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Cambodia Green Jobs

How the Greening of the Cambodian Economy can Impact Cambodia's Jobs and how to Prepare the Workforce

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Acknowledgments

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Executive summary

Context and Rationale

Cambodia has made a bold commitment to achieve net-zero emissions by 2050, with an intermediate target of reducing emissions by 42 percent below business-as-usual by 2030. This ambition, outlined in the Cambodia Long-Term Strategy for Carbon Neutrality (LTS4CN), is shaped not only by domestic priorities but also by the climate commitments of major export partners, notably the European Union. The EU's Carbon Border Adjustment Mechanism (CBAM), set to expand by 2030, will require Cambodia—whose exports to the EU account for 70 percent of total goods—to adapt its production processes and energy sources to meet new standards. While these global shifts present challenges, they also offer opportunities for Cambodia to participate in emerging green value chains.

Cambodia's National Strategic Plan on Green Growth (NSPGG) 2013-2030 recognizes the need to create green jobs across nine strategic sectors, including agriculture, industry, energy, and services. However, the lack of a clear definition and measurement of green jobs in Cambodia that impedes effective policy design, workforce preparation, and monitoring of the green transition's impact on people.

This report aims to fill the knowledge gap on green jobs by better defining them in Cambodia and establishing a baseline on their prevalence, their trends, their task content, and their key characteristics. The report intends to add the information base needed to align the education and training systems with the workforce skills needed to perform well in green jobs, to ensure the workforce optimally contributes to and benefits from the green transition.

The report adopts two approaches in measuring green jobs: (i) task-based: Using the tasks performed on the job; and (ii) output-based: Using the product or output produced by the job. These approaches stem from the fact that any job involves two dimensions: the worker and the firm. The two dimensions complement each other and can serve as a basis to define and identify green jobs. At the worker-level, the task-based approach focuses on whether tasks performed by workers produce green outputs or have the goal of reducing a firm's environmental footprint. At the firm level, the output-based approach focuses on the final products and services and whether they contribute to lessening the adverse environmental impacts and/or conserving the environment, e.g. solar panels.

Key Findings

The report finds that, although green jobs only account for 2 percent of employment, they are a realistic prospect for better jobs for Cambodians as they are low- and medium-skilled but pay 21 percent more compared to non-green jobs. Green jobs are absorbing young workers with mostly primary and lower secondary education: 54 percent of green jobs workers have either primary or lower-secondary education, compared to 47 percent among other workers. This indicates that Cambodia can achieve some greening of its economy using the current skillset in the workforce. Two occupations account for over half of employment in green jobs: Automobile mechanics and Motorbike mechanics, classified as green because they monitor the vehicle emissions when conducting maintenance. The third most frequent green job is Forestry and related workers.

At the same time, greening the economy also presents a promising avenue to upskill, as key medium- and high-skilled green jobs will need to expand in order to meet the ambitious targets Cambodia has set for renewable energy and energy efficiency. These occupations are related to Science Technology Engineering, and Mathematics (STEM) and to the key sectors identified by Cambodia's LTS4CN such as energy production and industrial processes. Key medium- and high-skilled occupations, requiring

technical and vocational education and training (TVET), are already deemed in shortage by firms active in renewable energy. Cambodia will therefore need to invest in both increasing STEM in general education and higher education, and TVET in order to fulfill its climate commitments.

Recommendations

The report identifies a series of recommendations, with a twofold objective: (i) making sure that the skills development system equips current and future workers with the skills that are needed to achieve Cambodia's green transition objectives; and (ii) ensuring that the Cambodian population benefits from the green transition through improved employment outcomes. These recommendations are summarized here:

- **Support the creation, expansion, and execution of green jobs.** This includes promoting the effective execution of green tasks by ensuring sufficient focus on the required skills for these tasks in education and training programs. If skills supply for green jobs needs to be developed quickly, skills interventions could focus on up- or reskilling current workers whose skills profile is relatively close to that required. In addition, it is important to identify and address additional constraints that might be preventing the expansion of green jobs, such as regulatory hurdles or financial disincentives.
- **To ensure responding to labor market demand on green jobs, maintaining close communication with key firms in green industries, and a regularly updated labor market information system that monitors green jobs is needed.** This information should be used as a basis for policy making, adapting the education and training offer and shared with students and workers (especially vulnerable workers and women) in a user-friendly way to help them make well-informed career decisions.
- **For inclusive access to better green jobs, alleviate barriers to accessing good green jobs for women, including by promoting their enrolment in STEM fields of education and training.** Women make up only 22 percent of workers in green jobs as these jobs are traditionally male dominated. Addressing the female underrepresentation in green jobs will require a package of interventions since its causes are presumed to be diverse. Promising interventions may include career guidance – making good use of the labor market information, ensuring a safe learning and working environment, female role models in green jobs, and better availability of childcare. Incentives such as free or subsidized skills training and possibly wage subsidies could facilitate the movement of women (and low-skilled men) into medium-skilled green jobs.

Overview

Cambodia's commitment to net-zero emissions by 2050, as well as climate commitments made by its major export partners will have implications for the country's production processes and its labor market. Cambodia committed to net-zero emissions by 2050 (Cambodia Long-Term Strategy for Carbon Neutrality, LTS4CN), with an ambitious intermediate goal of decreasing emissions by 42 percent below business-as-usual by 2030. Besides its own commitment to net-zero emissions, the commitments of its major export partners will have implications for Cambodia's production processes. As the EU's Carbon Border Adjustment Mechanism (CBAM) is expected to expand by 2030, Cambodia, which exports 70 percent of its goods to the EU (WTO, 2023), would need to change its production processes and energy sources to meet the CBAM requirements. Global commitments do not only present challenges, they also offer opportunities as Cambodia can take part in global and regional value chains for the production of green goods.

The job needs and implications of greening are already included in Cambodia's National Strategic Plan on Green Growth (NSPGG) 2013-2030, which sets forth the need to create green jobs. The NSPGG identifies nine strategic dimensions, the first one being the need for "Green investment and green jobs creation" by greening various sectors, among which agriculture, industry, trade, transport, tourism, energy, construction, finance, and services.

Despite these objectives, there is no measurement, let alone an agreed definition of green jobs in Cambodia, which prevents designing appropriate policies to prepare the workforce. The NSPGG does not define the concept of green job and defines the concept of green economy in a rather broad way. Such a gap prevents understanding barriers to greening the economy, monitoring how such greening will impact people in Cambodia, and designing appropriate policies to prepare the Cambodian workforce for green jobs. For key sectors of garments and construction in Cambodia, there are opportunities for greening the sectors (GGGI, 2018). However, for such greening to take place, workers need to be trained, e.g., in using new technologies that are more energy efficient, in reducing water usage, and in increasing energy efficiency.

This report aims to contribute to better defining green jobs in Cambodia and to establishing a baseline on their prevalence, their trends, their task content, and their key characteristics. It intends to add to the information base needed to align the education and training offer with the workforce skills needed to perform well in green jobs, so that the workforce optimally contributes to and benefits from the green transition. Given the lack of consensus on the definition of green jobs, we adopt two different approaches: the first approach focuses on jobs' task-content and recognizes that there are both "narrow" green jobs as well as jobs that can be seen as green under broader approaches or that have potential to become green in the future. The second approach focuses on the production of green goods, such as renewable energy.

What are green jobs?

There is no universally agreed-upon definition of green jobs, three approaches co-exist to identify them: (i) task-, (ii) output- and (iii) process-based. The latter two approaches being often combined. The co-existence of the different approaches stems from the fact that any job involves two dimensions: the worker and the firm. Both dimensions complement each other and can serve as a basis to define and identify green jobs. At the worker-level, the task-based approach focuses on whether tasks performed by workers produce green outputs or have the goal of reducing a firm's environmental footprint. At the firm level, the output-based approach focuses on the final products and services and whether they contribute

to lessening the adverse environmental impacts and/or conserving the environment, e.g. solar panels. Still at the firm level, the process-based approach refers to the production processes of goods and services, including integrating energy-saving technologies, reducing water, and reusing material.

This report uses task-based (henceforth "green jobs") and output-based (henceforth "jobs in green industries") approaches to measure green jobs in Cambodia. The advantage of the task-based approach is that it allows identifying how the greening of the economy is shaping jobs' task content and skills requirements. The task-based approach also allows the identification of the skills required to perform these tasks well and helps inform policymakers whether these skills are green-specific or can be transversal. It is useful to inform skills development policy. The output-based approach identifies industries that produce goods and services that lessen the environmental impact and considers all occupations demanded in these industries. Quantifying the number of jobs employed in these industries is vital to understand how much labor demand could expand with the increasing production of goods and services in these industries. It is helpful to inform sectoral policies.

Which jobs are green in Cambodia?

Using the task-based approach, 14 out of the 145 occupations in the CSES 2021/22 are green. Green jobs comprise only a small share of total employment: 2 percent, corresponding to 175,000 jobs. This is similar to what was found, using a similar methodology, in Indonesia (2.3 percent) and smaller than what was found in Viet Nam (3.6 percent) (Doan, Luu, Nguyen, & Safir, 2023; Granata & Posadas, 2024). Two occupations account for over half of green job employment: Automobile mechanics and Motorbike mechanics, classified as green because they monitor the vehicle emissions when conducting maintenance. The third most frequent green job is Forestry and related workers (Table O.1).

Table O.1 Green Occupations ranked by Green Task Intensity (GTI)

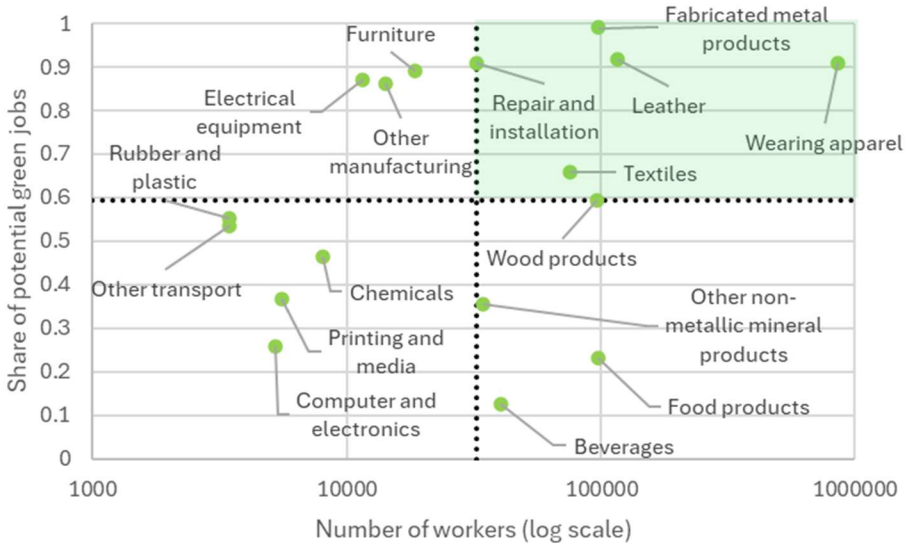
COC 3-digit	CSES Occupation Title	Weighted GTI	Green employment share (%)
962	Rag Picker	75	0.04
213	Life science professionals	64	0.03
961	Refuse workers	61	0.18
313	Process control technicians	26	0.04
621	Forestry and related workers	20	0.38
723	Machinery mechanics and repairers	13	0.09
724	Automobile mechanics and fitters	13	0.50
725	Motorcycle mechanics and fitters	13	0.61
314	Life science technicians and related associate professionals	7	0.01
814	Rubber, plastic and paper products machine operators	5	0.02
311	Physical and engineering science technicians	3	0.02
216	Architects, planners, surveyors and designers	2	0.00
741	Electrical equipment installers and repairers	1	0.04
531	Protective services workers	1	0.02
Total employment in green jobs			1.97

Source: CSES 2021/22.

Potential green jobs, which include a broader understanding of green tasks as well as jobs that could become green with different technologies, cover a much larger share of the Cambodian workforce: 48 occupations are potential green, covering 5 million workers and 56 percent of the workforce. This is much larger than what was found in Indonesia and Viet Nam, and is driven mostly by the large employment share of occupations related to agriculture (including animal husbandry, forestry and fishery). Three occupations account for half of employment in potential green jobs: Market gardeners and crop growers, Garment and related trades workers and Subsistence crop farmers.

There is a large potential for greening the economy through greening jobs in manufacturing, since most large manufacturing sub-sectors also have a large share of potential green jobs. The garment industry, which has a high share of potential green jobs, is by far the largest in terms of employment (Garment and related workers account for more than half the employment in manufacturing). Policies aimed at greening this sector therefore appear very important for greening the economy (Figure O.1).

Figure O.1 Concentration of Broad Green Jobs in Manufacturing Divisions (ISIC Level 2)



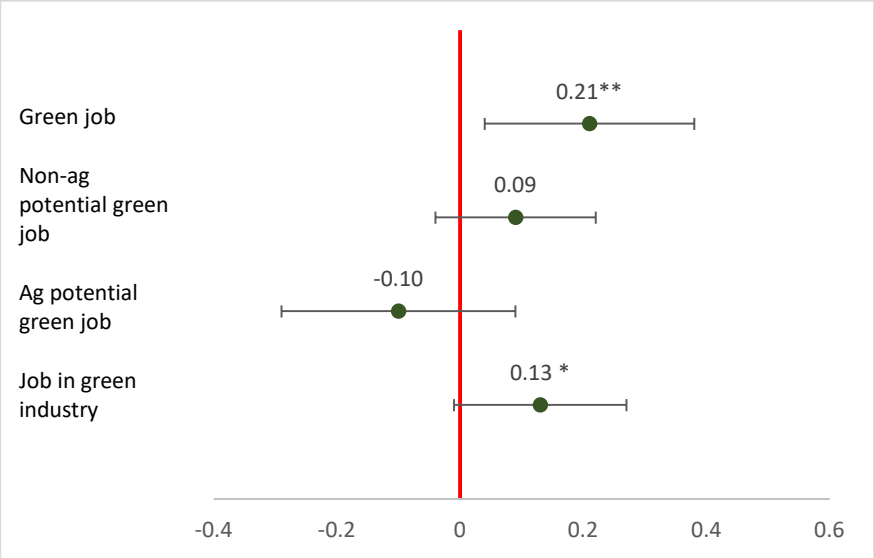
Source: CSES 2021/22, manufacturing divisions (ISIC level 2) with at least 10 observations.
Dashed lines show the median of each variable.

With the output-based approach, which focuses on the goods and services produced, we find that jobs in green industries account for 3.9 percent of total employment, corresponding to 348,000 workers. Fully green industries account for only 0.25 percent of employment while two industries – Other land transport and Other specialized construction activities – jointly account for 61 percent of jobs in green industries. Other land transport is green because it includes group passenger land transport activities such as railway, urban buses and intercity buses. Other specialized construction activities include the construction of green projects, such as parks and subways. The results of the 2 approaches – task-based and output-based – show their complementarity. By contrast to the task-based approach, only a small share of manufacturing industries is classified as green, amounting to only 2 percent of employment in the sector: These jobs are mostly in Solar heating systems and in Repair services. This is because the large textile manufacturing sector is not classified as green; textile not being a green output. However, workers in textile can have greener practices, e.g., reusing material and saving water, which is why they are potential green.

Characteristics, location and quality of green jobs

Green jobs appear to be a realistic prospect for better jobs for Cambodians as they are low- and medium-skilled but pay better and are absorbing young workers with mostly primary and lower secondary education. Controlling for workers' characteristics (age, gender, education, and location), as well as the job's sector and skill level, green jobs receive a large wage premium of 21 percent compared to non-green jobs and of 11 percent compared to potential green jobs (Figure O.2). Workers in green job also tend to be younger, as they are 4 percentage points more likely to be less than 34, compared to non-green jobs. Finally, they are 7 percentage points more likely to have primary or lower secondary education, compared to non-green jobs. These results indicate that Cambodia can achieve some greening of its economy using the current skillset in the workforce, although key green jobs, which are higher skilled, are missing.

Figure O.2 Green jobs wage premium



Source: Author's calculations using CSES 2021/2022. Regression coefficients from columns 3 and 6 of Table C.1. See table notes for details.

While current green jobs are less likely to be medium- or high-skilled than non-green jobs, greening presents a promising avenue to upskill, as most of the green jobs that are not observed in Cambodia are high skilled. Medium- and high-skilled jobs account only for 4 percent of green jobs, as opposed to 10 percent among non-green jobs). However, when comparing the green jobs prevailing in Cambodia to green jobs as defined by our methodology, 17 green jobs are not observed in Cambodia, most of which – 12 – are high skilled. Most missing occupations are related to Science Technology Engineering, and Mathematics (STEM) and to the key sectors identified by Cambodia's LTS4CN such as energy production and industrial processes (Science professionals and technicians, as well as Engineers), and transportation (Engineers and Town and traffic planners).

In addition, key medium-skilled green jobs will need to expand in order to meet the ambitious targets Cambodia has set for renewable energy and energy efficiency. Cambodia has made commitments to increase its share of renewal energy to 70 percent by 2030 and has set ambitious targets for energy efficiency, including a reduction in energy consumption by 19 percent by 2030 through energy efficiency. Besides local needs and energy mix, the global move toward low-carbon energy sources also creates export opportunities for Cambodia, such as the export of solar panel components, which has boomed since 2021. Key medium- and high-skilled occupations, requiring technical and vocational education and

training (TVET), are already deemed in shortage by firms active in renewable energy. Cambodia will therefore need to invest in both increasing STEM in general education and higher education, and TVET in order to fulfill its climate commitments.

However, green jobs are strongly male dominated as women represent only 22 percent of workers in these jobs; therefore, their rise may exacerbate gender inequality in access to good jobs. In non-green jobs and industries, they represent about half the workers. This lower share is driven by the fact that green jobs include mostly automobile and motorcycle mechanics as well as electricians, which are traditionally male dominated. The share of women is larger in medium- and high-skilled green jobs, although it remains below 50 percent. Potential green jobs are also male dominated, but to a lesser extent, with 45 percent of female workers, decreasing to 38 percent when agriculture is excluded. Similarly, as most jobs in green industries are in Construction and Transport services, these tend to be more male dominated.

Policy recommendations

The recommendations deriving from the analysis include both measures based on the type of green jobs (current green, potential, and missing) as well as cross-cutting measures to respond to both employer and worker needs on green jobs. The goal underlying these recommendations is twofold. First, making sure that the skills development system equips current and future workers with the skills that are needed to achieve Cambodia's green transition objectives. Ensuring that workforce skills do not become a constraint to realizing Cambodia's green ambitions requires the availability of the necessary workforce skills both to expand green industries and to implement green tasks across the economy. The second goal is ensuring that the Cambodian population benefits from the green transition through improved employment outcomes. This will not only contribute to Cambodia's goals to increase the availability of good jobs, but is also expected to harness political and public commitment to the greening agenda.

In the short term, the prioritization of green jobs would be jobs that face skills constraints and meet at least one of the following criteria: a) covering a relatively large portion of the workforce; b) being important for mitigation or adaptation. Because the green transition can affect tasks content and skills demand across the economy and for large numbers of occupations, prioritization of actions seems necessary. A first criterion would be to focus on green jobs that currently employ a large number of workers, such as automobile mechanics and motorbike mechanics. Focusing on those, already large, occupations would allow green regulations such as pollution control on vehicles to be rapidly and efficiently implemented at scale. A second criterion would be to focus on jobs or industries that have large impacts on mitigation or adaptation, such as for clean energy production or for energy efficiency. Once the priority green jobs have been identified, an assessment of skill demand and constraint needs to be carried out to inform capacity building interventions.

For green jobs: promote the effective execution of green tasks by facilitating current workers in green jobs, and ensuring sufficient focus on the required skills for these tasks in education and training programs. The analysis identified 14 jobs with green tasks in the Cambodian economy. The task description of each of these jobs includes at least one task that has been identified as green, but little is known about the actual execution of these tasks in practice. A representative survey of workers in these jobs can first confirm the extent to which these green tasks are executed in practice and identify any barriers these workers face to carrying out these tasks, after which appropriate activities (including possibly upskilling) can be designed and implemented to maximize the green impact of these jobs. To further optimize the positive impact of green jobs, the necessary skills to carry out these tasks should be

structurally incorporated in education and training programs that prepare individuals for these jobs. Since around three quarters of all workers in jobs with green tasks are automobile mechanics, motorbike mechanics, or forestry and related workers, these occupations could be prioritized in this activity. Another approach to prioritization may be to focus on jobs that are considered to be crucial for green industries in which substantial investments are pending (such as renewable energy and energy efficiency).

Table O.2 Recommendations for developing skills for the green economy and ensuring inclusive access to green

Policies by type of job	
Green jobs	Promote the effective execution of green tasks by facilitating current workers in jobs with green tasks and ensuring sufficient focus on the required skills for these tasks in education and training programs.
Potential green jobs	Turn potential green jobs into green jobs by addressing their skills requirements, providing financial incentives and implementing the required regulation.
Missing green jobs	Identify the most crucial missing jobs and develop a strategy to ensure that labor demand for these jobs can be met.
Cross-cutting measures	
Responsive workforce development	Industry engagement, a regularly updated labor market information system that monitors green jobs, and a flexible and responsive workforce development system.
Access to better green jobs for women	Alleviate barriers to accessing good green jobs for women, including by promoting their enrolment in STEM fields of education and training.

For potential green jobs: Turn them into green jobs. Jobs with potential green tasks make up well over half of the workforce in Cambodia, so are an important category to consider. A mix of deeper analysis of these jobs in Cambodia as well as a better understanding of the constraints to make them green jobs is needed. It is possible that the constraints are skills-related but they could also stem from regulations and financial incentives or constraints. This could be the case, for example, when farmers do not apply more environmentally sustainable farming methods because this would reduce their profit margin and there are no regulations obliging them to do so, or when they lack resources to invest in environmentally friendly tools or equipment. Considering the large share of jobs identified as potential green jobs, there may be a need to focus on those jobs where there is the clearest greening momentum or those with the largest number of workers: market gardeners and crop growers; garment and related trades workers; and subsistence crop farmers.

For missing green jobs, in particular those related to LTS4CN priority sectors: identify the most crucial missing jobs and develop a strategy to ensure that labor demand for these jobs can be met. Out of the 36 identified occupations with one or more green tasks, 20 jobs were not observed in the Cambodia data, implying that they are, at best, extremely rare. Most of these jobs require high skilled workers in STEM areas and many will be required for the greening of the key sectors identified by Cambodia's LTS4CN, such as energy production and industrial processes and transportation. To ensure that workforce skills facilitate rather than constrain the growth of these sectors, timely action needs to be taken to prepare the workforce for these jobs. It will therefore be important to identify the most crucial occupations that are

currently largely missing from Cambodia's labor market and to develop a strategy to make sure that sufficient workers with the necessary skills to carry out these jobs will be available to not derail the government's greening ambitions. If currently missing occupations are expected to be created in the short term, so that skills supply for these jobs needs to be developed quickly, skills interventions could focus on up- or reskilling current workers whose skills profile is relatively close to that required for the missing occupations, since this can be done relatively quickly. In addition to focusing on skills, it is important to identify and address additional constraints that might be preventing the expansion of these occupations, such as regulatory hurdles or financial disincentives.

To ensure responding to labor market demand on green jobs, maintain close communication with key firms in green industries, a regularly updated labor market information system that monitors green jobs is needed. Considering the importance of employer engagement to ensure the relevance and quality of skills development, there is a need to promote the collaboration between the private sector actors that are likely to invest in climate change mitigation and create green jobs, and the education and training providers that will be able to equip individuals with the necessary skills for these jobs. Developments in the number, nature, and quality of green jobs, as well as in their educational and skills requirements, should be regularly monitored. This information should be used as a basis for policy making and adapting the education and training offer and shared with students and workers (especially vulnerable workers and women) in a user-friendly way to help them make well-informed career decisions. To inform skills development policy, data on green jobs needs to be regularly updated and translated into quantitative and qualitative information on skill demand. Relevant stakeholders in the skills development ecosystem can then use this information to adapt their education and training offer.

For inclusive access to better green jobs: alleviate barriers to accessing good green jobs for women, including by promoting their enrolment in STEM fields of education and training. Women make up only 22 percent of workers in green jobs. The reason for this gender inequality is not per se related to these jobs being green, but to them often being traditionally male dominated, such as automobile and motorcycle mechanics. Addressing the female underrepresentation in green jobs will require a package of interventions since its causes are presumed to be diverse, ranging from constraints to their enrolment in STEM education and training programs to gender norms and lacking childcare facilities. A first step in this process would be analyzing the main constraints that prevent women from pursuing education and careers related to green jobs. Then, depending on the constraints that are identified, promising interventions may include career guidance – making good use of the labor market information, ensuring a safe learning and working environment, female role models in green jobs, and better availability of childcare. Incentives such as free or subsidized skills training and possibly wage subsidies could facilitate the movement of women (and low-skilled men) into medium-skilled green jobs. Key interventions should be piloted and evaluated first, before structurally incorporating them into education or labor market policies.

1. Introduction

Cambodia is committed to combating climate change and accelerating the transition to a climate-resilient, low-carbon sustainable mode of development, which will have a significant impact on the labor market. The country committed to net-zero emissions by 2050 (Cambodia Long-Term Strategy for Carbon Neutrality, LTS4CN), with an ambitious intermediate goal of decreasing emissions by 42 percent below business-as-usual by 2030. Cambodia also committed to increasing the share of renewable energy in its energy mix to 70 percent by 2030. In addition, Cambodia has adopted the Energy Efficiency Plan, with the objective of reducing energy consumption by 19 percent by 2030. Another notable commitment involves halting deforestation and increasing forest cover by 60 percent by 2030.

Besides Cambodia's own commitment to net-zero emissions, the commitments of its major export partners will have implications for Cambodia's production processes, while Cambodia could also integrate global value chains for green goods. As the EU's Carbon Border Adjustment Mechanism (CBAM) is expected to expand by 2030, Cambodia, which exports 70 percent of its goods to the EU (WTO, 2023), would need to change its production processes and energy sources to meet the CBAM requirements. Major textile companies that produce goods in Cambodia, such as Zara and H&M, have also set net zero targets, some by 2030. Global commitments do not only present challenges, they also offer opportunities as Cambodia can take part in global and regional value chains for the production of green goods, as can be seen for solar panel components, exports of which to the US have soared since 2021, although this could be related to trade diversion related to trade restrictions in bilateral US-China trade (World Bank, 2023).

The job needs and implications of greening are already included in Cambodia's National Strategic Plan on Green Growth (NSPGG) 2013-2030, which sets forth the need to create green jobs. The NSPGG identifies nine strategic dimensions, the first one being the need for "Green investment and green jobs creation" by greening various sectors, among which agriculture, industry, trade, transport, tourism, energy, construction, finance, and services. This requires engaging green investors and enhancing job opportunities for workers in those sectors. The plan also identifies human resources development as "a main factor in effective green growth", highlighting the need for both formal systematic and non-systematic education.

Despite these objectives, there is no measurement, let alone an agreed definition of green jobs in Cambodia. There exists no agreed-upon definition of what a green job is, and the concept is not defined in the NSPGG. The NSPGG defines the concept of green economy but in a rather broad way "the economic growth at the same time of sustainable environment that makes progress and social fraternity, and improve quality of life and green job opportunity for people nationwide via green growth, heavily relying on earth's ecological preservation for the Planet Earth to have sustainability in balance with its life carrying capacity."

These gaps in the understanding of green jobs prevent designing appropriate policies to prepare the workforce while; ultimately a green economy will only be achieved if the Cambodian workforce can take on new green jobs or implement green practices in current jobs. Such a gap prevents understanding barriers to greening the economy, monitoring how such greening will impact people in Cambodia, and designing appropriate policies to prepare the Cambodian workforce for green jobs. Energy-efficiency commitments imply a need for jobs that assess, monitor, and improve energy efficiency. To take another example, enforcing regulations on clean air implies that car mechanics not only monitor emissions when they conduct maintenance of vehicles but also that they systematically implement available fixes to allow vehicles to reduce emissions. For key sectors of garments and construction in Cambodia, there are opportunities for greening the sectors (GGGI, 2018). However, for such greening to take place, workers

need to be trained, e.g., in using new technologies that are more energy efficient, in reducing water usage, and in increasing energy efficiency.

This report aims to contribute to better defining green jobs in Cambodia and to establishing a baseline on their prevalence, their trends, their task content, and their key characteristics; it is aimed at both policymakers and technical audiences. For policymakers, the report provides a better understanding of the implications of greening in terms of job creation. Technical audiences can replicate this analysis, which can serve as a basis for the monitoring of green jobs in the future. The report intends to add to the information base needed to align the education and training offer with the workforce skills needed to perform well in green jobs, so that the workforce optimally contributes to and benefits from the green transition. This note answers the following questions: What are the jobs that involve green tasks and could therefore grow as Cambodia moves toward carbon neutrality as per the long-term strategy for carbon neutrality? Who holds these jobs? What is the quality of these jobs and their skill levels, are they better jobs?

Given the lack of consensus on the definition of green jobs, we adopt two different approaches and recognize that there are both "narrow" green jobs as well as jobs that can be seen as green under broader approaches or that have potential to become green in the future. As the concepts of green economy and green jobs are not universally defined and evolve over time, we recognize that there is need to take different perspectives to defining and measuring green jobs. The first approach we adopt focuses on jobs' task-content and whether these are green: For example, whether they involve the monitoring of environmental impacts such as GHG emissions or water pollution. The second approach focuses on the production of green goods, such as renewable energy. For the task-based approach, we also recognize that some tasks may not be seen as strictly green but are broadly green: For instance, tasks related to collective transport can be seen as helping reduce environmental footprint even as they may not be as green as tasks related to bicycles.

We find that green jobs employ 2 percent of the workforce, or 175,000 workers in Cambodia, and jobs in green industries employ 3.9 percent of the workforce; while another 5 million workers are in potential green jobs, in agriculture and garment. The share of workers in green jobs is slightly lower than in other middle-income countries. Two occupations account for over half of green job employment: Automobile mechanics and Motorbike mechanics, classified as green because they monitor the vehicle emissions when conducting maintenance. The third most frequent green job is Forestry and related workers**.** Owing to the large share of the workforce still working in agriculture, potential green jobs represent 56 percent of employment, or 5 million workers. Three occupations account for half of employment in potential green jobs: Market gardeners and crop growers, Garment and related trades workers and Subsistence crop farmers.

Green jobs seem to be a realistic prospect for better jobs for Cambodians in the short-term as they are low- and medium-skilled but pay better and are absorbing young workers with mostly primary and lower secondary education. The quality of green jobs is mixed as they are not higher skilled, but they pay much better: green jobs pay on average 21 percent higher wages than non-green wage jobs and jobs in green industries offer a 13 percent wage premium. Potential green jobs do not offer a wage premium and are lower-skilled than non-potential green jobs. However, they also have fewer elementary occupations compared to non-potential green jobs, especially when agriculture is excluded. As workers in green jobs tend to be younger, put together, these results indicate that Cambodia can achieve some greening of its economy using the current skillset in the workforce, although key green jobs, which are higher skilled, are missing.

At the same time, greening presents a promising avenue to upskill, as most missing green jobs are high-skilled and as key medium-skilled green jobs are facing labor shortages and are expected to grow. When

comparing the green jobs prevailing in Cambodia to green jobs as defined by our methodology, the majority of missing occupations are high-skilled. Most missing occupations are related to Physical and earth science (chemists, geologists, chemical science technicians), Engineering (Industrial and production engineers, Civil engineers, Environmental engineers), and Architects and planners (Landscape architects, Town and traffic planners). Furthermore, given Cambodia's plans for its energy mix and energy efficiency, key medium- and high-skilled occupations are already deemed in shortage by firms active in renewable energy.

To increase green jobs, Cambodia will need to invest in technical skills training as well as in STEM, with efforts to ensure that women, who are currently hugely under-represented in green jobs, are trained in these fields, in order to meet labor demand. These missing green jobs in Cambodia, when comparing to green jobs as per the task-based approach, are mostly related to Science Technology Engineering, and Mathematics. Furthermore, among occupations related to energy efficiency, many require technical and vocational education and training (TVET). Cambodia will need to invest in both increasing STEM in general education and higher education, and TVET. Particular efforts will need to be made to increase women's enrollments in these fields where they tend to be under-represented and as women are under-represented in green jobs and in green industries, representing respectively 22 and 10 percent of the workers in these occupations.

The report is organized as follows. Section 2 discusses various approaches to measuring green jobs and then presents the approaches used in this report and their application to Cambodian data. Sections 3 and 4 show the landscape of green jobs in Cambodia, using the different approaches, including their geographical distribution. Section 5 examines the skills distribution and earnings of green jobs while section 6 examines who has access to green jobs. Section 7 concludes with policy recommendations.

2. Measuring green jobs[1]

2.1 What are green jobs?

The concept of green jobs takes its root in the concept of green economy, which has no universally agreed upon definition, and which has evolved over time. After being first coined in 1989 (Pearce, Markandya, & Barbier, 1989), the concept was initially limited to climate change and the reduction of CO2 emissions. It has evolved to include broader energy and resource efficiency and social dimensions. A green economy is defined by the United Nations Environment Program (UNEP) as "one that results in improved wellbeing and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP, 2011).

There is no universally agreed-upon definition of green jobs. There is a broad consensus that green jobs should focus on mitigating environmental damage through the production of eco-friendly products and services, as well as by adopting sustainable production methods. However, the scope of this definition varies: one possibility is to define green jobs as jobs that do not damage the environment - thereby including all environmentally neutral jobs - and/or jobs that are needed for or are the by-product of greening the economy, even though they may be polluting (e.g., mining for minerals used in the production of electric vehicles) (ONET, 2010). Another, narrower, definition only classifies as green jobs those jobs that directly contribute to decreasing environmental damage (Eurostat, 2009; ILO, 2019)**.**

Three approaches co-exist to identify green jobs: (i) task-, (ii) output- and (iii) process-based. The latter two approaches being often combined. The co-existence of the different approaches stems from the fact

[1] This section follows closely Doan et al. (2023) report on green jobs in Vietnam; as well as on Granata & Posadas (2024).

that any job involves two dimensions: the worker and the firm. Both dimensions complement each other and can serve as a basis to define and identify green jobs. At the worker-level, the task-based approach focuses on whether tasks performed by workers produce green goods or services (e.g. solar panels) or reduce the environmental footprint (e.g. reuse material). For instance, an engineer in charge of treating wastewater from a mine would be categorized as having a green job. At the firm-level, the output-based approach focuses on the final products and services and whether they contribute to lessening the adverse environmental impacts and/or conserving the environment, e.g. the receptionist of a solar panel plant would be counted as having a green job, even as their work is not different from that of other secretaries in polluting industries. Still at the firm level, the process-based approach refers to the production processes of goods and services, including integrating energy-saving technologies, reducing water, and reusing material. For example, manning an electric vehicle would be classified as green according to the process-based approach. The ILO and the UNEP combine the output- and process-based approaches when they define green jobs as decent jobs in any sector that contribute to preserving, restoring, and enhancing environmental quality through: (i) the production of environmental outputs (goods and services – output-based) or (ii) the use of environmentally friendly technologies in production (process-based).

Defining green jobs using the task-based approach focuses on whether the jobs involve carrying out environmentally friendly tasks. The literature on job task and skill content was sparked by digitalization and skill-biased technological change (SBTC), with a seminal paper on measuring the task and skill content of jobs by Autor, Levy, & Murnane (2003). Francesco Vona and co-authors have applied this methodology to measure green jobs (Vona, Marin, Consoli, & Popp, 2018). The most prominent application of the task-content approach is the Occupational Information Network (O*NET) Green Economy Program (O*NET GEP). The objective of the O*NET GEP was to identify the occupations to be impacted by the greening of the economy (i.e., by green economic activities and technologies).

Defining green jobs using the output-based approach focuses on specific sectors that produce goods (outputs) deemed environmentally beneficial and includes all occupations in the industry. For example, the BLS defines green jobs according to this approach as “Jobs in businesses that produce goods and provide services that benefit the environment or conserve natural resources. These goods and services are sold to customers, and include research and development, installation, and maintenance services.” (Bureau of Labor Statistics, 2013) With this approach, all jobs in sectors that meet this criterion are considered green jobs, even if they do not directly contribute to green outputs.

Finally, defining green jobs using the process-based approach focuses on how goods and services are produced. The BLS defines green jobs according to this approach as “Jobs in which workers’ duties involve making their establishment’s production processes more environmentally friendly or use fewer natural resources. These workers research, develop, or use technologies and practices to lessen the environmental impact of their establishment, or train the establishment’s workers or contractors in these technologies and practices”. This approach is often combined with the output-based approach, as in the ILO and UNEP definitions mentioned above.

This note uses the task-based (“green jobs”) and output-based (“job in green industries”) approaches to measure green jobs in Cambodia. These two approaches have been used to identify and quantify green jobs in middle-income countries (Granata & Posadas, 2024;Doan, Luu, Nguyen, & Safir, 2023; Mosomi & Cunningham, 2023). They have the merit of allowing their operationalization and measurement using standard data such as usual household and firm surveys, even as, like any measurement exercise they have limitations. In particular, for the task-based approach, a key question is whether and to what degree workers actually implement the tasks included in their occupation description (see more discussion below). The process-based approach requires specific data collection on processes related to production

and would need specific and detailed data collection per detailed sector. To our knowledge, no such data exists for Cambodia and is generally not available economy-wide (see Granata & Posadas (2024) for a discussion).

Box 1: Definitions[2]

Green jobs. Those jobs that involve tasks related to developing or applying technologies and practices that lessen the footprint on the environment. These jobs involve green tasks, identified by applying the green dictionary developed by Granata & Posadas (2024). Green jobs will henceforth refer to the task-based approach, not the output-based one. We use jobs and occupations interchangeably.

Potential green jobs. Those jobs that involve tasks that may be considered green or could be green if greener technologies are adopted. This is identified by applying the potential green dictionary developed by Granata & Posadas (2024).

Green skills. The skills required in green jobs and likely related to green tasks.

Green tasks. The tasks performed in a job that involve developing or using green technologies.

Green task intensity (GTI). GTI measures the green task-content of occupations. It is the proportion of green tasks in an occupation and serves as a measure of greenness.

Weighted GTI. As the GTI index was created for occupations classified at the 4-digit level, occupations classified at the 3-digit level are assigned a weighted GTI, which is the average of the GTI in the corresponding 4-digit occupations, weighted by the share of each occupation in the LFS data

Green employment share. The share of a 3-digit occupation in total employment, weighed by its share of workers employed in a 4-digit green occupation in the LFS 2019.

Jobs in green industries. All the jobs in industries that produce green goods and services. For industries that produce both green and non-green outputs, we compute a share of green jobs reflecting the distribution of green outputs (at the 6-digit level) and the distribution of workers (at the 4-digit level). Jobs in green industries hence refer to the output-based approach.[3]

The advantage of the task-based approach is that it allows identifying how the greening of the economy is shaping jobs' task content and skills requirements: It is useful to inform skills development policy. The task-based approach also allows the identification of the skills required to perform these tasks well and helps inform policymakers whether these skills are green-specific or can be transversal and therefore transferred from non-green occupations. By looking at specific green tasks and linking tasks to occupations, the approach also allows for profiling occupations of green jobs. Occupational profiling is crucial in informing policymakers on the skills needed and training requirements that can prepare the workforce for embracing job opportunities created by the green transition.

The output-based approach identifies jobs in industries that produce goods and services that lessen the environmental impact and considers all occupations demanded in these industries: It is helpful to inform sectoral policies. The output-based approach identifies green industries. Quantifying the number of jobs employed in these industries is vital to understanding how much labor demand could expand with the increasing production of goods and services in these industries. The transition to a green economy will have implications at the sectoral level. How important are green sectors to the overall economy? In which specific regions and communities, and how many workers are employed in these sectors and

[2] These definitions are adapted from Granata & Posadas (2024)

[3] The BLS classification refers to "potential" green outputs, meaning outputs that are not necessarily green but can be green. For simplicity and to avoid any confusion with the potential green jobs of the task-based approach, we use the words "green outputs" and "green industries" to refer to those potential green outputs/industries.

regions? Answering these questions is helpful for policymakers in evaluating the impact of the green transition on the labor market.

While both approaches can result in overlapping classification, important differences remain on how they classify occupations. The output-based method adopts a top-down approach as it identifies green industries and assumes that all workers in those green industries have green jobs (e.g. the receptionist of a solar panel plant). On the other hand, the task-based approach is more bottom-up as it classifies occupations based on their task-content, regardless of the final good or service produced (e.g. the water engineer in a mine).

2.2 Green jobs: The task-based approach

The task-based approach, in this report, applies the Green Task Intensity (GTI) toolkit, which uses a dictionary of green terms to classify tasks into green, potential green, and non-green categories. The GTI, toolkit developed by Granata & Posadas (2024), has been applied to a few middle-income countries, including Indonesia, South Africa, and Viet Nam. This approach classifies occupations regardless of the final good or service produced. A particular task is classified as green or potentially green if its description contains at least one green or potentially green term, respectively. Green terms refer to terms that are strictly environmentally friendly (e.g., "green energy", "photovoltaic", "environmental awareness", "forest fire suppression").

Potential green terms include green terms as well as terms that may be considered green in a broader sense or could become green with greener technologies or processes. Terms considered green in a broader sense are terms that relate to reducing environmental impact in a broad sense (e.g. "repair"). Other terms could be green if greener technologies or processes are adopted (e.g., "passenger train" or "crop production"). This broad definition is meant to provide an upper bound for the prevalence of green jobs.

The (potential) GTI then calculates the proportion of (potential) green tasks among the total number of tasks in an occupation. The Green Task Intensity (GTI) index is calculated as the proportion of green tasks to the total number of tasks in an occupation. The index is calculated separately based on green and potential green tasks, resulting in a GTI and a potential GTI for each occupation. Hence, the task-based approach allows green jobs to vary in intensity due to the number of green tasks performed in each occupation. One example of an occupation with a positive GTI index is chemists, which has two green tasks "developing procedures for environmental control, quality control and various other procedures for manufacturers or users" and "conducting programs of sample and data collection and analysis to identify and quantify environmental toxicants," out of a total of eight tasks, yielding a GTI of 25. Another example of an occupation with positive potential GTI is deep-sea fishery workers, which have one potential green task "preparing and repairing nets and other fishing gear and equipment," out of a total of eight tasks, yielding a potential GTI of 12.5.

$$GTI = \frac{Number\ of\ green\ tasks}{Total\ number\ of\ tasks} * 100$$

$$Potential\ GTI = \frac{Number\ of\ potential\ green\ tasks}{Total\ number\ of\ tasks} * 100$$

To simplify the analysis, categorical variables of (potential) greenness are also used: A job is 1) green if it contains at least one green task, 2) potential green if it contains at least one task that is green or potential green, and 3) non-green if it contains no green or potentially green task. In the International Classification of Occupations 2008 (ISCO-08) 4-digit classification, for example, Town and traffic planners, is classified as a green occupation because it contains the task "reviewing and evaluating environmental impact reports"; Mechanical engineering technicians are classified as a potentially green occupations because one of their tasks is "monitoring technical aspects of manufacture, utilization, maintenance and repair of machines and mechanical installations, facilities and components to ensure satisfactory performance and compliance with specifications and regulations."[4] As green terms are a subset of the potential green terms, green occupations are a subset of potential green occupations. All green occupations are therefore also categorized as potential green.[5] This classification approach is only based on the job's task-content, regardless of its other characteristics (e.g. job quality).

We apply the methodology to the Cambodia Socio-Economic Survey (CSES) 2021/22; with a challenge that the CSES mostly uses 3-digit occupation classification while the GTI is calculated using 4-digit ISCO-08 occupations. The CSES is the most recent representative household survey of Cambodia.[6] It uses a slightly modified version of the ISCO classification, the Cambodian Occupational Classification (COC). The COC classifies occupations at the 3-digit level, corresponding broadly to the 3-digit ISCO-08 but with 37 additional occupations (mostly elementary and low skilled) that correspond to 4-digit ISCO-08 codes. There are 159 3-digit occupations in the COC, 61 of which correspond to a single ISCO-08 4-digit code, and 98 of which correspond to several ISCO-08 4-digit codes (Table A.1).[7] Occupations in the former category are assigned the GTI of their corresponding ISCO-08 4-digit occupation. For the latter category, if some of their ISCO-08 4-digit occupations are green and others are not, which creates the risk of misclassifying workers into green occupations. For example, the 3-digit occupation Physical and engineering science technicians (311) corresponds to 9 4-digit occupations, 3 of which are green. In the CSES data, it is impossible to know for sure whether a worker in this occupation should be classified as green or not. And while 3-digit ISCO-08 contains task descriptions, these are much more succinct than the description obtained with all the tasks contained in the corresponding 4-digit level occupations. For example, the above-mentioned occupation Physical and engineering science technicians does not have any green words in its task description, despite having 3 green occupations (out of 9) at the 4-digit level.

To overcome this data limitation, we use the distribution of occupations in the 2019 Labor Force Survey, which codes occupations at the 4-digit level, to compute weights when aggregating the GTI from the 4- to the 3-digit level. While we are not able to identify precisely the (potential) green jobs in the CSES, we impute the share of workers with a (potential) green job in each 3-digit occupation, using relatively recent data (2019) that is also collected following a similar methodology to the CSES.[8] We can then compute a

[4] The GTI toolkit uses the task description of occupations at the 4-digit level. Occupations have between 1 and 14 tasks, with a median at 7. While the GTI toolkit has been applied to ISCO-08, the steps and dictionary of green and potential green terms could be applied to any classification.

[5] For the purpose of the analysis, we sometimes use mutually exclusive categories, by which potential green jobs exclude the (narrow) green jobs.

[6] The number of observations in the CSES is similar to that of the LFS (around 10,000 households) so both datasets offer the same potential for detailed analysis.

[7] Although no official name exists for the Cambodian adaptation of ISCO, we refer to it as the Cambodian Occupation Classification (COC) in the rest of the report.

[8] We do not use the LFS as our main source of data because it is older than the CSES and has about the same number of observations as the CSES and hence, does not allow a richer analysis than the CSES. The main drawback of this weighting exercise is the risk that the occupational composition within 3-digit occupations may have shifted between 2019 and 2021 (e.g. due to the Covid pandemic). The bias introduced is however likely to be limited given the low number of 4-digit occupations in each 3-digit

weighted GTI, which is the average of the 4-digit GTI in each 3-digit occupation, weighted by their employment shares.[9] For example, occupation 723 in the COC, Machinery mechanics and repairers, corresponds to two ISCO 4-digit occupations: Agricultural and industrial machinery mechanics and repairers (ISCO-08 7233) with a GTI of 0, and Bicycle and related repairers (ISCO-08 7234) with a GTI of 33 because 2 of its 6 tasks contains the word "bicycle", which is a green term. In the LFS 2019, there are 8106 weighted observations of Agricultural and industrial machinery mechanics and repairers and 5256 weighted observations of Bicycle and related repairers. As a result, we consider that 39 percent (5256 divided by the sum of 5256 and 8106) of Machinery mechanics and repairers in the CSES have a green job. As this occupation accounts for 0.23 percent of total employment, their green employment share is equal to 0.0023 * 0.39 = 0.09 percent. Its weighted GTI is equal to 13 (33 * 0.39). See Appendix A1 for more detail.

The green employment share of occupation i is the sum of the total employment shares of its corresponding 4-digit occupations that are green:

$$Green\ employment\ share_i = \sum_{occ=1}^{n} Green_{occ} * \frac{Nb\ workers_{occ}}{Nb\ workers_{tot}}$$

The weighted GTI of occupation i is the sum of the GTI of all 4-digit occupations (occ) weighted by their employment share in i.

$$Weighted\ GTI_i = \sum_{occ=1}^{n} GTI_{occ} * \frac{Nb\ workers_{occ}}{Nb\ workers_i}$$

We also overcome another challenge, that of using an international classification, by manually reclassifying green occupations when in-country discussions indicated that a given green task may not be performed. As Cambodia uses ISCO, the list of tasks assigned to each occupation is therefore the international one and is not specific to the Cambodian context. We have reviewed the list of green and potential green occupations and, for green occupations in particular, we have reviewed the list of tasks identified as green, and we have reclassified based on in-country discussions with the relevant World Bank teams. In particular, we have reclassified workers in aquaculture from green to potential green as they were classified as green based on one task of "collecting and recording growth, production and environmental data," which is not performed in Cambodia (See Appendix A1 for more detail on the reclassification).

Despite these adaptations, this measurement exercise has limitations, like any measurement exercise. One limitation is that the GTI implicitly assumes that each task is actually performed and with the same intensity, for lack of more precise data. Doan, Luu, Nguyen, & Safir (2023) give credibility to this assumption as they measure task intensity in Viet Nam and find a high correlation between the GTI and their intensity-adjusted index. Another limitation, related to the previous point, is that the approach takes

occupation (56 percent have three or less) and the fact that one 4-digit usually accounts for the majority of employment (90 percent of 3-digit occupations).

[9] An alternative way of computing the weighted GTI would be to take the share of green tasks from the list of tasks of associated 4-digit occupations, which appears closer to the original GTI which is unweighted. However, we believe that our approach is better as we see the fact that the GTI is unweighted as a limitation rather than a feature of the approach and we believe that using more information is better.

the task content of occupations as given, which implies that the only possibility to green the economy is by increasing employment in green jobs, rather than by transforming existing jobs to make them greener. This issue is partly alleviated by differentiating between green and potential green jobs, as the latter correspond to both a broader definition of green and to jobs that could become green with different technologies. To better assess greenness, in particular for jobs that could be green, there would be need for more detailed in-country work to identify whether a potential green job is actually green. For Cambodia, this is particularly important for agriculture occupations, which are still highly prevalent, and all classified as potential green. Crop rotations are, for instance, an example of green tasks in agriculture, but they are not included in the ISCO-08 task descriptions.

2.3 Jobs in green industries: The output-based approach

We start from a classification of green industries in the Unites States, which we reclassify to reflect the Cambodian context and end up with a much narrower set of green industries, mostly in green energy production, reforestation, public transport, waste collection and management, and repair. The US Bureau of Labor Statistics (BLS) identifies 333 industries "potentially producing green goods and services" out of the 1192 6-digit codes of the North American Industry Classification System (NAICS) 2007 (BLS 2013). This classification, however, cannot be used directly for the purpose of this note, for two main reasons: first, it was developed for the US economy, and we would therefore need to assume that outputs produced in the US and in Cambodia are similar. While some goods and services are green per se (e.g. solar panel manufacturing, public transportation, waste management), others are classified as green because they can be produced in a way that makes them green. For example, most agriculture industries are classified as green by the BLS because of their potential for organic farming certification. Likewise, most manufacturing industries are eligible for certifications that are specific to the US (for instance, the WaterSense certificates for efficient use of water, Energy Star for energy-saving products) or globally recognized certifications such as the Leadership in Energy and Environmental Design (LEED). Most of these certifications are not available or have not been adopted in Cambodia. The BLS provides explanations for each industry classified as green, and sometimes examples of green goods and services produced by these industries. We carry out a careful check of these explanations and examples and reclassify as non-green all industries classified as green because of certification (organic, LEED, etc.). Second, the BLS classification uses a very wide definition of "green goods and services". For example, television and radio broadcasting, book publishing, graphic design and advertising agencies are considered green because they could be used to raise environmental awareness. We decided to use a more conservative definition and reclassified such industries as non-green. In the end, we keep only 90 out of 333 green industries. See Appendix A2.1 for more details on the reclassification.

The list of green industries is then combined with the CSES 2021/22 to analyze the characteristics of workers in these industries. Like for the task-based approach, this creates a challenge related to the use, in the CSES, of the ISIC level 3 classification while the NAICS is a 6-digit classification.[10]The share of green workers, according to the output-based method, is the result of two successive aggregations: (i) the unweighted share of green outputs from NAICS 6-digit to ISIC level 4 and (ii) the weighted average from ISIC level 4 (in the LFS 2019) to ISIC level 3 (in the CSES).

[10] The industry codes used in the CSES 2021/22 actually contain 4 digits, but the last digit is always a 0, except for the Agriculture sector. As a result, all industries are classified at the 3-digit level, except agricultural activities (Growing of non-perennial crops, Growing of perennial crops and Animal production).

Our reclassification of the BLS classification is first aggregated at the level 4 of the International Standard Classification of Industry 4th Revision (ISIC level 4), which is used in the LFS 2019. Most ISIC level 4 codes correspond to several 6-digit NAICS codes, so we do a crosswalk (which is very similar to Doan, Luu, Nguyen, & Safir (2023), see Appendix A2 for detail). We then classify ISIC level 4 industries as green (all corresponding NAICS industries produce green outputs), mixed green (some corresponding NAICS industries produce green outputs) and non-green (no corresponding NAICS industry produces green outputs). We also create a greenness measure based on the ratio of NAICS industries producing green outputs to the total number of NAICS industries corresponding to an ISIC level 4.[11]

As in the task-based approach, the distribution of employment within ISIC level 4 industries in the LFS is then used to compute weights for the aggregation at the ISIC level 3 in the CSES. To compute the share of workers in green industry in a 3-digit ISIC, we multiply the share of green subsectors in all corresponding 4-digit industries by their employment share in the LFS and take the sum. For example, level 3 industry Inland water transport (502) corresponds to two level 4 industries Inland passenger water transport (5021) and Inland freight water transport (5022). The latter corresponds to a single NAICS 6-digit industry that is not green, while the former corresponds to 2 NAICS industries: Inland Water Passenger Transportation (483212), classified as green because it includes ferry commuter services, and Scenic and Sightseeing Transportation, Water (487210) classified as non-green. The ISIC level 4 5021 is therefore mixed green, with a share of green outputs equal to 50 percent, while industry 5022 is non-green. In the LFS 2019, 21 percent of employment in the level 3 industry 502 is under the industry 5021, while 79 percent is for the industry 5022. The greenness measure of industry 502 is therefore 11 (which is 50 * 0.21).

Box 2: Summary of methodology and data

Step 1: Identify green and potential green occupations and green industries:

- For the task-based approach, cross walk green ISCO-08 occupations (4-digit) identified by the GTI toolkit to the Cambodian Occupational Classification (COC, 3-digit).
- For the output-based approach, industries are manually reclassified given the Cambodian context, and a crosswalk from NAICS (6-digit) to ISIC level 4 is used to identify industries likely to produce outputs and services in the green economy, as well as the share of green goods and services produced. Industries producing only green goods and services are classified as green, those producing at least one green good or service are classified as mixed green.

Step 2: Calculate weighted GTI and weighted employment shares due to use of 3-digit classifications in the CSES:

- Task-based approach: We use the distribution of occupations in the 2019 LFS (which codes occupations at the 4-digit level) to obtain the share of workers in each 3-digit occupation that is likely to be employed in a green 4-digit occupation. The result of this step is the share of green jobs in a given 3-digit occupation, as well as a weighted GTI index that reflects the share of green tasks and the share of workers carrying each green 4-digit occupation under a given 3-digit occupation.
- Output-based approach: We use the employment distribution of industries in the 2019 LFS (which codes industries at level 4) to obtain the share of workers in each level 3 industry that is likely to be employed in a (mixed) green industry. We then multiply the share of workers in

[11] Given that we do not have data on the employment share of the NAICS sectors, this share is unweighted and we therefore assume that all green outputs are produced in similar proportions.

(mixed) green industries by their share of green goods and services produced by those industries to obtain our output-based greenness index.

Step 3: Merge green occupations and industries with individual and firm-level data. Outputs from Steps 1 and 2 are merged with different databases:

- Task-based approach: The share of (potential) green jobs and the weighted (potential) GTI index are applied to the Cambodia Socio-Economic Survey (CSES) mainly for 2021/22 but also for previous years when examining changes over time.
- Output-based approach: The green ISIC classification is applied to the CSES 2021/22 data (ISIC level 3), as well as to firm-level data from the Economic Census 2022 (ISIC level 4) covering all formal firms in Cambodia, except household businesses in agriculture, forestry, fishing, diplomatic missions, embassies, consulates, and international organizations operating in Cambodia. For the Economic Census, the second crosswalk described in Step 2 is not carried out given that it uses ISIC level 4.

3. Which jobs are green in Cambodia?

3.1 Green jobs

A total of 14 out of the 145 occupations present in the CSES are considered green, and, while limited, they are very diverse. The 5 greenest occupations, i.e. those with the highest weighted GTI are rag pickers, life science professionals, refuse workers, process control technicians and forestry and related workers (Table 1). These occupations show the diversity of the green economy, ranging from elementary to high-skilled occupations. The classification of some occupations may seem surprising, but it is driven by the task content as well as reclassification based on understanding of in-country practices. For instance, the Rubber, plastic and paper products machine operators are classified as green because one of their tasks includes plastic recycling (which is taking place in the large firms that have such workers). Machinery mechanics and repairers are included because they include Bicycle and related repairers and bicycles are green. Process control technicians are green because they include Power production plant operators, who operate power-generating systems in hydroelectric plants, and Incinerator and water treatment plant operators who control furnaces that burn solid waste, and operate and monitor the equipment of wastewater and sewage treatment plants.

These 14 occupations account for 2 percent of the workforce, corresponding to 175,000 workers, which is comparable to what has been found in neighboring countries. This is similar to what was found in Indonesia (2.3 percent) and smaller than what was found in Viet Nam (3.6 percent) (Doan, Luu, Nguyen, & Safir, 2023; Granata & Posadas, 2024). These reports used the same approach as here, making the comparison relevant as differences between countries are not driven by differences in green classification but only by the number of workers in green occupations, reflecting differences in the economic activities of the three countries. For example, Life science professionals account for 0.03 percent of workers in Cambodia, while the corresponding occupations in Viet Nam are more common and account for 0.09 percent of the workforce.[12] Furthermore, some high-skilled green occupations in Viet Nam are missing or very rare in Cambodia, such as Environmental protection engineers and Chemists.[13]

[12] The corresponding 4-digit occupations for Life science professionals (213) are Biologists, botanists, zoologists and related professionals (2131), Farming, forestry and fisheries advisers (2132) and Environmental protection professionals (2133).

[13] While this does not imply that such occupations do not exist in the country, the fact that not a single respondent among the 23,607 workers surveyed in the CSES reported these occupations gives an indication of their rarity.

Table 1 Green Occupations ranked by GTI

COC 3-digit	CSES Occupation Title	Weighted GTI	Green employment share (%)
962	Rag Picker	75	0.04
213	Life science professionals	64	0.03
961	Refuse workers	61	0.18
313	Process control technicians	26	0.04
621	Forestry and related workers	20	0.38
723	Machinery mechanics and repairers	13	0.09
724	Automobile mechanics and fitters	13	0.50
725	Motorcycle mechanics and fitters	13	0.61
314	Life science technicians and related associate professionals	7	0.01
814	Rubber, plastic and paper products machine operators	5	0.02
311	Physical and engineering science technicians	3	0.02
216	Architects, planners, surveyors and designers	2	0.00
741	Electrical equipment installers and repairers	1	0.04
531	Protective services workers	1	0.02
Total employment in green jobs			1.97

Source: CSES 2021/22.

Notes: Sampling weights are included at the individual level. Sample includes working age (15-64 year-olds) and employed. Occupations are classified at the 3-digit level following the Cambodian Occupational Classification (COC). The weighted GTI of an occupation is the average of the GTI of the corresponding 4-digit occupations, weighted by the employment share of each 4-digit occupations in the LFS 2019. The green employment share of an occupation is the share of that 3-digit occupation in total employment in the CSES, weighted by the share, in the LFS 2019, of workers in that occupation whose 4-digit occupation is classified as green. Total sample size: 23,607 (8,893,183 with weights).

The top two green jobs by employment share are Motorcycle mechanics and fitters and Automobile mechanics and fitters, followed by Forestry workers. Motorcycle and Automobile mechanics are classified as green because one of their tasks includes "maintenance on vehicle in order to ensure compliance with pollution regulation".[14] Together, these two occupations account for 56 percent of workers in green jobs. Forestry workers are classified as green because two of their tasks are related to forest regeneration. Other occupations commonly understood as green, such as solar panel installer and energy auditor are respectively included in the Electrical equipment installers and repairers and in the Physical and engineering science technicians (See Appendix A1 for a detailed list of green tasks for each occupation).

Table 2 Topic areas of green and potentially green tasks in Cambodia

	Green tasks	Potential green tasks
Agriculture, forestry, and fish product	2	98
Clean energy	1	0
Climate change terms	3	1
Energy efficiency	0	2
GHG reduction, pollution reduction, and removal	4	0
Low-carbon mobility	1	5
Natural Resource Conservation	6	0
Recycling and reuse of waste and materials	10	0
Repair	0	87
Multiple	9	1
Total	42	195

Source: CSES 2021/2022

[14] In-country discussions confirmed that this task is performed in Cambodia.

Green tasks performed in green jobs in Cambodia are mostly related to recycling and reusing of waste and materials as well as to natural resource conservation. Of the 42 green tasks performed in Cambodia, 10 include the words durability, recycle, waste management, and waste treatment and are therefore related to recycling (Table 2). Another 6 tasks are related to natural resource conservation, and they include the terms "conserv, ecolog, fire detect, extinguishing fire, fire prevention, wildlife".

Potential green tasks are almost 5 times more prevalent than green tasks and are overwhelmingly related to agriculture and repair. These tasks contain words from the potential green dictionary that are absent from the green dictionary, such as "agri, aqua, crop, farm, forest, seed, tree, repair." Given the potential green jobs found in Cambodia, 195 tasks potential green tasks are performed, out of a total 246 potential green tasks. By contrast, the total number of green tasks in ISCO-08 are 83 and so the green tasks in Cambodia are very limited, as only half of them are performed. We examine in Box 4 the missing green tasks in Cambodia to better understand how greening the economy could modify the tasks performed by Cambodian workers in the future.

Table 3 Top 15 Potential Green Occupations by weighted potential GTI

COC 3-digit	CSES Occupation Title	Weighted potential GTI	Potential green employment share (%)
213	Life science professionals	91	0.03
611	Market gardeners and crop growers	82	10.06
621	Forestry and related workers	80	0.38
962	Rag Picker	75	0.04
961	Refuse workers	71	0.18
723	Machinery mechanics and repairers	54	0.23
742	Electronics and telecommunications installers and repairers	51	0.12
963	Firewood and water collectors	50	0.06
613	Mixed crop and animal producers	50	0.01
741	Electrical equipment installers and repairers	46	0.58
314	Life science technicians and related associate professionals	46	0.01
836	Mobile plant operators	33	0.34
921	Agricultural, forestry and fishery labourers	33	4.88
835	Heavy truck and bus drivers	33	0.28
711	Building frame and related trades workers	30	5.73
All other potential green jobs			22.91
Total Employed in potential Green Jobs			**56.29**

Source: CSES 2021/22.
Notes: See Table 1, potential GTI instead of GTI (see Appendix A).

Indeed, potential green jobs cover a much larger share of the Cambodian workforce than green jobs: 48 occupations are categorized as potential green, covering 5 million workers and 56 percent of the workforce. This is much larger than what was found in Indonesia and Viet Nam, and is driven mostly by the large employment share of occupations related to agriculture (including animal husbandry, forestry and fishery). Potential green jobs account for 17 percent of the workforce in Indonesia (Granata & Posadas, 2024) and 41 percent in Viet Nam (Doan, Luu, Nguyen, & Safir, 2023). This difference is mostly driven by the larger agriculture sector of the Cambodian economy. Among potential green jobs, 44 percent (23 percent of total workers) have a high GTI, i.e., have at least 30 percent of their tasks classified as potential green (Table 3).

Three occupations account for half of the employment in potential green jobs: Market gardeners and crop growers, Garment and related trades workers, and Subsistence crop farmers, reflecting the structure of the Cambodian economy. Together, these three occupations account for 29 percent of the total workforce (Table 4). Garment workers are classified as potential green formally because their tasks

include “repairing damaged fabrics, shoes and other leather products” but also because a survey of garment firms in Cambodia indicates practices of recycling and water savings (Figure 1). Other potential green occupations with employment shares above 2 percent include Building frame and related trades workers, Animal producers, and Agricultural, forestry and fishery laborers. These six occupations together account for 79 percent of potential green jobs.

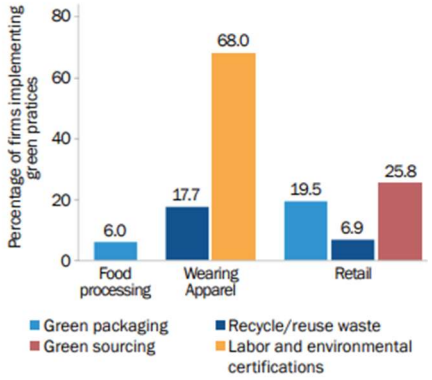
Table 4 Top 15 Potential Green Occupations by employment share

COC 3-digit	CSES Occupation Title	Weighted potential GTI	Potential green employment share (%)
611	Market gardeners and crop growers	82	10.06
755	Garment and related trades workers	12	9.80
631	Subsistence crop farmers	29	8.87
711	Building frame and related trades workers	30	5.73
612	Animal producers	16	5.71
921	Agricultural, forestry and fishery labourers	33	4.88
622	Fishery workers, hunters and trappers	24	1.78
834	Other motor-related drivers	13	1.20
721	Sheet and structural metal workers, moulders and welders, and related workers	13	1.02
634	Subsistence fishers, hunters, trappers and gatherers	13	0.92
753	Wood treaters, cabinet-makers and related trades workers	15	0.80
754	Tailors, dress makers, furriers and hatters	18	0.64
725	Motocycle mechanics and fitters	25	0.61
741	Electrical equipment installers and repairers	46	0.58
724	Automobile mechanics and fitters	25	0.50
All other potential green jobs			3.20
Total Employed in Broad Green Jobs			56.3

Source: CSES 2021/22.
Notes: See Table 1, potential GTI instead of GTI. Table A.6 contains the full list of potential green occupations.

The only industry with a sizable share of green jobs is Electricity and water (11 percent), while potential green jobs exist in most industries, indicating a potential for greening across the entire economy. Workers holding green jobs in Electricity and water are mostly Engineers and Electrical equipment installers and repairers working in electricity generation, as well as refuse workers in waste management (Figure 2).[15] Green jobs also account for a small percentage of jobs in Market services (car and motorbike mechanics and refuse workers) and Manufacturing (mostly Electrical equipment installers and repairers). Potential green jobs are most common in Agriculture (90 percent), Manufacturing (79 percent) and Construction (62 percent), with the last two having

Figure 1 Implementation of green technologies in firms

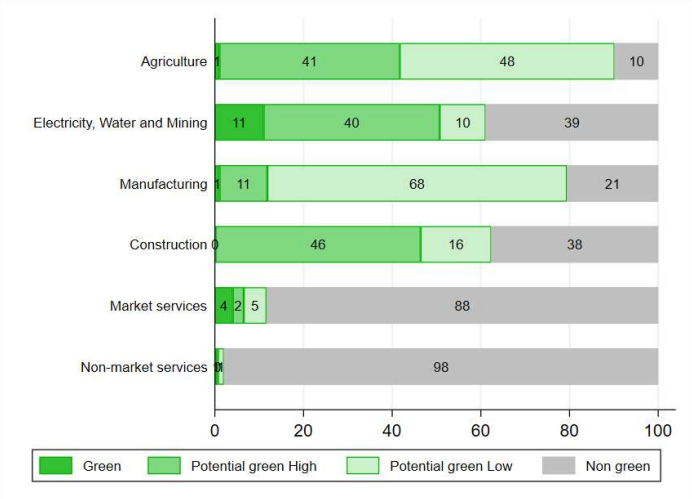


Source: (World Bank, 2023) using Cirera et al. 2023, Firm-Level Adoption of Green Technologies; Cambodia Technology Adoption Survey

[15] The Electricity and water sector includes the Mining sector. We made the grouping because the mining sector is very small, with only 60 observations (24370 weighted sample) and descriptive statistics for the sector only are not meaningful.

mostly high GTI potential green jobs.[16] Potential green jobs in manufacturing are mostly held by Garment and related trades workers because their tasks involve the repair of fabric, clothes, and shoes.

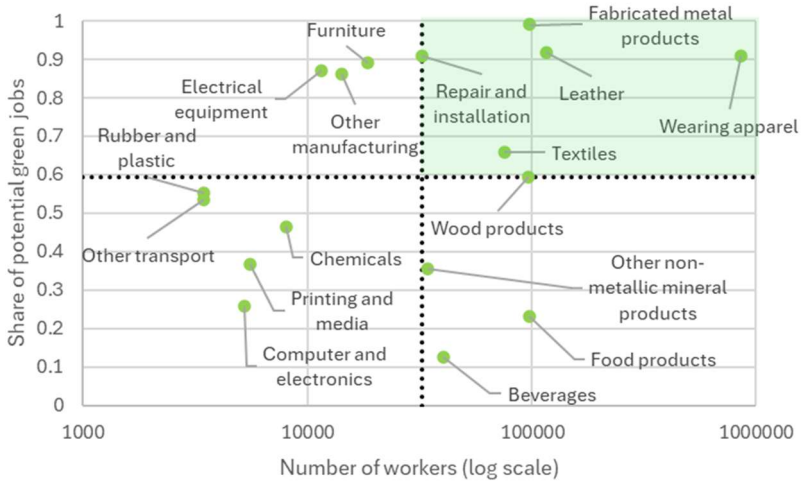
Figure 2 Share of green jobs within broad industry groups



Source: CSES 2021/22. Each observation is weighted by the sampling weights and the share of (potential) green jobs in the occupation. See Appendix A for more detail.

There is a large potential for greening the economy through greening jobs in manufacturing. Figure 3 displays the relationship between the size of manufacturing sub-sectors (defined at ISIC level 2) and their share of potential green jobs. Almost all sub-sectors employing a large number of workers (above median) also have a large share of potential green jobs (above median). The garment industry, which has a high share of potential green jobs, is by far the largest in terms of employment (Garment and related workers account for more than half the employment in manufacturing). Policies aimed at greening this sector therefore appear very important for greening the economy (GGGI, 2018). One small sector in terms of employment but with a high share of potential green jobs is the Manufacturing of electrical equipment, which mostly employs Electrical equipment installers and repairers, and includes the manufacturing of electric motors, batteries, and electronic equipment. The government's "Automotive and Electronics Sectors Development Roadmap", can boost this sector and contribute to a greener economy, through electric vehicles (assembly and auto parts).

Figure 3 Concentration of Broad Green Jobs in Manufacturing Divisions (ISIC Level 2)



Source: CSES 2021/22, manufacturing divisions (ISIC level 2) with at least 10 observations. Dashed lines show the median of each variable.

[16] These figures only include potential green jobs that are not also classified as green.

3.2 Jobs in green industries

Moving to classifying jobs' greenness based on their output, we find 37 green industries out of 178 in the CSES 2021/22, 8 green and 29 "mixed" green, henceforth all named green. Eight industries are fully green, which means that all the corresponding 4-digit industries produce only green outputs. These green industries include, among others, the Repair of computers and communication equipment, Water collection and treatment, and Higher education, which is classified as green because higher education institutions include training for some green jobs and because many curricula cover some form of green skills (Table 5). The remaining 29 industries are mixed-green, i.e., some of their sub-industries produce at least some non-green outputs. For example, Electric power generation (3510) is mixed-green because electricity can be produced with renewable energy or with fossil fuels. Another mixed-green industry is the Manufacture of electronic components, which includes solar cells (used in PV panels) as one of its many outputs. Other mixed-green sectors include the Building of ships and boats (for the building of ferries, used for mass transport), Travel agency and tour operator (included for eco-tourism) or Demolition and site preparation (necessary steps for heavy engineering projects such as dams).

Jobs in green industries account for 3.9 percent of total employment, corresponding to 348,000 workers. Fully green industries account for only 0.25 percent of employment while two industries – Other land transport and Other specialized construction activities – jointly account for 61 percent of jobs in green industries. Other land transport is green because it includes group passenger land transport activities such as railway, urban buses and intercity buses. By contrast, private transport services, e.g., taxis are not classified as green. Other specialized construction activities include the construction of green projects, such as parks and subways (See Appendix A2 for more details on green industry classification).

Table 5 List of green and mixed green industries identified with the output-based approach

Broad industry group	ISIC code	Industry name	Weighted share of green sub-sector	Green employment share (%)
AGRICULTURE	210	Silviculture and other forestry activities	100	0.00
	230	Gathering of non-wood forest products [Mixed green because of Forest nurseries]	50	0.15
	240	Support services to forestry	50	0.01
	Total green industries in Agriculture			**0.17**
MANUFACTURING	2510	Manufacture of structural metal products, tanks, reservoirs and steam generators	3	0.03
	2590	Manufacture of other fabricated metal products; metalworking service activities [Mixed green because of Specialized inputs for Renewable Energy]	1	0.00
	2610	Manufacture of electronic components [Specialized inputs for RE, such as solar cells]	11	0.00
	2810	Manufacture of general purpose machinery [Turbines for hydroelectricity and wind turbines]	14	0.00
	3010	Building of ships and boats [Ferries for mass transportation]	13	0.00
	3310	Repair of fabricated metal products, machinery and equipment	66	0.23
	Total green industries in Manufacturing			**0.27**
	3510	Electric power generation, transmission and distribution	50	0.16

ELECTRICITY WATER & MINING	3600	Water collection, treatment and supply	100	0.06
	3700	Sewerage	100	0.02
	3810	Waste collection	100	0.01
	3820	Waste treatment and disposal	100	0.00
	3830	Materials recovery	50	0.02
	Total green industries in Mining, Electricity and Water			**0.28**
CONSTRUCTION	4210	Construction of roads and railways	33	0.04
	4220	Construction of utility projects	75	0.03
	4290	Construction of other civil engineering projects	40	0.00
	4310	Demolition and site preparation [Site preparation for heavy engineering projects]	20	0.21
	4390	Other specialized construction activities	8	0.57
	Total green industries in Construction			**0.85**
MARKET SERVICES	4520	Maintenance and repair of motor vehicles	50	0.26
	4920	Other land transport	57	1.79
	5020	Inland water transport	11	0.00
	6200	Computer programming, consultancy and related activities [Programmes that monitor and regulate energy usage]	33	0.01
	7110	Architectural and engineering activities and related technical consultancy	29	0.00
	7910	Travel agency and tour operator activities [Eco-tourism]	65	0.03
	8120	Cleaning activities	0	0.00
	8130	Landscape care and maintenance service activities	100	0.04
	9490	Activities of other membership organizations	3	0.00
	9510	Repair of computers and communication equipment	100	0.07
	9520	Repair of personal and household goods	56	0.04
	Total green industries in Manufacturing			**2.14**
NON-MARKET SERVICES	8410	Administration of the State and the economic and social policy of the community	0	0.00
	8420	Provision of services to the community as a whole	3	0.02
	8520	Secondary education	2	0.01
	8530	Higher education	100	0.04
	8540	Other education	10	0.02
	9100	Libraries, archives, museums and other cultural activities	17	0.00
	Total green industries in Manufacturing			**0.20**
Total employment in green industries				**3.91**

Source: CSES 2021/22 and BLS green industries classification. The weighted share of green outputs of an industry (at 3-digit level) is the average share of green outputs produced by the 4-digit industries, weighted by their employment share in the LFS 2019. This share of green outputs (at 4-digit) is the share of the corresponding NAICS 6-digit industries that are classified as green. Green employment share is the product of the weighted share of green outputs by the total employment share in the industry.

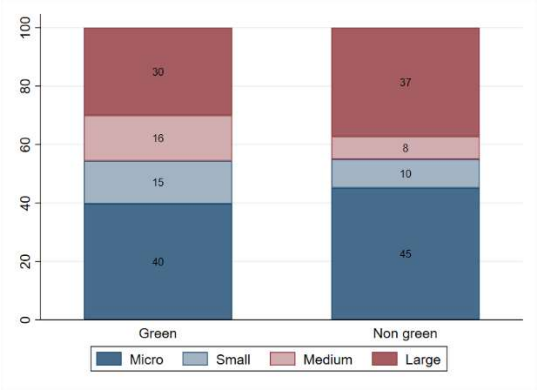
Jobs in green industries are mostly present in the Electricity and water, Construction, and Market services sectors. 51 percent of jobs in the Electricity and water sectors are in a green industry, owing to renewable electricity generation and to waste management. Green industry jobs in Construction account for 9 percent of employment in the sector and are related to Heavy and civil engineering construction projects, while green industry jobs in Market services (7 percent of employment in the sector) include Public transportation, Automobile repair and Cleaning services.

Cambodia's LTS4CN outlines key mitigation measures in these green industries in the path toward carbon neutrality, starting with Electricity generation Transportation, and Forestry. Cambodia has committed to halt deforestation by 2045 and aims, by 2050, to reach 2.7 million hectares of sustainable plantations and agroforestry. On energy, it has plans to increase solar, hydro, biomass and other renewables energies to 35 percent of the generation mix by 2050, of which 12 percent is from solar. For transportation, it plans to increase urban public transport to 30 percent in 2050, while investments in rail will start after 2030. Finally, it wants to expand waste collection coverage by 85 percent and implement a "Reduce, Reuse, and Recycle" strategy. All these commitments imply an expansion of green industries.

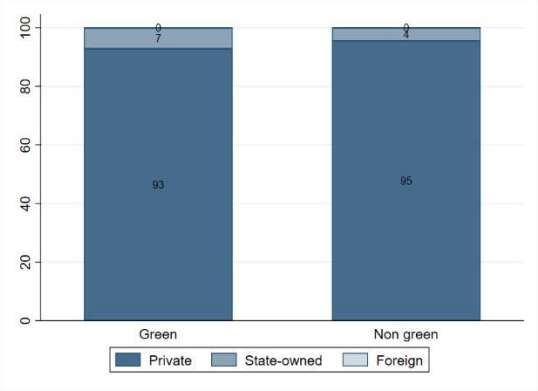
The results of the 2 approaches – task-based and output-based – show their complementarity. By contrast to the task-based approach, only a small share of manufacturing industries is classified as green, amounting to only 2 percent of employment in the sector: These jobs are mostly in Solar heating systems and in Repair services. This is because the large textile manufacturing sector is not classified as green; textile not being a green output. However, workers in textile can have greener practices, e.g., reusing material and saving water, which is why they are potential green.

Figure 4 Distribution of firms in green industries, by firm size and type of ownership (weighted by the number of workers in the top panel, unweighted in the bottom panel)

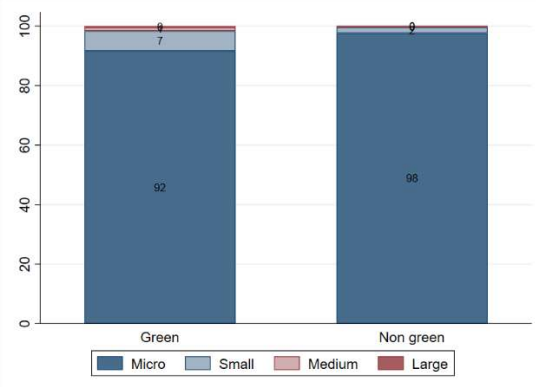
Panel A: Firms in green industries by firm size (weighted by employment)



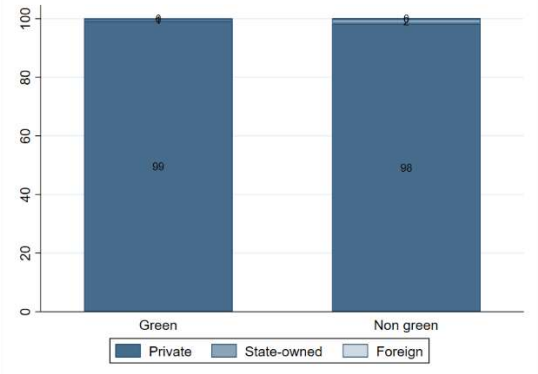
Panel B: Firms in green industries by ownership status (weighted by employment)



Panel C: Firms in green industries by firm size (unweighted)



Panel D: Firms in green industries by ownership status (unweighted)



Source: World Bank staff calculation using the Economic Census 2022.
Note: The sample includes formal business establishments operating in all economic forms except household businesses in agriculture, forestry, fishing, diplomatic missions, embassies, consulates, and international organizations. Micro: less than 10 workers, small: 10-49 workers, medium: 50-249 workers, large: more than 250 workers. This classification departs from the NIS classification of firm size which combines workforce, assets and sales, with different threshold for agriculture, industry and services. This classification, however, leaves 19 percent of the sample unclassified given that many companies do not report assets.

There are no significant differences between firms across green and non-green industries regarding size or ownership. However, workers in green industries are more likely to work in small and medium enterprises (SMEs) compared to those in non-green industries, indicating that interventions with SMEs could support greening across many workers. Focusing on the number of firms, there are no significant differences between firms in green and non-green industries (Figure 4, bottom panel). However, there are some differences when we weigh by the number of workers in each firm: Firms in green industries are more likely to be small and medium compared to non-green industries. It has been shown that micro, small, and medium-sized enterprises (MSMEs) can play a key role in the greening of the economy due to their large quantity and high adaptability to adopt green technologies (ITC 2021; OECD 2018).

Box 3: A forward look: Jobs likely to emerge in Cambodia as a result of an increase in renewable energy and energy efficiency

Cambodia has made commitments to increase its share of renewal energy to 70 percent by 2030, including installing 1GW of solar power in the next 10 years. These are ambitious targets as the solar power target is similar to that in high-income countries. The RE share would increase from the current 62 percent. The third objective of the Power Development Master Plan 2022-2040 is "to increase the share of clean energy, including renewable and variable renewable energy, and energy efficiency, by ensuring reliability and affordability of supply." The share of solar in Cambodia's power generation capacity has already increased sharply, from near zero in 2016 to 12% in 2021.

Cambodia has also set ambitious targets for energy efficiency, including a reduction in energy consumption by 19 percent by 2030 through energy efficiency, as outlined in the National Energy Efficiency Policy 2022-2030. Bringing these dimensions of savings on supply and on usage, the Energy Technology Roadmap (2023) aims to achieve the vision "To become an energy self-sufficient nation through the deployment of technology and innovation, and leveraging renewable energy sources for sustainable development by 2030". This includes increasing local energy generation, enlarging the share of renewable energy, and increasing energy efficiency.

The renewable energy and energy efficiency sectors have the potential to create many jobs and are currently facing labor and skills shortages. Estimates of the employment implications of the RGC's planned US$3 billion investments in solar energy by 2040, indicate a potential to create 20,000 - 25,000 jobs. A similar number of jobs is expected to be created in the energy efficiency sector (Sevea, 2023 using estimates of solar energy implications by Garrett-Peltier, 2017). The table below shows key occupations in-demand and expected to grow. For most of these, labor supply is "low to medium" at best, indicating the need to prepare the workforce to take on these jobs.

To meet the increased demand, both for internal net-zero targets and exports, Cambodia needs to quickly increase training in key occupations in demand, and reskilling could be an avenue for some occupations. Consultations with key players in the energy sector highlight the necessity to involve the private sector in TVET and university curriculum design and to increase opportunities for work-based learning. Interestingly, Sevea (2023), indicate the complementarity of skills in some occupations that are prevalent in Cambodia and some of the energy occupations. For instance, plumbing and welding skills are considered key for solar panel installers. This indicates the possibility to reskill workers with close skills.

New initiatives in the Institute of Technology of Cambodia (ITC) support increasing capacity for energy efficiency. They include strengthening the capacity of the ITC to train energy managers and energy auditors through training existing trainers as well as providing scholarships to increase the

number of experts. Aside from training students in the upcoming workforce, ITC will also provide training to select provincial departments of the Ministry of Mine and Energy, to support them in implementing the National Energy Efficiency

Sector	Occupation	Labor market potential	Availability of local labor	Skill level
Solar	Solar system designer	Medium	Low to medium	High
	Solar PV installer	High	Low to medium	Low
	Automation engineer	Medium to high	Low to medium	High
Energy efficiency	Energy auditor	Medium	Low	Medium
	MEP engineers	High	Medium	High
	M&V Specialists	High	Low	High

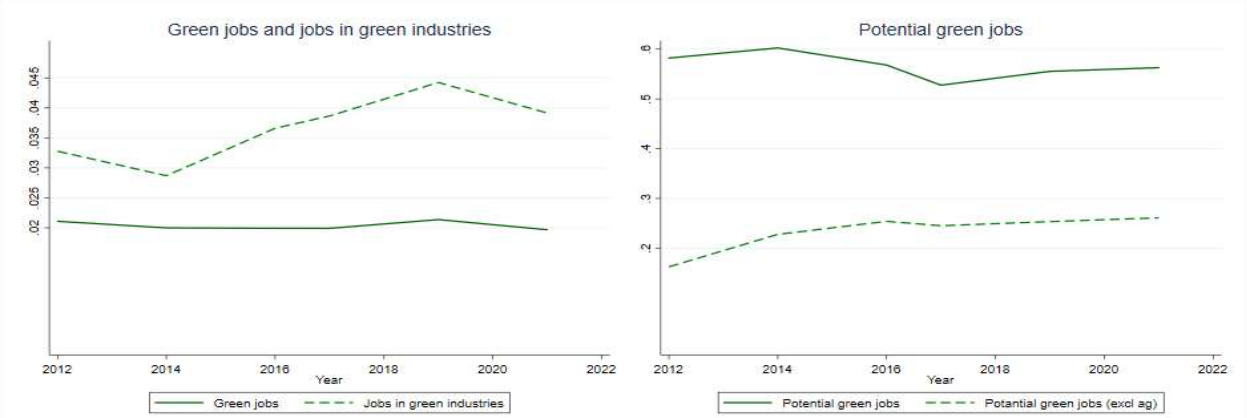
Source: Sevea (2023) for columns (1) to (4), WB staff classification based on ISCO-08 for column (5).

3.3. Growing green jobs

The share of green jobs remained constant between 2012 and 2021/2022, while the share of non-agricultural potential green jobs increased by 10 percentage points. This implies almost a doubling of non-agricultural potential green jobs, from 129,000 to 232,000 workers (Figure 5). Among potential green jobs, the Crafts and related trades workers – which include Garment and related trades workers and Building frame and related trades workers – make up six of the top ten growing occupations. Two other occupations are among Machine operators while the remaining two are Physical and engineering science technicians and Life science professionals. See Table B.1 for details on the growth of potential green occupations.

The share of jobs in green industries increased by 18 percent, rising from 3.3 to 3.9 percent of the workforce, mainly due to a combined increase in and a greening of the Construction and Market services sectors. Employment in the Construction and Market services sectors respectively increased by 5 and 6 percentage points over the period. In addition, within each sector, the share of employment in green industries increased – from 5 to 9 percent in Construction and from 6 to 7 percent in Market services. Green industries in construction are found under “Other specialized construction activities” (ISIC 4390), which accounts for two thirds of employment in the sector. It is green because it includes heavy engineering projects, such as hydroelectric dams. Green market services include passenger transport (urban, suburban and intercity buses) and the repair of motor vehicles.

Figure 5 Share of green jobs and jobs in green industries, 2012 to 2021/2022



Source: CSES 2012-2021. Aggregation from 4- to 3-digit occupations and industries using a linear interpolation of weights from LFS 2012 and 2019. 2019 weights applied to CSES 2021/22. See Appendix for more details.

Box 4: Missing green jobs

In order to illustrate which jobs could be growing as a result of a greening of the economy, we conduct two exercises: 1) We examine the missing green and potential green jobs in Cambodia when compared to all the green and potential green jobs in the GTI toolkit; 2) We compare green jobs in Cambodia to green jobs in a neighboring economy, Viet Nam.

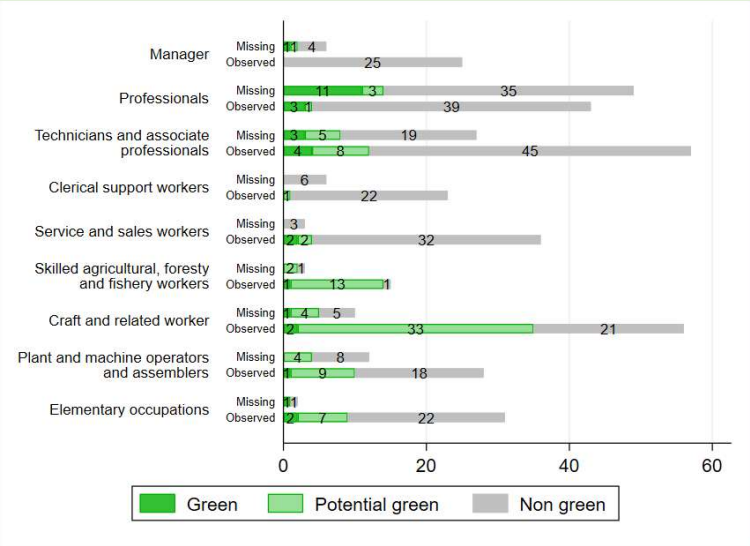
A total of 17 green jobs that are identified in the GTI toolkit are not observed in Cambodia, most of which – 12 – are high skilled, indicating how a greening of the economy could also contribute to Cambodia's objectives to skill-up. The GTI toolkit identifies 36 occupations (at the 4-digit level) with at least one green task, a number that decreases to 32 after excluding the three occupations mistakenly categorized as green and after reclassifying Aquaculture workers as potential green because their only green task is not carried out in Cambodia (see Appendix). Of those 32, only 15 are present in the LFS or CSES datasets and 17 are "missing", in the sense that they are not observed in the data.[17] No green Managers are found in CSES data and out of the 14 possible green Professionals occupations, only three are observed. Another 3 are missing among Technicians and associate professionals (Figure 6). While this does not imply that these occupations are completely absent from the Cambodian economy, the fact that they are not observed in the CSES indicates their rarity. See Table B.2 in Appendix B for the list of green occupations and green tasks not observed in the data.

These missing occupations are mostly related to STEM, which are also going to be required given Cambodia's priorities in its LTS4CN. Most missing occupations are related to Physical and earth science (chemists, geologists, chemical science technicians), Engineering (Industrial and production engineers, Civil engineers, Environmental engineers), and Architects and planners (Landscape architects, Town and traffic planners). They will be required in the greening of the key sectors identified by Cambodia's LTS4CN, such as energy production and industrial processes (requiring Science professionals and technicians, as well as Engineers), and transportation (requiring Engineers and Town and traffic

[17] Occupations are classified at the 4-digit level in GTI toolkit and in the LFS, but at the 3-digit level in the CSES. For occupations observed in the CSES, we assume that only the corresponding 4-digit occupations observed in the LFS are present in the economy. However, if an occupation is present in the CSES but none of its corresponding 4-digit occupations are observed in the LFS, we assume that all those 4-digit occupations are present in the economy. This approach reflects that used to compute the weights used in the aggregation to the 3-digit level and explained in detail in Appendix A.

planners). Increasing training in those key occupations therefore appears necessary if Cambodia is to fulfill its climate commitments.

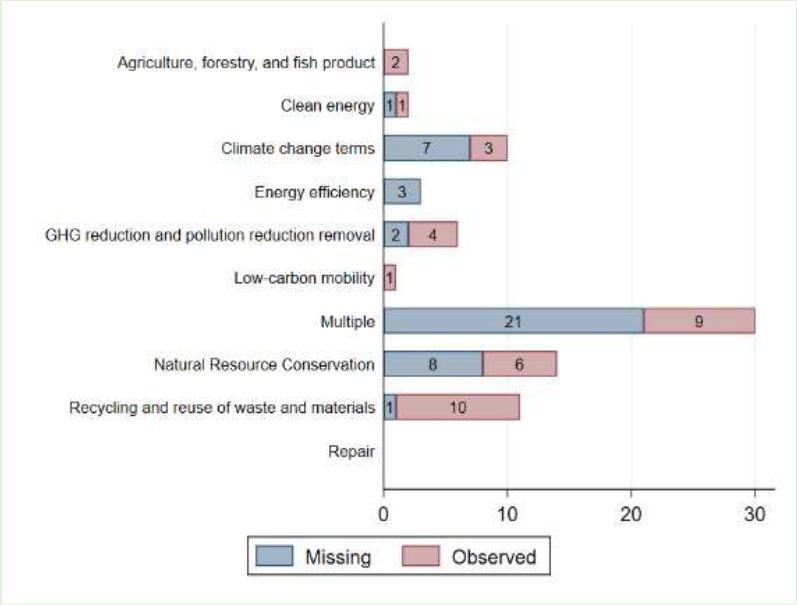
Figure 6 Jobs from the GTI toolkit observed and not observed in the CSES data



Source: CSES 2021/22.
Note: A 4-digit occupation is coded as "observed" if it is observed in the LFS and the corresponding 3-digit occupation is observed in the CSES. If a 3-digit occupation is observed in the CSES and none of its corresponding 4-digit occupations are observed in the LFS, they are all coded as "observed" as well.

Potential green jobs are less "absent", as 73 out of 92 potential green jobs are present in Cambodia, but those missing potential green jobs are also higher skilled than both current non-green and potential green jobs in Cambodia. Only one of the 5 high-skilled potential green jobs is observed in the data and only 9 of the 14 medium-skilled.

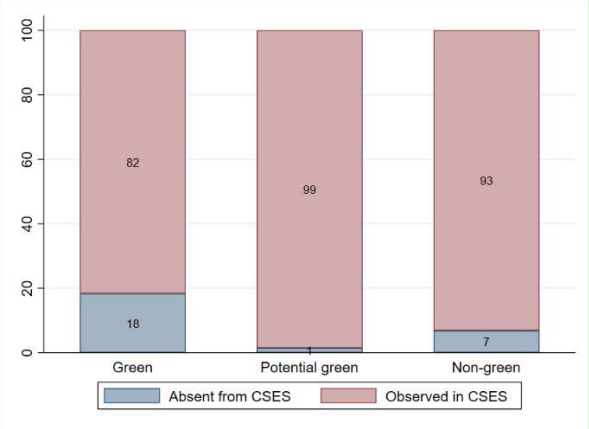
Figure 7 Topic areas of missing green tasks



Source: CSES 2021/22.

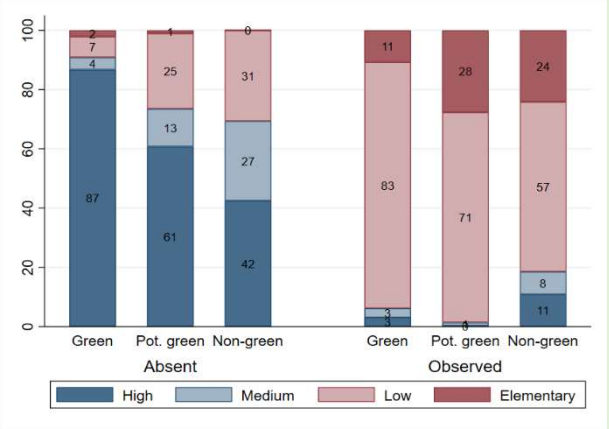
Looking deeper into the tasks involved in the missing green jobs, missing green tasks are mostly related to Climate change and Natural resource conservation. The GTI toolkit identifies 80 green tasks out of 3,244, and only 36 of those are performed in occupations observed in the CSES data.[18] Of the 44 missing green tasks, 21 are linked to more than one topic area and 8 are linked to Climate change and Natural resource conservation, each. The remaining tasks are related to Energy efficiency (3), Pollution reduction (2) and to Clean energy and Recycling (1 each, Figure 7). The missing potential green tasks are almost equally distributed between Agriculture, forestry and fisheries (26) and Repair (22), which is not surprising given that these two categories represent 94 percent of potential green tasks.

Figure 8 Viet Nam share of employment in occupations unobserved in Cambodia



Source: Viet Nam LFS 2022 and Cambodia CSES 2021/22

Figure 9 Skill distribution of missing jobs



Source: Viet Nam LFS 2022 and Cambodia CSES 2021/22

Examining a neighboring economy is another way to have a sense of missing green jobs that may grow in Cambodia: green jobs that are not present in Cambodia represent 18 percent of green jobs in Viet Nam in 2021; with most missing green jobs – when compared to Viet Nam where the same methodology has been applied - also being high- and medium-skilled.[19] Those missing green jobs are more likely to be high skilled than green jobs that are observed in Cambodia (and they are also more skilled than missing non-green jobs). These missing green jobs indicate that the greening of the Cambodian economy can happen at the extensive margin, with new green jobs emerging as a result of the greener economy, such as Environmental engineers, Industrial and production engineers and Town and traffic planners (Figure 8, Figure 9).

4. Where are the green jobs?

Green jobs are found in similar proportions in rural and urban areas, while non-agricultural potential green jobs are more common in urban areas, especially out of Phnom Penh. Green jobs are uniformly distributed: They account for 2 percent of employment in rural areas, 2.3 percent in Phnom Penh and 1.7 percent in other urban areas (Figure 10). The corresponding figures for non-agricultural potential green

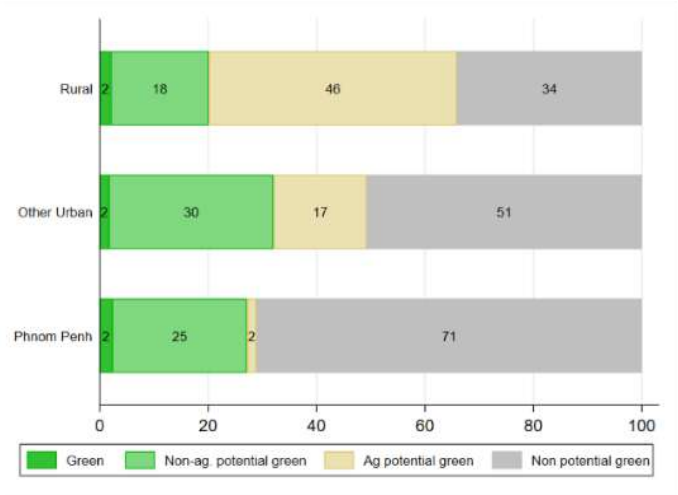
[18] There are actually 83 green tasks in the GTI toolkit, but in we reclassified three to non-green because of misclassification and one green task of Aquaculture workers is recoded as potential green. See Appendix for more detail.

[19] The methodology has been applied in Indonesia, South Africa, and Viet Nam. Of these three countries, Viet Nam is the closest to Cambodia's in terms of GDP per capita, the share of rural population, and not having commodities as key exports.

jobs are 18 percent (rural), 25 percent (Phnom Penh) and 30 percent (other urban). When agriculture is included, rural areas have a higher share of potential green jobs (64 percent).

While the share of green jobs is similar in rural and urban areas, their composition varies significantly by location, with Phnom Penh having a much higher concentration of skilled green jobs. Automobile and Motorcycle mechanics are the most common green jobs in all areas. Apart from these occupations, green jobs in rural areas are mostly elementary jobs and Forestry workers. In urban areas, and especially in Phnom Penh, they include higher skilled occupations, such as Process control technicians and Life science professionals. Overall, the high- and medium-skilled green occupations are mostly found in Phnom Penh (Table 6).

Figure 10 Distribution of green jobs in rural and urban areas



Source: CSES 2021/22.

Table 6 Composition of green occupations in rural and urban areas

			Share of occupation in total green jobs workers (%)		
	COC 3-digit	Occupation title	Rural	Other urban	Phnom Penh
High skilled	213	Life science professionals	1	0	6
	216	Architects, planners, surveyors and designers	0	0	0
Medium skilled	311	Physical and engineering science technicians	0	1	3
	313	Process control technicians	0	1	11
	314	Life science technicians and related associate professionals	0	1	1
Low skilled	531	Protective services workers	1	2	2
	621	Forestry and related workers	24	17	3
	723	Machinery mechanics and repairers	3	9	6
	724	Automobile mechanics and fitters	23	29	29
	725	Motorcycle mechanics and fitters	33	30	25
	741	Electrical equipment installers and repairers	2	4	2
	814	Rubber, plastic and paper products machine operators	1	1	0
Elementary	961	Refuse workers	11	5	8
	962	Rag Picker	2	1	3
	Total		100	100	100

Source: CSES 2021/22.

The share of potential green jobs is two to five times higher in rural areas compared to other urban areas and to Phnom Penh, driven by agricultural potential green jobs while the most common potential green jobs in urban areas are in manufacturing. Four of the top 5 potential green jobs in rural areas are in agriculture: Market gardeners, Subsistence crop farmers, Animal producers and Agricultural laborers

(Table 7). These occupations remain common in urban areas outside of Phnom Penh, although Garment and Building frame workers take over as the two most common potential green occupations. In Phnom Penh, these two occupations account for 59 percent of potential green jobs and the other occupations in the top 5 are also linked to manufacturing or transport.

The flat trend of green jobs between 2012 and 2021/2022 that we describe in Section 3 is observed in rural and urban areas but the composition of green jobs in each area changes over time. The share of Forestry workers declines and that of Automobile and Motorcycle mechanics, and Electrical equipment installers and repairers increase in rural areas. In urban areas, Automobile and Motorcycle mechanics are declining while Life science professionals and Protective service workers are increasing.

The 10 percentage points increase in non-agricultural potential green jobs is driven by the steady increase in garment workers in urban areas outside of Phnom Penh. Non-agricultural potential green jobs increased in other urban areas (by 15 percentage points) and in rural areas (by 8 percentage points). The increase in other urban areas is the result of the strong increase of Garment and related workers over the period (by 9 percentage points), while the increase in rural areas reflects a diversification outside of agriculture (Figure 11).

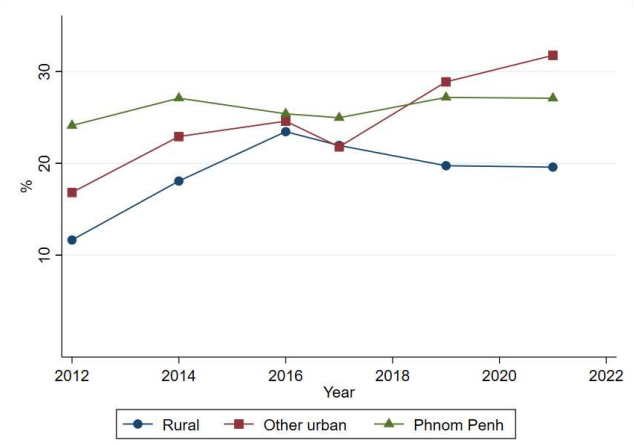
Table 7 Composition of potential green jobs in rural and urban areas

Rank	COC 3-digit	Occupation	Share of green jobs in the area (%)
		RURAL	
1	611	Market gardeners and crop growers	23
2	631	Subsistence crop farmers	19
3	612	Animal producers	12
4	921	Agricultural, forestry and fishery labourers	11
5	755	Garment and related trades workers	10
		Other	25
		OTHER URBAN	
1	755	Garment and related trades workers	30
2	711	Building frame and related trades workers	13
3	631	Subsistence crop farmers	10
4	611	Market gardeners and crop growers	8
5	612	Animal producers	7
		Other	32
		PHNOM PENH	
1	755	Garment and related trades workers	48
2	711	Building frame and related trades workers	12
3	721	Sheet and structural metal workers, moulders and welders, and related workers	5
4	834	Other motor-related drivers	5
5	753	Wood treaters, cabinet-makers and related trades workers	2
		Other	28

Source: CSES 2021/22. Table shows the 5 largest potential green occupations by green employment share in each area.

Driven by a larger share of Maintenance and repair of motor vehicles as well as of Collective transport, jobs in green industries are more common in Phnom Penh (6 percent) and in other urban areas (5 percent) than in rural areas (3 percent). Construction and Market services account for the majority of green industry jobs. 9 percent of employment in Construction is in green industry jobs, and this share is of similar size in urban and rural areas, accounting for 8-10 percent of the workforce. This sector, however, increased significantly in Phnom Penh between 2012 and 2021/2022, more than doubling its share from 3 to 8 percent. Most jobs in green industries in Market services are found in three industries: Maintenance and repair of motor vehicles, Cleaning services as well as Other land transport (which includes collective transport), which have a higher employment share in Phnom Penh (8 percent) compared to other urban and to rural areas (4 and 2 percent, respectively).

Figure 11 Non-agricultural potential green jobs

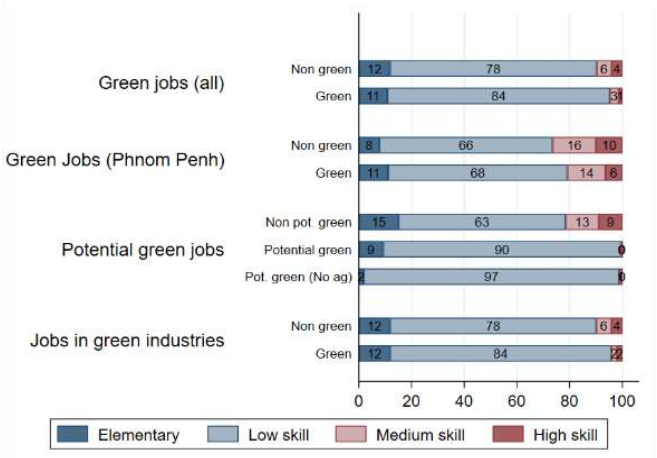


Source: CSES 2012-2021. Aggregation from 4- to 3-digit occupations using a linear interpolation of weights from LFS 2012 and 2019. 2019 weights applied to CSES 2021/22. See Appendix A for more details.

5. Are green jobs better jobs?

5.1. Skill Distribution

Figure 12 Skill distribution of green jobs and jobs in green industries



Source: CSES 2021/22

Notes: Low-skilled: Service and sales workers, craft and related workers, and plant and machine operators and assemblers, skilled agricultural, and forestry and fishery workers; medium-skilled: Technicians and associate professionals, clerical support workers; high-skilled: Managers and professionals.

Green jobs are less likely to be medium- or high-skilled than non-green jobs. Evidence on the skill distribution of green jobs is mixed, as they have been found to be predominantly low-skilled in Indonesia (Granata & Posadas, 2024) but higher-skilled in high-income countries such as the United States (Vona et al. 2018) and the United Kingdom (Valero, et al., 2021). In Cambodia, medium- and high-skilled jobs cover only 4 percent of green jobs and of jobs in green industries, vs 10 percent in non-green jobs (Figure 12).

Potential green jobs are also less likely to be medium- or high-skilled, but they are also less likely to be in elementary occupations, especially when agriculture is excluded. The high prevalence among potential green jobs of Garment workers, Building frame workers and Building finishers (all Crafts and related trades

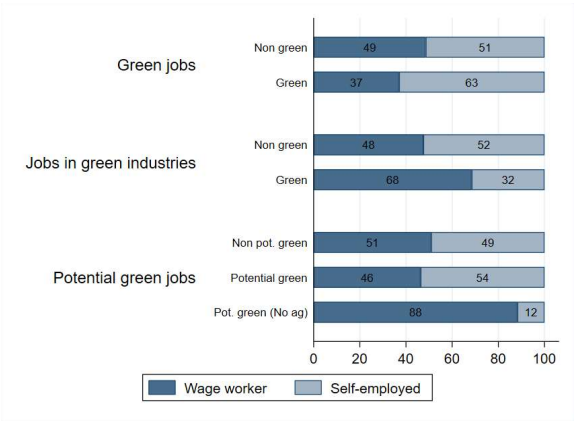
workers) explains the large share of low-skilled jobs. This large share of low-skilled potential green jobs indicates a strong potential for greening the economy using the current skills of the workforce.

Green jobs in Phnom Penh are more likely to be medium- or high-skilled, relative to other urban or to rural areas. As seen in Table 6, the majority of medium- and high-skilled green jobs are found in Phnom Penh, where they account for 20 percent of green jobs. However, this remains lower than the share of medium- and high-skilled jobs in total employment (26 percent).

5.2. Formality and employment status

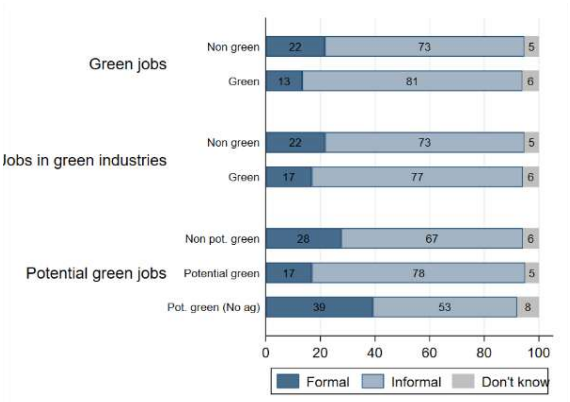
Potential green jobs outside of agriculture are closer to "modern economy" jobs: They are much more likely to be wage jobs and formal than non-potential green jobs; while green jobs and jobs in green industries present a mixed picture. Green jobs are less likely to be wage jobs and also less likely to be formal than non-green jobs (Figure 13, Figure 14).[20] This lower share of formal and wage jobs is driven by Forestry workers and Automobile and Motorbike repairers, while high and medium-skilled green jobs are overwhelmingly formal wage jobs. Jobs in green industries have 68 percent of wage workers but their level of formality is slightly lower than non-green industries. This mixed picture comes from the fact that large green industries, such as those in Construction, Transport and Vehicle maintenance, employ a high share of informal wage workers. Potential green jobs are unambiguously "better jobs" in that they are both more likely to be wage jobs and to be formal. This is driven by Garment workers, while Building workers are more likely to be informal wage workers.

Figure 13 Share of wage workers in green jobs



Source: CSES 2021/22.

Figure 14 Share of formal wage workers in green jobs



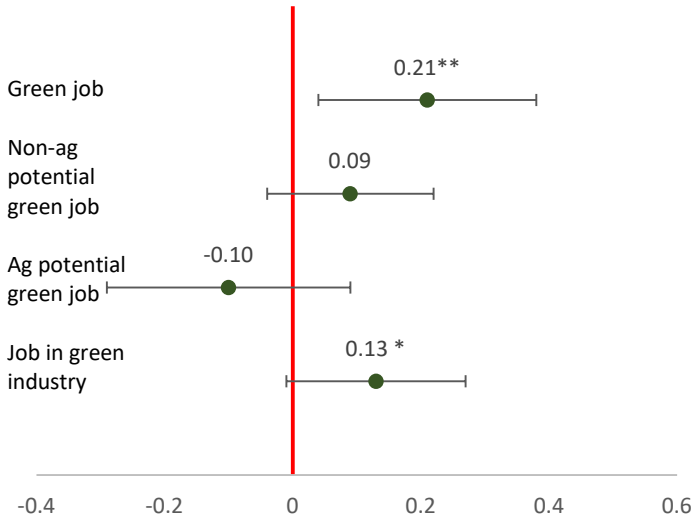
Source: LFS 2019. Own account workers and Contributing family workers are included as Informal. "Don't know" includes only employees.

[20] A formal job is defined as a job with a written contract.

5.3. Earnings

When it comes to wages, green jobs are better than jobs with similar key characteristics, including skill level: They receive a large wage premium of 21 percent compared to non-green jobs and of 11 percent compared to potential green jobs; jobs in green industries also earn more. This result controls for workers' characteristics (age, gender, education, and location), as well as the job's sector and skill level (Figure 15, Table C.1). This wage premium is only observed in Phnom Penh, reflecting the higher wage of automobile mechanics, electricians and Physical and engineering science technicians in the city (Table C.2). Potential green jobs pay 9 percent more than non-potential green jobs on average, but this difference is not statistically significant. Non-agricultural potential green jobs, however, pay better than agricultural potential green jobs (but not more than non-potential green jobs). Jobs in green industries also earn 13 percent more than other jobs, controlling for workers' characteristics, sector and skill level. This latter result is driven by the Manufacture of structural metal products and elementary jobs in Cleaning and Construction (Figure 15, Table C.1, Table C.2).[21]

Figure 15 Green jobs wage premium



Source: Author's calculations using CSES 2021/2022. Regression coefficients from columns 3 and 6 of Table C1. See table notes for details.

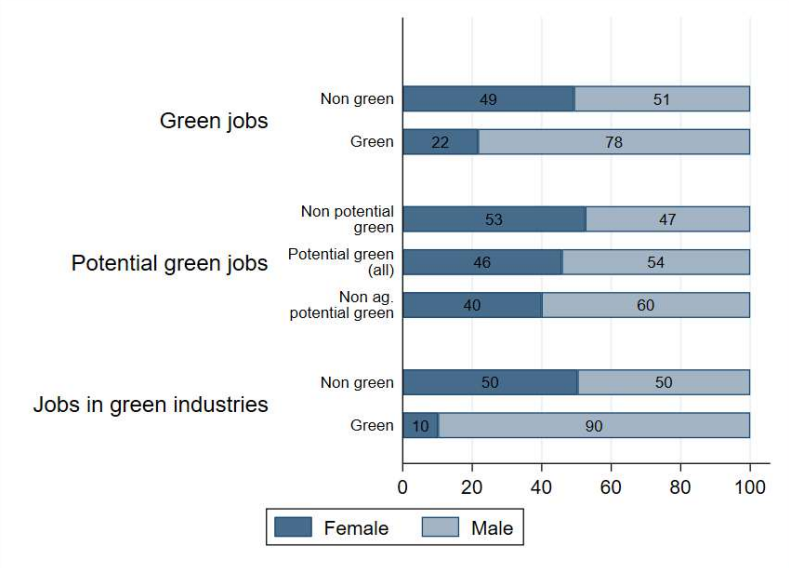
6. Who has access to green jobs?

Women are under-represented in green jobs and in green industries, representing respectively 22 and 10 percent of the workers in these occupations, while they represent about half the workers in non-green jobs and industries. This lower share is driven by the fact that green jobs include mostly automobile and motorcycle mechanics as well as electricians, which are traditionally male dominated. The share of women is larger in medium- and high-skilled green jobs – thanks to the high share of women among Life science technicians -, although it remains below 50 percent.[22] Potential green jobs are also male-dominated, but to a lesser extent, with 45 percent of female workers, decreasing to 38 percent when agriculture is excluded. Similarly, as most jobs in green industries are in Construction and Transport services, these tend to be more male-dominated (Figure 16).

[21] Given data limitations, we restrict the earnings analysis to wage workers in their primary occupation. See Notes to Table C1 for more detail.

[22] Women account for the majority of workers in two green occupations: Life science technicians and Rag pickers.

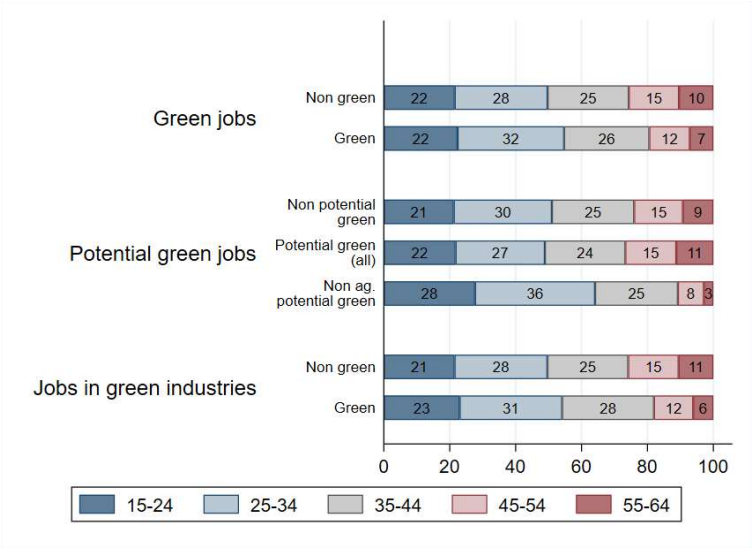
Figure 16 Green jobs gender distribution



Source: CSES 2021/22.

Workers in green jobs, non-agricultural potential green jobs and in green industries tend to be younger, indicating the potential for these jobs to absorb Cambodia's young workforce. Green jobs are 4 percentage points more likely to employ young workers (aged less than 34) compared to non-green jobs, a difference driven by the relatively low age of Automobile and Motorcycle mechanics and of Electricians. A similar difference - 5 percentage points, exists for workers in green industries. Workers in non-agricultural potential green jobs are even younger and are 11 percentage points more likely to be below 34 compared to other workers, driven by the Garment workers (Figure 17).

Figure 17 Green jobs age distribution



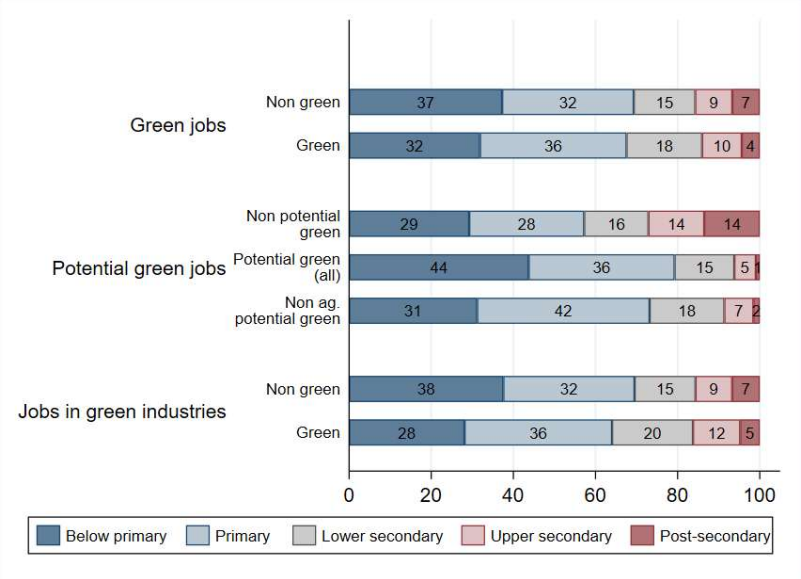
Source: CSES 2021/22.

Workers holding green jobs and jobs in green industries are more likely to have primary or lower secondary education. The share of workers with no education is 5 percentage points lower in green jobs compared to non-green jobs, and 10 percentage points lower in jobs in green industries (compared to non-green industries). Likewise, the share of workers with primary or lower-secondary education is 7 percentage points higher in green jobs and 9 percentage points higher in green industries, compared to non-green jobs. This reflects both the younger age of green jobs workers and the fact that, despite being seemingly low skilled, these jobs, possibly also because they pay better, actually require and attract workers with relatively higher levels of education. Non-agricultural potential green jobs are 15 percentage points more likely to have primary or lower-secondary education, compared to workers in non-potential green jobs, consistent with the educational attainment of Garment and Building workers (Figure 18).

Multivariate analysis confirms that women are less likely to work in green jobs; however, holding all else equal, workers in green jobs are not less educated. Women are 4 percentage point less likely to have

a green job compared to men, are 7 percentage points less likely to hold a potential green job (agricultural and non-agricultural) and are 2 percentage points less likely to work in a green industry. Controlling for gender, age and location, there is no significant difference in educational attainment between workers in green and non-green jobs, while workers with an intermediate level of education (primary and lower-secondary) are more likely to have a non-agricultural potential green job, compared to workers with no education (Table C.3). This indicates that some greening of the economy is possible with the current levels of education of the Cambodian workforce, although jobs in demand for accelerated energy transition and "missing" green jobs in Cambodia tend to be more skilled and will require upskilling (Box 4).

Figure 18 Green jobs education distribution



Source: CSES 2021/22.

7. Policy recommendations

The recommendations deriving from the analysis include both measures based on the type of green jobs (current green, potential, and missing) as well as cross-cutting measures to respond to both employer and worker needs on green jobs. The goal underlying these recommendations is twofold. First, making sure that the skills development system equips current and future workers with the skills that are needed to achieve Cambodia's green transition objectives. Ensuring that workforce skills do not become a constraint to realizing Cambodia's green ambitions requires the availability of the necessary workforce skills both to expand green industries and to implement green tasks across the economy. The second goal is ensuring that the Cambodian population benefits from the green transition through improved employment outcomes. This will not only contribute to Cambodia's goals to increase the availability of good jobs, but is also expected to harness political and public commitment to the greening agenda.

In the short term, the prioritization of green jobs would be jobs that face skills constraints and meet at least one of the following criteria: a) covering a relatively large portion of the workforce; b) being important for mitigation or adaptation. Because the green transition can affect tasks content and skills demand across the economy and for large numbers of occupations, prioritization of actions seems necessary. A first criterion would be to focus on green jobs that currently employ a large number of workers, such as automobile mechanics and motorbike mechanics. Focusing on those, already large, occupations would allow green regulations such as pollution control on vehicles to be rapidly and

efficiently implemented at scale. A second criterion would be to focus on jobs or industries that have large impacts on mitigation or adaptation. For example, if there is continued momentum in meeting Cambodia's ambitions for increasing the production and use of solar energy, interventions could focus on providing the skills for the most critical occupations in the solar panel production or installation. Similarly, as electric vehicle plans continue developing, jobs for their maintenance and the maintenance of charging stations would also become high priority.

Once the priority green jobs have been identified, an assessment of skill demand and constraint needs to be carried out to inform capacity building interventions. On the basis of this assessment, workers would be up- or reskilled for jobs in this value chain, relevant existing initial education and training programs would be augmented, and new qualifications would be introduced where needed. For example, in the solar value chain, an assessment would be conducted on constraints preventing the expansion of solar energy, and if these constraints include skills, then capacity building interventions can be implemented to address them. Support and financing interventions could also focus on promoting partnerships between industry and training providers, and attracting women into critical jobs for the solar power value chain.

Table 8 Recommendations for developing skills for the green economy and ensuring inclusive access to green jobs

Policies by type of job	
Green jobs	Promote the effective execution of green tasks by facilitating current workers in jobs with green tasks and ensuring sufficient focus on the required skills for these tasks in education and training programs.
Potential green jobs	Turn potential green jobs into green jobs by addressing their skills requirements, providing financial incentives and implementing the required regulation.
Missing green jobs	Identify the most crucial missing jobs and develop a strategy to ensure that labor demand for these jobs can be met.
Cross-cutting measures	
Responsive workforce development	Industry engagement, a regularly updated labor market information system that monitors green jobs, and a flexible and responsive workforce development system.
Access to better green jobs for women	Alleviate barriers to accessing good green jobs for women, including by promoting their enrolment in STEM fields of education and training.

7.1. Different policies for current, potential, and missing green jobs

For current green jobs: promote the effective execution of green tasks by facilitating current workers in green jobs and ensuring sufficient focus on the required skills for these tasks in education and training programs. The analysis identified 14 jobs in the Cambodian economy whose task description includes at least one task that has been identified as green, but little is known about the actual execution of these tasks in practice. A survey of workers in these jobs can first confirm the extent to which these green tasks are executed and identify any barriers these workers face to carrying out these tasks, after which appropriate activities (including possibly upskilling) can be designed and implemented to maximize the

green impact of these jobs. This is particularly important for occupations with a low GTI, as only a small fraction of their tasks are green. To further optimize the positive impact of green jobs, the necessary skills to carry out these tasks should be structurally incorporated in education and training programs that prepare individuals for these jobs. This requires, particularly, that curricula and assessments, teacher capacity, equipment and work-based learning opportunities all incorporate sufficient attention to the skills needed to execute green tasks. As an example, it may be necessary to ensure that car mechanics have the right equipment to monitor and reduce car emissions, and these activities should be explicitly taught and assessed in TVET programs for car maintenance technicians. In addition, limited implementation of green tasks can result from a lack of awareness at management level. In a country like Cambodia, where hierarchies play an important role, managers need to actively encourage the implementation of green tasks. Quality environmental education therefore needs to be included in curricula to increase environmental awareness of all workers, not only those carrying out green tasks.

For potential green jobs: Turn them into green jobs. Jobs with potential green tasks make up well over half of the workforce in Cambodia, so are an important category to consider. A mix of deeper analysis of these jobs in Cambodia as well as a better understanding of the constraints to make them green jobs is needed. It is possible that the constraints are skills-related but they could also stem from regulations and financial incentives or constraints. This could be the case, for example, when farmers do not apply more environmentally sustainable farming methods because this would reduce their profit margin and there are no regulations obliging them to do so, or when they lack resources to invest in environmentally friendly tools or equipment. In Vanuatu, for example, “rotavator” rotary tillers and drum seeders were found to improve both soil health and crop productivity. In addition to training farmers on the benefits and use of the rotavators, the Department of Agriculture offered farmers a financing scheme in which the Department covered 70 percent of the purchasing price (Daily Post, 2020).

For missing green jobs, in particular those related to LTS4CN priority sectors: identify the most crucial missing jobs and develop a strategy to ensure that labor demand for these jobs can be met. Out of the 32 identified occupations with one or more green tasks, 17 jobs were not observed in the Cambodia data, implying that they are, at best, extremely rare. Most of these jobs require high skilled workers in STEM areas (such as civil and environmental engineers, geologists, and town planners) and many will be required for the greening of the key sectors identified by Cambodia’s LTS4CN, such as energy production and industrial processes and transportation. For example, the development of the renewable energy and energy efficiency sectors could create 40,000 to 50,000 jobs by 2040, and these require skills such as in solar system technologies and energy auditing that are already scarce now. It is important to identify the most crucial occupations that are currently largely missing from Cambodia’s labor market and to develop a strategy to make sure that sufficient workers with the necessary skills to carry out these jobs will be available to not derail the government’s greening ambitions. In addition to focusing on skills, it is important to identify and address additional constraints that might be preventing the expansion of these occupations, such as regulatory hurdles or financial disincentives.

Box 5: Identifying the most crucial missing green jobs and developing skilling programs for them

A recent report in South Africa assesses labor and skill demand and the currently available skills supply of the hydrogen value chain in the country (Hoftijzer and Dulvy, E. Forthcoming). The report identifies the occupations that are required within the value chain, which ones are scarce or missing and reviews the current TVET and higher education offer in the country. The report notes that most of the qualifications that are relevant for the hydrogen value chain are already offered but require adaptation – such as through introducing new modules. For example, qualifications for a wide range of engineers,

technicians and managers already exist but would need to be expanded to include knowledge and skills related to hydrogen production processes, safety measures, and hydrogen-related regulations and standards *(Department of Higher Education and Training, s.d.)*.

If currently missing occupations are expected to be created in the short term, so that skills supply for these jobs needs to be developed quickly, skills interventions could focus on up- or reskilling current workers whose skills profile is relatively close to that required for the missing occupations. For example, car mechanics need to be trained in the maintenance and repair of hybrid and electric vehicles. Greening strategies should also consider which types of (missing green) jobs will be generated and population groups affected; that, together with the urgency of the needs, will indicate needs for either reskilling or upskilling. For example, the garment industry employs a lot of low-skilled, female workers and greening garment will thus affect such workers, mostly through reskilling; whereas other industries may include higher proportions of higher skilled workers and may need more investment in the upcoming workforce. In many cases, it may not be necessary to develop completely new education programs but to adapt or introduce new modules in existing programs (such as adding solar-focused modules in existing engineering curricula). Similarly, current engineers working in non-green industries may require relatively little reskilling to be able to perform in the currently missing jobs. Where education and upskilling are not a sufficient solution to ensuring the necessary skills supply, it can be considered to attract foreign labor, at least temporarily until the local workforce is sufficiently equipped to take on the currently missing jobs.

Box 6: Equipping current and future automotive mechanics with the skills to maintain electric vehicles

Examples of training possibilities for current automotive mechanics to acquire the skills to carry out green tasks can be found, for example, in Southern Maine Community College in the United States. The college offers a training in the diagnosis and repair of electric and hybrid vehicles that is free of charge and consists of 32 hours of online instruction followed by a week of face-to-face hands-on training (SMCC, 2024).

In India, the Automotive Skills Development Council announced a collaboration with the German agency for technical cooperation GIZ in 2023 to develop a 2.5-month training program for electric vehicle technicians, targeted at workers who already graduated from Industrial Training Institutes (Economic Times, 2023).

Skills related to the repair and maintenance of electric vehicles have also been integrated in TVET programs for future workers in many countries. Manchester college in the United Kingdom, for example, offers a 2-year diploma level program on maintenance and repair of light and electric vehicles, developed in collaboration with employers (TMC, 2024).

In Malaysia, the government announced substantial investments to introduce new TVET courses in the fields of electric vehicles and solar energy in 2023, in response to increased interest in renewable energy from investors and the associated increase demand for skills in these areas (New Straits Times, 2023).

7.2. Cross-cutting policies to respond to both employer and worker needs for green jobs

To ensure responding to labor market demand on green jobs monitor green jobs with a regularly updated labor market information system. Developments in the number, nature, and quality of green jobs, as well as in their educational and skills requirements, should be regularly monitored. To inform skills development policy, data on green jobs needs to be regularly updated and translated into quantitative

and qualitative information on skill demand. Relevant stakeholders in the skills development ecosystem can then use this information to adapt their education and training offer. This information should also be shared with students and workers (especially vulnerable workers and women) in a user-friendly way to help them make well-informed career decisions.

To respond to and anticipate on employer needs, maintain close communication with key firms in green industries, and ensure that workforce development responds to their needs. In addition, a flexible and responsive workforce development system guarantees an efficient collection and dissemination of the relevant data. Considering the importance of employer engagement to ensure the relevance and quality of skills development, there is a need to promote collaboration between the private sector actors that are likely to invest in climate change mitigation or adaptation and create green jobs, and the education and training providers that will be able to equip individuals with the necessary skills for these jobs. A structurally well-performing skills development system has institutionalized mechanisms that promote effective employer engagement, besides the collection and use of labor market information. The mechanisms include, for example, sector skills councils, labor market observatories, and levy-based skills funds that promote industry-provider collaboration. Where these institutions do not exist, they should be built gradually; meanwhile, more ad-hoc and possibly project-based actions can be taken, such as commissioning sectoral skills studies or promoting industry-provider collaboration through donor-funded skills funds.

Box 7: Promoting data collection and collaboration between firms and education and training providers

In France, the National Observatory for Green Economy Jobs and Skills has been established to examine the impact of the green transition with particular attention to its implications on the numbers of jobs and skills requirements. In Denmark, the skills development system relies on its regular mechanisms for assessing skills demand to also gauge skills requirement for the green economy.

Examples of collaboration between firms and universities can be found in Spain and in Singapore. In Spain, the multinational in infrastructure and renewable energy Acciona, provided nearly 35,000 training hours to employees in green and environmental subjects in cooperation with the University of Alcalá in Madrid (CEDEFOP, 2019). In Singapore, the Green Finance Centre of Singapore Management University (SMU), recently launched four new courses in sustainable finance. This center is supported by leading financial institutions such as Bank of China Limited, Goldman Sachs and BNP Paribas (SMU, 2024).

Finally in Tanzania, the TVET-focused World Bank-financed East Africa Skills Transformation and Regional Integration Project (EASTRIP) supports the Arusha Technical College (ATC) as the Regional Flagship TVET Institute in renewable energy. ATC has established a research center for small hydro turbines and offers training in hydropower, solar and wind energy, ensuring demand-responsiveness among others through its strong partnerships with local and international firms (EASTRIP, 2024).

For inclusive access to better green jobs: alleviate barriers to accessing good green jobs for women, including by promoting their enrolment in STEM fields of education and training. Women make up only 22 percent of workers in green jobs, 10 percent of workers in green industries, and 38 percent of workers in non-agricultural potential green jobs. The reason for this gender inequality is not per se related to these jobs being green, but to them often being traditionally male dominated, such as automobile and motorcycle mechanics; green industries include construction and transport services. Addressing the female underrepresentation in green jobs will require a package of interventions since its causes are

presumed to be diverse, ranging from constraints to their enrolment in STEM education and training programs to gender norms and lacking childcare facilities (Levin V. , et al., 2023). A first step in this process would be analyzing the main constraints that prevent women from pursuing education and careers related to green jobs. Then, depending on the constraints that are identified, promising interventions may include career guidance – making good use of the labor market information, ensuring a safe learning and working environment, female role models in green jobs, promotion by business associations, and better availability of childcare (See also World Bank, forthcoming). Incentives such as free or subsidized skills training and possibly wage subsidies could facilitate the movement of women (and low-skilled men) into medium-skilled green jobs. Key interventions should be piloted and evaluated first, before structurally incorporating them into education or labor market policies.

Box 8: Increasing access to good green jobs by women

Various interventions exist that have been shown to support women accessing good jobs, including good green jobs. Girls and women can be motivated to seek a career in traditionally male dominated fields, including in STEM areas that are so important for green jobs, through information provision on expected labor market, and providing mentors and role models.

In Australia, for example, the FutureYou initiative, funded by the government as part of the Women in STEM Ambassador Initiative, aims to inspire children – especially girls - between the ages of 8 to 12 to pursue STEM fields by showcasing career pathways and role models.

Examples of interventions that specifically aim to attract and prepare women for green jobs include the Women in Renewable Energy Sector in Africa (W-REA), which was launched in 2021 by the International Finance Corporation (IFC) to develop a pipeline of female leaders for the renewable energy sector. The Young Women in African Power Leadership training program, an initiative of Power Africa and the Young African Leaders Initiative (YALI), has trained women across Africa to enhance their leadership skills and build energy sector knowledge. Power Africa also launched several apprenticeship programs for women in the sector.

Attracting women into green jobs can also be done by alerting them to opportunities for good jobs that are not male-dominated, and therefore potentially considered more attractive. For example, a 2021 report on green jobs in Africa highlighted “green advisory services”, as a new areas of jobs that might appeal to women that includes “advising or performing specialized tasks for businesses, governments and communities in such areas as renewable energy, energy efficiency, efficient water use, environmental health, green finance, environmental compliance and corporate sustainability” (UNWOMEN, 2021). The report poses that these can offer particular opportunities for women, considering women’s relatively high participation in other advisory services and that these jobs are “good jobs” in terms of pay, are relatively new and therefore not (yet) male-dominated.

References

Autor, D., Levy, F., & Murnane, R. (2003). The Skill Content of Recent Technological Change: An Empirical Exploration. *The Quarterly Journal of Economics Volume 118, Issue 4*, 1279–1333.

Bureau of Labor Statistics. (2013). BLS green jobs overview. *Monthly Labor Review*.

CEDEFOP. (2019). *Skills for green jobs: 2018 update.* Luxembourg: European Synthesis Report.

Daily Post. (2020, Sepember 11). First training for farmers on using rotavators as part of mechanization policy.

Department of Higher Education and Training. (s.d.). *Identification of Skill Needs for the Hydrogen Economy.* Prepared by CSIR for the DHET LMI Research Programme.

Doan, D., Luu, T., Nguyen, N. T., & Safir, A. (2023). *Upskilling and Reskilling Vietnam's Workforce for a Greener Economy.* Phnom Penh, Cambodia: World Bank.

EASTRIP. (2024, May 12). *EASTRIP Champions TVET as the Engine for Sustainable Industrialisation*. Retrieved from https://www.eastrip.iucea.org/eastrip-champions-tvet-as-the-engine-for-sustainable-industrialisation/

Economic Times. (2023, September 21). ASDC and GIZ India launch innovative EV Technician course.

Eurostat. (2009). The environmental goods and services sector. *Eurostat methodologies and working papers*.

Garrett-Peltier, H. (2017). Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model. *Economic Modelling vol. 61.*

GGGI. (2018). *The Economic, Social and Environmental Impacts of Greening the Industrial Sector in Cambodia.* Seoul, Korea: The Global Green Growth Institute.

Granata , J., & Posadas, J. (2022). *Which jobs are green? A methodological note on how to measure green jobs for skills policy and an application to Indonesia.* Jakarta, Indonesia: World Bank.

Granata, J., & Posadas, J. (2024). Why Look at Tasks When Designing Skills Policy for the Green Transition? A Methodological Note on How to Identify Green Occupations and the Skills They Require. *Policy Research Working Paper 10753*.

Hoftijzer, M., & Ninan Dulvy, E. (Forthcoming). *Skills for the Green Economy.* World Bank Group.

ILO. (2019). *Skills for a greener future: A global view based on 32 country studies.* Geneva.

Kering. (2024, May 13). *Kering collaborates with the National University of Singapore to launch three-year research study* . Retrieved from https://www.kering.com/en/news/kering-collaborates-with-the-national-university-of-singapore-to-launch-three-year-research-study/

Levin, V., Santos, I. V., Weber, M., Iqbal, S. A., Aggarwal, A., Comyn, P. J., . . . Hoftijzer, M. (2023). *Building Better Formal TVET Systems : Principles and Practice in Low- and Middle-Income Countries.* Washington D.C.: World Bank Group.

Mosomi , J., & Cunningham , W. (2023). *Measuring Green Jobs in South Africa.* World Bank.

New Straits Times. (2023, October 15). Malaysia's RM6.8 Billion TVET investment aims to power a green workforce.

ONET. (2010). *O*NET® Green Task Development Project.*

Pearce, D., Markandya, A., & Barbier, E. (1989). *Blueprint for a Green Economy.* London: Earthscan.

Sevea. (2023). *Assessment for the Need of Skill Development in the Clean Energy Sector in Cambodia.*

SMCC. (2024, June 12). *Electric Vehicle Repair Short-Term Training*. Retrieved from https://www.smccme.edu/academics/pathways/industrial-technology-transportation/electric-vehicle-repair-short-term-training/

SMU. (2024, April 17). *MU's Singapore Green Finance Centre launches new courses to grow in-demand sustainability management skills for financial services professionals*. Retrieved from https://news.smu.edu.sg/news/2024/04/17/smus-singapore-green-finance-centre-launches-new-courses-grow-demand-sustainability

TMC. (2024, June 12). *T Level – Maintenance Installation and Repair (Light and Electrical Vehicles) - Industry Excellence Academy*. Retrieved from https://www.tmc.ac.uk/courses/industry-excellence-academy-t-level-maintenance-installation-and-repair-vehicles/

UNEP. (2011). *owards a Green Economy: Pathways to Sustainable Development and Poverty Eradication.* Nairobi: United Nations Environment Programme.

UNWOMEN. (2021). *Green Jobs for Women in Africa.* West and Central Africa Regional Office .

Valero, A., Li, J., Muller, S., Riom, C., Nguyen-Tien, V., & Draca, M. (2021). *Are 'Green' Jobs Good Jobs? How Lessons from the Experience to-Date Can Inform Labour Market Transitions of the Future.* London: Grantham Research Institute on Climate Change and the Environment Grantham Research Institute on Climate Change and the Environment.

Vona, F., Marin, G., Consoli, D., & Popp, D. (2018). Environmental Regulation and Green Skills: An Empirical Exploration. *Journal of the Association of Environmental and Resource Economists*, 713–53.

World Bank. (2023). *Cambodia Country Climate and Development Report.* Washington: World Bank.

World Bank. (forthcoming). *An assessment of technical and vocational education and training institutes under the oversight of the Ministry of Labor and Vocational Training.* Kingdom of Cambodia: Training Assessment Project. .

World Bank; UNESCO; ILO. (2023). *Building Better Formal TVET Systems: Principles and Practice in Low- and Middle-Income Countries.* Washington D.C, Paris, Geneva: World Bank, UNESCO and ILO.

Appendix A. Methodology

A1. Task-based approach: Green jobs

This report uses the GTI toolkit developed by Granata & Posadas (2024), which assigns a Green Task Intensity index (GTI) to 433 ISCO-08 occupations. The GTI toolkit classifies the 433 occupations from ISCO-08 (4-digit) into green (36 occupations) and potential green (127 occupations). This approach classifies occupations regardless of the final good or service produced. For example, an engineer in charge of treating the wastewater from a factory would be categorized as having a green job, despite working in a polluting industry. This approach has now been applied to a few middle-income countries, including Indonesia, Viet Nam and South Africa.

A1.1. Manual reclassification of green occupations in the GTI toolkit

Given the Cambodian context, some manual reclassifications are carried out, resulting in decreasing the number of green occupations by one and leaving the number of potential green occupations unchanged:

- **Reclassification into green:**
    - Electrical engineers (2151) from non-green to green: + 1 green task for their role in EV sector
    - Electronics engineers (2152) from potential green to green: + 1 green task for their role in EV sector
    - Building and related electricians (7411) from potential green to green: + 1 green task for PV panel installation. Cambodia has recently developed its solar energy sector and has made commitments to further expand it.
- **Reclassification into potential green:**
    - Aquaculture workers (6221) from green to potential green: green task on collecting environmental data not performed by aquaculture workers in Cambodia. Potential green tasks are performed in Cambodia so reclassified to potential green.
    - Underwater divers (7541) from green to potential green: “Obtaining information about diving tasks and environmental conditions.”, in which the word “environment” does not refer to the “natural world” but to the specific conditions in which the dive is taking place. This occupation also carries out potential green tasks so reclassified to potential green.
- **Reclassification into non-green:**
    - Floor layers and tile setters (7122) from green to non-green: one task classified as green because contained the word “insulation”, which was about acoustic insulation. No other green or potential green task so reclassified to non-green
    - Steam engine and boiler operators (8182) from green to non-green: green task “Resting boiler water quality or arranging for testing, adjusting and taking necessary corrective action, such as adding chemicals to prevent corrosion and harmful deposits;” in which the water quality does not refer to the level of pollutant of the potential for environmental damage.

A1.2. Crosswalk from ISCO-08 4-digit codes to COC 3-digit codes

The 2021 Cambodia Socio-Economic Survey (CSES) uses a slightly modified version of the ISCO classification, developed for the Cambodia General Population Census of 2008, the Cambodian Occupational Classification (COC). This system classifies occupations at the 3-digit level, corresponding

broadly to the 3-digit ISCO-08 but with 37 additional occupations (mostly elementary and low skilled) that correspond to 4-digit ISCO-08 codes. Official census documentation provides a correspondence between this national classification and the 4-digit ISCO-08.[23] The crosswalk file contains 432 occupations at the ISCO-08 4-digit level, and 159 at the 3-digit level (which is used in the CSES).[24] All occupations from the crosswalk file are merged with the GTI, except for one occupation which does not have a correspondence in COC: Food service counter attendants (ISCO-08 5246).[25]

Table A.1 summarizes these different cases of the crosswalk between ISCO 4-digit and COC 3-digit and shows how many occupations (total, green and non-green) are involved in each one.

Table A.1 Methodology for computation of weighted GTI

	Comparison of COC (3-digit) to ISCO-08 (4-digit)	**Approach**	**Number of COC 3-digit occupations**	**Number of COC 3-digit occupations observed in CSES 2021/22**
1	3-digit COC occupation corresponds to 1 ISCO-08 4-digit	Assign GTI of the ISCO-08 4-digit occupation.	61, (4 green, 13 potential green)[26]	55 (4 green, 12 potential green)
2	3-digit COC occupation corresponds to multiple ISCO-08 4-digit. At least one of the corresponding ISCO-08 4-digit occupations are present in the LFS	Each 4-digit occupation is assigned a weight equal to its employment share (within the 3-digit occupation) in the LFS. Missing 4-digit occupations in the LFS are assigned a weight equal to zero. The GTI is the weighted average of the GTI of the corresponding 4-digit occupations.	94 (16 green, 41 potential green)	87 (9 green, 34 potential green)
3	3-digit COC occupation corresponds to multiple ISCO-08 4-digit. None of the corresponding ISCO-08 4-digit occupations are present in the LFS	Each 4-digit occupation is assigned the same weight. GTI is the weighted average of the GTI of the corresponding 4-digit occupations.	5 (2 green, 3 potential green)	3 (1 green, 2 potential green)
Total			159 (22 green, 57 potential green)	145 (14 green, 48 potential green)

61 occupations in the COC correspond to a single ISCO-08 4-digit code, those occupations are assigned the same GTI as their corresponding 4-digit occupation [Row 1 in Table A.1]. For the 1-to-1 matches, the GTI of the 4-digit occupation is assigned to the COC 3-digit occupation. For example, Automobile

[23] This list is available on https://www.stat.go.jp/english/info/meetings/cambodia/c8_profi.html

[24] There are 161 codes in the COC, but code 998 is "Occupation not adequately described" and code 999 is "Occupation not stated", making the total of occupations 159.

[25] This occupation is classified as non-green in the GTI toolkit. Nothing is done about this occupation as it is not in the CSES data.

[26] All green occupations are also potential green, so those categories are not mutually exclusive but Green in included in potential green.

mechanics and fitters (COC 724) correspond to the ISCO occupation code 7321 (Motor vehicle mechanics and repairers), which has a GTI of 12.5. This GTI is then assigned to occupation 724 in the COC.[27]

98 occupations in the COC correspond to multiple ISCO 4-digit codes, their GTI is the weighted mean of the GTI of the 4-digit occupations, using the employment share in the LFS 2019 as weights [Rows 2, and 3, in Table A.1]. Each 4-digit occupation is assigned a weight equal to its employment share in its corresponding COC 3-digit occupation, in the LFS 2019 - which uses the ISCO-08 4-digit level. Among those 98, 54 have at least one 4-digit occupation that is not observed in the LFS and is assigned a weight equal to zero. These weights are used to compute the weighted GTI score of the COC 3-digit occupations. The sum of the weights of green occupations corresponds to the share of green jobs in the 3-digit occupation. Table A.2 below shows as an example the occupation Machinery mechanics and repairers (COC 723), which corresponds to two ISCO 4-digit occupations: Bicycle and related repairers (ISCO 7234) which has a GTI of 33, and Agricultural and industrial machinery mechanics and repairers (ISCO 7233) which is non green (GTI = 0).[28]

Table A.2 Example of multiple ISCO 4-digit corresponding to the COC 3-digit occupation

Occupation code	Occupation title	GTI	Green employment share (%)
7233 (ISCO-08 4-digit)	Agricultural and industrial machinery mechanics and repairers	33	39
7234 (ISCO-08 4-digit)	Bicycle and related repairers	0	61
723 (COC)	Machinery mechanics and repairers	13 (=33*0.39+0*0.61)	0.09 (=0.39*0.23(percentage of 3-digit COC in CSES)

In the LFS, the Bicycles repairers account for 39 percent of employment in those two occupations, so it gets a weight of 0.39, while the Agricultural and industrial machinery mechanics are assigned a weight of 0.61. Occupation 723 therefore has 39 percent of green jobs and its weighted GTI is 33*0.39 + 0*0.61 = 13. The total employment share of the occupation (share of workers in the total workforce) is 0.23 percent, so its green employment share if 0.23 * 0.39 = 0.09 percent.

Of those 98 COC 3-digit occupations, 5 have none of their corresponding ISCO-08 4-digit occupations observed in the LFS, so we assign an equal weight to all of them. For example, the COC 3-digit occupation Life science technicians and related associate professionals (314) corresponds to the following 3 ISCO-08 4-digit occupations: Life science technicians (excluding medical) (3141), Agricultural technicians (3142) and Forestry technicians (3143), which has a GTI of 20. As none of these occupations are observed in the LFS, they are all assigned a weight of 0.33, and the weighted GTI of Life science technicians and related associate professionals is equal to 20*0.33 = 7.

Table A.3 shows the list of COC 3-digit green jobs found in the CSES 2021/2022, and the green tasks associated with their corresponding ISCO-08 4-digit green occupation.

[27] Among the 61 COC 3-digit occupations, 23 are matched to the same ISCO-08 4-digit code as (at least) one other COC occupation. In total, these 23 occupations correspond to only 9 ISCO 4-digit codes. For example, the Automobile mechanics and fitters (COC 724) and the Motorcycle mechanics and fitters (COC 725) both correspond to the ISCO occupation code 7321 (Motor vehicle mechanics and repairers), so both get assigned the same GTI.

[28] One of these 98 COC 3-digit occupations corresponds to an ISCO-08 4-digit code that is also linked to another COC 3-digit occupation: Refuse workers (COC 961) and Rag pickers (COC 962) have in common the ISCO-08 4-digit occupation Garbage and recycling collectors (9611), while Refuse workers also include Refuse sorters (9612) and Sweepers and related labourers (9613)

Table A.3 List of green tasks associated with green occupations observed in the CSES

COC 3-digit	ISCO 4-digit	Occupation title	Green tasks
962	**9611**	Garbage and recycling collectors	Collecting rubbish and recyclable materials and locating them into bins and garbage and recycling trucks; Riding on or in garbage and recycling trucks; Unloading garbage and recycling trucks.
213	**2132**	Farming, forestry and fisheries advisers	Collecting and analysing data and samples related to produce, feed, soil, water quality and other factors affecting farm, forest or fishery production; Managing forest and fisheries resources to maximize their long-term commercial, recreational and environmental benefits; Investigating, planning and implementing management procedures to cope with the effects of fires, floods, droughts, soil erosion, pests and diseases;
	2133	Environmental protection professionals	Conducting research, performing tests, collecting samples, performing field and laboratory analysis to identify sources of environmental problems, and recommending ways to prevent, control and remediate the impact of such problems; Developing and coordinating the implementation of environmental management systems to enable organizations to identify, monitor and control the impact of their activities, products and services on the environment; Conducting audits to evaluate the environmental impact of existing activities, processes, wastes, noises and substances; Assessing an organization's compliance with government and internal environmental regulations and guidelines, identifying violations and determining appropriate remedial action; Providing technical advice and support services to organizations on how best to deal with environmental problems in order to reduce environmental damage and minimize financial loss; Developing conservation plans
961	**9611**	Garbage and recycling collectors	Collecting rubbish and recyclable materials and locating them into bins and garbage and recycling trucks; Riding on or in garbage and recycling trucks; Unloading garbage and recycling trucks.
	9612	Refuse sorters	Searching through refuse and collecting items for recycling from dump sites, domestic, commercial and industrial premises or from public places such as streets; Sorting cardboard, paper, glass, plastic, aluminium or other recyclable materials by type; Placing recyclable items and materials in designated compartments and containers for storage or transportation; Transporting recyclable items by hand or using non-motorized vehicles; Selling recyclable or reusable materials
313	**3131**	Power production plant operators	Operating and controlling power-generating systems and equipment including boilers, turbines, generators, condensers and reactors in hydro, thermal, coal, oil, natural gas and nuclear power plants to generate and distribute electrical power
	3132	Incinerator and water treatment plant operators	Operating and monitoring computerized control systems, machinery and related equipment in wastewater treatment, sewage treatment, and liquid waste plants to regulate flow, treatment and disposal of sewage

			and wastes, and in water filtration and treatment plants to regulate the treatment and distribution of water for human consumption and for later disposal into natural water systems; Controlling the operation of multiple-hearth incinerator furnaces and related equipment to burn sludge and solid waste in waste treatment plants; Collecting and testing water and sewage samples for chemical and bacterial content, using test equipment and colour analysis standards; Analysing test results to make adjustments to plant equipment and systems to disinfect and deodorize water and other liquids
621	**6210**	Forestry and related workers	Controlling weeds and undergrowth in regenerating forest stands using manual tools and chemicals; Operating and maintaining a skidder, bulldozer or other prime mover to pull a variety of scarification or site preparation equipment over areas to be regenerated
723	**7234**	Bicycle and related repairers	Examining, servicing and repairing bicycles and other non-motorized transport equipment; Assembling new bicycles, wheelchairs and similar non-motorized equipment
724	**7231**	Motor vehicle mechanics and repairers	Performing scheduled maintenance services, such as oil changes, lubrications and engine tune-ups, to achieve smoother running of vehicles and ensure compliance with pollution regulations
725	**7231**	Motor vehicle mechanics and repairers	Performing scheduled maintenance services, such as oil changes, lubrications and engine tune-ups, to achieve smoother running of vehicles and ensure compliance with pollution regulations
314	**3143**	Forestry technicians	Coordinating activities such as timber scaling, forest fire suppression, disease or insect control or pre-commercial thinning of forest stands; Ensuring adherence to regulations and policies concerning environmental protection, resource utilization, fire safety and accident prevention
814	**8142**	Plastic products machine operators	Recycling waste plastic materials;
311	**3112**	Civil engineering technicians	Performing or assisting with field and laboratory tests of soils and construction materials; Advising on the installation of fire detectors and sprinkler systems and the use of materials in the construction of buildings, and means of transportation to reduce risk of fire and extent of damage and danger if fire occurs
216	**2163**	Product and garment designers	Harmonizing aesthetic considerations with technical, functional, ecological and production requirements;
741	**7411**	Building and related electricians	NOT IDENTIFIED AS GREEN BY THE GTI TOOLKIT Added to the list of green jobs because includes solar panel installers
531	**5411**	Fire-fighters	Controlling and extinguishing fires using manual and power equipment and firefighting chemicals; Informing the public about fire prevention.
	5419	Protective services workers not elsewhere classified	Responding to citizen complaints concerning stray domestic animals, livestock and wildlife, issuing warnings and citations to owners and impounding lost, homeless and dangerous animals

Source: GTI toolkit.

A1.3. Computing the share of green and potential green jobs in the CSES 2021/2022 using weights from the LFS 2019

Following the same logic used to compute the weighted GTI, all descriptive statistics used in this report weigh the observations with the share of (potential) green jobs in the occupation. For all descriptive statistics, we multiply the sampling weights by the share of (potential) green jobs in the occupation. We then use this as weights for the share of the green jobs and for the composition of green jobs (by occupation, gender, age, education etc). If we were assuming that all workers in a COC 3-digit occupation classified as green are working in green jobs, the share of green jobs increases from 2 percent to 3.8 percent (Column (5) "Total employment share" in Table A.4), thus almost doubling the share of green jobs. However, this assumes that the occupations not highlighted in Table A.5, such as Prison guards and Security guards, are green, while they aren't. This shows the need to use weights from the 4-digit distribution, as we do in the last column of Table A.4, "Green employment share".

Table A.4 Green occupations with total employment share

COC 3-digit	Occupation Title	Share of green workers in the 3-digit occupation	Weighted GTI	Total employment share	Green employment share
962	Rag Picker	100	75	0.04	0.04
213	Life science professionals	100	64	0.03	0.03
961	Refuse workers	74	61	0.24	0.18
313	Process control technicians	72	26	0.06	0.04
621	Forestry and related workers	100	20	0.38	0.38
723	Machinery mechanics and repairers	39	13	0.23	0.09
724	Automobile mechanics and fitters	100	13	0.50	0.50
725	Motocycle mechanics and fitters	100	13	0.61	0.61
314	Life science technicians and related associate professionals	33	7	0.02	0.01
814	Rubber, plastic and paper products machine operators	38	5	0.05	0.02
311	Physical and engineering science technicians	14	3	0.13	0.02
216	Architects, planners, surveyors and designers	15	2	0.01	0.00
741	Electrical equipment installers and repairers	7	1	0.58	0.04
531	Protective services workers	2	1	0.92	0.02
Total green jobs			1.26%	3.79	2.0

Source: CSES 2021/22.
Notes: Sampling weights are included at the individual level. Sample includes working age (15-64 year-olds) and employed. Share of green workers is obtained from the distribution of workers in 4-digit occupation in the LFS 2019. Total sample size: 23.607 (8.893.183 with weights).

Table A.5 shows the ISCO 4-digit occupations corresponding to each COC 3-digit green occupation, and the weights. Rows highlighted in green correspond to occupations classified as green by the GTI toolkit. Only the ISCO-08 4-digit observed in the LFS 2019 are reported.[29]

[29] Two occupations (Deep-sea fishery workers and Hunters and trappers) have an employment share of 0, which is the result of rounding as they correspond to at least 1 observation in the LFS.

Table A.5 Composition of 3-digit green occupations

COC 3-digit	ISCO-08 4-digit	Occupation title	GTI (Weighted at 3-digit level and original, unweighted GTI at 4-digit level	4-digit employment share in 3-digit occupation (%)
962		**Rag Picker**	**75**	
	9611	Garbage and recycling collectors	75	100
213		**Life science professionals**	**64**	
	2132	Farming, forestry and fisheries advisers	25	35
	2133	Environmental protection professionals	86	65
961		**Refuse workers**	**61**	
	9611	Garbage and recycling collectors	75	12
	9612	Refuse sorters	83	62
	9613	Sweepers and related labourers	0	26
313		**Process control technicians**	**26**	
	3131	Power production plant operators	17	31
	3132	Incinerator and water treatment plant operators	50	41
	3135	Metal production process controllers	0	28
621		**Forestry and related workers**	**20**	
	6210	Forestry and related workers	20	100
723		**Machinery mechanics and repairers**	**11**	
	7234	Bicycle and related repairers	33	39
	7233	Agricultural and industrial machinery mechanics and repairers	0	61
724		**Automobile mechanics and fitters**		
	7231	Motor vehicle mechanics and repairers	13	100
725		**Motorcycle mechanics and fitters**		
	7231	Motor vehicle mechanics and repairers	13	100
314		**Life science technicians and related associate professionals**	**7**	
	3141	Life science technicians (excluding medical)	0	33
	3142	Agricultural technicians	0	33
	3143	Forestry technicians	20	33
814		**Rubber, plastic and paper products machine operators**	**5**	
	8141	Rubber products machine operators	0	62
	8142	Plastic products machine operators	14	38
311		**Physical and engineering science technicians**	**3**	
	3112	Civil engineering technicians	22	14
	3113	Electrical engineering technicians	0	71
	3115	Mechanical engineering technicians	0	14
622		**Fishery workers, hunters and trappers**	**2**	
	6221	Aquaculture workers	11	16
	6222	Inland and coastal waters fishery workers	0	84
	6223	Deep-sea fishery workers	0	0
	6224	Hunters and trappers	0	0
216		**Architects, planners, surveyors and designers**	**2**	
	2161	Building architects	0	77

	2163	Product and garment designers	11	15
	2165	Cartographers and surveyors	0	9
741		**Electrical equipment installers and repairers**	**1**	
	7411	Building and related electricians	11	7
	7412	Electrical mechanics and fitters	0	55
	7413	Electrical line installers and repairers	0	37
531		**Protective services workers**	**1**	
	5411	Fire-fighters	33	1
	5413	Prison guards	0	3
	5414	Security guards	0	95
	5419	Protective services workers not elsewhere classified	20	1

Source: LFS 2019

Notes: Employment share in red (occupation 314) indicates that there is no observation for any 4-digit occupation in the LFS data and that an equal weight has been assigned to each occupation.

A1.4. Full list of potential green occupations

Table A.6 Complete list of potential green occupations, ranked by potential green employment share

COC 3-digit	CSES Occupation Title	Weighted potential GTI	Potential green employment share (%)
611	Market gardeners and crop growers	82	10.06
755	Garment and related trades workers	12	9.80
631	Subsistence crop farmers	29	8.87
711	Building frame and related trades workers	30	5.73
612	Animal producers	16	5.71
921	Agricultural, forestry and fishery labourers	33	4.88
622	Fishery workers, hunters and trappers	22	1.78
834	Other motor-related drivers	13	1.20
721	Sheet and structural metal workers, moulders and welders, and related workers	13	1.02
634	Subsistence fishers, hunters, trappers and gatherers	13	0.92
753	Wood treaters, cabinet-makers and related trades workers	15	0.80
754	Tailors, dress makers, furriers and hatters	18	0.64
725	Motocycle mechanics and fitters	25	0.61
741	Electrical equipment installers and repairers	46	0.58
724	Automobile mechanics and fitters	25	0.50
621	Forestry and related workers	80	0.38
836	Mobile plant operators	33	0.34
751	Food processing and related trades workers	5	0.31
835	Heavy truck and bus drivers	33	0.28
833	Taxi drivers	13	0.25
723	Machinery mechanics and repairers	54	0.23
712	Building finishers and related trades workers	4	0.22
731	Handicraft workers	9	0.18
961	Refuse workers	71	0.18
311	Physical and engineering science technicians	30	0.13
742	Electronics and telecommunications installers and repairers	51	0.12
811	Mining and mineral processing plant operators	10	0.09
722	Blacksmiths, toolmakers and related trades workers	20	0.08

963	Firewood and water collectors	50	0.06
814	Rubber, plastic and paper products machine operators	21	0.05
739	Printing trades workers	6	0.04
313	Process control technicians	26	0.04
962	Rag Picker	75	0.04
213	Life science professionals	91	0.03
323	Traditional and complementary medicine associate professionals	17	0.03
226	Other health professionals	4	0.03
933	Transport and storage labourers	0	0.02
815	Textile, fur and leather products machine operators	9	0.02
531	Protective services workers	1	0.02
314	Life science technicians and related associate professionals	46	0.01
321	Medical and pharmaceutical technicians	4	0.01
613	Mixed crop and animal producers	50	0.01
511	Travel attendants, conductors and guides	2	0.01
964	Other elementary workers	2	0.01
422	Client information workers	1	0.01
315	Ship and aircraft controllers and technicians	16	0.01
216	Architects, planners, surveyors and designers	2	0.00
515	Building and housekeeping supervisors	2	0.00

Source: CSES 2021/22.

Notes: Sampling weights are included at the individual level. Sample includes working age (15-64 years of age) and actively employed. Occupations are classified at the 3-digit level following the Cambodian Occupational Classification (COC).

A2. Output-based approach: Jobs in green industries[30]

Following Posadas et al. 2023, we apply the output-based approach to classify industries in Cambodia. The classification is based on the BLS categorization of industries in the United States, using the NAICS2007, which is reclassified to accommodate the Cambodian context. NAICS 6-digit codes are crosswalk to ISIC Revision 4 level 4 codes, similarly to what have been done in Granata & Posadas (2024) and Doan, Luu, Nguyen, & Safir (2023). We then link the list of level 4 industries to the 2019 Labor Force Survey (LFS) in order to compute weights for the aggregation to ISIC level 3, used in the CSES.

This section documents the step-by-step procedure of manual reclassification of NAICS codes, crosswalk from NAICS 2007 to ISIC level 4, merging with the LFS 2019 and aggregation from ISIC level 4 to ISIC level 3.

A2.1. Manual reclassification of green industries in the 6-digit NAICS 2007

In 2010, the U.S. BLS classified 333 industries out of the 1192 6-digit NAICS 2007 codes as green industries.[31] To estimate green jobs in the United States, the BLS first categorized "potential green" industries, and then conducted a survey of firms in these industries to estimate the number of green jobs as per their definition, meaning jobs "producing goods and services that benefit the environment or conserve natural resources across the country".[32] Jobs are estimated from the reported percentage of

[30] This section follows closely the methodological appendix of Doan, Luu, Nguyen, & Safir (2023).

[31] These 333 industries represent 23 percent of all establishments and 20 percent of employment in the U.S. economy in 2010.

[32] While the BLS classifies industries as "potential green", we call them "green" to avoid confusion with the potential green category of the task-based approach.

revenue derived from green products from sampled firms that responded to the survey and the overall employment of the firm. The firm-level survey forms the Green Goods and Services database and includes about 120,000 firms. It was estimated that there were 3.4 million green jobs in the United States in 2011, accounting for 2.6 percent of all jobs.

To ensure the information on green industries from the U.S. is relevant to Cambodia, we revise the classification NAICS green industry and reclassify 243 as non-green. For example, most agriculture industries in NAICS are coded as green because the BLS assumed that the United State Department of Agriculture (USDA) could certify organic produce. Since most of the agricultural production in Cambodia is not organic certified, we revise the classification from green to non-green. Similar reasoning applied to the fishery industries. Wood logging is recoded to non-green in Cambodia, since the outputs are not used for biomass as in the U.S. case. Sugarcane plantation and sugarcane manufacturing is reclassified as non-green since sugarcane is not yet used for ethanol production in Cambodia. Similarly, most manufacturing industries classified as green in NAICS because the output materials might be eligible for green certifications that are not yet available in Cambodia; hence, we have reclassified them as non-green**.** The certifications that green manufacturing industries can benefit from are specific to the U.S. context (i.e., the WaterSense certificates for efficient use of water, Energy Star for energy saving products), or globally recognized certifications not yet widespread in Cambodia (i.e., the Leadership in Energy and Environmental Design (LEED) certificates) or use recycled inputs. We also reclassify to non-green industries such as television and radio broadcasting, book publishing, newspapers, graphic design and marketing agencies, as their activities related to raising awareness on environmental issues in Cambodia is very limited. Finally, we reclassified to non-green industries that include consulting activities, legal activities, professional and political organizations and the administration of general economic programs because their role for the implementation of a low-carbon economy in Cambodia is still limited. The full list of reclassified NAICS industry is available upon request.

A2.2. Crosswalk from NAICS 2007 6-digit to ISIC Rev-4 level 4

We crosswalk from NAICS 2007 6-digit codes to ISIC Rev.4th 4-digit codes using the official crosswalk file from the BLS website, with some adjustments.[33] There is a discrepancy between the total number of NAICS 2007 6-digit codes in the green identification file (1192 6-digit NAICS industries and the crosswalk file (1176 6-digit NAICS industries). This discrepancy is the result of (a) 38 codes in the green file that are not listed in the crosswalk file, and (b) 22 codes in the crosswalk file that are not included in the green file. These are handled through the following approaches. First, the 38 codes in the green identification file are comparable to 19 6-digit NAICS industries in the crosswalk file. These codes are related to construction, further split into residential and nonresidential construction contractor categories in the BLS green file. All these 38 industries are classified as non-green except two. Of the 19 equivalent 6-digit NAICS codes in the crosswalk file, we therefore identify 18 as non-green and one as green. Second, the remaining three unmatched industries in the crosswalk file are manually identified as green/non-green based on other similar industries in the BLS green file. These are *Dual-Purpose Cattle Ranching and Farming*, identified as green; *Offices of Notaries*, identified as non-green, and missing value (to be matched with ISIC4 codes 9810 & 9820- Undifferentiated service & goods-producing activities of private households for own use), identified as nongreen. We manage to identify 1176 6-digit NAICS in the crosswalk file as green/non-green classification based on the BLS green file.

The next step involves a crosswalk from 1176 6-digit NAICS2007 codes to 419 4-digit ISIC Rev.4 codes. Three possible situations may arise:

[33] The crosswalk relies on document downloaded from BLS website: https://www.census.gov/naics/?68967

a. One NAICS 6-digit code corresponds to one ISIC 4-digit code. In this case, the ISIC is classified according to the matched NAICS. There are 62 out of the 419 ISIC codes of this type.
b. Multiple NAICS 6-digit codes correspond to one ISIC 4-digit code:
    i. If all NAICS are green (respectively non-green), then the ISIC 4-digit code is green (respectively non-green). There are 206 out of the 419 ISIC codes of this type.
    ii. If the 6-digit NAICS codes corresponding to one 4-digit ISIC codes are a mix of green and non-green, we then create weights proportional to the number of green and non-green 6-digit NAICS for each 4-digit ISIC code (see example in Table A.6). There are 122 out of the 419 cases of this type.
    iii. One NAICS 6-digit code corresponds to many 4-digit ISIC codes. In this case, the multiple ISIC codes take green/non-green values of the single NAICS 6-digit codes. There are 29 out of 419 cases of this type.

A2.3. Aggregate the ISIC4 level 4-digit code to the Cambodian adaptation of ISIC level 33-digit code

The CSES uses an adaptation of ISIC level 3 to classify industries. This classification follows closely the ISIC classification, except for the two industry groups 011 and 014 that are further subdivided using the ISIC level 4 categories. For these two industry groups, the greenness levels of their industries is directly obtained from the ISIC level 4 crosswalk explained above. In addition, the level 3 industry 639 "Other information service activities" uses the code 632 in the Cambodian classification.

Table A.7 Examples of how weights are assigned

NAICS 2007 6-digit	NAICS industry titles	Green / Non green	ISIC Rev. 4 level 4 code	ISIC industry title	Green ISIC type	Share of green industry
332313	Plate Work Manufacturing	Non green	2512	Manufacture of tanks, reservoirs and containers of metal	Mixed-green	25%
332420	Metal Tank (Heavy Gauge) Manufacturing	Non green				
332439	Other Metal Container Manufacturing	Non green				
333414	Heating Equipment (except Warm Air Furnaces) Manufacturing	Green				

Source: Adapted from Granata & Posadas (2024)

We use the distribution of employment in the LFS as weights in the aggregation from ISIC level 4 to ISIC level 3. We compute the employment share of each level 4 industries within level 3 industries using the 2019 Labor Force Survey. Unobserved industries are assigned a share equal to zero, unless none of the level 4 industries corresponding to a level 3 industry are unobserved, in which case they are all assigned the same share, summing to one. We multiply this share by the share of green outputs produced, and sum over all level 4 industries in a given level 3 industry to obtain our industry greenness measure. This is similar to the aggregation from ISCO 4-digit to COC 3-digit in the task-based approach. The final greenness measure is therefore the result of a double aggregation: (i) the unweighted aggregation of 6-digit into 4-digit industry codes and (ii) the weighted aggregation of 4-digit into 3-digit codes, in which the weights reflect the distribution of employment in the LFS 2019.

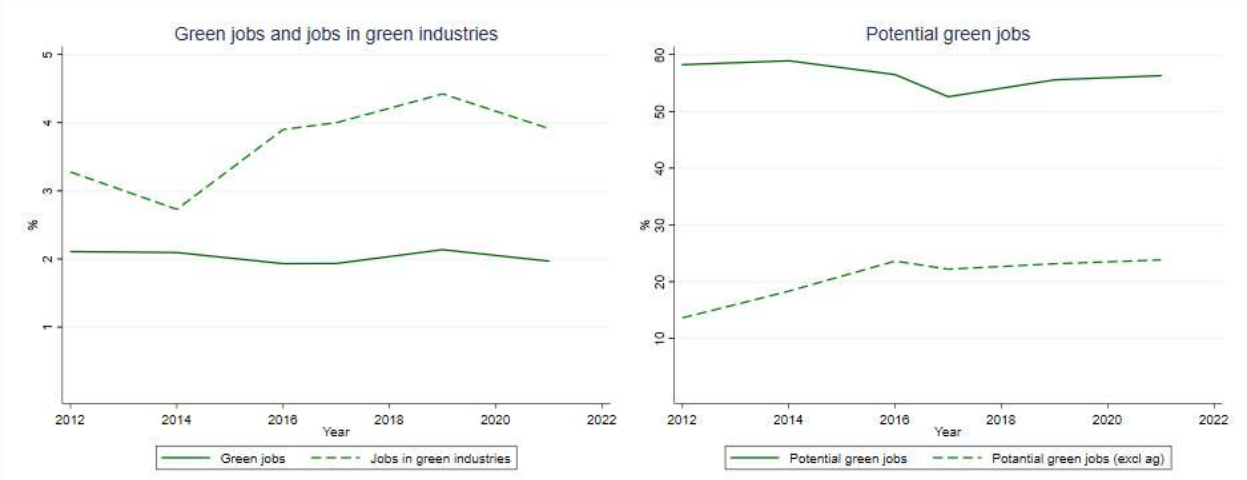
A3. Weights used in the trend analysis

The trend analysis from 2012 to 2021/22 requires an alternative weighting method than the 2021/22 analysis, using the LFS 2012 and 2019. The final step of the task- and output-based approaches uses the distribution of employment in ISCO 4-digit occupations (respectively ISIC level 4 industries) from the LFS 2019 to aggregate to COC 3-digit (ISIC level 3). Section 3.3 presents the evolution of the share of green jobs using CSES data from 2012, 2014, 2015, 2016, 2017 and 2019. The LFS was only collected in 2012 and 2019, so we assign weights from those years to the corresponding CSES waves. For the other CSES waves, we use two weighting methods.

a) A linear interpolation between the 2012 and 2019 weights in order to create year-specific weights for the aggregation. The weight assigned to an occupation o in year t is therefore equal to $weight_{ot} = weight_{o20} + (weight_{o201} - weight_{o201}) * \left(\frac{t-2012}{7}\right)$. This is the method used in the results presented in the main text. Note that we do not extend the interpolation to observations in 2021/22, as in the rest of the analysis, they use the 2019 weights.
b) Assigning the 2012 weights to observations from 2012-2015 and the 2019 weights to observations from 2016-2021.

The second method yields substantively similar results, as shown in Figure A.1.

Figure A.1 Green job trends using alternative weighting method



Source: CSES 2012-2021. Weights from LFS 2012 are used for the years 2012-2015, weights from LFS 2019 are used for the years 2016-2021.

Appendix B. Additional results

B1. Growing green jobs

Table B.1 Growth of potential green occupations

COC 3-digit	Occupation title	Average annual growth rate (%)	2012-21 Change in potential green employment share (%)	Potential green employment share (%)
611	Market gardeners and crop growers	10.97	6.90	11.20
711	Building frame and related trades workers	14.48	4.43	6.38
612	Animal producers	10.14	3.61	6.35
755	Garment and related trades workers	5.33	3.10	10.91
834	Other motor-related drivers	17.22	1.06	1.34
721	Sheet and structural metal workers, moulders and welders, and related workers	11.98	0.77	1.14
741	Electrical equipment installers and repairers	14.35	0.45	0.64
724	Automobile mechanics and fitters	7.67	0.27	0.56
712	Building finishers and related trades workers	32.05	0.25	0.24
622	Fishery workers, hunters and trappers	2.64	0.20	1.98
725	Motocycle mechanics and fitters	4.15	0.17	0.68
833	Taxi drivers	4.56	0.09	0.28
723	Machinery mechanics and repairers	3.38	0.05	0.26
531	Protective services workers	-3.06	-0.01	0.02
753	Wood treaters, cabinet-makers and related trades workers	0.37	-0.06	0.89
933	Transport and storage labourers	-18.52	-0.12	0.03
751	Food processing and related trades workers	-5.36	-0.26	0.34
835	Heavy truck and bus drivers	-5.36	-0.26	0.31
621	Forestry and related workers	-6.65	-0.39	0.42
634	Subsistence fishers, hunters, trappers and gatherers	-3.25	-0.52	1.02
921	Agricultural, forestry and fishery labourers	-3.13	-2.38	5.43
631	Subsistence crop farmers	-11.03	-18.61	9.87

Source: CSES 2012, 2014, 2016, 2017, 2019 and 2021/22. Average annual growth rate is estimated by regressing the log of potential green workers on year. The change in potential green employment share is estimated by regressing the potential green employment share on year, and multiplying the coefficient by 9.

B2. Missing green jobs

Table B.2 shows the list of green tasks associated with ISCO-08 4-digit green occupations not observed in the CSES 2021/2022.

Table B.2 Green occupations and green tasks not observed in the CSES

ISCO 4-digit code	Occupation title	Green task
1311	Agricultural and forestry production managers	Identifying and controlling agricultural and forest environmental toxins, weeds, pests and diseases;
2112	Meteorologists	Investigating direction and speed of air movements, pressures, temperatures, humidity, physical and chemical transformation of pollutants and other phenomena such as cloud formation and precipitation, electrical disturbances or solar radiation; Studying data collected from meteorological stations, radar and satellite imagery and computer model output to plot and forecast weather conditions; Preparing and reporting short-term or long-term weather maps, forecasts and warnings relating to atmospheric phenomena such as cyclones, storms and other hazards to life and property, and disseminating information about atmospheric conditions through a variety of media including radio, television, print and the internet; Developing and testing mathematical computer models of weather and climate for experimental or operational use; Participating in studies of the effect of weather on the environment; Analysing the impact of industrial projects and human activity on the climate and quality of the air, and working with the social science, engineering and economic communities to develop appropriate mitigation strategies; Conducting research on and improving or developing concepts, theories and operational methods related to the composition, structure and dynamics of the atmosphere, and preparing scientific papers and reports on the outcome of this research.
2113	Chemists	Developing procedures for environmental control, quality control and various other procedures for manufacturers or users; Conducting programmes of sample and data collection and analysis to identify and quantify environmental toxicants;

2114	Geologists and geophysicists	Using various remote sensing programmes to investigate and measure seismic, gravitational, electrical, thermal and magnetic forces affecting the earth; Studying and measuring physical properties of seas and the atmosphere and their interrelationship, such as the exchange of thermal energy; Advising in areas such as waste management, route and site selection and the restoration of contaminated sites.
2131	Biologists, botanists, zoologists and related professionals	Undertaking research in laboratories and in the field to increase scientific knowledge of living organisms, to discover new information, to test hypotheses, to solve problems in areas such as the environment, agriculture and health, and to develop new products, processes and techniques for pharmaceutical, agricultural and environmental use; Designing and carrying out environmental impact assessments to identify changes caused by natural or human factors; Providing advice to governments, organizations and businesses in areas such as conservation, management of natural resources, and the effects of climate change and pollution.
2141	Industrial and production engineers	Analysing workforce utilization, facility layout, operational data and production schedules and costs to determine optimum worker and equipment efficiencies;
2142	Civil engineers	Establishing control systems to ensure efficient functioning of structures as well as safety and environmental protection; Analysing the stability of structures and testing the behaviour and durability of materials used in their construction.
2143	Environmental engineers	Conducting research, assessing and reporting on the environmental impact of existing and proposed construction, civil engineering and other activities; Inspecting industrial and municipal facilities and programmes to evaluate operational effectiveness and ensure compliance with environmental regulations; Designing and overseeing the development of systems, processes and equipment for control, management, or remediation of water, air or soil quality; Providing environmental engineering assistance in network analysis, regulatory analysis, and planning or reviewing database development; Providing engineering and technical support for environmental remediation and litigation projects, including remediation system design and determination of regulatory applicability; Monitoring progress of environmental improvement programmes; Advising corporations and government agencies of procedures to follow in cleaning up contaminated sites to protect people and the environment;

		Collaborating with environmental scientists, planners, hazardous waste technicians, engineers from other disciplines, and specialists in law and business to address environmental problems.
2149	Engineering professionals not elsewhere classified	Designing and overseeing the construction and operation of nuclear reactors and power plants and nuclear fuels reprocessing and reclamation systems;
2162	Landscape architects	Compiling and analysing site and community data about geographical and ecological features, landforms, soils, vegetation, site hydrology, visual characteristics and human-made structures, to formulate land use and development recommendations, feasibility studies and environmental impact statements;
2164	Town and traffic planners	Reviewing and evaluating environmental impact reports;
2263	Environmental and occupational health and hygiene professionals	Developing, implementing and reviewing programmes and policies to minimize potential environmental and occupational risks to health and safety; Implementing prevention programmes and strategies for communicable diseases, food safety, wastewater treatment and disposal systems, recreation and domestic water quality, contaminated and hazardous substances; Developing, implementing and monitoring programmes to minimize workplace and environmental pollution involving chemical, physical and biological hazards;
3111	Chemical and physical science technicians	Collecting and testing earth and water samples, recording observations and analysing data in support of geologists or geophysicists.
3119	Physical and engineering science technicians not elsewhere classified	Modifying and testing equipment and devices used in the prevention, control and remediation of environmental pollution, in site remediation and land reclamation; Assisting in the development of environmental pollution remediation devices under the direction of an engineer;
3257	Environmental and occupational health inspectors and associates	Giving advice on environmental sanitary problems and techniques; Inspecting establishments to ensure that they conform to governmental and other rules and regulations concerning emission of pollutants and disposal of dangerous wastes; Initiating action to maintain or improve hygiene and prevent pollution of water, air, food or soil; Estimating quantities and costs of materials and labour required for health, safety and sanitation remediation projects;
6221	Aquaculture workers[34]	Collecting and recording growth, production and environmental data;

[34] Aquaculture workers are observed in the LFS and the CSES. However, in-country discussion highlighted the fact that this task is not carried out by Aquaculture workers in Cambodia.

7122	Floor layers and tile setters[35]	Preparing wall areas for covering with tiles or other materials for decorative or other purposes such as acoustic insulation;
7124	Insulation workers	Cutting insulation material by size and shape; Examining plans, specifications and work sites to determine the type, quality and quantity of insulation material required;
7541	Underwater divers	Obtaining information about diving tasks and environmental conditions.
8182	Steam engine and boiler operators	Resting boiler water quality or arranging for testing, adjusting and taking necessary corrective action, such as adding chemicals to prevent corrosion and harmful deposits;
9623	Meter readers and vending-machine collectors	Reading electricity, gas or water meters and recording consumption;

Source: GTI toolkit

[35] Floor layers and tile setters are observed in the LFS and the CSES. However, we reclassified this task because the word "insulation" relates to acoustic insulation, which is not green.

Appendix C. Regression tables

Table C.1 Earnings premium for green jobs - Correlates of hourly wage (log)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	GREEN & POTENTIAL GREEN JOBS (AG & NON-AG)			JOBS IN GREEN INDUSTRY		
Green job	0.02	0.07	0.21**			
	(0.12)	(0.08)	(0.09)			
Non ag potential green job	-0.08	0.10***	0.09			
	(0.06)	(0.04)	(0.07)			
Ag potential green job	-0.64***	-0.37***	-0.10			
	(0.06)	(0.04)	(0.10)			
Green industry				0.07	0.03	0.13*
				(0.13)	(0.10)	(0.07)
Other urban		0.09***	0.09***		0.13***	0.09***
		(0.02)	(0.02)		(0.04)	(0.02)
Phnom Penh		0.12***	0.11***		0.16**	0.11**
		(0.04)	(0.04)		(0.06)	(0.04)
Secondary education		0.14***	0.11***		0.15***	0.10***
		(0.04)	(0.03)		(0.05)	(0.03)
Post-secondary		0.64***	0.45***		0.61***	0.45***
		(0.03)	(0.06)		(0.05)	(0.06)
Female		-0.09***	-0.12***		-0.09*	-0.11***
		(0.03)	(0.03)		(0.05)	(0.03)
Age		0.04***	0.04***		0.04***	0.04***
		(0.01)	(0.01)		(0.01)	(0.01)
Age square		-0.00***	-0.00***		-0.00***	-0.00***
		(0.00)	(0.00)		(0.00)	(0.00)
Low skills			0.04			0.09**
			(0.06)			(0.04)
Medium skills			0.22***			0.24***
			(0.08)			(0.07)
High skills			0.31***			0.33***
			(0.09)			(0.09)
Constant	8.48***	7.58***	7.56***	8.40***	7.49***	7.54***
	(0.06)	(0.13)	(0.11)	(0.06)	(0.11)	(0.11)
Observations	8,514	8,044	8,043	8,513	8,043	8,043
R-squared	0.073	0.242	0.273	0.000	0.207	0.270
Sector FE (ISIC level 2)	No	No	Yes	No	No	Yes

Source: CSES 2021/22 using individual sampling weights. Dependent variable is the log of hourly wage, standard errors clustered at the occupation level. Omitted education category is "None or Primary", "Secondary education" includes lower- and upper-secondary. Medium skills include Clerks, and Technicians and associate professionals. High skills include Managers and Professionals, omitted skills category is Elementary occupations. The CSES 2021/22 survey collects earnings data only of those who are wage employees in their primary or secondary occupations and only collects total earnings (i.e. not by occupation). There are 10,771 respondents aged 15-64 who report being an employee in their primary occupation (after excluding Armed forces occupations). 2,184 also report a secondary occupation, and 1 did not answer the question on the number of secondary occupations. These 2,185 observations are excluded from the analysis because the survey asks for the total amount received for all occupations. Of the remaining 8,586, 7 individuals have missing earnings information, and 65 reported zero wages in the previous month, leaving us with 8514 observations with strictly positive hourly wage. *** p<0.01, ** p<0.05, * p<0.1

Table C.2 Earnings premium for green jobs per location - Correlates of hourly wage (log)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	GREEN JOB INTERACTION		POTENTIAL GREEN JOB INTERACTION		GREEN INDUSTRY INTERACTION	
Green job	-0.040	0.103	0.083	0.209**		
	(0.115)	(0.122)	(0.083)	(0.088)		
Potential green job			0.018	0.091		
			(0.101)	(0.074)		
Non ag potential green job	0.097***	0.093				
	(0.037)	(0.066)				
Ag potential green job	-0.370***	-0.116				
	(0.041)	(0.094)				
Green industry					0.083	0.108
					(0.143)	(0.068)
Phnom Penh	0.113***	0.106**	0.177***	0.157***	0.171**	0.111**
	(0.043)	(0.042)	(0.045)	(0.040)	(0.072)	(0.047)
Phnom Penh * Green	0.318**	0.287**				
	(0.122)	(0.129)				
Phnom Penh * Potential green			-0.055	-0.118		
			(0.122)	(0.082)		
Phnom Penh * Green industry					-0.188	-0.054
					(0.209)	(0.167)
Other urban	0.089***	0.087***	0.065**	0.055*	0.132***	0.082***
	(0.017)	(0.017)	(0.031)	(0.029)	(0.046)	(0.018)
Other urban * Green	0.055	0.044				
	(0.135)	(0.108)				
Other urban * Potential green			0.128*	0.064**		
			(0.073)	(0.032)		
Other urban * Green industry					0.016	0.103
					(0.129)	(0.085)
Secondary and below	0.143***	0.108***	0.160***	0.109***	0.149***	0.104***
	(0.039)	(0.034)	(0.042)	(0.034)	(0.046)	(0.033)
Post-secondary	0.642***	0.454***	0.634***	0.444***	0.612***	0.452***
	(0.035)	(0.059)	(0.041)	(0.062)	(0.045)	(0.061)
Female	-0.091***	-0.116***	-0.094**	-0.116***	-0.089*	-0.114***
	(0.030)	(0.029)	(0.044)	(0.029)	(0.048)	(0.031)
Age	0.037***	0.036***	0.042***	0.036***	0.043***	0.037***
	(0.007)	(0.007)	(0.005)	(0.006)	(0.005)	(0.007)
Age square	-0.000***	-0.000***	-0.001***	-0.000***	-0.001***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Low skills		0.042		0.041		0.088**
		(0.064)		(0.061)		(0.040)
Medium skills		0.223***		0.218***		0.238***
		(0.077)		(0.075)		(0.074)
High skills		0.310***		0.300***		0.327***
		(0.086)		(0.082)		(0.087)
Constant	7.581***	7.560***	7.494***	7.546***	7.489***	7.546***
	(0.129)	(0.112)	(0.094)	(0.108)	(0.110)	(0.110)
Observations	8,044	8,043	8,044	8,043	8,043	8,043
R-squared	0.242	0.273	0.212	0.276	0.207	0.271
Sector FE (ISIC level 2)	No	Yes	No	Yes	No	Yes

Source and Notes: See Table C1. Standard errors clustered at the occupation level. *** p<0.01, ** p<0.05, * p<0.1

Table C.3 Who holds a green job?

VARIABLES	(1) Green job	(2) Potential green job	(3) Non-agricultural potential green job	(4) Job in green industry
Female	-0.036*	-0.067*	-0.067	-0.020**
	(0.020)	(0.040)	(0.046)	(0.009)
Primary education	-0.000	0.027***	0.040***	0.005*
	(0.003)	(0.009)	(0.012)	(0.003)
Lower secondary	-0.002	0.016	0.032**	0.008
	(0.005)	(0.013)	(0.016)	(0.005)
Upper secondary	-0.008	-0.002	0.001	0.009*
	(0.005)	(0.015)	(0.017)	(0.005)
Post-secondary	0.017	-0.007	0.007	-0.000
	(0.023)	(0.031)	(0.030)	(0.008)
Age	0.001	0.008**	0.010**	0.000
	(0.001)	(0.004)	(0.004)	(0.001)
Age square	-0.000	-0.000**	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Other urban	-0.007	-0.008	0.002	0.001
	(0.006)	(0.013)	(0.013)	(0.002)
Phnom Penh	-0.004	-0.037	-0.031	0.007
	(0.007)	(0.025)	(0.026)	(0.007)
Constant	0.034	0.449***	0.267***	0.039**
	(0.021)	(0.084)	(0.098)	(0.017)
Observations	21,021	21,021	13,893	21,020
R-squared	0.064	0.591	0.542	0.498
Sector FE (ISIC level 2)	Yes	Yes	Yes	Yes

Source: CSES 2021/22. Linear probability model, standard errors clustered at the occupation level. Dependent variable is the share of workers in the 3-digit occupation with a green job (column 1), a potential green job (columns 2-3) or a job in green industry (column 4). Omitted education category is "Less than Primary", omitted location category is “Rural“. Column 3 excludes workers in Agriculture, fishery and forestry.*** p<0.01, ** p<0.05, * p<0.1