4 jobs per cumulative MW (operations and maintenance), declining gradually (with rising labour productivity) to 11 and 0.29 jobs, respectively, by 2030	Electricity production by wind (GWh)	The European Wind Energy Association (2008)
Solar			Electricity production by solar (GWh)	International Energy Agency (2006)
Biomass			Electricity production by biomass (GWh)	International Energy Agency (2006)
Geothermal			Electricity production by geothermal (GWh)	International Energy Agency (2006)
Green buildings		Building retrofit (200 jobs/58 million investment)	Number of LEED registered buildings	US Green Building Council (2009)
Energy-efficient cars			Fuel economy standard for new passenger vehicles (MPG-converted to Cafe test cycle) – 2010 estimate	International Council on Clean Transportation (2007)
Waste management		1% of urban population are waste pickers (India) 0.6% labour force in OECD countries	% of waste recycled and composted (% of all municipal waste collected)	United Nations Statistics Division, United Nations Environment Programme (2007)
Sustainable agriculture			Organic land area (hectares)	Food and Agriculture Organization (2006)
Green finance			Expected average annual certified emissions reduction (CER) credits from registered projects by host party (average annual reductions)	United Nations Framework Convention on Climate Change
Eco-tourism			Protected natural areas: World Heritage sites (thousands of hectares)	United Nations Environment Programme World Database on Protected Areas (2009)

Box T3.2 An example: Estimating jobs related to investment in the Clean Air and Sustainable Environment Project for Bangladesh

The objective of the Clean Air and Sustainable Environment Project for Bangladesh is to improve air quality and safe mobility in Dhaka through the implementation of demonstration initiatives in urban transport and brickmaking. The project provides technical assistance and funding to demonstrate environmental initiatives in the key air-polluting sectors in Bangladesh.

The total investment has been allocated to various sectors as given below. The employment sustained can be estimated by using employment–output ratios by sector as shown in the table.

Environment-related jobs estimated from investment in green activity

Approval date	12 May 2009			
Closing date	31 Dec. 2014			
Borrower	Government of Bangladesh			
Implementing agency	Ministry of Environment and Forests			
		Project cost (in US\$ mil)	Emp./output ratio*	Jobs
Major sectors	Transportation (general transportation sector) (61%)	43.46	0.0007	30 510
	Public administration, law and justice (central government administration) (16%)	11.40	0.0018	19 959
	Public administration, law and justice (public administration – transportation) (14%)	9.98	0.0018	17 464
	Industry and trade (general industry and trade sector) (9%)	6.41	0.0005	3 340
Total		71.25		71 273

Note: * Employment–output ratio calculated from 2005–2006 Bangladesh Labour Force Survey and Bangladesh Bureau of Statistics.

Source: World Bank: *Bangladesh: Projects, programs and results*, online, available at:

<http://www.worldbank.org.bd/external/default/main?menuPK=295791&pagePK=141155&piPK=141124&theSitePK=295760>.

Box T3.3 An example: Estimating jobs related to fuel-efficient engine production

Among members of the European Automobile Manufacturers Association (ACEA), approximately 26 per cent of passenger vehicles sold in 2004 satisfied a limit of 140 grams per kilometre of driving. But only 7.5 per cent of vehicles sold met a stricter standard of 120g CO₂/km (see the table below). Assuming that the portion of sales represented by efficient cars can be applied to the industry's workforce, some 150,000 auto industry jobs could be attributed to production under the stricter standard and 526,000 jobs under the more lenient one.

Estimated jobs related to fuel-efficient vehicle production, European manufacturers, 2004

	Vehicle production/employment	
	Number of vehicles	
Vehicles sold in Europe by ACEA members	11 484 785	
Share of vehicles emitting less than:	120 g CO ₂ /km: 879 401	140 g CO ₂ /km: 3 085 165
Share of total sales (%)	7.5	26.3
	Number of employees	
Passenger car manufacturing workforce	2 000 000	
Employment associated with "clean" vehicles, estimated on a pro rata basis	150 000	526 000

Source: European Federation for Transport and Environment (T&E): *Reducing CO₂ emissions from new cars: A study of major car manufacturers' progress in 2007* (Brussels, 2008).

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Table T3.4 Examples illustrating labour market interactions of green activities

	Environment-related broad sector (Boundary 1)	Green economic activity (Boundary 2)	Impact of green jobs on labour market (new jobs, substitution or transformation)
Primary natural resource	1.1. Agriculture	1. Sustainable agriculture <i>(organic growing methods; mushroom cultivation; bee keeping; sericulture; soil conservation/bioslurry; water efficiency and conservation)</i>	Substitution
	1.2. Forestry	2. Sustainable & participatory forestry	Substitution
	1.3. Fishing	3. Sustainable capture fisheries	Substitution/new jobs
	2. Energy	<i>Renewable energy sources & services:</i> 4. Solar photovoltaic and thermal/ CSP 5. Wind energy 6. Biogas/biomass gasification 7. Micro-hydro power 8. Other renewable energy sources (biofuels, gasohol, geothermal, river current, wave and tidal energy) 9. Power grids efficiency and management/smart grids and distributed technologies	New jobs (rural areas) New jobs (rural & remote coastal areas) New jobs (rural areas) New jobs (rural areas) New jobs Substitution/ new jobs (rural areas)
Protection and management	3. Water and waste management, recycling	10. Waste management and recycling 11. Water sanitation and water distribution efficiency	Transformation New jobs/ substitution
	4. Climate adaptation activities	12. Physical measures: • Construction of new infrastructure (cyclone shelters, coastal embankments for flood protection and landfills) • Planting of mangrove belts (against coastal storms) • Irrigation/increase of surface water storage capacity • Drainage congestion reduction	New jobs New jobs New jobs/ transformation New jobs

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Table T3.4 Examples illustrating labour market interactions of green activities (Continued)

	Environment-related broad sector (Boundary 1)	Green economic activity (Boundary 2)	Impact of green jobs on labour market (new jobs, substitution or transformation)
Protection and management	4. Climate adaptation activities (cont'd)	13. Soft measures <ul style="list-style-type: none"> • Early warning systems for cyclonic disasters and floods • Operation and maintenance of sluices and regulators • Groundwater management, land use/agricultural practices, water-saving techniques 	New jobs/ New jobs New jobs/ transformation
	5. Manufacturing and energy efficiency services	14. Manufacturing and energy efficiency (including industrial co-generation)	New jobs/ transformation
Periphery environmental-eco activities	6. Urban transport and transit schemes	15. Hybrid and clean fuel vehicles	Transformation
		16. Eco-efficient public transportation and transit transportation	Transformation
	7. Construction/energy efficiency in buildings	17. Buildings efficiency/green buildings	Transformation
	8. Others/finance (not mentioned in advance)	18. Green-focused banking and microfinance	New jobs
Environmental quality	9. Manufacturing and services (not mentioned in advance)	19. Environment-related tourism	Transformation
		20. Post-natural disaster management	New jobs

Task 3.2 Screen core environment-related jobs to estimate green jobs

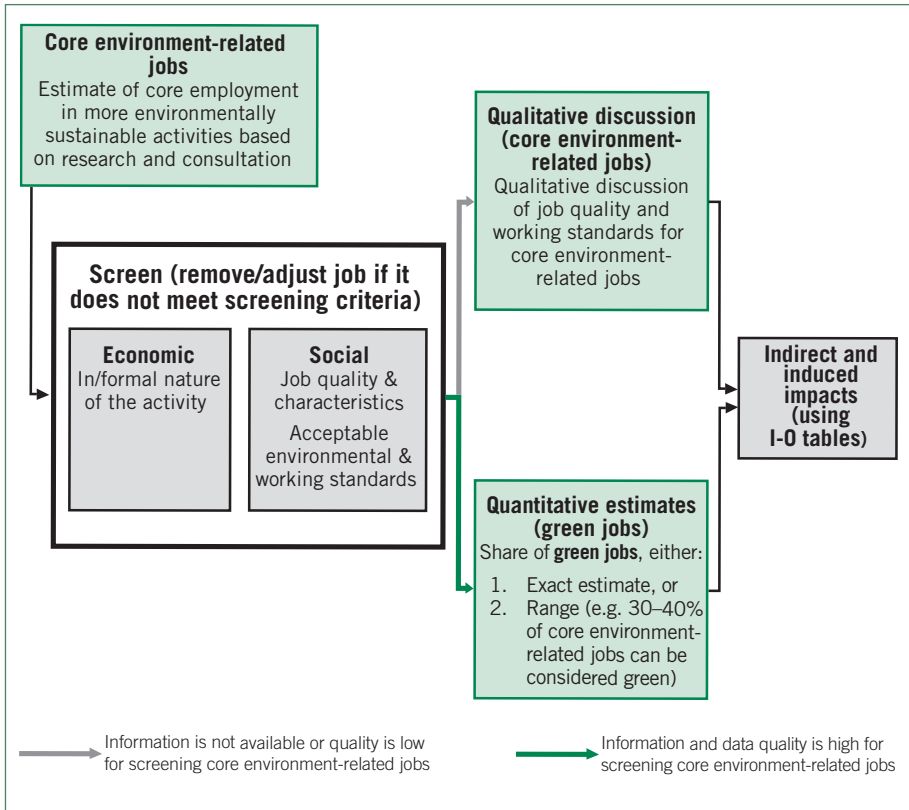
As discussed in Chapter 2, core environment-related jobs can only be considered green if they are also decent. The screening tool is designed to help distinguish green jobs from other core environment-related employment. The screening criteria are applied to the activity's economic (informal nature) and social (quality of work, etc.) characteristics. Variation in the strictness of the screening criteria will lead to broader or narrower estimates for green jobs. The estimates are also sensitive to the interpretations and boundaries adopted for the screening tool. These should be set on the basis of what is regarded as reasonable by the “consumers” of each country study, whether policy-makers or researchers. Research for the Bangladesh country study suggests that information available for screening core environment-related jobs and estimation of green employment is imperfect. The quality of the information differs by type of environment-related activity or sector. Thus, direct and indirect estimates of green jobs should clearly acknowledge the quality of the information used in the screening criteria.

The range of outcomes set by the strength and quality of the screening tool is given in figure T3.3. The outcomes can either be:

- a qualitative review of core environment-related jobs (when the quality of information is not good enough to provide a quantitative share of green jobs);
- an indicative range for the share of green jobs, e.g. 30–40 per cent of core environment-related jobs that can be considered green (when data are available but not robust enough to provide an exact estimate); or
- an exact estimate of the number of jobs that can be considered green.

The screening tool should be applied to core environment-related job estimates in the sequence shown in figure T3.3. Initial green job estimates from the sector profiles and consultation should be screened based on the acceptable economic (informal nature) and social (quality of work, etc.) dimension of green jobs for each country. The indirect and induced impacts should then be estimated (see Task 4 for more details).

Figure T3.3 Screening tool for core environment-related job estimates



Economic dimension

Jobs should be screened out or adjusted if the informal nature of the activity makes the data too unreliable to be used with confidence and also affects the quality of jobs (discussed below). Chapter 2 presented the different methods available to estimate the size of the informal economy. The methods and findings can differ by country and sector. The scope and type of informal activities should be considered before they are included in the analysis. Labour force surveys (LFS) in developing countries are a good source of data for determining the number of persons and economic units engaged in the informal economy. In order to use the LFS for data collection, however, a sound sample design is needed to obtain a representative sample of households in which there were informal activities. The overall share of informal jobs by sector (table T1.2 in Task 1) will also help in estimating the share of indirect green jobs in the informal economy.

Social dimension

Job estimates should be screened using decent work indicators. The estimate should be adjusted where employment in green economic activities does not satisfy acceptable working standards according to the ILO/UNEP definition of green jobs in Chapter 2 (box 2.1). Indicators to look for are:

- core ILO labour standards;
- other ILO labour standards, including those for occupational health and safety (OHS);
- job difficulty and any occupational and health hazards. For example, recycling jobs (such as shipbreaking) in many developing countries are often precarious, involving serious occupational as well as public safety and health hazards, and generate less than living wages and incomes. Feedstock production for biofuels also can involve excessive workloads, exposure to hazardous chemicals and even the violation of fundamental rights such as the use of child and slave labour.⁴⁰

An understanding of the social dimension is needed to ensure that the jobs identified on the basis of environmental performance are also decent according to the ILO definition (box 2.2). Data for determining job decency in developing countries are not widely available or accessible.

The ILO indicators in box 2.3 in Chapter 2 can be used as a guide to collect data on decent work and screen environment-related jobs. Even though quantitative estimates are available for some of the indicators, data availability at sectoral level is highly uncertain (see *Decent work indicators for Asia and the Pacific: A guidebook for policy-makers and researchers* (ILO, 2008) for more details on the different types of decent work indicators and methodology and measurement of the less easily quantifiable dimensions of decent work; see also box T3.4). The guidebook is designed to be a practical resource for collectors and users of labour market information; it presents a detailed overview of key indicators for monitoring labour market trends and measures progress towards national and international goals related to the promotion of decent work.

Given the number of indicators for decent work and the qualitative nature of most indicators, some form of scoring or qualitative judgement will be required to confirm whether environment-related jobs are also decent, for each sector. The range of indicators and the scoring criteria will differ among countries.

The employment estimates can be linked to labour force surveys to provide estimates of the number of male and female or skilled and unskilled workers, as

⁴⁰ P. Poschen: *Green jobs for Asia and the Pacific*, background paper for research conference, Niigata, Japan, 21–23 April 2008.

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well as other worker characteristics available from these surveys. Income-induced effects from household expenditures may also be estimated if they are available. As with labour force surveys, these can either be based on assuming the same relationship between environment-related sectors and the parent or synthetic sector, or more specific estimates can be undertaken for environment-related sectors, depending on time and resources available. An example for Bangladesh is given in box T3.5.

Box T3.4 Decent work indicators for Asia and the Pacific

Rights at work

1. Child labour
 - 1a. Economically active children aged 10–14
 - 1b. Child school non-enrolment rate 5–14 years (from UNESCO)
2. Women in the workplace
 - 2a. Female share of employment by 1-digit ISCO
 - 2b. Female share of employment by 1-digit ISIC
 - 2c. Gap between female and male labour force participation rates
3. Complaints/cases brought to labour courts or ILO

Employment

4. Labour force participation rate
5. Employment-to-population ratio
6. The working poor
7. Wages
 - 7a. Number and wages of casual/daily workers
 - 7b. Manufacturing wage indices
8. Unemployment
 - 8a. Total unemployment rate
 - 8b. Unemployment by level of education
9. Youth unemployment
10. Youth inactivity
 - 10a. Youth inactivity rate
 - 10b. Youth not in education and not in employment
11. Time-related underemployment
12. Employment by status of employment and branch of economic activity
13. Labour productivity
14. Real per capita earnings (from national accounts)

Social protection

15. Informality and social protection
 - 15a. Informal employment
 - 15b. Social security coverage (for wages and salary earners)
16. Rates of occupational injuries (fatal/non-fatal)
17. Hours of work
 - 17a. Usual hours of work (in standardized hour bands)
 - 17b. Annual hours worked per person

Social dialogue

18. Trade union membership rate
19. Number of enterprises belonging to employer organizations
20. Collective bargaining coverage rate
21. Strikes and lockouts: Rates of days not worked

Source: ILO: *Decent work indicators for Asia and the Pacific: A guidebook for policy-makers and researchers* (Bangkok, 2008).

Box T3.5 Key findings from the Bangladesh Green Jobs Study

GHK analysed the social dimension of green jobs using data from field interviews, published material such as the Bangladesh Labour Force Survey (LFS) and desk research. The main findings were:

- High-quality data on wages (by gender) are available at sectoral level from the LFS.
- Job-quality data on work conditions and workers' rights and benefits are patchy and unreliable. Employment/work standards either do not exist, employers/employees lack awareness or standards are not enforced properly.
- The majority of environment-related jobs are in the informal economy and it is mostly women who work here. Some jobs in the informal economy may provide better social conditions but this has to be considered on a case-by-case basis.
- Information is generally not available to calculate the exact share of core environment-related jobs that do not satisfy acceptable working standards according to the ILO definition of green jobs.

The sectoral analysis suggested there are nearly 2.8 million core environment-related jobs in Bangladesh. These account for nearly 6 per cent of total employment in the economy (49.5 million jobs). Another 4 million jobs are indirectly supported as a result of these core environment-related jobs.

- Sustainable agriculture and forestry account for a very small share (0.2%) of total agriculture and forestry jobs. It was relatively difficult to find green jobs in the agriculture sector amidst the growth in intensive cultivation practices in the last 10–15 years. Nevertheless, jobs identified in sustainable farming (about 42,000) can be considered green on the basis of their environmental contribution (i.e. better soil conservation, water efficiency practices, reliance on natural nutrient cycling and reduced farm-to-market distances), as well as better working conditions and higher wages. However, some social aspects of these jobs can be further improved.
- In the sustainable forestry sector (about 29,000 jobs), not all of the jobs can be considered green, and it is difficult to accurately differentiate sustainable forestry from other forestry (laws and regulations on social and sustainable forestry and wildlife preservation are not properly enforced).
- In the sustainable energy sector (sustaining between approximately 70,000 and 120,000 direct and indirect jobs), investment in solar photovoltaics and biogas/biomass is creating new job opportunities in rural parts of Bangladesh. These renewable technologies are well suited to rural parts of the country as they are cheap to install and run. Biogas/biomass-based technologies have abundant supplies of organic waste from crop production and cattle. Most jobs identified in this sector can be considered green (see table T3.5 below). They are in the formal economy and enjoy better working conditions than the national norm, though there is still scope for improvement.
- Jobs in waste management and recycling are thought to be growing at a high rate. Composting urban waste (90,000 jobs) and plastic waste recycling (68,000 jobs) account for the majority of these jobs. However, employment in this sector often seems not to comply with basic health and safety standards. Workers are often unprotected and work in hazardous conditions. Working hours tend to be long, as wage rates are based on units of material recycled rather than on time. This is particularly the case of jobs in shipbreaking. It is also the case with most of the composting plants, because of a supply chain with many informal collectors or

Task 3: Estimate core environment-related jobs and green jobs

brokers. However, evidence suggests that jobs in composting of organic waste, door-to-door collection of household waste, upstream scrap metal and aluminium or plastic recycling represent an improvement over working conditions of scavengers on landfills or dumping sites. But greater efforts and policy interventions to enforce labour standards are still required in this sector to comply with ILO decent work conditions.

- Energy efficiency initiatives have been limited in the Bangladeshi manufacturing sector. Isolated efforts have been made to increase energy efficiency and implement conservation measures or co-generation in some industrial facilities such as sugar mills, spinning mills, fertilizer factories, processing mills, cement mills and brick kilns. Co-generation has significant advantages in Bangladesh due to very low installation costs, small size of installations, suitability for rural areas (minimum transmission and distribution losses) and because it places no financial and administrative burden on the company. This technology has huge potential to generate green jobs, given that nearly 2 million workers are employed in textile industries. However, there are very few estimates of energy-efficient activities in the manufacturing sector. Brick kilns are the best-documented activity; most of the jobs in new brick kilns can be considered green and decent, as opposed to the traditional brick kilns.
- The sustainable construction sector is the second most important in terms of core environment-related jobs. However, a very high share of construction jobs is in the informal economy. These jobs are characterized by low health and safety standards, thereby preventing about 50 to 60 per cent of the 1.34 million core environment-related construction jobs to be classified as green. Indirectly, the sustainable construction sector supports another 1.4 million jobs.
- In the transportation sector, potential green jobs have been identified in areas such as the conversion of vehicles to run on CNG (compressed natural gas). In 2008, there were 250 CNG filling stations and 121 conversion centres, supporting nearly 150,000 jobs (to which another 62,500 jobs have to be added). Most of the jobs in CNG conversions and filling stations can be considered green (formal economy; relatively high working conditions and standards; and a wage disparity between women and men (only 10 per cent) significantly inferior to other sectors).
- Climate change adaptation activities account for most of the identified core environment-related jobs. However, estimating the number of green jobs in these activities is difficult, given the scope and extent of the labour market concerned. It is estimated that the US\$2 billion per annum worth of adaptation spending in Bangladesh supports nearly 1.7 million jobs (or about 863 jobs created per US\$1 million spent). In addition to the direct jobs created, climate change adaptation investments would indirectly support another 2.2 million jobs. Adaptation jobs are created by investment in physical adaptive measures (e.g. flood protection, cyclone shelters and water-efficient irrigation) as well as “soft” measures (e.g. early warning systems for natural hazards, and better guidelines, education and communication). It is relatively difficult to confirm if these jobs are decent, as adaptation activities cut across a number of sectors. However, the essentially international sources of funds provide a minimum level of assurance that the jobs created would comply with minimum working standards, as would jobs created through public/government employment programmes.

Source: *Estimating green jobs in Bangladesh*, a GHK report for the ILO (forthcoming).

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Table T3.5 Bangladesh: Estimates of employment in the sustainable energy sector

	Jobs		
	Direct	Indirect	Total
Sustainable energy (broad estimate)¹	32 523	86 497	119 019
Sustainable energy (narrow estimate)	18 823	50 061	68 884
Hydroelectric	1 287	3 423	4 710
Solar photovoltaic and thermal	15 000	39 894	54 894
Wind energy	36	96	132
Biogas/biomass	2 500	6 649	9 149
(Power grid efficiency and management) ²	13 700	36 436	50 135

Notes: ¹ Broad estimate includes jobs related to power grid efficiency and management. ² Job estimates based on World Bank project finance for power grid efficiency and management; see World Bank: *Additional financing for rural electrification and renewable energy development project in Bangladesh*, online (2009). Industry-wide employment sector ratios were used to estimate jobs related to this spending. Not all jobs can be considered green, as the number includes jobs in grid management and electricity distribution.

Sources: Waste Concern: *Assessment of green jobs in renewable energy sector* (Dhaka, ILO, 2010); Bangladesh Bureau of Statistics: Report on Labour Force Survey, 2006; GHK analysis.

Issues to consider

Narrow and broad definitions of green activity

Given the various factors affecting the boundaries of green jobs, it is worth testing a number of definitions (both narrow and broad) for green economic activities. The definition of the technical boundaries for green jobs is country-specific. These boundaries will be determined at the beginning of the exercise and estimates carried out on that basis (and must be clearly indicated by the analyst from any early stage). For example, judgements about which elements of the agricultural economy are sustainable will have a large effect on the estimate of the share of green jobs in the overall economy. In Bangladesh, alternative systems based on ecological principles have been developed (such as the Nayakrishi Andolon movement). These contrast with the intensive rice and other crop production that is based on Green Revolution principles. There are also subsistence farmers who practise low-input farming through poverty rather than choice.

For the above reasons, we suggest testing a number of definitions for green activities, given available data options for disaggregating relevant green activities from the baseline activity. Some examples for sustainable/green agriculture are: organic farming, mushroom cultivation, bee keeping, sericulture, soil improvement and bioslurry, water conservation and pesticide-free vegetable cultivation.

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Standard definitions for most green sectors or activities should be used to the extent possible (figure T3.2 and table T3.2). The definition proposed for agriculture above is one such example.

The presentation of the narrative and results should be designed in such a way as to help policy-makers understand the structure of the green economy and its relationship to environmental management performance, labour standards and the informal economy. This will help to avoid an unproductive preoccupation with definitions and instead give a sense of how to encourage the kind of transitions that will promote more employment, under decent conditions of work, in economic activities that are more environmentally sustainable than the present norm.

Decent work indicators

Accurately screening employment data in order to estimate green jobs is difficult because the decent work status is often difficult to determine, particularly in the informal economy (see box T3.6). It is not the main objective of this guide to develop a precise (and probably expensive) decent work screening tool. Instead, it is important to acknowledge the existence of jobs that are not decent, the reasons they exist and what can be done to upgrade these jobs.

Box T3.6 Estimating jobs in the informal economy

The difference between total environment-related employment, total employment in core environment-related activities and the number of green (i.e. also decent) jobs helps to define a development pathway. A key consideration in a developing country context is the high share of jobs in the informal economy. Excluding informal jobs from a working definition of green employment leads to very low estimates of green jobs. Estimates inside and outside this filter should be provided where possible in order to highlight the distinction, and the significance of the informal (or “not decent”) aspect of the work available in the economy.

Methodologies for identifying and estimating direct green employment

The methodologies for identifying and estimating green employment (e.g. using case study findings or ratios) may not be rigorous enough to provide overall estimates. Any assumptions and data limitations should be identified at the outset. The stakeholder consultation exercise described below should aim to address limitations and improve the methodology.

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Outputs

- Green job estimates, with a description of the type of method used (for example, sector-specific studies or extrapolating green job ratios such as jobs per unit of waste recycled).
- Summary of each green activity identified, using the screening tool as the template, and presenting a general discussion of the key factors that make it difficult to monitor and quantify green jobs.

Useful sources

Details of potentially useful sources are provided in Annex 1.

Both Tasks 3.1 and 3.2 should be informed by stakeholder consultations

Stakeholder consultations should inform Tasks 3.1 and 3.2. They should be undertaken in parallel with the analysis and screening process.

The main objectives are to:

- obtain further estimates for green jobs not available from the initial literature review and sector profiles;
- verify the factors selected for defining the boundary (or boundaries) for green jobs using the screening tool; and
- understand the economic impact on final markets and supply chains for green jobs (indirect and multiplier effects of green jobs).

The basic steps are to:

- identify key experts by stakeholder type (NGOs, research organizations, industry, government and international agencies); and
- conduct stakeholder surveys through email, phone and/or in person.

It is helpful to prepare a topic guide (see box T3.7) for the stakeholder consultation. The topic guide should target areas where data and information are most difficult to obtain.

Box T3.7 Topic guide for stakeholder consultations

Discuss the main factors affecting the boundary for green jobs, using the screening tool.

Further possible questions:

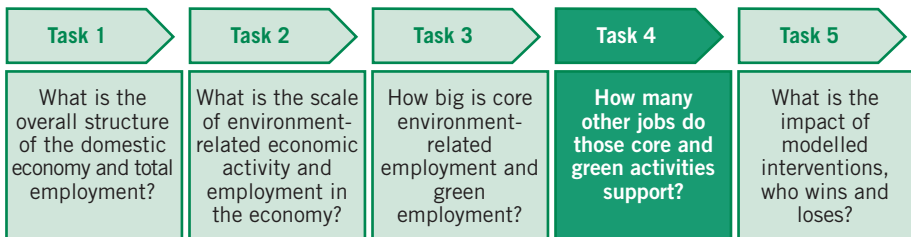
- Any other environmental/sustainable activity that can be included in the subset of green jobs? If yes, is there information on the number of jobs and their sustainable impacts?
- Main drivers for green activity and their importance?
- Any spillover benefits (e.g. educational, cultural, quality of life, etc.)?

Where resources and timing permit, site visits can be very useful ways of getting verification of environmental and labour practices, and uncovering further details. This approach is more feasible where the activities of interest are concentrated in a few firms or a geographical area.

The pilot study on green jobs in Bangladesh (publication forthcoming) provides some insights on how to undertake a stakeholder survey in this context. In particular, there is a need for a shared understanding of the concept of green jobs on the basis of the definition above. Lack of reliable quantitative data may also be a constraint on the process. Research methods that engage with stakeholders face-to-face are likely to be more successful than remotely administered surveys.

Task 4

Estimate direct, indirect and induced employment



Objective

The purpose of this task is to quantify the direct, indirect and induced impacts (see Chapter 2 for more details) of the selected core environment-related activities and that subset which sustains green jobs. These impacts will be quantified in terms of jobs and outputs using national input–output tables or social accounting matrices (SAMs).

Each coefficient in an input–output (I-O) table indicates the amount of each product required to produce one unit of product output. The coefficients range from 0 to 1 (table T4.1). The sum of each coefficient column is 1, and each column shows the proportion of inputs needed to produce that specific product (i.e. the technology pattern for the product).

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Table T4.1 Example of a coefficients matrix for an input–output (I-O) table

	Agriculture	Mining	Steel	Manufacturing	Services
Agriculture	0.081	0.000	0.000	0.010	0.001
Mining	0.000	0.079	0.100	0.050	0.026
Steel	0.001	0.002	0.201	0.100	0.001
.....
Services	0.300	0.251	0.300	0.284	0.379

Changes in the coefficients indicate changes in the structure of the economy. They assist in the study of:

- changes in relative prices;
- capital/labour intensity;
- technological change;
- product type (complement, substitute, etc.); and
- import substitution.

I-O coefficients can capture the net effects of direct substitution to green activities

Modelling the indicators above through changes in I-O coefficients is particularly important for estimating the net impact of substituting to green activities. For example, policies to protect the climate and relative price changes triggered by resource scarcity can lead to job losses in energy and resource-intensive sectors. On the other hand, green growth and clean production will transform some sectors in the economy, raising energy and resource efficiency, and reducing environmental impact.

The changes in I-O coefficients can also capture labour market dynamics and restructuring effects of substituting to green activities. Green growth can have impacts on large sections of the economy and the associated employment, in both green and non-green sectors. This impact depends on the nature and type of activities in the supply chain. The supply chain characteristics are important for input–output modelling. Information on the economic performance (purchases, sales, exports) and differences between the green activity and the baseline activity will be required for modelling direct and indirect impacts of green jobs on the economy (see Task 5). A “short” supply chain comprising a few large companies (or integrated within the same company) would likely be more responsive to public

Task 4: Estimate direct, indirect and induced employment

policy incentives (e.g. abolition of fuel subsidies), but would also have a smaller impact on green jobs creation. Conversely, a long supply chain comprising a large number of SMEs would likely be less responsive in terms of “green” behavioural changes. But once the changes have been integrated by the actors, their economic impact would be much greater in terms of jobs and output, as well as more dispersed in the economy (since SMEs represent 90 per cent of the industrial base in most developing countries). An example of this is the “short” and less diversified supply chain for aggregates and mining compared to a longer diversified supply chain for recycling and reuse of industrial and construction waste.

Not all indirect jobs will be green. Green activities can also affect jobs in sectors that use the green products and services. A limited number of jobs in renewable energy, for example, substantially lower the environmental footprint of the sector it supplies. Similarly, greener forms of cement reduce the CO₂ lifecycle emissions from buildings. It also requires upskilling and training architects, planners, construction engineers and investors to use more sustainable construction practices.

Method

The purpose of this task is to use green job estimates and/or core environment-related jobs from Task 3 and quantify the indirect and induced impacts of these jobs using I-O tables. Indirect and induced jobs are created to supply goods and services as a result of the expenditure/investment to support direct green, or core, environment-related jobs. For example, biomass energy generation will require inputs from woodchip providers, waste services and transportation companies, creating indirect jobs in the process.

Calculating induced impacts (using Type II multipliers) requires data on household expenditures and incomes by industry, and these may not necessarily be provided in I-O tables. They are also more difficult to construct.

Task 4.1 Assemble direct core environment-related job and/or green job estimates from Task 3

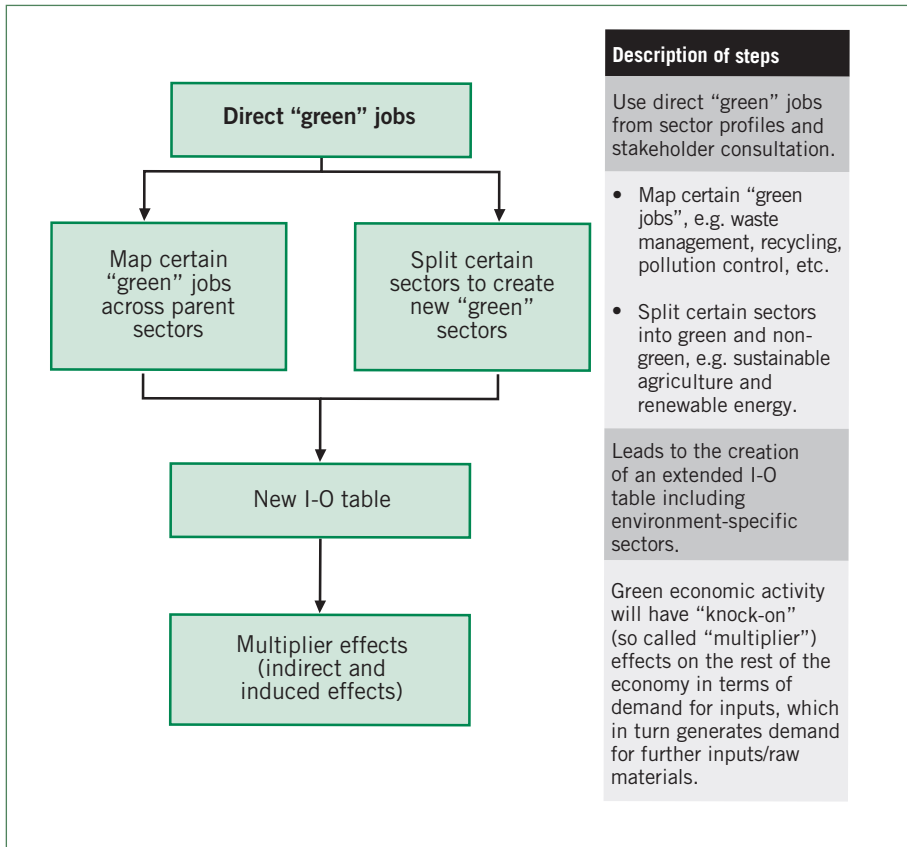
The key steps for estimating direct, indirect and induced impacts of green jobs are shown in Figure T4.1.

The first step is to assemble the direct estimates of core environment-related jobs and/or green jobs (as appropriate) from the sector profiles and stakeholder

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consultations. In countries where data constraints prevent a comprehensive estimation of green jobs, it may be more useful to focus on core environment-related employment. The choice, and balance of effort, can be determined on the basis of policy-maker/audience requirements.

Figure T4.1 Key steps for estimating multiplier effects (using green jobs as a base in this example)



Task 4.2 Incorporate new industries in the I-O tables or SAMs

The next step involves carrying out adjustments that facilitate the "isolation" and analysis of green activities within the model of the economy provided by the I-O tables or social accounting matrices.

It is helpful for the analysis to pick up two types of transition – the greening of existing sectors, and the emergence of green activities that cut across a number

Task 4: Estimate direct, indirect and induced employment

of different sectors. The coefficients in the I-O table must be adjusted to model these two broad classifications of green activities. Depending on the sector, these can be tackled using either a “parent sector” approach or a “synthetic” approach.

The parent sector approach is used when an environment-related sector is contained within a larger sector of an I-O table or SAM (such as retrofitting of insulation materials in buildings, which falls within “construction”, or renewable energy, which lies within “utilities”). It involves splitting certain sectors and adjusting coefficients of the green subsector, based on difference in prices, capital/labour intensity, technology and inputs for the green subsector.

The synthetic approach is used when an environment-related sector is spread across a number of existing sectors in an I-O table or SAM, such as eco-tourism. It involves assigning shares to the relevant sectors (table T4.2) and adjusting the coefficients accordingly.

Table T4.2 Example for adjusting tourism-related sectors using appropriate sector shares (percentages)

Accommodation	58
Restaurants, cafés, bars, etc.	40
Travel agencies, etc.	58
Rail travel	15
Other land transport	8
Water transport	35
Air transport	63
Other transport services	2
Transport – rentals	2

Source: Department for Culture, Media and Sport, United Kingdom.

For certain environment-related activities, sufficient data will not be readily available to explicitly define them in the input-output structure. Air pollution control or metal waste recycling are some examples. In this case, the multiplier values from the relevant parent sector can be used to estimate the indirect effects. The pros and cons of different methods to obtain information for technical coefficients related to creating new green sectors are given in table T4.3.

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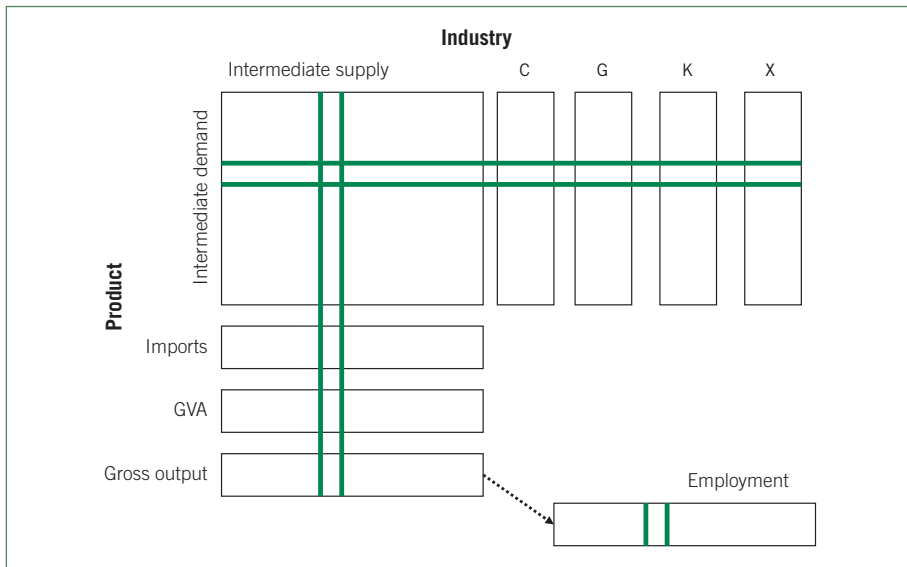
Splitting sectors to create new green sectors

Splitting sectors into green and other components requires input–output data that describe the purchases and sales within these subsectors. This is shown in figure T4.2, with the green lines representing the new data points required for the new sectors. The data needed to adjust the coefficients of the green sector are not readily available from published material. Therefore, either assumptions must be made in the data processing or the information should be collected through other means.

The data availability and quality determine which environmental sectors can be analysed through the use of input–output tables. If the data are lacking, sectors cannot be “split out” from the parent sectors. Furthermore, the quality of the data is important to adjust the I-O coefficients for green subsectors.

The general principle is that both parts of the sector should be structured in exactly the same way as the parent sector unless there are data (qualitative or preferably quantitative) to suggest otherwise. This means, for example, that organic and non-organic farming would use the same inputs, and sell to the same industry groups as the agriculture sector as a whole (a proposition which in that farming example does not strictly apply). Thus the industry columns in the I-O tables (in coefficients) for these two sectors are set to be identical and the product rows are shared out using gross output shares.

Figure T4.2 Expanding a single industry



Notes: C = consumption; G = government expenditure; K = capital; X = exports. GVA = gross value added.

Table T4.3 Survey methods to obtain information for technical coefficients related to creating new green sectors

Methods	Example or description	Pros	Cons
1. Survey of environment sectors and activities by national statistical agencies using same methods as in constructing the original I-O tables	R. Pollin et al.: <i>Green recovery: A program to create good jobs and start building a low-carbon economy</i> (Washington, DC, Center for American Progress, 2008)	Provides accurate relationships between sectors considered for policy intervention Captures economic impacts of green restructuring Exhaustive and detailed surveys will avoid double counting Helpful for policy decisions and scenarios	Expensive and time-consuming Data access may be limited or require long application process
2. Using sophisticated company database and advanced internet search technology	Pew Charitable Trusts: <i>The clean energy economy: Repowering jobs, businesses and investments across America</i> (Pew Center on the States, 2009)	Data are more up to date Accurate description of business activities rather than relying on estimates Helpful for policy decisions and scenarios	Expensive Requires specialist knowledge
3. Surveying a representative sample (large size) of companies for each green activity	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: <i>Renewable energy. Employment effects: Impact of the expansion of renewable energy on the German labour market</i> (2006)	Provides accurate information for adjusting the coefficients Can provide additional information to link I-O data with skills, trade effects and impact of changes in relative prices Data can be used to scale up to industry level using appropriate weights Helpful for policy decisions and scenarios	Can be expensive and time-consuming Appropriate sampling technique would be required (stratified or random)

High-end options

Table T4.3 Survey methods to obtain information for technical coefficients related to creating new green sectors (Continued)

Methods	Example or description	Pros	Cons
High-end options	4. Using a representative sample (small size) of companies for each green activity	Provides indicative data for adjusting coefficients Less time-consuming and expensive Data can be used to scale up to industry level using appropriate weights	High risk of double counting Poor representation of the green activity
	5. Desk research and literature reviews	European Commission, Directorate-General Environment: <i>Links between the environment, economy and jobs</i> (2007)	High risk of double counting Less accurate information for adjusting technical coefficients; data will not be uniform for all green sectors
Low-end options	6. Assume same coefficient as the parent sector	Least time-consuming and expensive	Passive approach and crude assumptions Not helpful for policy decisions and scenarios

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The next stage is to enter the assumptions or the information about the different purchasing and sales patterns of these subsectors. A wide range of methods can be used to collect the information to construct these new technical coefficients. At one extreme, it is possible to survey firms undertaking environment-related activities and ask the same kinds of questions about their inputs and outputs as is done in the construction of I-O tables. At the other extreme, one could simply use input–output coefficients from parent industries. This would enable an estimate of the number of direct and indirect jobs, but would not enable the testing of policy scenarios (Task 5). A range of methods could be employed between these two extremes, depending on available time and resources.

Table T4.3 outlines some of the methods (high-end and low-end options) used in the literature to collect the information to construct new technical coefficients and the pros and cons of each. The business survey methods described earlier in table T3.3 for estimating direct core environment-related jobs can also be used to collect information for the I-O technical coefficients. In Task 3.2, there is a potential complementarity between using business surveys and I-O modelling. The choice of methods would also depend on the guide user’s green job related policy priorities, objectives and constraints. A brief review of policy priorities and choice of methods is given in table T4.4.

Table T4.4 Policy priorities and choice of methods

Policy priority and time & resource constraints	Survey methods
Priorities: Broad estimates of environment-related and green jobs. Constraints: Time and resources are short.	Methods 5 and 6 are best suited and would provide reasonable estimates.
Priorities: Policy-makers are interested in estimating jobs in key environment-related subsectors (e.g. sustainable construction) where jobs are substantially different from parent sectors. Constraints: Time and resources are adequate not only just adequate.	Methods 3 and 4 would provide more reliable estimates as I-O technical coefficients would be adjusted to accurately describe the purchases and sales within these subsectors.
Priorities: Policy-makers are interested in economy-wide accurate estimates of green jobs, especially to estimate net job effects. i.e. job losses and gains. Constraints: None. Substantial time and resources are available.	Methods 1 and 2 should be used as they are the most advanced and accurate methods to estimate I-O coefficients.
Priorities: Policy-makers are interested in policy scenarios for understanding the effects of sectoral changes on total green employment. Constraints: None. Substantial time and resources are available.	Methods 1 and 2 would be ideally suited but methods 3 and 4 can also be considered if time and resources are constrained.

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A sample questionnaire/topic guide for use in surveys or literature reviews is given in table T4.5. The information collected can be used to adjust the I-O coefficient (and to estimate the multiplier effects) of direct green jobs.

The survey methods in table T4.3 covering the questions in table T4.5 will provide information that can be used to adjust the coefficients and thus reflect the purchasing patterns of green subsectors. Table T4.6 shows the information obtained from interviews with experts who were involved in the estimation of direct core environment-related jobs and a literature review for selected green activities in Bangladesh (see the forthcoming study by GMK for the ILO) to adjust I-O coefficients. The “Green subsector” represents the columns that were changed in the I-O tables and the “Input to adjust” the rows that were changed. The information in table T4.6 corresponds to the “Low-end options” in table T4.3 due to time and resource constraints. The processing of the I-O coefficients was based on the information in table T4.6. As mentioned above, the information required to adjust the I-O coefficient is not easy to collect. Consultation responses (using email questionnaires and phone interviews) provided very scant information, and the information in table T4.6 should be considered as indicative only. However, information on the substitution of fertilizers in organic farming is based on actual industry experience. Investing time and resources in the “High-end options” in table T4.3 can provide more reliable information to increase the credibility of the adjusted I-O coefficients.

The green subsector industry information gathered by surveys will differ from country to country. However, some assumptions can be generically applied. Organic production is one possible example: the literature on the economic performance of organic farming is well developed, and the key differences in purchasing and selling patterns compared to conventional farming can be standardized to some degree. Nonetheless, organic farming practices can differ considerably, especially in developing countries, and country-specific information for the green subsectors should be used as much as possible for creating the new I-O coefficients.

Annex 2 provides more detail on estimating coefficients, by reference to the Bangladesh country study. This area of the guide should be updated as more information is available from country studies to adjust I-O coefficients for the green subsectors.

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Table T4.5 Sample questionnaire for conducting surveys

Main questions	Description
Revenue	<p>Respondent's turnover from sales:</p> <ul style="list-style-type: none"> • sales to industry – these are business-to-business transactions • retail sales – sales to households and individual consumers • other sales – for example, sales to the Government <p>Income from public grants or subsidies</p>
Sales to industry	<p>Identify sales and the proportion of sales to primary industries (e.g. provide five to ten primary industries) and identify which of the industries is their main customer</p> <p>Identify proportion of sales nationally and as exports</p>
Employment and wages	<p>Number of full-time and part-time workers</p> <p>Wage expenditure</p>
Expenditure and purchases	<p>Respondent's purchases and proportion of their purchases toward goods, materials, services and energy from primary industries (e.g. provide five to ten primary industries). Identify the most important supplier. Identify purchases nationally and from imports.</p>
Optional questions	
Price of goods or services	<p>Difference in final price of good or service compared to non-green activity. (Is there a price premium for green good or service?)</p>
Public-sector financial assistance	<p>Information about the impact of withdrawal of a public subsidy on the respondent's activity – both operationally and financially. Helpful for policy scenarios in developing countries and understanding whether a public subsidy is additive or substitutional.</p>

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Table T4.6 Adjustment of I-O coefficients from surveys, expert interviews and literature reviews

Green subsector	Input to adjust		Notes
	From	To	
Sustainable agriculture	Chemicals, fertilizers (80%) ¹ Water (10%) ² Energy (15–20%) ³	Professional services Other services	Data from Bangladesh
Sustainable forestry	Chemicals, fertilizers (80%)	Public administration Other services	No forestry certification programmes in Bangladesh. No particular differences except for reduction in fertilizers and changes in ownership pattern from private to public
Sustainable construction & infrastructure	Mining and primary (10%) ⁴	Manufacturing (recycling) +10%	Assumption based on survey by Waste Concern ⁵
Sustainable energy	Coal, oil and gas, fuels, etc. ⁶	Forestry (5%) Agriculture and sustainable agriculture (20%) Professional services (10%) Manufacturing (installation and maintenance) (50%) Public administration (15%)	Weighted by type of renewable technology
Sustainable transport	Manufacturing (petroleum) (83%)	Energy gas (83%) Public administration +5% Manufacturing industry +2%	Based on inputs required for CNG conversions and investments to reduce transport emissions

Notes: ¹ Sustainable farming consumes 80 per cent less fertilizers compared to conventional farming.

² Sustainable farming can save 10 per cent water compared to conventional farming.

³ See <http://www.news.cornell.edu/stories/July05/organic.farm.vs.other.ssl.html>; <http://www.fao.org/docs/eims/upload/233069/energy-use-0a.pdf>; <http://www.fao.org/DOCREP/005/Y4137E/y4137e02b.htm#92>.

⁴ 10 per cent less inputs from the mining and primary sector.

⁵ See <http://www.wasteconcern.org>.

⁶ Set coefficients for coal, gas, fuels, etc. to zero. Solar home systems reduce consumption of gas and kerosene.

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Mapping green activities across primary industrial sectors in cases where data are not available to split them out as separate sectors

The next step is to map direct values for “green” jobs across the primary industrial sectors in national I-O tables where sufficient data are not available to explicitly define them in the input–output structure (table T4.7). Indirect effects can be estimated using the same multiplier values as the relevant parent sectors. The mapping exercise has the following requirements:

- the parent sector of each activity should be known; and
- various linear assumptions have to be made initially, regarding:
 - the productivity levels of activities and the related economic sector (in other words, assumptions regarding average outputs and wages per person for the activity compared to the parent sector); and
 - the purchase pattern of inputs and expenditures, or outputs of the activity and the related economic sector.

These assumptions should then be replaced or supplemented with evidence from the literature and consultations, which illustrate the difference in productivity of the green activity compared to the broader parent sector. For example, productivity in organic farming can be expected to be different from that of conventional farming.

Table T4.7 provides an illustration of how green activities can be mapped across the main industrial sectors. The table summarizes environmental sectors and the corresponding industrial-sector categories. This should be adapted/modified based on the research and consultation findings.

Some green activities, such as waste recycling and adaptation activities, are spread across various I-O sectors (e.g. manufacturing, construction, public administration and transport) and are relatively difficult to map. The mapping process in this case can be reconciled by using, where available, national or OECD/global industrial sector classification codes for the green activity. Alternatively, experts working in a field related to the green activity can be asked to classify the activities across the parent sectors.

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Table T4.7 Mapping green activities across primary industrial sectors

Green economic activity	Main industrial-related sector (parent sector)
Energy and resource efficiency	
Air pollution control, noise and vibration control	Electrical engineering and instruments
Recycling of materials (3Rs)	Manufacturing, recycling
Private environmental management (PEM)	Other business services ¹
Soil and groundwater remediation (RCSG)	Miscellaneous services
Wastewater treatment	Miscellaneous services, recycling
Municipal waste management	Miscellaneous services, public administration
Hazardous waste management	
Prevention of desertification	Agriculture, water, transport, construction, public administration and defence, social services, education and communication
Climate adaptation sectors (including coastal management, adaptation in agriculture, fisheries, etc., risk management of extreme climate-related event)	
Non-climate-related natural risk management	
Central/local administration, research and education, NGOs, etc. linked to environmental management and pollution control	
Conservation (endangered species, natural habitats, national parks, etc.)	
Water extraction and supply	Water supply

Note: ¹ Defined as activities where the natural environment (not the built environment) is responsible for influencing the choice of destination for the tourism activity.

Task 4.3 Calculate multiplier effects

Green activities will have “knock-on” (so-called “multiplier”) effects on the rest of the economy, as discussed in Chapter 2. For example, spending on pollution control generates a demand for components, which in turn generates demand for raw materials. These effects can be calculated by using I-O tables that show the inputs each industry needs to produce its own output. The multiplier effects, which are based on these economic linkages, capture the economic value generated by the direct use and management of the environment as it affects the rest of the economy, i.e. the indirect and induced output effects (table T4.8).

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Table T4.8 Indirect and induced economic impact of green activity

Type of impact	Nature of impact	Key direct impacts	Key indirect/ induced impacts
Nature management or pollution control	Construction, land management and development and investment in plant or machinery	1. JOBS (FTE) created during construction/development	1. Local EXPENDITURE by suppliers to the project/company purchasing goods and services from other firms for the project/company, creating further JOBS in the process
		2. Value of local GOODS and SERVICES used during construction/development	2. Local EXPENDITURE by employees of the project/company and its suppliers spending their wages in the local economy, creating further JOBS in the process
			3. TRAINING opportunities afforded during construction/development

I-O methodology for derived tables and multipliers⁴¹

Step 1: Derive Leontief inverse matrices (Type I and Type II)

The Leontief inverse matrices are derived from the industry-by-industry (I×I) I-O matrix and show how much of each industry’s output is needed, in terms of direct, indirect and, in Type II matrices, induced requirements, to produce one unit of a given industry’s output. The formula for the Type I Leontief is as follows:

$L = (I - A)^{-1}$	<p>Where:</p> <p>L = Leontief inverse matrix</p> <p>I = Identity matrix</p> <p>A = Direct requirements matrix – each cell of the I×I matrix divided by its column total</p>
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As an example, an aggregate Type I Leontief based upon the aggregate I×I matrix is shown in table T4.9. This table does not contain household expenditure, which is necessary for the calculation of the Type II Leontief.

⁴¹ The following guidance document served as reference for this section: UK National Statistics: *United Kingdom input-output analytical tables* (London, 1995, 2002).

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Table T4.9 Industry-by-industry (I×I) I-O matrix

	Agriculture, forestry & fishing	Mining	Manufacturing	Energy & water	Construction
Industry					
Agriculture, forestry and fishing	477	6	908	0	29
Mining	0	99	253	629	156
Manufacturing	408	80	3 243	230	934
Energy and water	48	15	650	2 150	25
Construction	67	74	19	26	1 183
Distribution and catering	318	171	2 700	126	338
Transport and communication	87	153	491	22	77
Finance and business	143	785	1 793	220	1 744
Public administration, etc.	136	33	200	37	66
Other services	12	1	3	1	140
Total domestic purchases at basic prices	1 697	1 417	10 259	3 440	4 693
Imports from rest of UK	309	576	7 188	465	753
Imports from rest of world	161	212	6 889	19	146
Total intermediate consumption at basic prices	2 166	2 205	24 336	3 925	5 592
Taxes on products	66	82	1 075	165	233
Taxes less subsidies on production	11	14	293	133	34
Compensation of employees	585	672	7 066	709	2 606
Gross operating surplus	600	682	5 477	809	350
Gross value added at basic prices	1 196	1 368	12 836	1 650	2 990
Output at basic prices	3 428	3 655	38 247	5 740	8 815

Source: UK National Statistics: *United Kingdom input-output analytical tables* (London, 2002 edition).

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Distribution & catering	Transport & communication	Finance & business	Public administration, etc.	Other services	Total intermediate consumption
284	7	15	22	0	1 749
17	1	1	17	0	1 174
882	319	736	1 054	72	7 957
288	53	90	436	16	3 770
326	103	988	733	63	3 583
717	337	660	810	23	6 201
426	2 225	1 228	404	149	5 262
1 077	1 316	3 387	2 140	83	12 687
55	154	229	3 915	6	4 830
14	31	32	112	3	348
4 086	4 545	7 367	9 642	415	47 560
1 722	808	2 454	2 105	17	16 397
458	160	238	739	0	9 022
6 266	5 512	10 059	12 487	432	72 979
233	338	466	495	47	3 202
504	94	187	248	22	1 539
5 033	3 192	5 380	12 637	516	38 396
5 080	1 030	6 308	1 595	286	22 218
10 618	4 315	11 875	14 480	824	62 153
17 117	10 166	22 400	27 462	1 304	138 334

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Table T4.10 Direct requirements table (A), or matrix of coefficients

	Agriculture, forestry & fishing	Mining	Manufacturing	Energy & water
Industry				
Agriculture, forestry and fishing	0.14	0.00	0.02	0.00
Mining	0.00	0.03	0.01	0.11
Manufacturing	0.12	0.02	0.08	0.04
Energy and water	0.01	0.00	0.02	0.37
Construction	0.02	0.02	0.00	0.00
Distribution and catering	0.09	0.05	0.07	0.02
Transport and communication	0.03	0.04	0.01	0.00
Finance and business	0.04	0.21	0.05	0.04
Public administration, etc.	0.04	0.01	0.01	0.01
Other services	0.00	0.00	0.00	0.00

Source: UK National Statistics: *United Kingdom input-output analytical tables* (London, 2002 edition).

Table T4.11 Type I Leontief inverse matrix

	Agriculture, forestry & fishing	Mining	Manufacturing	Energy & water
Industry				
Agriculture, forestry and fishing	1.17	0.01	0.03	0.00
Mining	0.01	1.03	0.01	0.18
Manufacturing	0.17	0.05	1.11	0.09
Energy and water	0.04	0.01	0.03	1.61
Construction	0.04	0.04	0.01	0.02
Distribution and catering	0.14	0.07	0.09	0.06
Transport and communication	0.06	0.08	0.03	0.03
Finance and business	0.10	0.29	0.08	0.14
Public administration, etc.	0.06	0.02	0.01	0.02
Other services	0.01	0.00	0.00	0.00

Source: UK National Statistics: *United Kingdom input-output analytical tables* (London, 2002 edition).

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Construction	Distribution & catering	Transport & communication	Finance & business	Public administration, etc.	Other services
0.00	0.02	0.00	0.00	0.00	0.00
0.02	0.00	0.00	0.00	0.00	0.00
0.11	0.05	0.03	0.03	0.04	0.06
0.00	0.02	0.01	0.00	0.02	0.01
0.13	0.02	0.01	0.04	0.03	0.05
0.04	0.04	0.03	0.03	0.03	0.02
0.01	0.02	0.22	0.05	0.01	0.11
0.20	0.06	0.13	0.15	0.08	0.06
0.01	0.00	0.02	0.01	0.14	0.00
0.02	0.00	0.00	0.00	0.00	0.00

Construction	Distribution & catering	Transport & communication	Finance & business	Public administration, etc.	Other services
0.01	0.02	0.00	0.00	0.00	0.00
0.02	0.01	0.00	0.00	0.01	0.01
0.16	0.07	0.06	0.06	0.07	0.08
0.02	0.03	0.02	0.01	0.03	0.03
1.18	0.03	0.03	0.07	0.05	0.07
0.07	1.06	0.06	0.05	0.05	0.04
0.04	0.04	1.30	0.09	0.04	0.16
0.31	0.10	0.22	1.22	0.13	0.13
0.02	0.01	0.03	0.02	1.17	0.01
0.02	0.00	0.00	0.00	0.01	1.00

Dividing each cell in the intermediate demand quadrant of the I×I matrix (table T4.9) by its column total (“Output at basic prices”) produces the direct requirements table (A) (table T4.10). This shows the amount (£ or US\$) purchased by the industries in the columns from the industries in the rows, in order to produce US\$1.00 of their own output. The values in the direct requirements table provide the factor coefficients which give an indication of the proportion of inputs required to produce a unit (£ or US\$) of output of a particular product. The direct requirements table is also called the “matrix of coefficients”.

Constructing an identity matrix of the same dimensions as the direct requirements table (in this case a 10×10 matrix) and subtracting the A-matrix from the identity matrix produces the “I-A” matrix, the inverse of which is the Type I Leontief inverse matrix (table T4.11).

The Type II Leontief is calculated in the same way as the Type I but, as its purpose is also to estimate the flows of money in and out of households and the effect of these transactions upon industries, it is necessary to “endogenize the household sector”. Put simply, households can be treated as an additional industry by adding an extra row and column into the direct requirements table for “Compensation of employees” and “Household expenditure” coefficients respectively.

Step 2: Derive multiplier effects

The next step is to derive the multiplier effects from the Type I and II Leontief. The I-O tables can provide three different types of aggregate multiplier for both Type I and Type II effects.

$$\text{Output multiplier } (O_{MULT})_j = \sum_i L_{ij}$$

The Type I output multiplier for a particular industry is defined as the total of all outputs from each domestic industry required in order to produce one additional unit of output: that is, the sum of the column (\sum_i) from the Type I Leontief inverse matrix (L_{ij}). Similarly, the Type II output multiplier is given from the column sums of industry rows (i.e. exclude compensation of employees) from the Type II Leontief.

$$\text{Employment multiplier } (E_{MULT})_j = \sum_i w_i L_{ij} / w_j$$

The employment multipliers show the total increases in employment throughout the economy which result from an increase in final demand which is

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enough to create one additional employment in that industry. In the formula above, w is equal to job per unit (£/\$) of total output for each industry.

Estimating the employment multiplier uses the results of the I-O table analysis, but additionally requires employment data for each sector in the I-O table. Employment data by sector is usually available from labour force surveys or national statistical agencies. The employment multipliers are derived from the output effects. For example, the direct spending on pollution control in the economy and its indirect impacts are measured in monetary terms (e.g. US\$mil). This is then translated into employment by using the sectoral ratios between output and employment, giving direct and indirect employment effects.

$$\text{Income multiplier } (I_{MULT})_j = \sum_i v_i L_{ij} / v_j$$

The Type I and II income multipliers show the increase in income from employment (IfE) throughout the economy that results from a change of unit (£ or \$) of income from employment in each industry. In the formula above, v refers to the ratio of IfE/total output for each industry.

Both output and employment multipliers are determined solely by the input-output structure. Multipliers will vary across sectors according to the level of the various “leakages” from the economic system. Leakages can be thought of as payments to operators outside the I-O framework, mainly imports from abroad, taxes and company profits. For estimating Type I multipliers (indirect impact), wage payments also count as a leakage from the system.⁴²

The multipliers can be used to simulate or forecast the impact of policy interventions in the economy to promote green jobs (see Task 5 for more details). A combination of time series and cross-section data to produce a forecast will provide some insights into which of the green economic activities are the most important in terms of growth.

Issues to consider

- Availability of up-to-date national I-O tables or social accounting matrices (SAMs).
- Quality and reliability of data on supply chain for green activity.

⁴² The ratio of the direct, indirect and induced income effects to the direct effect is termed the Type II output multiplier. A Type I output multiplier excludes the induced effects, i.e. it is the ratio of direct and indirect to direct effects.

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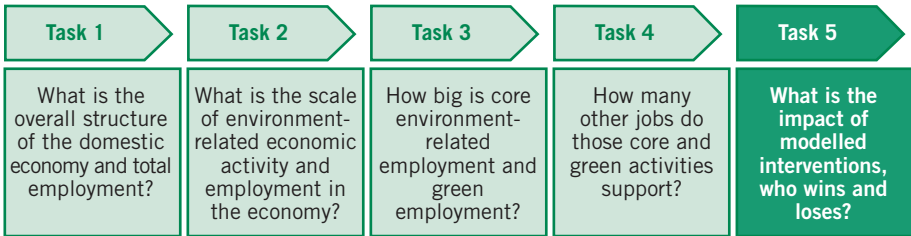
- Quality and availability of data for splitting certain sectors (i.e. data required for adjusting the I-O coefficient).

Useful sources

- National I-O tables or social accounting matrices (SAMs).

Task 5

Identify “what if” scenarios



Objective

The purpose of Task 5 is to show the links between environmental policy and the economy and how selected examples of policy intervention can contribute to the economy. It will support the definition and sensitivity tests through which the effects of sectoral changes on total green employment are examined.

The aim is to:

- provide the basis for a simple calculation for policy-makers when determining possible actions for transitioning to a green economy; and
- demonstrate the economic impact of the change towards a more sustainable mix of inputs, both directly on the firms subject to the intervention, and indirectly on the economy as a whole.

Task 5 is not intended to provide a detailed policy impact assessment.

Method

I-O analysis, though static by design, can be used to aid future policy development by helping the policy-maker to explore the impacts of specified scenarios. The “what if” scenarios can help policy-makers:

- design programmes to upskill and retrain workers in sectors at risk of losing jobs;
- help identify winning and losing sectors;
- encourage green activities by providing regulatory and market incentives; and
- address market failure by removing institutional and financial barriers.

The analysis can provide information, through multiplier analysis, on the economic impacts of changes in production and consumption patterns. Impacts could result from changing patterns of consumer demand, new technologies or policy interventions. The “what if” scenario analysis illustrates the economic impacts of a specified policy intervention that changes the nature and/or input costs to a sector or group of sectors (e.g. higher fuel costs or changes in current technology). It also illustrates the subsequent economic impacts in terms of output and employment attributable to the intervention.

The model can be used to generate results for simple “what if” scenarios in which output is shifted from less green to greener options, such as:

- agricultural production, with an increase in output from the sustainable agriculture sector;
- increase in electricity generation from renewable energy technologies;
- increase in output from the sustainable construction industry; and
- increase in output from the sustainable transport sector.

The scenarios can identify the sectors which stand to gain and lose from the substitution and the net impact of the substitution. Most studies have found positive net benefits from substitution due to the longer supply chain and higher labour intensity of more environmentally friendly sectors.

Identify the scenarios to be modelled

The following discussion assumes that the scenario to be modelled shifts activity from the “conventional” activity towards a green activity.

The options for modelling the scenarios depend on:

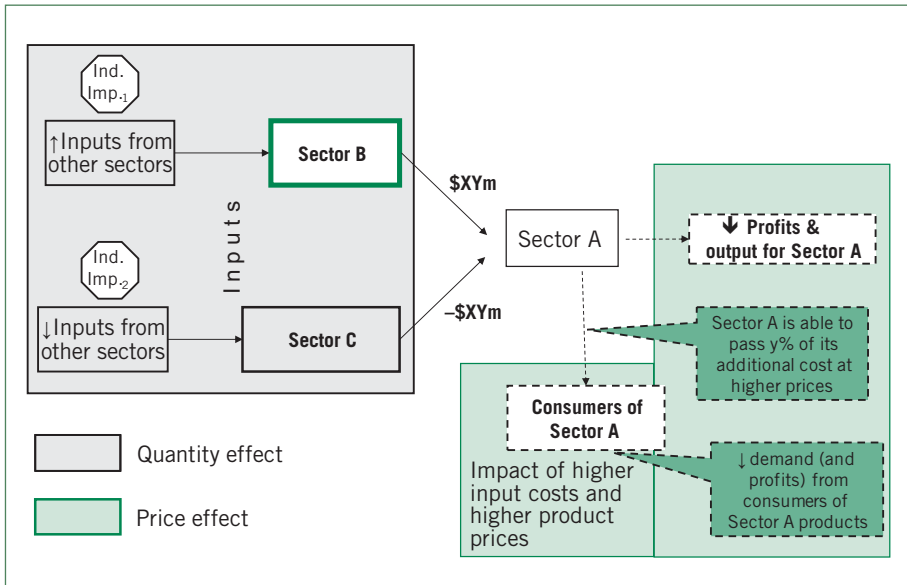
- technical capability of the model – ability to model the quantity or price effect of the substitution or both; and
- range of environmental policy interests – to frame the “what if” scenarios.

Step 1: Confirm the technical capability of the I-O model

The scenarios can be considered as a quantity and price effect arising from the specified shift (figure T5.1). A simple I-O table can only model the *quantity effects* of the substitution. Policies are designed assuming that the substituting sectors provide less environmentally intensive inputs (e.g. recycled material sector for virgin material).

Such changes are incorporated in the I-O table under Sector C by lowering the coefficient for Sector C by X per cent and increasing the coefficient of Sector B by the same amount (box T5.1). This calculation assumes that Sector B inputs cost the same as Sector C, leaving costs unchanged, but with indirect effects on the rest of the economy caused by the substitution. For the quantity effect, it is assumed that the changes in production and consumption do not have any impact on the overall price base.

Figure T5.1 Quantity and price effects



Box T5.1 Quantity substitution

“What if” scenario: This scenario considers the impact of substituting primary raw material with recycled materials in the steel sector. The scenario is based on a 50 per cent substitution by value of inputs from the mining sector with the same value of inputs from the waste recycling sector (manufacturing sector), with no effect on overall input costs.

Initial I-O table

	Agriculture	Mining	Steel	Manufacturing	Services
Agriculture	0.081	0.000	0.000	0.010	0.001
Mining	0.000	0.079	0.100	0.050	0.026
Steel	0.001	0.002	0.201	0.100	0.001
Manufacturing	0.167	0.118	0.110	0.246	0.078
Services	0.300	0.251	0.300	0.284	0.379

If the steel industry uses 50 per cent less inputs from mining ($X=50\%$), then the coefficient representing purchases of mining products by the steel industry is reduced by 0.05 (0.1×0.5) and the coefficient representing manufacturing purchases (recycling) is increased to 0.16 ($0.05 + 0.11$). This is shown in the table below (coefficients that have changed are in bold).

Initial I-O table with quantity changes

	Agriculture	Mining	Steel	Manufacturing	Services
Agriculture	0.081	0.000	0.000	0.010	0.001
Mining	0.000	0.079	0.050	0.050	0.026
Steel	0.001	0.002	0.201	0.100	0.001
Manufacturing	0.167	0.118	0.160	0.246	0.078
Services	0.300	0.251	0.300	0.284	0.379

If the substitution were to lead to an increase in the input costs from the substituting sector then this would be reflected in the cost structure of Sector A and partly paid by consumers of Sector A products – the price effect (figure T5.1). Output and profits from Sector A would be expected to fall due to higher product costs. The elasticity of demand for its products and the cost will determine how much of the increase in costs can be passed on to its consumers.

The price effect of the substitution also leads to the so-called “budget effect” which results from the cost differential between the products of the two sectors and its impact on consumers. For example, if renewable energy is more expensive than conventional energy, then the higher cost burden would fall on energy consumers. This money would not be available to spend on other goods, creating a drain on demand. This budget effect results in negative employment impacts in other sectors and must also be considered when analysing the net effect of substituting to greener activities. Cost-effective green activities that have a negligible or even positive budget effect would have a higher net positive employment effect. The overall impact of the budget effect would depend on the magnitude of the price difference and the payback period of substitution to greener products. The

impact of the budget effect on net employment will be low if the payback period is short, or when the cost differential falls at a faster rate over time.

A basic I-O table will not be sufficient to calculate the multiplier effects from increased profits for Sector B when providing inputs to Sector A at higher prices. It also cannot compute the contracting multiplier effect of the fall in output and profits of Sector A due to higher product prices.

A basic input–output model would have to be developed further to capture the effect of higher prices on profits and output for any sector when substituting inputs from a less environmentally intensive sector. Price elasticities of demand and cost passed through assumptions from other macro models would be required to calculate the subsequent impact of the high cost of inputs through to the product prices for consumers in a particular sector.

The final impact on the economy will be determined by the net effect of the positive impacts from resource allocation and the negative impacts of high input costs and product prices.

Step 2: Create “what if” scenarios

A range of environmental policy interests can be identified to frame the “what if” scenarios. These interests range from a broad concern with improving the sustainability of consumption and production patterns, to specific interests in relation to the use of greener technologies and in climate change and energy efficiency.

The green growth indicators are a good source of inspiration for creating “what if” policy scenarios. Some examples are given below:

- Greening business and markets
 - Increased energy efficiency in the manufacturing sector due to increased use of more efficient production technologies
 - Increased energy efficiency in the energy-intensive industries⁴³ (a subset of manufacturing)
- Sustainable consumption and production (SCP) (demand-side management)
 - Steel production with increased substitution of recycled materials
 - Agricultural production with an increase in output from the organic sector
 - Reduced water consumption
- Green tax and budget reform
 - Impact of carbon taxes for reducing CO₂ intensity across the whole economy or for energy-intensive industries

⁴³ Manufacture of pulp, paper and paper products; publishing and printing; manufacture of chemicals, chemical products and man-made fibres; manufacture of rubber and plastic products; manufacture of other non-metallic mineral products (including cements, lime, glass); manufacture of basic metals and fabricated metal products (includes ferro-alloys, steel and non-ferrous metals).

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- Sustainable infrastructure
 - Increased output from sustainable construction to meet higher building standards
 - Increase in electricity generation from renewable energy technologies
- Investment in natural capital
 - Exogenous injection of investment to improve environmental infrastructure (e.g. waste management, water, forestry, etc.)

Table T5.1 shows the net impacts of hypothesized “what if” scenarios on jobs and output created directly and indirectly for the EU-27. These are mostly based on 10 per cent substitutions towards more environmentally friendly production, or on 10 per cent reductions in resource use.

Table T5.1 Policy scenario results for the EU-27

	Overall change in:	
	Income (euros, millions)	Jobs
Steel production with increased substitution of recycled material (10% reduction)	197	3 641
Agricultural production with an increase in output from the organic sector (10% substitution)	554	43 834
Reducing water consumption (10% reduction)	976	5 490
Increased energy efficiency in the manufacturing sector (10% reduction assuming near market technologies for reduction exist)	482	137 171
Increased energy efficiency in the manufacturing sector (10% reduction assuming higher investment costs for technologies than prior scenario)	8 938	90 915
Increase in biofuels in transport (10% substitution)	1 499	139 525
Increase in electricity generation from renewable energy technologies (RET) (10% substitution)	8 613	58 212
Increase in electricity generation from RET at higher costs (10% substitution)	22 854	58 615
Increased use of structural funds for environmental infrastructure (7 billion euro injection)	17 301 to 19 789	148 685 to 166 933

Source: GHK Consulting Ltd: *Links between environment, economy and jobs* (European Commission, 2007).

Though these scenarios create winners and losers at the industry level, the overall changes in income and jobs are estimated to be consistently positive. Identifying the winning and losing sectors can help policy-makers in developing appropriate training and upskilling programmes in affected sectors. The substitution analysis would clearly provide job losses and gains by sectors (table T5.2). The net impact of the structural change and reallocation of resources is positive, mainly due to longer and diversified supply chains, higher labour intensity and higher net profit margins.

Increased spending attributed to new jobs would lead to additional output, thus creating a ripple effect in the economy. A smaller supply chain, on the other hand, has less leakage in profits and taxes, resulting in a lower multiplier effect. As a caution, however, it should be noted that these results do not account for price effects, and a model that did account for price effects might lead to substantively different results. Modelling the impact of resource substitution at higher prices would invariably be desirable for most environmental policy encouraging structural change – especially in the short run when businesses and consumers have to adjust to the structural change.

Even without the price effect, however, the analysis can still explain the effects of policies, that although designed to move toward greener options, also raise prices (for example, in relation to the use of renewable energy technologies or the switch to energy-saving technologies). Whilst the basic I-O model is unable to examine these price effects (which would require considerably more complex modelling), scenarios provide some indication of the scale of negative economic impacts from higher prices that would have to occur were they to outweigh the positive effects of the policy.

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Table T5.2 Identify winning and losing sectors

Scenario	Main sectors	Sectors affected negatively	Sectors affected positively
Steel production with increased substitution of recycled materials	Basic metals	Other mining	Manufacturing Recycling
Agricultural production with an increase in output from the organic sector	Food, drink and tobacco Household	Other agriculture	Organic agriculture
Reducing water consumption	Agriculture and all sectors (except water supply)		Mechanical engineering Construction Professional services
Increased energy efficiency in manufacturing sector due to increased use of efficient product technology	All manufacturing sectors	Coal Oil and gas Manufactured fuel Non-renewable electricity Water supply	All sectors (except energy and household)
Increase in biofuels in transport	Land transport Water transport	Manufactured fuel	Other agriculture
Increase in electricity generation from renewable energy technology	All sectors (except electricity)	Non-renewable electricity	Renewable electricity

ANNEX 1

Useful source material

For Task 2

Many relevant sources will be country-specific. Global sources and references that may be helpful include:

- economic reviews available on ministry/government websites (e.g. the *Bangladesh Economic Review 2008*);
- sources on the Green Jobs Initiative, available on the ILO website, <http://www.ilo.org>;
- international conference reports (e.g. the World Forestry Congress reports for various countries, available on the FAO website, <http://www.fao.org/forestry/wfc/en/>);
- the World Bank Development Series, e.g. reports at <http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/0,,menuPK:633491~pagePK:64167657~piPK:64167661~theSitePK:469372,00.html>;
- United Nations Environment Programme (UNEP) publications, available at http://www.unep.org/labour_environment/features/greenjobs.asp; and
- regional union/group publications (e.g. the South Asian Association for Regional Cooperation (SAARC) Workshop on Solid Waste Management, Country Paper on Bangladesh).

Annex 1

For Task 3

Informal economy

Carr, M.; Chen, M. 2004. *Globalization, social exclusion and work: With special reference to informal employment and gender*, Working Paper No. 20, Policy Integration Department, World Commission on the Social Dimension of Globalization (Geneva, ILO).

Charmes, J. 2000. *Informal sector, poverty and gender: A review of empirical evidence*, Background Paper for the World Bank *World Development Report 2001* (Washington, World Bank).

Chen, M.; Jhabvala, R.; Lund, F. 2002. *Supporting workers in the informal economy: A policy framework*, Working Paper on the Informal Economy, Employment Sector (Geneva, ILO).

Hussmans, R. 2004. *Statistical definition of informal employment: Guidelines endorsed by 17th ICLS (2003)*, Seventh Meeting of the Delhi Group, 2004. Available at http://www.mospi.gov.in/ralf_hussmanns_7th.htm.

ILO. 2002. *Women and men in the informal economy: A statistical picture* (Geneva).

Maligalig, D.; Cuevas, S.; Rosario, A. 2009. *Informal employment in Bangladesh*, ADB Economics Working Paper Series, No. 155 (Asian Development Bank, 2009).

Palmer, R. 2008. *Skills and productivity in the informal economy*, Working Paper No. 5, Skills and Employment Department, Employment Sector (Geneva, ILO).

Decent work

Anker, R. et al. 2002. *Measuring decent work with statistical indicators*, Working Paper No. 2, Policy Integration Department, Statistical Development and Analysis Group (Geneva, ILO).

ILO. 1999. *Decent work*, Report of the Director-General, International Labour Conference, 87th Session, Geneva, 1999 (Geneva).

– 2001. *Reducing the decent work deficit: A global challenge*, Report of the Director-General, International Labour Conference, 89th Session, Geneva, 2001 (Geneva).

– 2004. *Globalization and decent work: A report for the Decent Work Pilot Programme in Bangladesh* (Dhaka).

- 2005. *Key findings from the Decent Work Indicators Pilot Survey – 2005*, Concept Note, Decent Work Pilot Programme, Bangladesh (Dhaka).
 - 2008. *Decent work indicators for Asia and the Pacific: A guidebook for policy-makers and researchers* (Geneva).
- Mujeri, M. J. 2004. *Bangladesh decent work statistical indicators: A fact-finding study* (Dhaka, ILO).

Other sources

Global sources and references online that may be helpful include:

- country profiles on economics, business and the environment, available at: http://earthtrends.wri.org/country_profiles/index.php?theme=5;
- LABORSTA: ILO database on labour statistics, containing data and metadata for over 200 countries and territories, available at: <http://laborsta.ilo.org/>;
- millennium development indicators, available at: <http://mdgs.un.org/unsd/mdg/Data.aspx>;
- United Nations Environment Programme (UNEP) on ecosystems management, available at: <http://www.unep.org/ecosystemmanagement/>; and
- World Bank: information available at <http://web.worldbank.org> on:
 - *Global Monitoring Report 2009* (Washington, DC);
 - statistical indicators; and
 - environmental economics and indicators.

ANNEX 2

Adjusting input–output coefficients

This annex is based on evidence from the Bangladesh country study prepared by GHK Consulting for the ILO (forthcoming). Where data were available, sectors were split into conventional and sustainable subsectors. This was accomplished mainly using secondary data and expert advice and evidence of environment-related activities within the Bangladeshi economy. A stepwise approach to adjust the coefficients is given below.

Step 1: Split output shares into conventional and sustainable sectors

The estimated shares of output for each of the sectors were used to split the aggregate sectors into conventional and sustainable subsectors. These shares were also used to split the amounts being purchased and sold to the affected sectors. The output shares used to split the sectors are shown in table A2.1.

Table A2.1 Selected output shares for splitting into subsectors, Bangladesh

Sector	Output estimates: GDP at current prices 2007–08 (mn Taka)
Agriculture	716 000
Sustainable agriculture	10 966
Forestry	72 008
Sustainable forestry	3 041
Construction and infrastructure	149 103
Sustainable construction and infrastructure	289 435
Energy	56 713
Sustainable energy	13 281
Transport	485 936
Sustainable transport	23 706

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The sectors were split into conventional and sustainable sectors using the derived adjusted shares shown in table A2.2 and in the following equation:

$$A = a_1 + a_2$$

where A is the original coefficient

a_1 = conventional share of original coefficient

a_2 = sustainable share of original coefficient

$$a_1 = xA$$

$$a_2 = yA$$

where x is the conventional sector-adjusted share and y is the sustainable sector-adjusted share.

Table A2.2 Derived adjusted shares for conventional and sustainable sectors

Sector	Adjusted shares
Agriculture	0.98
Sustainable agriculture	0.02
Forestry	0.96
Sustainable forestry	0.04
Construction and infrastructure	0.34
Sustainable construction and infrastructure	0.66
Energy	0.81
Sustainable energy	0.19
Transport	0.95
Sustainable transport	0.05

Step 2: Adjust I-O coefficients to reflect different purchasing and sale pattern of sustainable subsectors

Step 2 involves adjusting the I-O coefficients to reflect the empirical evidence on purchasing and sale patterns of green subsectors as given in the Bangladesh study. The empirical evidence suggests that, for example, the sustainable agriculture sector uses 80 per cent less chemicals and fertilizers, 10 per cent less water and 15–20 per cent less energy than the conventional agriculture sector. However, since the overall output within the adjusted I-O table must be consistent with the original I-O matrix, the input savings from these purchases in the sustainable agriculture sector are transferred to professional and other services, indicating that the sustainable agriculture sector now utilizes more of these services for its output. The calculations are shown below.

If we use the example, where 80 per cent of purchases are transferred from the Chemical sector to Professional and Other Services, then:

SA_C denotes sustainable agriculture purchases from the Chemical sector,

SA_{ps} denotes sustainable agriculture purchases from the Professional Services sector, and

SA_{os} denotes sustainable agriculture purchases from the Other Services sector.

$$SA_C \cdot 0.8 = SA_C T,$$

where $SA_C T$ is the transferred purchases from the Chemical sector.

Adjusted purchases from the Chemical sector are then transferred in equal shares to Professional and Other Services.

$$SA_C T \left\{ \begin{array}{l} SA_{ps} + 0.5(SA_C T) \\ SA_{os} + 0.5(SA_C T) \end{array} \right.$$

These adjustments are shown in table A2.3. Note that purchases from the Chemical sector are a subset of the aggregate Manufacturing sector. Therefore the coefficients for the aggregate Manufacturing sector are lower in the Sustainable Agriculture sector than in the conventional Agriculture sector, reflecting the 80 per cent reduction in purchases from the Chemical subsector, etc. Likewise, the coefficients for Professional and Other Services are slightly higher, reflecting the transferred purchases to these sectors from the Chemical sector.

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Table A2.3 Adjusted coefficients for the sustainable subsectors

	Agriculture	Sustainable Agriculture
Agriculture	0.2521	–
Sustainable Agriculture	–	0.2521
Fishing	0.0042	–
Forestry	0.0013	–
Sustainable Forestry	–	–
Manufacturing	0.0401	0.0288
Construction and Infrastructure	–	–
Sustainable Construction and Infrastructure	–	–
Energy	0.0007	0.0006
Sustainable Energy	0.0002	0.0003
Water	0.0000	0.0000
Mining and Primary	0.0009	0.0009
Wholesale and Retail	0.0865	0.0865
Transport	0.0463	0.0463
Sustainable Transport	0.0023	0.0023
Housing Service	0.0002	0.0002
Health Service	0.0263	0.0263
Education Service	–	–
Public Administration and Defence	0.0003	0.0003
Bank Insurance and Real Estate	0.0035	0.0035
Professional Services	0.0003	0.0056
Hotel and Restaurant	–	–
Entertainment	–	–
Communication	–	–
Other Services	0.0062	0.0115
Information Technology and E-commerce	–	–

After adjusting the coefficients, the new I-O table can be used to estimate the output and employment multipliers.