ITUC green jobs assessments research project
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Methodology Overview

Millennium Institute
1634 I Street NW, 3rd Floor
Washington, DC 20006, USA
Email: ab@millennium-institute.org
Website: www.millennium-institute.org

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1. Purpose of the study and deliverables

1.1. Project Justification

The creation of "green jobs" has been recognized as an important indicator for sustainable development. It is expected to provide decent work that improves the well-being of the population and social development, and to preserve the natural environment. The ongoing environmental deterioration due to human activities that seriously threatens current global economic and social development also has far-reaching implications for green jobs in terms of both number and quality of jobs.

By considering the potential for creating green jobs, we explore the opportunities and outlook for transitioning to a greener economy. Different countries will have to adapt different specific policies related to their current and anticipated future socio-economic development, and they will need to understand the implications across all sectors to assure both economic and environmental benefits occur in a synergetic manner, while minimizing possible negative impacts. National and sectoral modeling analysis is very relevant to demonstrate the required policies and benefits at the country level so policy makers understand what needs to be done, are able to build public support for the changes, and can monitor progress. They will also have to do this in concert with other countries so their national actions will promote positive synergies and not offset one another.

In line with ITUC's mission, in order to build trade unions' support for an environmentally-friendly agenda for Rio+20, and for fostering progress in the climate negotiations, there is a need to make the employment case of the green economy on a country by country and sector by sector basis. The study hereby proposed aims at filling this gap with an innovative, flexible and transparent methodology.

1.2 Project Goal and Outcomes

The goal of the project is to identify the amount of jobs that could be created (or transformed into green or decent jobs) in 12 countries under green investment scenarios, through the creation and simulation of a dynamic quantitative and transparent model that supports policy analysis.

The proposed project involves 12 countries and 6 sectors. The countries are:

- Europe (Germany, Spain, Bulgaria);
- The Americas (Brazil, Dominican Republic, US);
- Africa (South Africa, Ghana, Tunisia);
- Asia and the Pacific (Indonesia, Nepal, Australia).

For each country model, the following scenario analysis is conducted:

- **Simulation of green investments (2 percent of GDP) in four sectors for each country.** Simulation of a scenario where 2% of the annual GDP is oriented towards greening of 4 priority economic sectors (chosen from a cohort of 6 sectors) in a 1-5 year scenario timeframe for each country. The priority sectors across which the total investment has been disaggregated vary across countries.

For each sector and country, the number of jobs has been estimated as the key indicator to analyze the impact of green economy policies and investments.

2. Methodology

The starting point for the calculation of employment generation from green investments is the calculation of the actual investment allocated across all sectors considered. In the various scenarios analysed, this amount is obtained by multiplying GDP by the desired share to be simulated (e.g., 2% of GDP).

Once the total investment amount is known, it is disaggregated across sectors. In our analysis, for simplicity, we have initially decided to prioritize four sectors (e.g., energy, construction, manufacturing and agriculture in the case of Australia). The investment is divided using shares (or percentages) of the total amount, allocated to each of the sectors analysed.

More specifically, once the sectoral investment amount is known, the calculation of employment creation is as follows:

2.1 Energy

- The investment is divided by an average cost per MW (of power generating capacity) to obtain the total MW of power capacity that can be afforded with the amount invested. The average cost per MW is calculated using the IEA World Energy Outlook[1] assumptions on construction and O&M costs (disaggregated by region). The energy sources considered, based on which the average is calculated are biomass, solar PV and wind (geothermal and hydro have also similar costs, within the range considered).
- The amount of jobs created is the result of the multiplication of MW to be constructed (or affordable, see above) and the amount of jobs created per MW. This information is obtained from two studies.[2,3] The former, reviewing several available studies, provides information on jobs created per MW of power capacity by energy source and for manufacturing, construction/installation and O&M in the US. The latter instead, also reviewing several global studies, provides information on regional differences in labour intensity, which allows us to calculate jobs/MW for all countries analysed in this study. The coefficients utilized in our study are obtained by calculating the average of all the coefficients included in the studies above, and by adjusting regional coefficients using the Greenpeace report.
- <u>Nature of job creation</u>: additional, if new RE capacity does not replace plans for the construction of thermal power generation. The estimations for job creation in this sector include the manufacturing of RE capacity: if this instead takes place abroad and RE capacity (e.g., wind turbines and solar panels are imported), job creation would be considerably lower but still very similar (equal or slightly above) to conventional thermal power.

[1] International Energy Agency IEA (2010). World Energy Outlook 2010. Paris.

[2] Wei M., S. Patadia, and M. Kammen (2010). Putting Renewables and Energy Efficiency to Work: How Many Jobs Can the Clean Energy Industry Generate in the US? Energy Policy 38 (2010) 919-931.

[3] Greenpeace International (2009). Energy Sector Jobs to 2030: A Global Analysis.

Example of calculation: *As the methodology employed to estimate green energy employment is the same for all countries selected for this study, the calculation of US energy employment driven by green investment is explained below as an example.*

(1) Assuming that the capacity of power generation is a key factor for green energy employment, we first obtain the average cost per MW of power generating capacity based on assumptions for the IEA WEO report. Both construction and O&M costs are covered.

- US average cost per MW = Average ($ of cost per MW of power produced by biomass, solar PV and wind)

(2) Dividing the amount of green investment by the reference cost presented above gives us the total MW of investment-driven power capacity:

- US power capacity due to green investment = US green investment in energy / US average cost per MW

(3) The reference employment level per MW of power generating capacity is obtained as an average between values from the Wei et al. study[1] and the Greenpeace[1] report. For each energy source, the current global average value of jobs per MW is equal to the sum values for manufacturing, construction/installation and O&M, which are multiplied by learning factors include din the Greenpeace report to obtain future employment coefficients by sector and region.

(4) Finally, the employment coefficient per MW is multiplied by the US power capacity due to investment (obtained above) to get the total energy jobs created by green investment:

*- US energy employment from green investment = US MW of power capacity due to investment * energy jobs per MW*

2.2 Construction

- The green investment simulated is multiplied by an employment coefficient for the construction sector, expressed in "jobs per $ invested". This is calculated in two steps: first, an average of nine studies is calculated, and then, since these refer to the US (five),[4,5,6,7,8] Europe (three)[9,10,11] and Australia[12], the coefficient is adjusted using the labour intensity of each country analysed in this study. The country-specific labour intensities are estimated as the number of job created (from ILO[13]) per $ of value added in the construction sector (from UNSD[14]). These two data sources are also used to calculate labour intensities of the other sectors analysed in this study, and presented below.
- Nature of job creation: Additional. In this study the employment coefficients utilized are for retrofits and efficiency improvements, not for the construction of new buildings that comply with high environmental (e.g., energy) standards.

[4] Gold et al., Appliance and Equipment Efficiency Standards: A Moneymaker and Job Creator. ACEEE, 2011.

[5] ECONorthwest, Economic Multipliers and Metrics for Green Sector Strategies and Green Industries in Oregon. 2010.

[6] EPA, National Action Plan for Energy Efficiency (Washington, DC: June 2006).

[7] Apollo Alliance, New Energy for New America (Washington, DC: January 2004).

[8] Table II.2-2 from World Green Building Council Web site, www.usgbc.org, 9 November 2007.

[9] Joanne Wade, Victoria Wiltshire, and Ivan Scrase, National and Local Employment Impacts of Energy Efficiency Investment Programmes (London: Association for the Conservation of Energy, 2000).

[10] Carsten Petersdorff et al., Cost Effective Climate Protection in the Building Stock of the New EU Member States (Cologne, Germany: Ecofys, 2005).

[11] German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), "Question and Answer: Energy Efficiency Tips for Buildings and Heating," www.bmu.de/english/energy_efficiency/buildings/doc/38270.php, updated October 2006.

[12] Year Book Australia, 2002. The Construction Industry's Linkages with the Economy.

[13] ILO. LABORSTA: Total Employment by Economic Activity; Economically Active Population by Industry and Status in Employment. Available online at: http://laborsta.ilo.org/. Accessed on December 2011.

[14] UNSD (United Nations Statistics Division). National Accounts Estimates of Main Aggregates: Gross Value Added by Kind of Economic Activity: National Accounts Official Country Data. Available online at: http://data.un.org/Browse.aspx. Accessed on December 2011.

<u>Example of calculation:</u> As the methodology employed to estimate construction sector employment is the same for all countries selected for this study, the calculation for Brazil is described below as an example.

(1) First, we calculate the construction sector baseline employment coefficient, as an average ratio of employment over investment from nine studies, as indicated above:

- Construction baseline coefficient = average (construction sector employment / investment)

(2) As the baseline coefficient obtained above primarily depends on estimates of the US and other similarly developed countries, the construction employment coefficients for other countries are estimated by making country adjustments. The adjustment is based on the national employment coefficient per $ of value added (VA) compared to the US. The Brazil construction labour intensity, for instance, is calculated as:

*- Brazil construction labour intensity = construction baseline coefficient * Brazil construction jobs per VA indexed to US*

- Brazil construction jobs per VA indexed to US = Brazil construction jobs per VA / US construction jobs per VA

Where,

- Brazil construction jobs per VA = Brazil construction employment / Brazil construction value added

- US construction jobs per VA = US construction employment / US construction value added

Note that for each country the number of jobs per value added is calculated based on the latest year with data available by sector for both employment from ILO and value added from UNSD. The same year is used for all sectors for consistency, which is 2008 for most countries (Australia, Bulgaria, Indonesia, South Africa, Spain and the US), 2007 for (Brazil and Dominican Republic), 2000 for Ghana, 1999 for Nepal and 1997 for Tunisia.

(3) Finally, the employment created in the construction sector is obtained as construction employment coefficient (calculated above) times the amount of green investment allocated to the construction sector of the country:

*- Brazil construction green employment = Brazil construction labour intensity * Brazil green investment in construction*

2.3 Transport

- Employment in the transport sector is calculated using the same methodology describe in the construction sector, using two main reference studies (on the US[15] and Europe[16]) and UNEP's Green Jobs Report[17]. Further, the country adjustment is made using labour intensity (i.e. ratio of employment over value added, obtained from ILO and UNSD respectively) for the transport, storage and communications sector (ISIC-Rev.3 sector I) due to the lack of further disaggregated data that highlight transport in isolation.
- <u>Nature of job creation</u>: Additional, if this new investment does not replace existing plans to expand the road network or its maintenance, among others.

[15] ECONorthwest, Economic Multipliers and Metrics for Green Sector Strategies and Green Industries in Oregon. 2010.

[16] Heather Allen, Senior Manager for Sustainable Development, IAPT, Brussels, e-mail to Lucien Royer, Trade Union Advisory Committee to the OECD, Paris, 29 February 2008.

[17] UNEP, International Labor Organization (ILO), International Organization of Employers (IOE), and International Trade Union Confederation (ITUC), *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World* (2008).

Example of calculation: *Similar to the construction sector, the transport sector employment for each country is calculated in three steps. Taking Germany as an example:*

(1) First, we calculate the transport sector baseline employment coefficient, as an average ratio of job creation in public transport (with and without transit operations jobs) over sectoral investment, based on studies in Europe and the US:

- Transport baseline coefficient without operations = public transport jobs created without operations / investment in public transport

- Transport baseline coefficient without operations = (public transport jobs created without operations + additional transit operations jobs created) / investment in public transport

- Average transport baseline coefficient = (transport baseline coefficient with operations + transport baseline coefficient without operations) / 2

(2) Considering this coefficient as characterizing the US (or similar) transport labour intensity, we adjust it for other countries based on the national level of jobs per $ of value added (VA) compared to the US level. The Germany transport labour intensity, for instance, is calculated as:

*- Germany transport labour intensity = average transport baseline coefficient * Germany transport jobs per VA indexed to US*

- Germany transport jobs per VA indexed to US = Germany transport jobs per VA / US transport jobs per VA

As disaggregated data for transport sector is not provided by the ILO or UNSD, the employment coefficient per VA is calculated as the ratio of national employment over value added of the aggregated transport, storage and communications sector.

(3) Finally, the transport sector employment created in each country by green investments is calculated by multiplying the employment coefficient obtained above, by the amount of green investment allocated to transport sector in the country:

*Germany transport green employment = Germany transport labour intensity * Germany green investment in transport*

2.4 Manufacturing

- Employment in the manufacturing sector is calculated as in the case of construction and transport, using a reference study on Oregon[18], US for the calculation of the employment coefficient, on top of which a country adjustment is made based on the labour intensity (jobs per $ of value added) of the manufacturing sector in the countries analyzed. In this case, the Oregon study was chosen as it provides a higher level of detail relative to other studies, which normally focus more on waste reduction and reuse rather than on process and efficiency improvements. Our analysis therefore accounts for several potential interventions in the manufacturing sector (including improvements in efficiency and process), and excludes the construction of renewable energy power capacity, already included in the energy sector, to avoid double counting.
- Nature of job creation: Additional, as it refers primarily to EE improvements and process improvements.

[18] ECONorthwest, Economic Multipliers and Metrics for Green Sector Strategies and Green Industries in Oregon. 2010.

Example of calculation: *Similar to the construction sector, the manufacturing sector employment for each country is calculated in three steps. Spain is described below as an example:*

(1) First, we calculate the manufacturing sector baseline employment coefficient, as an average ratio of job creation in manufacturing over investment, based on the study on Oregon, US:

- Manufacturing baseline employment coefficient = Average (manufacturing jobs created / investment in manufacturing)

(2) Considering this coefficient as the US green manufacturing labour intensity, we adjust it for other countries based on the national jobs per $ of value added (VA) indicator, compared to the US level. The green manufacturing labour intensity for Spain, for instance, is calculated as:

*- Spain manufacturing labour intensity = manufacturing baseline coefficient * Spain manufacturing jobs per VA indexed to US*

- Spain manufacturing jobs per VA indexed to US = Spain manufacturing jobs per VA / US manufacturing jobs per VA

The number of green manufacturing jobs per VA is calculated as the ratio of national employment over value added of the manufacturing sector.

(3) Finally, the green manufacturing employment created in each country is calculated by multiplying manufacturing labour intensity obtained above, by the amount of green investment allocated to manufacturing sector in the country:

*- Spain manufacturing green employment = Spain manufacturing labour intensity * Spain green investment in manufacturing*

2.5 Agriculture

- Employment in the agriculture sector is calculated in several steps. First of all, the investment is divided by the cost to employ "green" or more ecological practices per ha of land. This cost is set at $200/ha[19]. This calculation gives us the total amount of ha that can be converted to ecological agriculture with the investment simulated.
- Utilizing the assumption that ecological agriculture requires on average 30% more labour than conventional practices[20], we multiply the country agriculture labour intensity (in terms of total agricultural sector jobs per ha of agricultural land, obtained from ILO and WDI respectively) by the land converted to obtain the total expected employment level in the agriculture (crop production) sector. For certain countries in which fishery, forestry and crop production (and employment) are grouped, the employment coefficient is reduced to avoid the overestimation of potential job creation.
- Nature of job creation: Additional, as it considers only the additional labour requirement when adopting ecological agriculture practices. In other words, in order to avoid double counting job creation, we only consider the additional 30% employment intensity under green agriculture practices to be the net additional job creation resulting from green investments in the agriculture sector.

[19] Khan, Z. R., Midega, C. A. O., Amudavi, D. M., Njuguna, E. M, Wanyama, J. W., and Pickett, J. A. (2008). Economic Performance of the 'Push-Pull' Technology for Stemborer and Striga Control in Smallholder Farming Systems in Western Kenya. Crop Protection 27: 1084-1097.

[20] Pretty, J. N., A. D. Noble, D. Bossio, J. Dixon, R. E. Hine, F. W. T. Penning de Vries, and J. I. L. Moriso. Resource-Conserving Agriculture Increases Yields in Developing Countries. *Environmental Science and Technology*, Vol. 40, No. 4, 2006.

Example of calculation: *The green agriculture employment created in the countries analysed is calculated as in the case of Tunisia:*

(1) Identifying land area as a key factor for employment in the agriculture sector, we first obtain the reference cost of converting to green agriculture practices (US$200/ha).

(2) Then, by dividing the amount of green investment by the reference cost above, the total ha of land that can be converted to ecological agriculture is calculated:

- Tunisia ecological agriculture land from investment = Tunisia green investment in agriculture / cost of ecological agriculture per ha

*- Tunisia green investment in agriculture = Tunisia green investment * share of Tunisia green investment allocated to the agriculture sector*

(3) In addition, the number of agriculture jobs per ha is estimated for each country, as:

- Tunisia agriculture jobs per ha = Tunisia agriculture employment / Tunisia agricultural land

The total agriculture, hunting and forestry sector is often used in the equation above (as total agriculture employment, primary sector) due to lack of disaggregated data. Thus, to estimate jobs in crop production the reference value is reduced (e.g., halved) for some of the countries studied (Brazil, Dominican Republic, Ghana, Indonesia, Nepal, Tunisia) where the number of non-crop primary sector jobs could be substantial. In the case of Tunisia, the equation is:

- Tunisia agriculture jobs per ha = Tunisia agriculture employment / Tunisia agricultural land / 2

(3) Considering the 30% higher labour intensity in ecological agriculture, the total additional jobs in the agriculture sector created by green investment is estimated by multiplying the ecological agriculture land converted from investment, by the agriculture employment coefficient per ha (obtained above) and the additional 30%:

*- Tunisia additional employment in ecological agriculture = Tunisia ecological agriculture land from investment * Tunisia agriculture jobs per ha * 30%*

2.6 Forestry

- Employment in the forestry sector, resulting from reforestation investments is calculated as in the case of agriculture. The average forest conservation cost is set at $433/ha[21] and the labour intensity per ha is obtained from UNEP/ILO[22].
- Nature of job creation: Additional, as it considers only the additional labour requirement for conserving forestland.

[21] In Costa Rica, the national government's National Forestry Financing Fund (FONAFIFO) has implemented a payment for environmental services (PES) program that has paid an average of US$433 per hectare of forest land over a five year period (ranging from US$205 to US$816 depending on the particular type of forest management practice) to land owners for forest protection, forest management, reforestation and other conservation techniques. http://www.fonafifo.go.cr/

[22] UNEP (2008). Green Jobs: Towards Decent Work In A Sustainable, Low-Carbon World. As part of the joint UNEP, ILO, IOE, ITUC Green Jobs Initiative.

Example of calculation: *The steps of calculating Indonesia forestry employment from reforestation investment are explained below, as it is the only country for which we assume the allocation of green investment to the forestry sector.*

(1) Similar to the agriculture sector, reforestation employment is assumed to be driven by the forestland area. We obtain the reference cost of US$433 per hectare of forestland based on the PES program in Costa Rica[1].

(2) Dividing the green investment by this reference cost gives the total ha of land reforested in the green investment scenario:

- Indonesia land reforested due to investment = Indonesia green investment in forestry / cost of reforestation employment per ha

(3) The reference number of reforestation jobs per ha is obtained from UNEP/ILO. Finally, to obtain the total reforestation jobs created by green investment, the employment factor is multiplied by the ha of land reforested:

*- Indonesia reforestation employment from green investment = Indonesia agriculture land from investment * Reforestation jobs per ha*

2.7 Water

- The calculation of water employment follows the same methodology applied for construction, transport and manufacturing, where we utilize an employment coefficient expressed as jobs/$ invested. The baseline coefficient is calculated using India's NREGA project[23], which is then adjusted by comparing to the level of employment per $ invested in the India water, electricity and gas supply sector (ISIC-Rev.3 sector E, due to lack of further disaggregation in the ILO and UNSD database). Country-specific employment coefficients are thus obtained by using the national labour intensity in the water and energy supply sector, as compared to India.
- Nature of job creation: Additional, as it considers only the additional labour requirement for conserving water and restoring watersheds.

[23] ILO 2010, NREGA – A review of Decent Work and Green Jobs.

Example of calculation: Since the calculation of water employment is the same for all the countries analysed, only the calculation for South Africa is described below:

(1) First, we calculate the water sector employment coefficient from the NREGA project, as ratio of NREGA project employment over NREGA investment, averaged for recent years (between 2006/2007 and 2009/2010):

- Water baseline employment coefficient = average (NREGA employment / NREGA investment)

(2) The second step consists in the estimation of the water sector labour intensity (i.e. number of jobs per $ of investment) for each of the countries analysed. This is obtained by multiplying the baseline employment coefficient from NREGA by an adjustment factor for India (to ensure consistency across countries) and then by the national labour intensity of each country studied. Thus the intensities of the countries analysed are adjusted to make sure that they reflect the NREGA labour requirement in the Indian context, but are then adjusted at the country level. The equations of South Africa water labour intensity is:

*- South Africa water labour intensity = baseline coefficient from NREGA * South Africa water jobs per VA indexed to India * water adjustment factor*

Here, similar to the construction, transport and manufacturing sectors, South Africa water labour intensity indexed to India is defined as the ratio of South Africa water labour intensity (measured by number of jobs per $ of value added) over the India level:

- South Africa water jobs per VA indexed to India = South Africa water jobs per VA / India water jobs per VA

Where South Africa water jobs per VA is measured as employment divided by value added of the South Africa water, electricity and gas supply sector. The same measurement is used for India. As mentioned above, the aggregated water, electricity and gas supply sector is used due to lack of disaggregated data for the water sector only.

In addition, the water adjustment factor is obtained by comparing the number of jobs created by the NREGA investment using India water labour intensity, with the NREGA employment figures:

*- Water adjustment factor = India water labour intensity * NREGA investment / NREGA employment*

Here the India water labour intensity is equal to employment divided by investment in the India water, electricity and gas supply sector, due to lack of data.

(3) Finally, the green employment created in the water sector is obtained as water labour intensity times the amount of green investment allocated to water sector:

*- South Africa water green employment = South Africa water labour intensity * South Africa green investment in water*

3 Definition of Scenarios

Considering that green scenarios would generally aim for (1) resource efficiency, (2) low carbon development and (3) economic growth and employment creation, the policies and data listed below aim at capturing these three goals, with particular emphasis on employment creation.

3.1 Countries

Twelve (12) countries are covered that span four geographic regions as described below. The countries have been identified to also reflect a fair distribution across developing and developed countries.

The allocation of investments (for a total of 2% of GDP) is as follows:

- Europe
    - Germany

  - Spain
  - Bulgaria

For European countries it seems more relevant to focus on (A) energy, (B) manufacturing, (C) construction and (D) transport. Energy is crucial to economic productivity, and Europe has leaders in RE to learn from. Manufacturing is under considerable pressure and increasing its productivity is high on the agenda of all developed countries. Construction is struggling after the boom and bust of the ahead of the 2008-2010 crisis. The current stock of buildings has to be retrofitted and employment has to be brought back to the sector. Transport is currently highly relying on fossil fuels in many countries and a transition to low carbon public transport would increase efficiency and create employment in infrastructure construction (e.g. rail).

- The Americas
  - Brazil
  - Dominican Republic
  - US

While the US would have the same focus as European countries, Brazil and the Dominican Republic would focus more on infrastructure and the environment: (A) energy, (B) transport, (C) construction, (D) agriculture or forestry. These sectors are relatively more relevant than others in transitioning countries.

- Africa
  - South Africa
  - Ghana
  - Tunisia

Concerning African countries, the focus should be on basic services, including (A) energy -to promote energy access-, (B) water -for improved sanitation and access-, (C) agriculture -for economic development- and (D) transport -for access to basic services (e.g. health) and productivity-.

- Asia and the Pacific
  - Indonesia
  - Nepal
  - Australia

In Asia and the Pacific, for the countries selected, focus should be put on natural resources, such (A) agriculture or forestry and (B) water. (C) Energy also plays a very important role in these countries and (D) transport is becoming more and more relevant for the trade of natural resources.

Table 1 presents the investment allocations per country and sectors as a share of the 2% of GDP investment.

Table 1. Percentage allocation of sectoral investments of a 2% share of GDP for countries studied.

SHARES	Energy	Construction	Transport	Manufacturing	Agriculture	Forestry	Water
Australia	0.3	0.3	0.2	0.2			
Brazil	0.3	0.2	0.3		0.2		
Bulgaria	0.3	0.3	0.2	0.2			
Dominican Republic	0.4	0.25	0.3		0.05		
Germany	0.3	0.3	0.2	0.2			
Ghana	0.3	0.2			0.3		0.2
Indonesia	0.4	0.2	0.3			0.1	
Nepal	0.3	0.2			0.2		0.3
South Africa	0.3	0.3	0.2				0.2
Spain	0.3	0.3	0.2	0.2			
Tunisia	0.3	0.3			0.2		0.2
USA	0.3	0.3	0.2	0.2			

3.2 Presentation of key results across countries

It must be noted that the analysis and data collection are made within the context of the formal economy for all countries. Substantial differences may exist between countries on the quantity and magnitude of activities which are neither taxed nor monitored.

Table 2 below indicates the investment allocated across countries and sectors. Tables 3(a) and 3(b) provide an overview of job creation across countries, and sectors. A total of 8,760,306 jobs are generated from a total investment of $320.2 Bn. Most jobs would be created per million dollars invested in Nepal, followed by Indonesia and Ghana, while the highest quantity of jobs would be created in the United States, followed by Brazil and Indonesia. Worth noting, certain employment coefficients are very high, primarily due to lack of data and studies that cover the context of developing and transitioning countries, where labor intensity is very high.

Table 2. Overview of total investments across countries and priority sectors, USD.

INVESTMENT	Energy	Construction	Transport	Manufacturing	Agriculture	Forestry	Water
Australia	3,288,604,143	3,288,604,143	2,192,402,762	2,192,402,762	0	0	0
Brazil	5,113,784,379	3,409,189,586	5,113,784,379	0	3,409,189,586	0	0
Bulgaria	115,016,562	115,016,562	76,677,708	76,677,708	0	0	0
Dominican Republic	298,436,391	186,522,745	223,827,294	0	37,304,549	0	0
Germany	11,991,915,423	11,991,915,423	7,994,610,282	7,994,610,282	0	0	0
Ghana	49,083,608	32,722,405	0	0	49,083,608	0	32,722,405
Indonesia	2,068,678,841	1,034,339,420	1,551,509,131	0	0	517,169,710	0
Nepal	46,120,697	30,747,131	0	0	30,747,131	0	46,120,697
South Africa	1,092,369,401	1,092,369,401	728,246,267	0	0	0	728,246,267
Spain	4,280,184,780	4,280,184,780	2,853,456,520	2,853,456,520	0	0	0
Tunisia	175,589,251	175,589,251	0	0	117,059,501	0	117,059,501
USA	68,142,411,340	68,142,411,340	45,428,274,227	45,428,274,227	0	0	0

Table 3a. Job creation per country over a 1-5 year timeframe (high results). The number of jobs created for every million USD invested is also listed.

	1 yr job creation	share of employment	5 yr job creation	share of employment	Jobs per Mn $ invested
Australia	183,821	1.71%	919,106	8.56%	16.8
Brazil	2,153,520	2.37%	10,767,602	11.86%	126.3
Bulgaria	35,466	1.06%	177,331	5.28%	92.5
Dominican Republic	87,213	2.46%	436,067	12.28%	116.9
Germany	967,992	2.50%	4,839,959	12.50%	24.2
Ghana	33,914	0.35%	169,569	1.77%	207.3
Indonesia	1,270,390	1.24%	6,351,949	6.19%	245.6
Nepal	89,165	0.76%	445,823	3.78%	580.0
South Africa	300,586	2.19%	1,502,932	10.96%	82.6
Spain	357,068	1.76%	1,785,342	8.81%	25.0
Tunisia	61,438	1.89%	307,189	9.45%	105.0
USA	4,147,168	2.85%	20,735,841	14.26%	18.3

Table 3b. Breakdown of job creation per million $ investment (with 15% confidence level[24]) in priority sectors for countries studied.

Jobs/Mn $	Energy	Construction	Transport	Manufacturing	Agriculture	Forestry	Water
Australia	4 - 6	15 - 21	26 - 35	7 - 9			
Brazil	9 - 12	134 - 182	185 - 250		42 - 56		
Bulgaria	10 - 13	78 - 106	153 - 207	56 - 76			
Dominican Republic	9 - 12	88 - 119	181 - 245		128 - 173		
Germany	5 - 6	23 - 31	40 - 54	8 - 11			
Ghana	31 - 42	332 - 449			215 - 291		65 - 88
Indonesia	12 - 17	160 - 217	478 - 646			13 - 18	
Nepal	12 - 17	739 - 999			1,173 - 1,588		142 - 192
South Africa	11 - 16	122 - 165	93 - 126				12 - 16
Spain	5 - 6	17 - 24	48 - 65	11 - 15			
Tunisia	31 - 42	145 - 197			115 - 156		8 - 11
USA	4 - 6	20 - 27	26 - 35	6 - 7			

[24] Note that in countries where labor has been reduced in favor of capital investment during the recent financial and economic crisis, the lower bound of job creation estimated in our study may be more likely (and realistic) than the upper estimate.

Annex I: Notes on the key references utilized

Energy

The main references used for the analysis of the energy sector are:

- International Energy Agency IEA (2011). World Energy Outlook 2011. Paris.
- Wei M., S. Patadia, and M. Kammen (2010). Putting Renewables and Energy Efficiency to Work: How Many Jobs Can the Clean Energy Industry Generate in the US? Energy Policy 38 (2010) 919-931.
- Greenpeace International (2009). Energy Sector Jobs to 2030: A Global Analysis.
  - More details on the methodology used in the Greenpeace report are available in *Rutovitz, J., Atherton, A. 2009, Energy sector jobs to 2030: a global analysis. Prepared for Greenpeace International by the Institute for Sustainable Futures, University of Technology, Sydney.*

The employment coefficients used in this study are calculated as the average of those presented in the studies above (each of which surveys several sources of energy employment coefficients). Further:

- Only direct employment in development, construction, manufacturing, operations and maintenance, and fuel supply is included in the employment coefficients calculated.
- Construction, installation, manufacturing and development (CMI), as well as operations and maintenance (O&M) are all expressed in terms of job years per MW new capacity.
- The employment factors presented in Table X2 below are all for OECD countries or regions. These are further adjusted at the national level to:
  - Take account of differing stages of economic development by using regional job multipliers.
  - Take account of the proportion of manufacturing that occurs locally by using local manufacturing percentages.
  - Take account of the reduction in technology costs and the corresponding fall in employment per MW by using decline factors.

Table X1. Key characteristics of power supply options: costs, efficiency and capacity factor.

United States values	Construction cost	O&M cost	Efficiency	Capacity factor
	$10/kW	$10/kW	%	%
Coal Subcritical	1800	45	39%	
Gas turbine	500	20	38%	
Nuclear	4600	104	33%	
Biomass CHP Medium	3845	146	70%	68%
Biomass - waste incineration	8000	304	50%	65%
Hydropower – Large scale	2485	62	100%	33%
Wind onshore	1785	27	100%	27%
Solar PV - Large scale	3075	46	100%	19%
Geothermal	2055	42	15%	76%
Marine	6275	189	100%	48%

Table X2. Employment coefficients per MW, by energy source 2010-2015.

GLOBAL average	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Construction and Installation (C/I)						
Coal	14.397	14.2674	14.1390	14.0118	13.8857	13.7607
Gas	3.399	3.3854	3.3719	3.3584	3.3449	3.3316
Nuclear	16.000	16.0000	16.0000	16.0000	16.0000	16.0000
Biomass	3.900	3.8610	3.8224	3.7842	3.7463	3.7089
Hydro	10.800	10.8648	10.9300	10.9956	11.0615	11.1279
Wind (onshore)	2.900	2.8594	2.8194	2.7799	2.7410	2.7026
Wind (offshore)	4.800	4.6128	4.4329	4.2600	4.0939	3.9342
PV	29.300	27.2842	25.4070	23.6590	22.0313	20.5155
Geothermal	3.100	3.0287	2.9590	2.8910	2.8245	2.7595
Solar thermal	6.000	6.0000	6.0000	6.0000	6.0000	6.0000
Ocean	9.000	8.2980	7.6508	7.0540	6.5038	5.9965
Manufacturing (M)						
Coal	0.003	0.0030	0.0029	0.0029	0.0029	0.0029
Gas	0.001	0.0010	0.0010	0.0010	0.0010	0.0010
Nuclear						
Biomass	0.400	0.3960	0.3920	0.3881	0.3842	0.3804
Hydro	0.500	0.5030	0.5060	0.5091	0.5121	0.5152
Wind (onshore)	12.500	12.3250	12.1525	11.9823	11.8146	11.6492
Wind (offshore)	24.000	23.0640	22.1645	21.3001	20.4694	19.6711
PV	9.100	8.4739	7.8909	7.3480	6.8425	6.3717
Geothermal	3.300	3.2241	3.1499	3.0775	3.0067	2.9376
Solar thermal	4.000	4.0000	4.0000	4.0000	4.0000	4.0000
Ocean	1.000	0.9220	0.8501	0.7838	0.7226	0.6663
Operations and Management (O&M)						
Coal	0.22	0.2131	0.2111	0.2092	0.2074	0.2055
Gas	0.29	0.2839	0.2827	0.2816	0.2805	0.2793
Nuclear	0.52	0.5150	0.5150	0.5150	0.5150	0.5150
Biomass	2.06	2.0361	2.0157	1.9956	1.9756	1.9559
Hydro	0.22	0.2213	0.2226	0.2240	0.2253	0.2267
Wind (onshore)	0.27	0.2646	0.2609	0.2572	0.2536	0.2501
Wind (offshore)	0.77	0.7400	0.7111	0.6834	0.6567	0.6311
PV	0.47	0.4400	0.4097	0.3815	0.3553	0.3308
Geothermal	1.48	1.4411	1.4079	1.3755	1.3439	1.3130
Solar thermal	0.48	0.4750	0.4750	0.4750	0.4750	0.4750
Ocean	0.32	0.2950	0.2720	0.2508	0.2312	0.2132

Construction

The main references used for the analysis of the energy sector are:

- Apollo Alliance, New Energy for New America (Washington, DC: January 2004).
- Carsten Petersdorff et al., Cost Effective Climate Protection in the Building Stock of the New EU Member States (Cologne, Germany: Ecofys, 2005).
- ECONorthwest, Economic Multipliers and Metrics for Green Sector Strategies and Green

Industries in Oregon. 2010.

- EPA, National Action Plan for Energy Efficiency (Washington, DC: June 2006).
- German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), "Question and Answer: Energy Efficiency Tips for Buildings and Heating," www.bmu.de/english/energy_efficiency/buildings/doc/38270.php, updated October 2006.
- Gold et al., Appliance and Equipment Efficiency Standards: A Moneymaker and Job Creator. ACEEE, 2011.
- Joanne Wade, Victoria Wiltshire, and Ivan Scrase, National and Local Employment Impacts of Energy Efficiency Investment Programmes (London: Association for the Conservation of Energy, 2000).
- Table II.2-2 from World Green Building Council Web site, www.usgbc.org, 9 November 2007.
- Year Book Australia, 2002. The Construction Industry's Linkages with the Economy.

Our study utilizes employment coefficients for the construction sector calculated from the sources above, and adjustments are made at the national level. The employment coefficient considers direct employment for a variety of interventions in the construction sector. Selected excerpts are presented below, to highlight the characteristics of the studies (and coefficients) utilized.

Germany

Germany's large Building Rehabilitation Program is part of the government's Energy Concept 2050 that includes the goal of achieving a "climate-neutral building stock" by 2050. Established in January 2001 in response to an economic crisis in the building sector, the Programme provides favourable loans for the retrofitting of buildings to improve energy efficiency. In the first five years, around 342,000 energy upgrades for homes had received support under the program. The Programme was expanded as part of the economic stimulus package in response to the recent global economic crisis. Data shows that every Euro of public funding invested 'crowds in' four Euros of private investment. These investments recover their cost through energy savings, avoid large amounts of greenhouse gas emissions and stimulate the labour market: 1 billion invested in the building stock safeguards or creates around 25,000 jobs.

Source: German Federal Ministry of Transport, Building and Urban Development 2010: http://www.bmvbs.de/SharedDocs/EN/Artikel/IR/the-german-government-s-climate-change-programme

Brazil

The Brazilian social housing program "My Home My Life" was launched in March 2009. It provides housing for low-income families, integrating solar water heating where appropriate. Poor households around the world spend a disproportionately high share of their income on energy. Solar water heaters significantly reduce the energy expenditure of users and help to contain peak load on the electricity grid. In the first phase of 2009-2010, out of 350,000 build houses 40,000 households had benefited from a solar water heater. The second phase of the housing program foresees the construction of 2 million new homes, of which 1.2 million are going to be reserved for low-income families. As of 2011 up to 500,000 houses are expected to be equipped. It is estimated that this will generate 30.000 green jobs over the next four years not including employment created through the construction work itself.

Source: ILO Office Brazil

Europe

More specific to the residential sector, the study determined that for every €1 million ($1.37 million) spent in energy-efficiency programs, 11.3 to 13.5 full-time equivalent jobs were created. Jobs were created mainly in the installation and delivery of new efficient materials or equipment, but also in management, administration, auditing, and research and development.

Source: Joanne Wade, Victoria Wiltshire, and Ivan Scrase, National and Local Employment Impacts of Energy Efficiency Investment Programmes (London: Association for the Conservation of Energy, 2000). Sophie Dupressoir et al., Climate Change and Employment: Impact on Employment in the European Union-25 of Climate Change and CO2 Emission Reduction Measures by 2030 (Brussels: European Trade Union Confederation (ETUC), Instituto Sindical de Trabajo, Ambiente y Salud (ISTAS), Social Development Agency (SDA), Syndex, and Wuppertal Institute, 2007).

Australia

For every $1m spent on construction output (houses, non-residential buildings, etc.) in 1996-97, a possible $2.9m in output would be generated in the economy as a whole, giving rise to 9 jobs in the construction industry (the initial employment effect), and 37 jobs in the economy as a whole from all effects.

Source: Year Book Australia, 2002. The Construction Industry's Linkages with the Economy.

USA

The impact of $1 Mn in consumer energy bill savings implies a net gain of roughly 10 jobs (or about 17 jobs supported by a more typical set of consumer purchases compared to the 17 jobs supported by electric and natural gas utilities)

Source: Gold et al., Appliance and Equipment Efficiency Standards: A Moneymaker and Job Creator. ACEEE, 2011.

Transport

Several studies on employment were reviewed, and the main references used for the analysis of the transport sector are:

- UNEP, International Labor Organization (ILO), International Organization of Employers (IOE), and International Trade Union Confederation (ITUC), *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World* (2008).
- Heather Allen, Senior Manager for Sustainable Development, IAPT, Brussels, e-mail to Lucien Royer, Trade Union Advisory Committee to the OECD, Paris, 29 February 2008.
- ECONorthwest, Economic Multipliers and Metrics for Green Sector Strategies and Green Industries in Oregon. 2010.

An excerpt and two tables are presented below, to highlight the characteristics of the studies used and the coefficients utilized.

According to the International Association of Public Transport (UITP), an estimated 900,000 people are employed in urban public transport in the 25 member states of the European Union. UITP has 2,900 members from 90 countries, and national statistics from these countries suggest that the number of direct jobs in public transport amounts to about 1–2 percent of total employment. In European economies, public transit investments seem to have a multiplier effect of 2 to 2.5. But in countries that focus intensely on public transport, such as Switzerland, every direct job is linked to as many as 4.1 indirect jobs. Studies in Europe and the United States show that about 30 jobs are created for each $1.4 million (€1 million) invested in public transport infrastructure, and 57 jobs for the same level of investment on the transit operations side.

Source: UNEP, International Labor Organization (ILO), International Organization of Employers (IOE), and International Trade Union Confederation (ITUC), Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World (2008).

Figure X1. Economic impacts per US$1 million expenditures (Source: United Nations Environment Programme (UNEP), *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication* (2011).

Expense category	Value added 2006 dollars	Employment FTEs	Compensation 2006 dollars
Auto fuel	1,139,110	12.8	516,438
Other vehicle expenses	1,088,845	13.7	600,082
Household bundles			
Including auto expenses	1,278,440	17.0	625,533
Redistributed auto expenses	1,292,362	17.3	627,465
Public transit	1,815,823	31.3	1,591,993

Figure X2. Total economic impacts per million dollars of output for green transportation (Source: ECONorthwest, 2010).

Industry	Output	Gross State Product (a+b+c)	Personal Income (a)	Other Income (b)	Indirect Business Taxes (c)	Jobs	State and Local Taxes and Fees
Electric Vehicle	$1,338,027	$236,130	$155,119	$64,815	$16,196	2.8	$23,085
Batteries	$1,723,648	$670,771	$415,577	$208,538	$46,656	7.9	$66,345
Fuel cells	$1,811,581	$823,989	$528,513	$244,913	$50,563	8.9	$76,038
Emissions control and testing equipment	$1,819,678	$783,773	$581,289	$156,618	$45,866	7.8	$69,804
Drive trains and electric motors	$1,675,567	$708,675	$375,378	$291,467	$41,830	6.4	$64,852
Charging station equipment	$1,855,863	$847,123	$362,439	$242,342	$242,342	7.3	$62,576
Installation residential chargers	$1,882,594	$1,036,493	$744,851	$240,414	$51,228	17.1	$85,605
Average All	$1,729,565	$729,565	$451,881	$207,015	$70,669	8.3	$64,044

*Note: Indirect business taxes are a subset of state and local taxes, and the two should not be added together

Manufacturing

Several studies on employment were reviewed, and the main references used for the analysis of the manufacturing sector are:

- ECONorthwest, Economic Multipliers and Metrics for Green Sector Strategies and Green Industries in Oregon. 2010.

- Garrett-Peltier, H., Employment Estimates for Energy Efficiency Retrofits of Commercial Buildings, Political Economy Research Institute University of Massachusetts, Amherst, 2011.

Figures X3 and X4 highlight the main results of the studies mentioned above, with details on the nature of job creation and on the interventions analysed. Our study considers an average of the impacts without analysing individually specific interventions nor technology options.

Figure X3. Total economic impacts per million dollars in spending on energy efficiency, by sector and measure (Source: ECONorthwest, 2010).

Sector / Measure	Output	Gross State Product (a+b+c)	Personal Income (a)	Other Income (b)	Indirect Business Taxes (c)	Jobs	State and Local Taxes and Fees
Residential							
Lighting	$724,279	$407,487	$252,965	$136,131	$18,391	5.9	$32,833
HVAC	$922,625	$523,779	$330,415	$170,047	$23,317	7.9	$41,946
Water heating	$466,614	$252,178	$150,679	$90,098	$11,401	3.5	$20,390
Appliances	$590,736	$332,684	$211,632	$98,173	$22,879	5.0	$32,846
Weatherization	$1,195,124	$648,035	$408,666	$209,696	$29,673	9.5	$52,480
Residential All (average)	$779,876	$432,833	$270,871	$140,829	$21,132	6.4	$36,099
Commercial							
Lighting	$899,888	$476,873	$358,575	$93,522	$24,776	6.9	$40,070
HVAC	$825,019	$426,923	$324,541	$79,960	$22,422	6.3	$36,030
Water heating	$445,542	$216,420	$161,035	$43,836	$11,549	3.1	$18,435
Appliances	$533,095	$264,469	$197,989	$52,330	$14,150	3.8	$22,545
Weatherization (insulation)	$1,191,368	$618,292	$463,619	$122,362	$32,311	8.8	$52,131
Controls	$676,152	$361,713	$281,365	$61,567	$18,781	5.5	$30,302
Motors and drives	$348,091	$185,291	$140,508	$34,920	$9,863	2.6	$15,742
Commercial All (average)	$702,736	$364,283	$275,376	$69,785	$19,122	5.3	$30,751
Industrial							
Lighting	$899,888	$476,873	$358,575	$93,522	$24,776	6.9	$40,070
Weatherization (insulation)	$1,191,368	$618,292	$463,619	$122,362	$32,311	8.8	$52,131
Motors and drives	$348,091	$185,291	$140,508	$34,920	$9,863	2.6	$15,742
Irrigation	$768,527	$323,232	$217,458	$87,683	$18,091	4.2	$28,406
HVAC	$658,545	$332,641	$249,688	$65,329	$17,624	4.8	$28,221
Industrial All (average)	$773,284	$387,266	$285,970	$80,763	$20,533	5.5	$32,914
Efficiency All (average)	$746,174	$391,204	$277,167	$93,909	$20,128	5.7	$32,960
Other							
Energy audits	$1,875,878	$1,038,367	$737,015	$254,733	$46,619	14.4	$82,605
Household energy savings	$1,308,413	$741,517	$420,971	$245,600	$74,946	11.0	$92,066

*Notes:
1. Indirect business taxes are a subset of state and local taxes, and the two should not be added together.
2. Sector averages are simple averages.

Figure X4. Total economic impacts per million dollars in spending on the manufacture and installation of various technologies (Source: PERI, 2011).

EE technology group	*Direct employment per $1 million*	*Indirect employment per $1 million*	*Induced employment per $1 million*	*Total employment per $1 million*
Lighting	5.1	4.2	3.7	12.9
HVAC	5.3	4.2	3.8	13.3
Motors and drives	4.5	3.9	3.4	11.9
Water heating	5.0	4.1	3.6	12.6
Office equipment	3.8	3.7	3.0	10.5
Environmental controls	5.0	4.3	3.7	13.0
Envelope improvements	7.7	3.9	4.7	16.3
Straight average	5.1	4.0	3.7	12.8
Weighted average	5.7	4.1	3.9	13.6

Agriculture

Several studies on employment were reviewed, and the main references used for the analysis of the agriculture sector are:

- Pretty, J. N., A. D. Noble, D. Bossio, J. Dixon, R. E. Hine, F. W. T. Penning de Vries, and J. I. L. Moriso. Resource-Conserving Agriculture Increases Yields in Developing Countries. *Environmental Science and Technology*, Vol. 40, No. 4, 2006.
- Khan, Z. R., Midega, C. A. O., Amudavi, D. M., Njuguna, E. M, Wanyama, J. W., and Pickett, J. A. (2008). Economic Performance of the 'Push-Pull' Technology for Stemborer and Striga Control in Smallholder Farming Systems in Western Kenya. Crop Protection 27: 1084-1097.
- UNEP, International Labor Organization (ILO), International Organization of Employers (IOE), and International Trade Union Confederation (ITUC), *Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World* (2008).
- United Nations Environment Programme (UNEP), *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication* (2011).

Two excerpts are presented below, to highlight the characteristics of the studies used and the coefficients utilized.

The GHK report, "Links between the Environment, Economy and Jobs" (2007) shows strong links between the economy and the environment, and evaluates the broad impact of environmental policies on jobs, outputs and the added value of environment rehabilitation and conservation activities. Policies to ensure the protection of our environment should not be viewed as imposing a depressing effect on the economy. In fact, they may to be a source of new jobs and innovation that help increase economic health and social wellbeing. In particular, the study estimates that in the entire EU-27 economy there were 500,000 full-time equivalent jobs in organic farming as of 2000: 300,000 direct (directly engaged in farming), 151,000 indirect (indirectly engaged through employment in organic agricultural supply chains), and 48,000 induced (additional jobs generated by the expenditure of incomes earned by direct and indirect labor). This study provides direct, indirect and induced output and gross value added data for the sector as well, from which Type I (i.e. direct) and Type II (i.e. indirect and induced) multipliers are calculated to reflect the relationship between direct impacts and the consequential indirect or induced effects. Using these multipliers, the scenario of a 10% demand shift from conventional to organic farming is expected to have a net gain of 43,834 jobs (66,012 direct jobs less 22,718 indirect) jobs lost in the agrichemical input supply chain) in EU 27 countries.

Sources: GHK Consulting (2007). Links between the Environment, Economy and Jobs. In association with Cambridge Econometrics CE and Institute of European Environmental Policy IEEP. Herren, H.R., A.M. Bassi, Z. Tan, W.P. Binns (2012). Green Jobs for a Revitalized Food and Agriculture Sector. Millennium Institute, for the Natural Resources Management and Environment Department, Food and Agriculture Organization of the United Nations.

An economic study of the performance of "Push Pull" farming in Kenya concluded that its innovative multi-cropping practices provided both stem borer and Striga weed control, natural nitrogen fixation in soils, improved maize yields, provided fodder for livestock and utilized manure as an organic fertilizer. These evocative green agriculture techniques required between 20 and 30 per cent higher labor requirements than conventional local farming practices (Khan et al, 2008). However, the significantly higher crop yields and total farm outputs resulted in higher earnings per day of labor on the Push Pull farms.

An economic analysis of a "Push-Pull" field trial in East Africa with 21,300 farmers found that they achieved higher net returns on their land and labor (Khan et al, 2008), with an average economic gain a factor of 2.5 relative to cost. Even when considering the increased level of labor inputs for Push Pull, the income returns for labor was 3.7 USD/man day with Push Pull as opposed to 1 USD/man day with their previous maize mono cropping practice. The gross revenues range between 424 and 880 USD/ha under Push Pull and 81.9 to 132USD/ha in maize mono crop. Similar systems are being field trialed for other cropping systems and it is likely that comparable rates of return will be realized.

Sources: Khan, Z. R., Midega, C. A. O., Amudavi, D. M., Njuguna, E. M, Wanyama, J. W., and Pickett, J. A. (2008). Economic Performance of the 'Push-Pull' Technology for Stemborer and Striga Control in Smallholder Farming Systems in Western Kenya. Crop Protection 27: 1084-1097. Herren, H.R., A.M. Bassi, Z. Tan, W.P. Binns (2012). Green Jobs for a Revitalized Food and Agriculture Sector. Millennium Institute, for the Natural Resources Management and Environment Department, Food and Agriculture Organization of the United Nations.

Forestry

Several studies on employment were reviewed, and the main references used for the analysis of the forestry sector are:

- In Costa Rica, the national government's National Forestry Financing Fund (FONAFIFO) has implemented a payment for environmental services (PES) program that has paid an average of US$433 per hectare of forest land over a five year period (ranging from US$205 to US$816 depending on the particular type of forest management practice) to land owners for forest protection, forest management, reforestation and other conservation techniques. http://www.fonafifo.go.cr/
- UNEP (2008). Green Jobs: Towards Decent Work In A Sustainable, Low-Carbon World. As part of the joint UNEP, ILO, IOE, ITUC Green Jobs Initiative.
- United Nations Environment Programme (UNEP), *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication* (2011).

Two excerpts are presented below, to highlight the characteristics of the studies used and the coefficients utilized.

In Costa Rica, the national government's National Forestry Financing Fund (FONAFIFO) has implemented a payment for environmental services (PES) program that has paid an average of US$433 per hectare of forest land over a five year period (ranging from US$205 to

US$816 depending on the particular type of forest management practice) to land owners for forest protection, forest management, reforestation and other conservation techniques. FONAFIFO is funded by a national tax on fossil fuel use in Costa Rica. Between 1997 and 2008 FONAFIFO distributed US$206 million, the majority of which were for forest protection (73%), covering 460 thousand hectares of forest, indicating an average annual cost of $327 per ha (FONAFIFO, 2010). Besides PES, Costa Rican private companies could invest in forest conservation (mainly for emissions mitigation) with Certificates of Environmental Services (CES). FONAFIFO (2010) estimates a CES value of US$285 per ha for 7,000 hectares of forest conservation work in the Guanacaste region.

Source: UNEP (2008). Green Jobs: Towards Decent Work In A Sustainable, Low-Carbon World. As part of the joint UNEP, ILO, IOE, ITUC Green Jobs Initiative.

Investing in protected areas may bring economic benefits to the national economy in the long term. Some countries have been able to build up a lucrative nature-based tourism industry, which has brought in foreign exchange and generated employment. For example Costa Rica, where protected areas received more than 1 million visitors per year in the five years up to 2006, generated entrance-fee revenue of over US$5 million in 2005 and directly employed 500 people (Robalino et al. 2010). Protected areas in Latin America receive large numbers of visitors and generate many associated jobs, for example, 14 million visitors per year and 25,000 jobs in Mexico (Ibid.).

Source: United Nations Environment Programme (UNEP), Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication (2011).

Water

Several studies on employment were reviewed, and the main reference used for the analysis of the water sector is:

- ILO 2010, NREGA – A review of Decent Work and Green Jobs.

An excerpt is presented below, to highlight the characteristics of the NREGA project and coefficients utilized.

The National Rural Employment Guarantee Scheme (NREGS) has been devised as a public work programme "to provide for the enhancement of livelihood security of the households in rural areas by providing at least 100 days of guaranteed wage employment in every financial year to every household whose adult members volunteer to do unskilled manual work.

Categories of works eligible under NREGS are inter alia water conservation, drought-proofing (including plantation and afforestation), flood protection, small-scale irrigation, horticulture and land development. Environmental protection and conservation constitute the lion share of work performed.

The programme has an economic as well as a social and environmental function and is part of the broader sustainable development agenda. The Government of India has an active policy in this regard which includes the National Action Plan on Climate Change (NAPCC 2008) and an interministerial Task Force to deal with the employment issues related to Climate Change, renewable energies and Green Jobs.

Source: ILO 2010, NREGA – A review of Decent Work and Green Jobs.

Tables X3a and X3b below present the main impacts of the NREGA project. Country adjustments are made to coherently calculate employment creation in the countries analysed in our study.

Table X3a. NREGA, Total Employment and Investment.

	2006/2007	**2007/2008**	**2008/2009**	**2009/2010**
Investment, in billion US$	2	3.5	5.6	8.1
Number of beneficiary households, in million	21	33	45	59
Number of working days, in million	907	1437	2163	3000
US$ per household	*95.24*	*106.06*	*124.44*	*137.29*
Full time man/year	2,484,932	3,936,986	5,926,027	8,219,178
US$ per full time man/year	*804.85*	*889.00*	*944.98*	*985.50*

Table X3b. NREGA, employment coefficients.

Average *US$ spent per full time man/year*	**Water NREGA baseline multiplier (jobs per M$)**
906.08	1103.65