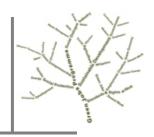# Methodologies for assessing Green Jobs
Policy Brief

Introduction

By pioneering sustainable economic activities, both developed and developing countries stand to generate new jobs and strengthen their economies, whilst also addressing the threats and challenges of climate change. A crucial first step in developing a greener economy is to carry out preliminary assessments that outline the potential implications of different policy choices. This policy brief sets out the different methodologies available to assess the employment potential that green policies can offer and, in so doing, aims to help to focus policy decision-making in order to make it as efficient and productive as possible.

Assessing Green Jobs

Various tools or methodologies for the assessment of green employment exist; they offer a means for both the identification and quantification of existing jobs and for forecasting how effective policies and investment programmes can be in providing new green employment. The selection of which tools are most appropriate for carrying out a study is largely dependent upon the questions that it sets out to answer. For example, will the study set out to estimate current or potential jobs? Will it take only a 'snapshot' or is it intended to take a more dynamic or longer-term view? Not only are different methodologies suited to answering different questions, but their selection is also dependent on other factors such as the available budget and skills capacity of the project, and most importantly, the quality of data that is available.

A statistical definition for Green Jobs

Policy definitions for green jobs emphasise their capacity for reducing negative environmental impacts, their potential for building more environmentally, economically and socially sustainable enterprises and for providing fair employment. However, projects that set out to calculate the number of sustainable jobs in an economy or region, or the impact of policies designed to boost employment in sustainable sectors, require a clear statistical definition for *green jobs*. Various empirically measurable definitions have already been developed - for example, Eurostat has published a data collection handbook in conjunction with the OECD (Eurostat Data Collection Handbook on Environmental Goods and Services Sector, 2009). However, the application of such definitions is constrained by the quantity, quality and consistency of data available. New studies must consider whether available data is sufficiently detailed that jobs may be assessed for their green credentials on an individual basis, or whether there is only enough detail for certain industries or companies, in their entirety, to be treated as *green*. Even if there is sufficient information to attempt a classification of green jobs within industries, there is still the problem of determining which criteria to use in identifying green jobs. For example, should working as a bus driver be identified as a green job because travel by bus is more sustainable than travel by car? Should a bus driver's work only be considered green if his bus is run on bio-fuel?

Employment effects

Any study wanting to estimate the potential employment generated by a policy investing in the sustainable economy must also consider what employment effects it will measure. For example, will it seek only to quantify the creation of direct jobs or will it also seek to gauge indirect and induced job creation too? (*See text box, right*) Employees of a

> **Direct, Indirect and Induced Employment Effects**
>
> Investment in sustainable sectors will result in an expansion of production and the generation of a number of *direct jobs*. Expanded production invariably leads to a higher demand for inputs, resulting in an increase in *indirect jobs* in supplier industries. The increased consumer spending of those in these newly created direct and indirect jobs will also create a number of *induced jobs*.

geothermal energy plant, for example, may be considered to have green jobs. However, a study might also want to take into account the indirect jobs in businesses that supply the computers and stationery for the plant and the induced employment resulting from these direct and indirect jobs.

It is also important to consider whether gross or net employment effects will be calculated. A study that measures the potential new jobs resulting from a policy or project calculates the *gross employment* effects. However, investment in sustainable energy sectors may also have negative indirect or induced employment effects on other sectors; for example, investment in new renewable energies may also have some negative effects on employment in traditional fossil energy sectors. For the *net employment* effect to be calculated, both the new jobs generated and the potential job losses must be taken into account. Data availability and the methodology or methodologies chosen for the study determine the different employment effects that can be measured.

Methodologies for assessing Green Jobs

Various methodologies exist for assessing green jobs on a regional, national or global basis. In the following section the methodologies are split into three general types, though in practice studies often employ multiple methodologies in combination.

Inventories and surveys

Surveys and inventories can provide a simple and effective way of assessing how many green jobs exist in specific sectors, regions or countries. A survey is usually carried out in the form of a questionnaire sent out to relevant companies, government departments or analysts, whilst an inventory commonly draws on a national or regional database to provide employment statistics. Some such studies are comprehensive, whilst others offer only a snapshot, or 'scale-up' a more limited review so that it can provide an estimate of green jobs for a whole country or region. Inventories and surveys, if repeated consistently over a prolonged period, can also provide a useful measure of the extent of the new employment realised by policies aimed at developing employment in sustainable sectors.

Green jobs in Spain (2009)

A study carried out by the Spanish government estimated the number of green jobs in Spain to be 530,947 in 2009, equivalent to 2.6% of Spain's working population. The extensive research employed a combination of both interview and survey techniques to identify and quantify green jobs, and to calculate totals on a sectoral basis. The approach chosen meant that only direct green employment was included in the total number of green jobs, though the depth of analysis was also able to provide some information as to the potential within each sector for the generation of new employment.

Green Jobs in Spain in 2009	
Sector	**No. of Jobs**
Waste water treatment and purification	58,264
Management and treatment of waste	140,343
Renewable energy	109,368
Forest management	32,400
Environmental services to business	26,354
Environmental education	7,871
Organic agriculture and stock breeding	49,867
Management of green spaces	10,935
Industry and services	20,004
Public Sector	53,072
Environmental research & development	21,929
Services	540
Total	530,947
Source: Green Jobs in a Sustainable Economy	

Solar electrification in rural Uganda (2009)

A survey was carried out to ascertain the effects of a project to provide financial and business support for Ugandan companies providing solar heating systems (SHS) to households in rural Uganda. The survey examined the activities of three companies and their regional business activities. It found that the companies supported were able to expand their business and that over 30 direct jobs were created

because of an increase in sales of SHS devices, and a further 5 indirect jobs were generated as a result of market expansion. The study was also able to conclude that no jobs were 'crowded out' by this expansion and therefore these were 'net' increases resulting from the ability of SHS businesses to target a previously untapped market.

Brazilian inventory of Green Jobs (2009)

The Brazilian government has made green jobs a central part of its national development policy, with the ILO providing technical support for the implementation of green jobs strategy at

Inventory of Green Jobs in Brazil			
	2006	**2007**	**2008**
Total Green Jobs	2,293,505	2,484,799	2,653,059
Total formal jobs	35,155,249	37,607,430	39,411,566
Source: Adapted from the ILO Study: 'Green Jobs in Brazil: How many are there? Where are they? How will they evolve over the coming years?'[1]			

both federal and state level. Many of Brazils green jobs have been created by extensive development of its renewable energy sector - with many jobs in wind, solar thermal power and solar photovoltaic (PV) power. Brazil has also invested in innovative projects such as the 'My House, My Life' housing program which orchestrated the construction of 300,000 new homes with solar heating systems (SHS) installed, creating 30,000 new green jobs. The inventory was undertaken using data from the Annual Inventory of Social Statistics compiled by the Ministry of Work and Jobs. The original inventory compiled statistics for formal employment in Brazil and the ILO study then disaggregated these figures so that a specific total for *green jobs* could be reached.

Input-output analysis and Social Accounting Matrices

Input-output (I-O) analysis and Social Accounting Matrices (SAMs)[2] are empirical tools that rely on the construction of a matrix or table listing all subsectors in an economy and detailing how outputs from one sector are used as inputs in others. These models draw on information from the national accounts and

Simplified Input-output table					
	Agriculture	**Food & Beverages**	**Land Transport**	**Final Demand**	**Total Output**
Agriculture	1323	2290	6	1911	6467
Food and Beverages	333	1390	17	8074	11670
Land Transport	34	261	480	5794	10775
Source: Adapted from GHK's forthcoming guide: 'Exploring the links between the environment, economy and employment in developing countries: A practitioner's guide'					

are the most widely employed methodology for assessing green jobs.

On the table above, the rows show the total output of an industry that is consumed by either other sectors or through final demand (e.g. household consumption). The columns show the share of inputs a sector uses in order to reach its final output. The basic input-output model measures how much additional output is needed from each sector to meet an increase in final demand. If information on the labour intensity of the different sectors in an economy can be obtained, then the matrix can be used to estimate the effect on employment of an increase in demand for a green service or product. Thus, these models can be used to answer questions such as "How many jobs might result from a given program of investment in sustainable economic areas?" or "For a given level of investment, which sector or sectors would yield the greatest number of jobs?" I-O models and SAMs are usually used to provide short to medium term projections for policies.

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[1] Original publication: Empregos Verdes no Brasil: Quantos são, onde estão e como evouirão nos próximos anos?

[2] The difference between I-Os and SAMs: Whilst I-O tables provide a disaggregation of the system of production and can illustrate the interactions within it, SAMs go further by describing the interrelationships of income and transfer flows between different institutional units.

South Korea's Green New Deal (2009)

In January 2009, the Republic of Korea announced its 'Green New Deal'. Under the initiative, South Korea will invest heavily in energy conservation, recycling, clean energy development, green transportation and infrastructure, clean water supply and technology development. National input-output tables were used as the basis for calculating the number of jobs likely to be created for each element of the investment program. The study concluded that the initiative has the potential to create nearly one million new green jobs.

South Korea's Green New Deal Initiatives	
Project	**Predicted Jobs Created**
Eco-friendly transportation networks	200,000
National green information infrastructure	138,100
Water resource facilities & management	3,100
Green cars and clean energy	16,100
Recycling resources	14,300
Forest restoration	16,200
Energy conservation	133,600
Environmentally-friendly living space	170,700
Revitalization of four major rivers	10,800
Other related projects	257,100
Total	960,000
Source: Ministry of Strategy and Finance	

Building retrofitting in Hungary (2010)

This study estimated the potential employment impacts of a building retrofitting[3] programme by using figures from case studies and up-scaling them in order to estimate the number of direct jobs likely to be created. I-O analysis was then used so that the indirect and induced employment effects could also be calculated. The study incorporated various scenarios with varying levels of investment and therefore produced a range of different employment impacts, depending on the pace and scale of implementation.

Additional jobs according to retrofitting scenarios					
Scenario	Baseline scenario	Deep retrofit			Suboptimal retrofit
		Fast rate of implementation	Medium rate of implementation	Slow rate of implementation	Medium rate of implementation
Millions of Euros Invested in 2020	224	3,506	2,104	1,402	1,040
Net Employment Impacts in 2020	11,000	131,000	78,000	52,000	43,000
Data Source: Employment Impacts of a Large-Scale Deep Building Energy Retrofit Programme in Hungary					

Bangladesh's Green Jobs (2010)

Input-output (I-O) and Social Accounting Matrix analysis was used to estimate the current number of direct and indirect green jobs in Bangladesh. The research employed I-O tables constructed by the Department of Economics in Dhaka University as the basis for its calculations but disaggregated the data into conventional and sustainable sub-sectors. The study identified nearly 3.5 million 'core environment-related' jobs in Bangladesh, over 800,000 of which can be considered *green* according to the ILO's decent work standards. I-O tables were also used as the basis for estimating future scenarios for green jobs in Bangladesh. The study concluded that, although shifting more resources into green jobs had the potential to create new employment in some areas of Bangladesh's economy, some jobs would also be likely to be lost in agricultural sectors.

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[3] The proposed retrofitting focuses on reducing the energy required for heating by renovating existing buildings.

Green Jobs in China (2010)

This study employed input-output analysis to examine the potential for employment in renewable energy between 2005 and 2020. China's

Employment and low-carbon development in China 2005 to 2020			
Sector	**Direct jobs**	**Indirect jobs**	**Sub-total**
Renewable energy	1,149,000	3,575,000	4,724,000
Data Source: Low Carbon Development and Green Employment in China			

thermal, wind and solar power industries were all included, with figures calculated using both direct and indirect jobs. The study found that China has the potential to generate millions of jobs in the renewable energy industry over the coming years.

The Green Stimulus Program in the United States of America (2008)

A study carried out by PERI (Political Economy Research Institute) set out to estimate the green jobs potential of the Green Stimulus Program in the USA. The study utilized survey figures provided by the U.S. Department of Commerce in the form of I-O tables combined with a series of economic equations to capture indirect and induced employment effects. The model's results indicated that the stimulus program had the potential to create almost two million green jobs. PERI now support the U.S. Department of Energy's work in estimating the employment potential of investment programs.

Total Job Creation through $100 Billion Green Stimulus Program	
Direct jobs	935,200
Indirect jobs	586,000
Induced jobs	496,000
Total job creation	1,999,200
Source: PERI Green Recovery – A program to create Good Jobs and Start Building a Low Carbon Economy	

Computable General Equilibrium and related complex models

These models take the work of I-O analysis and SAMs a step further by simulating full economy responses to exogenous changes. Typically they combine empirical data, usually in the form of I-O tables or SAMs, with a series of economic equations designed to comprehensively capture the dynamism and complexity of an entire economy. In this way, they can explore the effects of policies over time on a variety of different macroeconomic parameters, including future employment scenarios. These models allow policy-makers the opportunity to calculate the long-term impacts of policies.

Renewable energy sources in the European Union (2009)

This study set out to discover the potential impact of renewable energy sources (RES) on economic growth and employment in the EU. Analysis of the historic situation, based on an I-O model, was used to assess the effect that developments in the RES sector have had on other economic sectors.

The I-O tables were constructed using employment data from the EU's Eurostat database, combined with employment coefficients from the EU-KLEMS (Growth and Productivity Accounts) database. The study also utilised two separate macro-economic modelling tools, to project potential future economic and employment impacts. The study reached the conclusion that, if renewable energy sources were developed to the point where they provided 20% of the total energy consumption in the EU, there would be a net increase of around 410,000 additional jobs.

Germany's renewable energy sector growth (2010)

Continued investment in Germany's renewable energy sector has meant that employment has grown year-on-year. The empirical basis for this study was a comprehensive survey of companies. This provided the key data for input-output analysis to establish estimates for total employment. By developing a complex macroeconomic model named PANTA RHEI, the long-term net employment impacts in Germany resulting from an expansion of

Employment in Germany's renewable energy sector		
2007	**2008**	**2009**
277,300	322,100	339,500
Data Source: Renewably Employed! Short and long-term impacts of the expansion of renewable energy on the German labour market		

the renewable energy sector could be calculated. The use of PANTA RHEI enabled the study to estimate

net employment impacts for various scenarios, depending on electricity prices, the expansion of renewable energy sources and export activity. The highest net employment estimate found that over 300,000 additional jobs will be generated in the renewable energy industry in Germany by 2030.

A brief comparison of methodologies

Inventories and surveys	Input-output analysis and Social Accounting Matrices	Computable General Equilibrium and related complex models
-Relatively simple to carry out, they provide a useful snapshot of the current employment situation and a basis for further assessment using more complex models. -Do not allow the assessment of future employment impacts. More complex models are needed to do this.	-They are geared to estimating potential employment effects over the short and medium term. -They are relatively fast to construct and both flexible and practical. Their use of data from national accounts means that they also provide a high degree of accuracy. -Most models offer only a short to mid-term 'snapshot' and cannot provide predictions for a long-term period. Many computable general equilibrium and related models are built upon I-O analysis or SAMs but include additional assumptions to provide more comprehensive, dynamic and long-term analysis of employment effects.	-The detailed level of the models means that they can create a comprehensive picture of an economy and allows the analysis of long-term employment effects. -Building these models requires time, resources and a high level of expertise. -Developing these models requires numerous assumptions and simplifications to be made about how an economy operates over time. Some models assume that markets always clear or do not include unemployment. Such assumptions will ultimately influence model outcomes and limit their explanatory capacity.

Investing in Green Jobs

At a time when the global economic crisis has had a disastrous effect on jobs and incomes, countries are increasingly turning to stimulus packages that emphasise investment in greening their economy. The weight of evidence indicates that spending directed towards green jobs is better at generating additional jobs than spending in other areas. This is because the majority of sustainable sectors are far more labour intensive than other sectors. For example, building a wind energy facility will generate jobs in constructing and maintaining turbines and will produce indirect employment in jobs associated with industries supplying intermediate goods for the turbines such as steel and transportation. The increased employment resulting from the investment in the wind facility will mean a greater level of spending, which will itself produce an induced employment effect. Thus, the employment effects from the wind plant will produce more jobs than a comparable non-renewable power source.

Making Green Jobs a reality

The ILO endeavours to become the recognised international organisation for dealing with the impact of climate change and other environmental challenges and opportunities in the *world of work*. To facilitate policymakers in developing their own assessments for sustainable development the green jobs team has created a handbook which includes a more in-depth introduction to the different methodologies available for assessing Green Jobs, a detailed analysis of several case studies and a bibliography detailing existing work on the topic. Please contact the Green Jobs Team for a copy.

The Green Jobs Programme of the International Labour Organization
For more information please refer to our homepage: *www.ilo.org/green-jobs-programme*
Policy paper written by Daniel Phillips and Marek Harsdorff