International Labour Organization

Linking green trade and employment

Are there opportunities for job creation?

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Abstract

This paper examined global trade patterns in green goods from 2012 to 2022, using comprehensive international trade flow data from the World Integrated Trade Solution (WITS) and the United Nations International Trade Statistics Database (UN Comtrade), and combining that data with the International Monetary Fund (IMF) list of environmental goods. The analysis reveals a considerable increase in the export of green goods over the past decade, with China and middle-income countries demonstrating the most significant growth. Furthermore, high-income countries and China continue to dominate green trade flows.

To estimate the employment impacts of green goods exports, a multi-regional input-output (MRIO) model was used. The model integrated the Organisation for Economic Co-operation and Development (OECD) Inter-Country Input-Output tables (ICIO) with labour statistics from the International Labour Organization statistics database (ILOSTAT), which facilitated an estimate of direct and indirect employment effects across countries and sectors using labour characteristics such as age, gender, skill level and formality status.

The findings underscored the growing relevance of green trade in fostering sustainable economic development and highlighted the role of global value chains in disseminating green technologies and creating employment opportunities. This report contributes to the existing literature by delivering a comprehensive analysis of green trade flows and their associated employment impacts at an in-depth level of country and sectoral disaggregation.

Acknowledgements

This report was produced under the guidance of Mito Tsukamoto, Chief of the Employment in Investments branch at ILO. The authors would like to thank Sangheon Lee, Marva Corley-Coulibaly, Reina Kuwashima and Ariana Rossi for their valuable comments on previous versions of the report.

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Acronyms and abbreviations

CAPEC	Asia-Pacific Economic Cooperation CIF - Cost, Insurance, Freight
DLI	Domestic Labour Input EU - European Union
FLI	Foreign Labour Input FOB - Free on Board
GDP	Gross Domestic Product GHG - Greenhouse Gas
HS	Harmonized System
ICIO	Inter-Country Input-Output (Matrix) ILO - International Labour Organization
ILOSTAT	International Labour Organization Statistics database IMF - International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change LCT - Low Carbon Technology
MRIO	Multi-Regional Input-Output
OECD	Organisation for Economic Co-operation and Development PPP - Purchasing Power Parity
UNFSS	United Nations Forum on Sustainability Standards WITS - World Integrated Trade Solution

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1. Introduction

The world is at a critical juncture regarding environmental challenges, and addressing those challenges requires a collective effort. A recent report by the secretariat of the United Nations Framework Convention on Climate Change indicates that greenhouse gas (GHG) emissions must be reduced by 30 to 50 per cent in order to avoid a rise in global temperatures of 1.5 degrees Celsius over the next two decades (IPCC 2023). The consequences of climate change are evidenced by increasingly frequent and severe heat waves, decreasing ice levels at the poles and warming oceans. In addition, natural disasters including floods, droughts and hurricanes as well as other types of extreme weather events are intensifying.

One of the most significant factors contributing to the observed increase in emissions is globalization, which has resulted in the fragmentation of productive activities and an increased demand for goods and services (Hummels et al. 2001). The value of global merchandise exports has risen significantly since 1948, with exports accounting for an average of 29 per cent of national gross domestic product (GDP) in 2016 (Wiedmann and Lenzen 2018). However, trade globalization often has the effect of shifting environmental and social impacts of production away from the country of consumption to another country or several countries. For example, the energy consumption, pollution and employment impacts of a food product could have effects on several countries in the chain of production.

Due to the current global situation, the global economic development agenda should be reconsidered. The Paris Agreement, adopted in 2015 and endorsed by 195 countries, has prompted governments to explore transformations in production structures with a view to reducing GHG emissions. The objective is to achieve a significant reduction in emissions by 2030, with the ultimate goal of reaching zero emissions by 2050. Achieving this goal requires decoupling economic growth from emissions and environmental degradation. This can be accomplished by shifting the energy matrix away from fossil fuels, increasing energy efficiency, and promoting a circular economy, in tandem with other relevant policies (Cevik and Jalles 2023). Sustainable trade plays a pivotal role in advancing the green growth agenda and reaching the net zero target by 2050.[1]

Sustainable trade within the international trade structure initially focused on the environmental effects of production and trading (Kang and Lee 2021). However, initiatives including the United Nations Forum on Sustainability Standards (UNFSS) in 2022 broadened this focus to encompass social and economic dimensions as well. The UNFSS has highlighted the necessity of sustainability standards for the effective transformation of production, global supply chains and consumption patterns. New standards address social justice, human rights, economic productivity, welfare and the preservation of local and indigenous communities and equity issues (UNFSS 2022).

Within the realm of sustainable trade, “green trade” refers to trade practices that benefit the environment. However, while the concept of green trade implies an environmental benefit, there is no precise definition of its components (Balineau and De Melo 2013). Furthermore, definitions of green goods vary among governments, and include a wide range of products, such as renewable energy and energy-efficient technologies, organically produced agricultural goods and certified biodiversity-based products. For example, the Asia-Pacific Economic

1 For further information see: https://www.un.org/en/climatechange/net-zero-coalition.

Cooperation forum (APEC) defines environmental goods based on their ability to improve access to environmental technologies and contribute to green growth (Kuriyama 2021).

Adequate access is essential for enabling newly industrialized countries to catch up with developed nations in the area of green technology (Kirchherr and Urban 2018). While technology is increasingly available around the world, structural barriers can impede the technology adoption process. Labour is a critical factor in the adoption of new technologies because mismatches of skills and difficulties in mobilizing labour from brown to green technologies may impede the green transition (ILO 2018).

Green jobs and green trade are aligned with the United Nations Sustainable Development Goals, set out in the 2030 Agenda for Sustainable Development, and in particular, those related to decent work and economic growth (Goal 8); industry, innovation and infrastructure (Goal 9), and sustainable cities and communities (Goal 11). Promoting green jobs supports the achievement of the Goals, while green trade facilitates the global sharing of sustainable technologies and practices (Stanef-Puica et al. 2022). Most empirical research on green jobs builds on the definition proposed by Jarvis (2011) in the ILO Green Jobs Initiative. According to this definition, "green jobs" are those in economic activities that are more environmentally sustainable than conventional alternatives and offer working conditions that meet accepted standards of decent work. Green jobs can be identified using three principal methodologies: the industry affiliation approach, the production methods approach (ILO 2017), and the task-based approach (Vona 2021).

Due to data and methodological constraints that prevent comprehensive estimations of green jobs it was not possible to use the aforementioned approaches in the present report. The analysis for this report was limited to jobs sustained by green exports. Given that the analysis did not assess the environmental sustainability of the jobs themselves, the jobs may be found in both green and brown industries, or they may be classified as green or brown based on the specific tasks performed.

In addition to trade in goods, trade in services, and environmental services in particular, are important for achieving broader sustainability goals (OECD 1999). For example, environmental services may include sewage, waste disposal, recycling, nature conservation, ecotourism, green construction and engineering. However, with the exception of tourism, those activities are non-tradables. Due to the level of aggregation of the available services data, it was not possible to estimate green commerce within trade in services. Consequently, this report focused exclusively on goods trading.

The report used comprehensive data on international trade flows and the International Monetary Fund (IMF) list of environmental goods (IMF, 2021). The paper delivers a comprehensive examination of global trade patterns in green goods from 2012 to 2022. During that timeframe, a notable surge in exports of green goods occurred across all regions, with China and middle-income countries demonstrating the highest rates of growth. While high-income countries experienced a 51 per cent increase in green goods exports overall, China had the most substantial increase of 147 per cent growth, primarily due to strategic investment in green technology and manufacturing capabilities. Furthermore, green trade was still dominated by the trade flows of high-income countries, with China playing an increasingly significant role in the trade flow of exports. Those trends align with current research on trade and quality, which reveal that high-income countries tend to produce and export sophisticated products due to both their advanced technological capabilities and a higher demand for those goods domestically (Hallak 2006; Feenstra and Romalis 2014).

In order to estimate the impact of green goods exports on employment, the report employed a MRIO model that integrated the OECD Inter-Country Input-Output tables with labour statistics contained in the ILOSTAT database. This approach enabled the calculation of both direct and indirect employment opportunities across countries and sectors by establishing a link between final demand and economic structures through the Leontief inverse matrix (Leontief 1951).

While previous research employed input-output models to examine the economic and environmental consequences of trade (Timmer et al. 2015; Johnson and Noguera 2012), the methodology used in this report was distinctive in that it integrated the OECD Inter-Country Input-Output tables with granular labour data from the ILOSTAT database. This integration allowed for precise estimates of both the direct and indirect employment effects across countries and sectors, and took into consideration labour characteristics such as age, gender, skill level and formality status. By explicitly linking trade flows to employment outcomes and providing insights into the quality of jobs associated with green exports, this advancement in methodology emphasized the significance of global value chains and expanded on the work of Hummels and Timmer on value-added trade (Hummels et al. 2001) (Timmer et al. 2014).

The remainder of this study is organized as follows. Section two describes the data used in conjunction with empirical work while section three provides a detailed analysis of the green goods trade globally. Section four examines the connection between the export of sustainable goods and employment demand-based trading flows. Section five presents conclusions and outlines recommended next steps.

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2. Data

The following section describes the data used to assess the employment impact of green goods exports, which included an MRIO data matrix, the environmental goods list, employment data and bilateral trade flows. Each of the sources are described in more detail below.

2.1 Employment

The ILO collects underlying household survey datasets compiled by national statistical offices in 161 countries. The raw data is then systematically processed to produce harmonized indicators based on international statistical standards. The ILOSTAT[2] database complies a wide range of detailed and internationally comparable labour statistics, which form the basis of published reports.

For this analysis, all employment-related parameters were sourced from a satellite account containing employment data from ILOSTAT. The parameters used included the working-age population actively employed, defined as individuals engaged in any activity for at least one hour to produce goods or services in exchange for pay or profit, even if they are temporarily absent from work (ILO 2013).

The labour data included breakdowns by age group, gender, skill level and employment formality status. Within the data parameters, informal employment referred to jobs that, whether in practice or by law, were not subject to national labour legislation, income taxation, or social protection and did not provide entitlement to benefits such as paid leave (ILO 2013). Skill levels were divided into two groups: skilled and unskilled workers, and the skill level associated with an occupation reflected the complexity and scope of job tasks. Complexity was assessed by examining occupational requirements or educational attainment. Skilled occupations included roles such as managers, professionals and technicians, all of which require advanced education, specialized training, or significant experience. Unskilled occupations involve routine tasks requiring less formal education or training and include clerical support workers, service and sales workers, and elementary occupations. Workers between the ages of 15 and 29 were classified as youth while those aged 30 and over were categorized as adults.

2.2 International trade flows

To estimate the international flow of green goods, including their countries of origin and destination, bilateral import data from 2012 to 2022 from the United Nations International Trade Statistics Database (UN Comtrade) were used. The UN Comtrade data provided detailed information on bilateral export (Free on Board (FOB)) and import (Cost, Insurance, Freight (CIF)) values and quantities at the Harmonized System (HS) six-digit-level for approximately 178 countries.

2 For further information see: https://ilostat.ilo.org/data/.

Trade flows valued on the basis of CIF and FOB often had discrepancies between of between 5 and 20 per cent, with data accuracy varying among countries. Those discrepancies may have occurred when products were categorized in different ways by countries based on whether they were exporting or importing. Since imports were generally recorded more precisely due to their association with tariff revenues, this report used CIF bilateral trade data for analysis.

2.3 Environmental goods

In the absence of a unified definition of environmental goods, this report relied on data from the International Monetary Fund (IMF 2021). Environmental goods were categorized in two groups: connected goods, which are directly used for environmental protection; and adapted goods, which have been modified to be more environmentally friendly. Examples of connected goods include septic tanks and catalytic converters, while adapted goods include biofuels and electric vehicles. The initial IMF list of environmental goods (IMF 2021) drew on the OECD and Eurostat classification mapped to the 2017 HS codes (OECD and Eurostat 1999), with additional items added on the basis of recent research and updates to the HS nomenclature. That list had much in common with the APEC list of environmental goods.[3] According to Steenblik (2005), APEC was greatly influenced by the OECD/Eurostat classification, and thus the two lists are similar.

While the most recent IMF list is comprehensive, it is not exhaustive because some environmental goods do not have specific HS codes, and some codes may include non–environmental goods. For example, the IMF list has added an additional set of 108 products, mainly based on the Pigato definition of Low Carbon Technology (LCT) products (Pigato et al. 2020). For the purposes of this report, the list was converted to the HS 2012 classification to ensure compatibility with the selected trade data and analysis period. The final list included 225 HS six-digit products.

2.4 Multi-regional input-output (MRIO) matrix

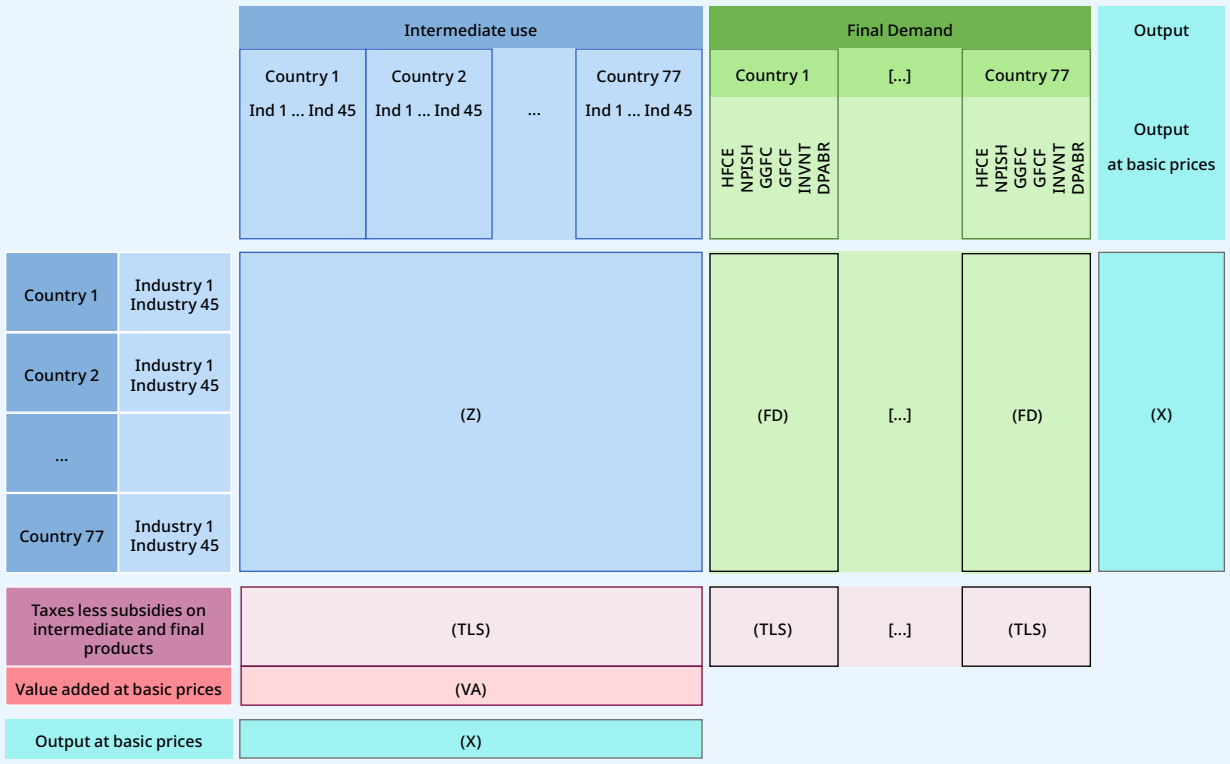
To calculate employment related to exports this report used the OECD ICIO matrix with a base year of 2019 and synthesized data on 45 economic activities for 76 individual countries and one additional region representing the rest of the world.

The input-output table represented monetary transactions between productive and institutional sectors within an economy. It captured the sectoral composition of GDP components, including household consumption, government expenditure, investment, exports and imports, as well as the sectoral composition of taxes and value- added components, such as wages and profits.

In the MRIO matrix shown in figure 1, the intermediate transactions matrix (Z) shows the purchases and sales of inputs between sectors in the same country, as well as external sales and purchases to and from third-party destinations. Final demand is represented as a matrix with rows indicating sectoral level final purchases by countries, including imports. The matrix also includes columns detailing domestic demand components such as private consumption, public consumption and investment. Lastly, since the imports of one country are the exports of another country, external sales at the sectoral level and by component are represented in the final demand matrix, in the columns outside the main diagonal.

3 For further information see: https://www.apec.org/meeting-papers/leaders-declarations/2012/2012_aelm/2012_aelm_annexc.

▶ Figure 1. Structure of the MRIO matrix



Source: OECD, 2022.


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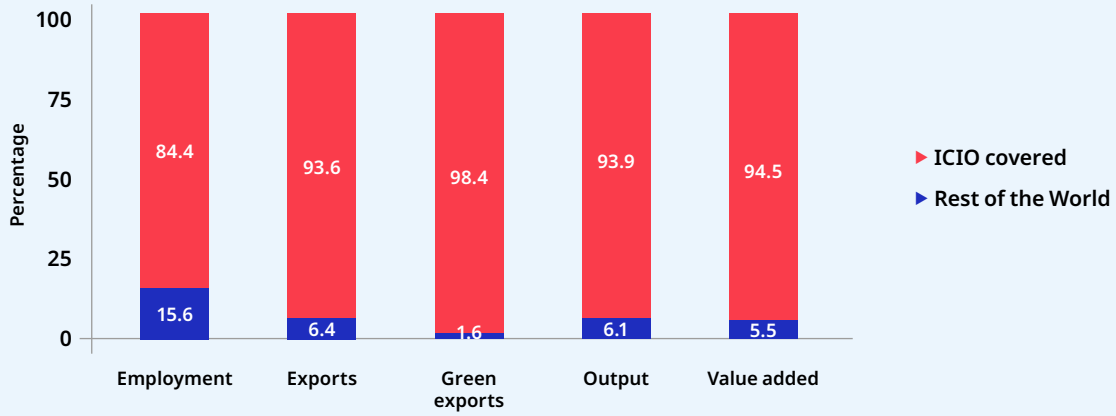
Figure 2 provides a comparative analysis of five economic indicators, including green exports, total exports, employment, output and value added designated by the ICIO individual countries and the region representing the rest of the world. The figure shows a significant concentration of economic activity within ICIO-indicated countries, which accounted for the majority of green exports (98.45 per cent), total exports (93.6 per cent), employment (84.4 per cent), output (93.93 per cent), and value added (94.5 per cent). Those results indicated a high degree of coverage in the ICIO MRIO database in terms of the primary economic variables considered, with only a very small part of the world economy being excluded.

▶ Figure 2. Individual country coverage by main indicators (76 ICIO countries)



Source: Author estimates on the basis of data available in ILOSTAT, WITS/COMTRADE and ICIO/OECD databases.

Throughout the report, the macroeconomic data available in the ICIO has been supplemented with additional variables, including GDP and population, which were sourced from the most recent version of the Penn World Table, published in 2023 (Feenstra et al. 2015). The Penn World Table is a comprehensive database and provides information on relative levels of income, output, input and productivity for 183 countries, including all 76 countries in the ICIO MRIO matrix. It includes the time period 1950–2021.

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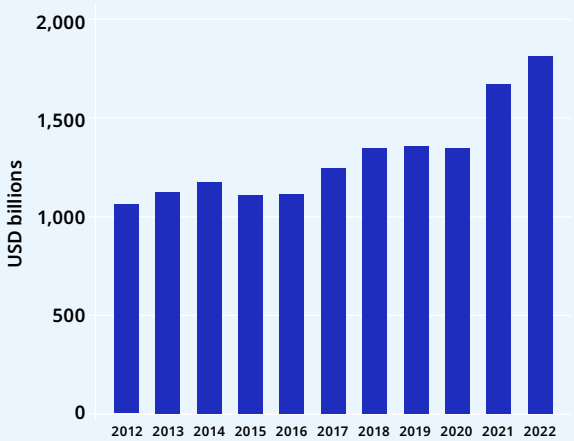
3. The international trade in green goods

This section presents the results of analysing the dynamics of international trade in green goods. The research focused on trends in exports and imports during the period 2012 to 2022. It also analysed the fundamental characteristics of green trade, taking both regional and sectoral composition into consideration. The findings indicated that the export of green goods by China and middle-income countries increased significantly in the decade in question, while exports by high- and low-income countries experienced less substantial growth. With respect to trade balances, China, the European Union, and the East Asia and Pacific region showed the most significant surplus globally. In contrast, North America, Europe and Central Asia, and Latin America exhibited the greatest deficits, suggesting a discrepancy between structural changes in demand and a lack of technological capabilities to meet that demand.

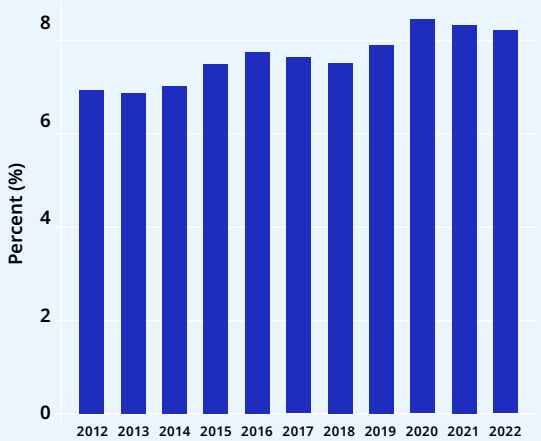
Figure 3a illustrates the growth of green trade in the decade 2012 to 2022. It shows a remarkable expansion of trade in green products, with an upward trajectory beginning in 2021 and reaching approximately $1.8 trillion in 2022. To account for post-pandemic inflation levels, figure 3b illustrates variations in green trade expressed as a proportion of global trade. The data show that the proportion of green trade increased between 2013 and 2016 and remained relatively stable during the period 2016 to 2019. The proportion of green goods as a percentage of world trade peaked at 8.5 per cent in 2020. Although the proportion declined in subsequent years, levels of green trade remained above pre-pandemic levels and exceeded 8 per cent of total world trade.

Figure 3. Green goods global trade, 2012–2022

a. Current prices in United States dollars (billions)



b. Share of world trade

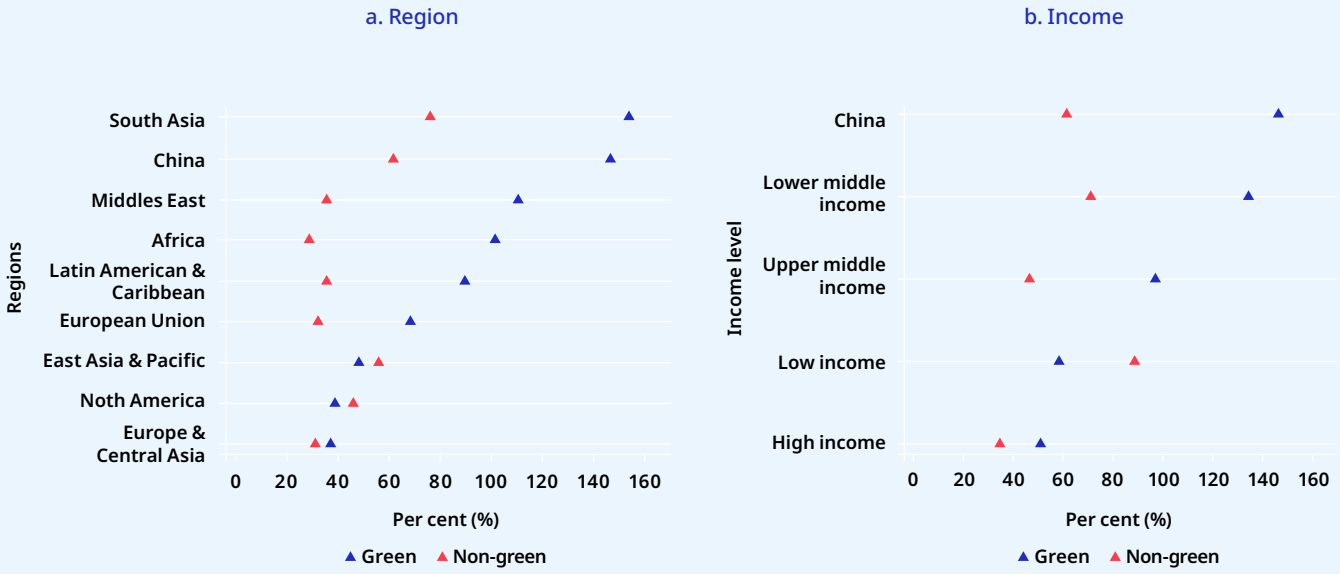


Source: Author estimates based on the WITS/COMTRADE database.

The evolution of exports by region showed notable disparities between 2012 and 2022, as illustrated in figure 4a. At current prices, green exports recorded the most substantial growth in South Asia, at 154.2 per cent, followed by China at 147.0 per cent and the Middle East at 110.8 per cent. In those regions, the disparity between the growth rates of green and non-green exports was most pronounced. In the East Asia and Pacific and North America regions, the growth rate of green exports was lower than that of non-green exports, at 48.3 per cent and 39.9 per cent, respectively.

Figure 4b aggregates the growth rate results by income level based on the World Bank classification[4], with China shown separately, given its key role in the global economy. When examining the growth rate of green exports by income level, the data showed that all regions, except for low-income countries, achieved a growth rate for green exports that exceeded the growth of non-green exports in the period in question. High-income countries exhibited the lowest growth rate, at 51 per cent, while China demonstrated the highest rate, at 147 per cent.

▶ Figure 4. Growth rates of green and non-green export products, 2012–2022



Note: Growth rate estimated on the basis of trade at current prices.

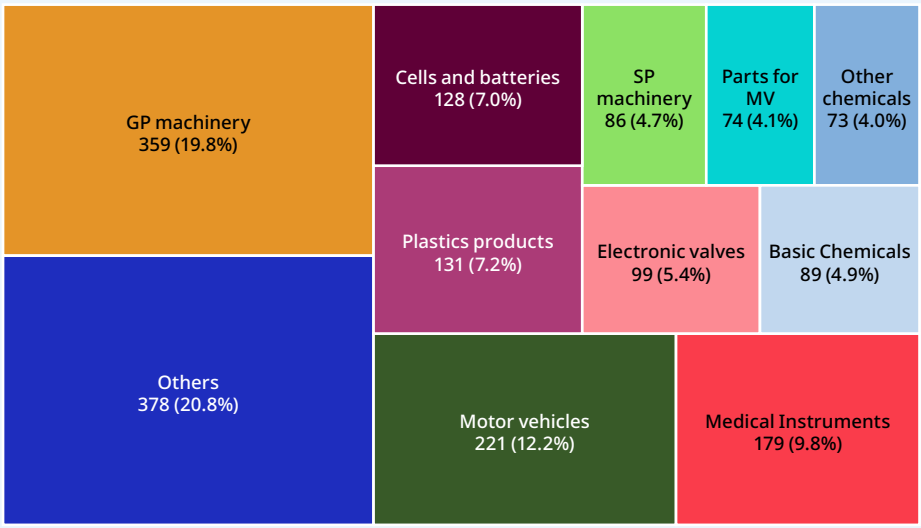
Source: Author estimates based on the WITS/COMTRADE database

Figure 5 illustrates the composition of the green goods trade globally. The three sectors with the highest shares were general purpose machinery at 19.8 per cent, vehicle engines at 12.2 per cent, and medical instruments at 9.8 per cent, which collectively accounted for 43 per cent of total green exports. The "others" category included several significant industries, such as manufacturers of electricity distribution and control apparatuses, electrical equipment and electric motors, generators and transformers, at 3.9 per cent, 3.8 per cent and 2.8 per cent, respectively. When the chemicals sectors were included, they accounted for 9.8 per cent of

4 For further information see: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

the total. The totals of the aforementioned sectors illustrated the significant contribution of advanced technologies and capital-intensive industries in the context of the green goods list, and highlighted how important those sectors are in the transition towards a low-carbon global economy (Kirchherr and Urban 2018).

▶ Figure 5. Green goods as a share of world trade by sector (International Standard Industrial Classification of All Economic Activities, Rev. 3, 2022)



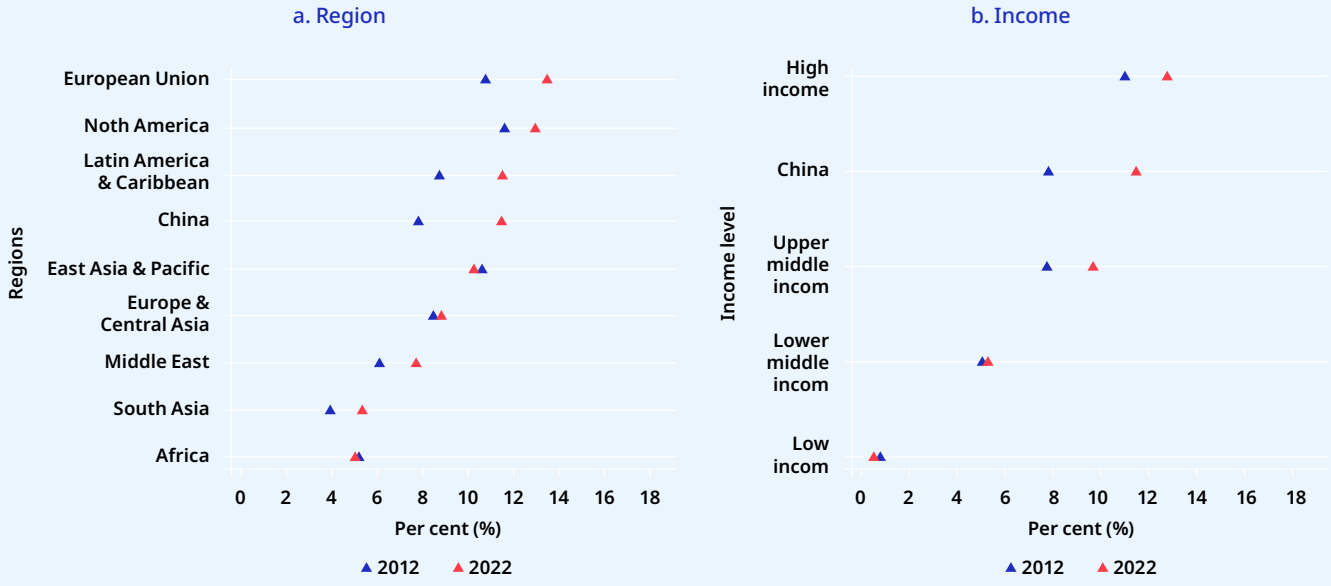
Note: The value to the left of the percentage label indicates billions of United States dollars exported in 2022.
* SP Machinery: Special Purpose Machinery; GP Machinery: General Purpose Machinery.

Source: Author estimates based on the WITS/COMTRADE database, 2022.

Several trends of note are illustrated in figure 6, which show the distribution of green exports by region and income level in the years 2012 and 2022. The European Union, at 12.9 per cent in 2022, was the region with the highest proportion of green exports as a percentage of total manufacturing exports. North America was the region with the highest share in 2012 and was second highest in 2022, at 10.5 per cent. China was the country with the highest value in 2022. The East Asia and Pacific region was the only region where the proportion of green trade declined between 2012 and 2022.

As illustrated in figure 6b, as of 2022 high-income countries were found to have the highest proportion of green exports in manufacturing at 12.7 percent. However, the most notable shift between 2012 and 2022 was in China, which registered an increase of approximately 4 per cent. In contrast, lower-middle-income countries and low- income countries showed minimal change in their share of green exports during the observed period.

▶ Figure 6. Green goods exports as a share of manufacturing exports, 2012 and 2022

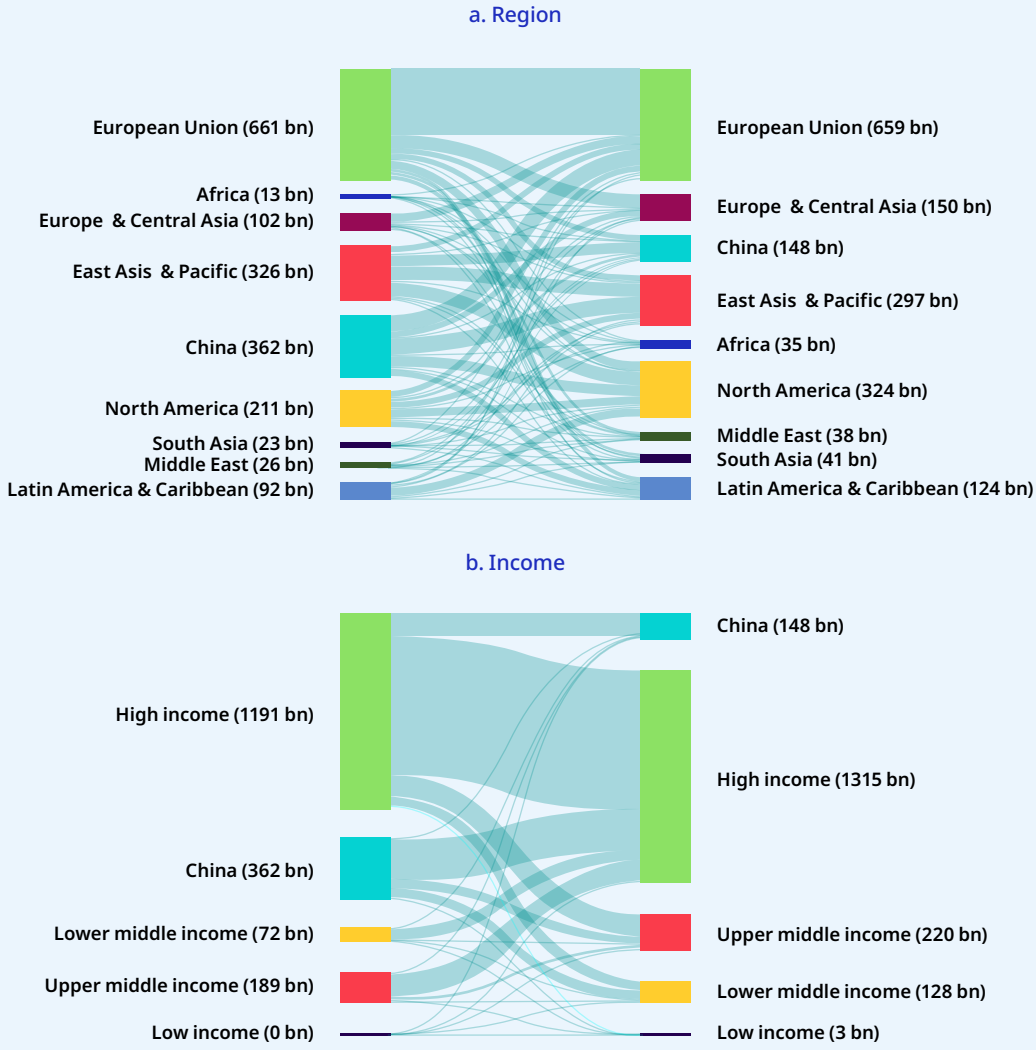


Source: Author estimates based on the WITS/COMTRADE database, 2022.

Shown as a Sankey diagram and divided by region and income level, figure 7 provides additional insight into the trade flows of green goods. In the figure, trade flows are shown moving from exports on the left to imports on the right. Figure 7a demonstrates that the European Union, China, East Asia and North America are major exporters. In 2022, European Union countries engaged in extensive trade within Europe and Central Asia but also traded with other global regions. Trade flows between East Asia and China were also significant, and additionally, China exported high volumes of green goods to the European Union and North America. On a smaller scale, exports from Latin America primarily went to North America. The chart also reveals the considerable trade surplus in China, which was offset by a substantial trade deficit in North America.

Figure 7b illustrates that high-income countries are the primary trading partners for green products, with China ranking as the second largest exporter to those countries. Additionally, high-income countries played a significant role in the trade flows of green products in 2022 within upper- and lower-middle-income countries. In contrast, lower-middle-income countries imported more green products than they exported. Low-income countries, meanwhile, had a negligible impact on world trade. The trade patterns shown in Figure 7b were consistent with existing literature on trade and quality (Hallak 2006; Feenstra and Romalis 2014), which suggests that high-income countries tend to have both a demand for more sophisticated products, and access to the technology necessary to produce them.

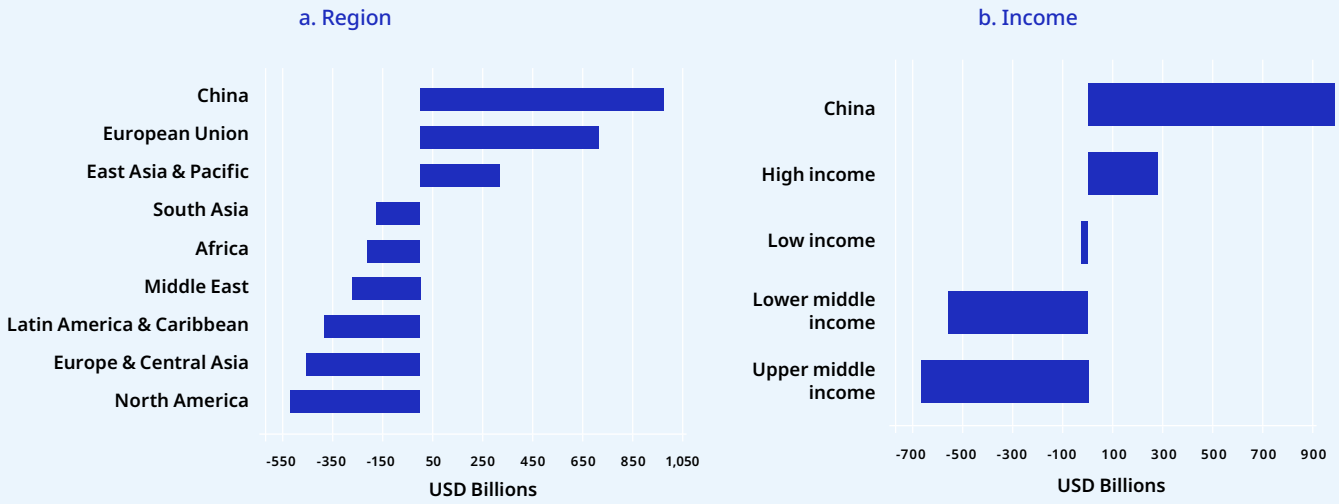
▶ Figure 7. World trade in green goods in United States dollars (billions), Sankey diagram by region and income level, 2022



Source: Author estimates based on the WITS/COMTRADE database, 2022.

Figure 8 shows the trade balance of green products by region and by income, presented in terms of accumulated trade between 2012 and 2022. China had the most substantial surplus when ranked both by region and by income. The European Union ranked second in the region chart, followed by East Asia, while North America had the largest trade deficit, with Europe and Central Asia and Latin America showing the second and third largest deficits, respectively. Upper and lower-middle-income countries had the largest deficits, while low-income countries showed a small deficit, in line with their limited participation in sustainable trade.

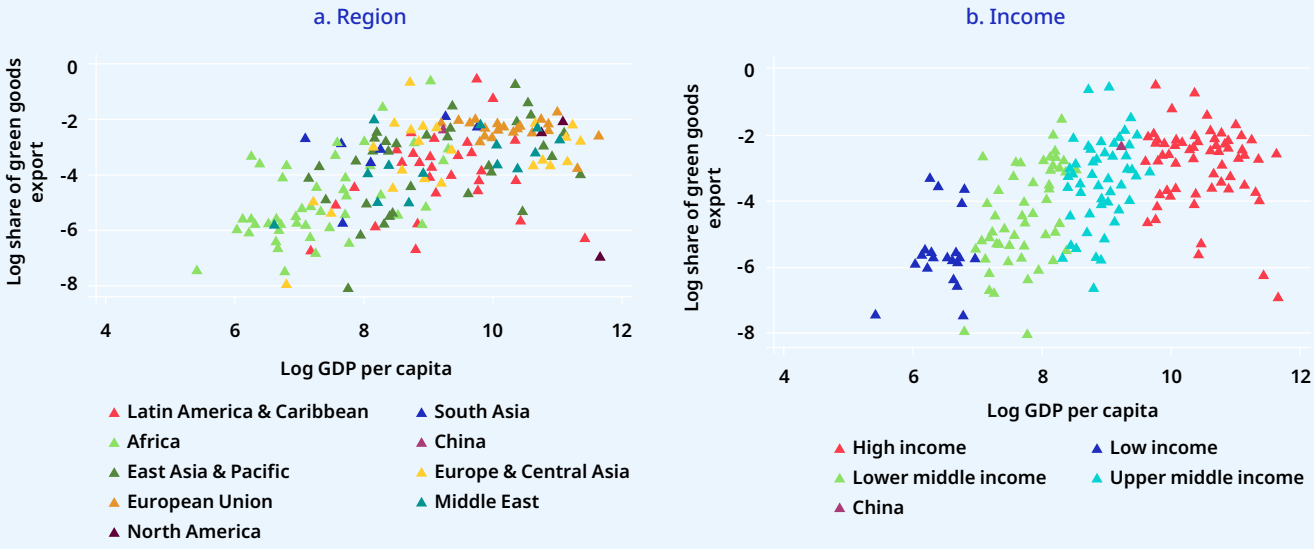
▶ Figure 8. Trade balance of green goods in United States dollars (billions), accumulated 2012– 2022



Source: Author estimates based on the WITS/COMTRADE database, 2022.

Both charts in figure 9 illustrate a positive correlation between per capita income levels and the per cent share of green products as a proportion of manufacturing exports. With a few exceptions, figure 9a features countries in the European Union, East Asia and Pacific and North America in the upper right quadrant of the chart, indicating that, on average, those regions had the highest per capita income levels and exports of green products in 2019. In contrast, countries with the lowest share of green exports were predominantly within the Africa region. Figure 9b uses the same type of scatter chart, but shows exports by country income category, demonstrating a clear relationship between income and the export of green goods.

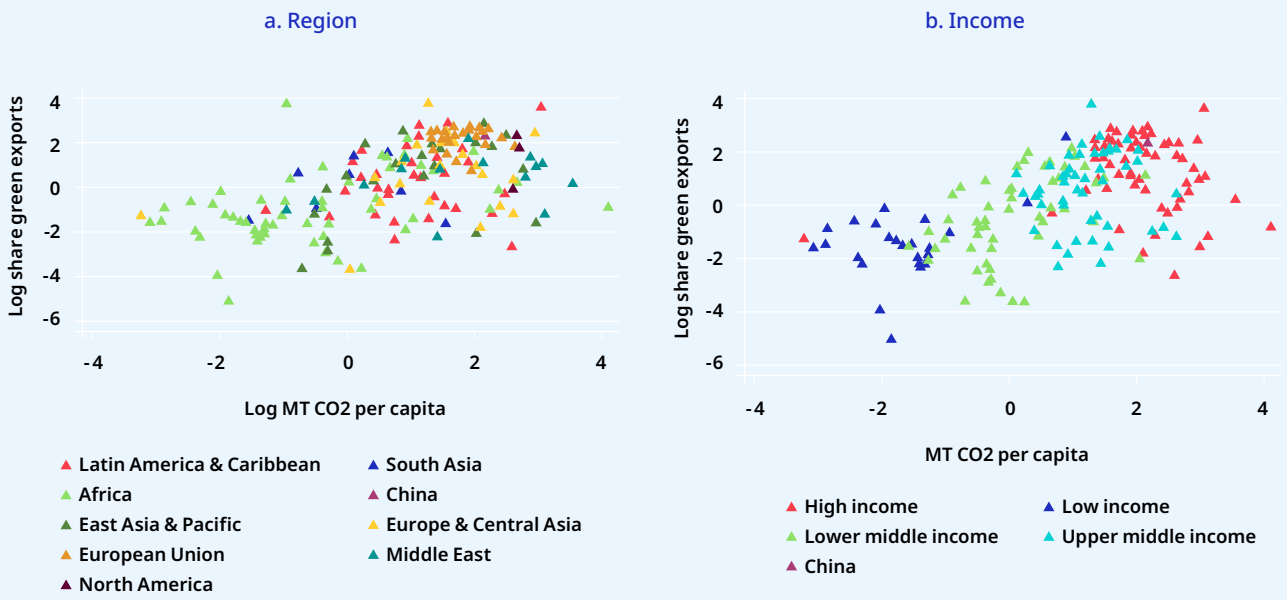
▶ Figure 9.Exports of green goods (expressed as a percentage of manufacturing exports) mapped against GDP per capita (expressed in 2005 United States dollars at PPP), 2019



Source: Author estimates based on the WITS/COMTRADE database and World Bank data, 2019.

Similarly, figure 10 shows a positive correlation between per capita carbon dioxide emissions (MtCO2) and the per cent share of green products within manufacturing exports. Given the high correlation between income levels and emissions established in available research and literature, the correlation was unsurprising (OECD 2020).

▶ Figure 10. Exports of green goods as a percentage of manufacturing exports mapped against carbon dioxide emissions (MtCO2) per capita, 2019



Source: Author estimates based on the WITS/COMTRADE database and World Bank data, 2019.

4

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4. Employment and green trade

This section analyses the labour dimension of green trade and focuses on the quantity and quality of jobs that are directly and indirectly created through the export of green products. While jobs can be categorized as either green or brown, limited data precludes a detailed assessment of job categorization.

The selected technique for estimating the impact of green trade on employment is the input-output model. Multisectoral models have a long tradition, originating with the seminal work of Leontief (1951). However, those models present a simplified framework of the circular flow in a manner analogous to *Tableau Economique* (Quesnay, 1759). Within that framework, firms require labour, intermediate inputs and capital to produce goods and services. The outputs are subsequently sold to households, other firms, governments or on the global market. Households, in turn, use their incomes to purchase goods and services, and to pay taxes (T), while saving the remainder (S). The government collects revenue through taxation, requests and pays for goods and services (G), and influences changes in investment and savings.

As previously stated, this report employs a multi-regional input-output approach (OECD 2018; Timmer et al. 2014). To facilitate meaningful cross-country comparisons of employment, it is essential to consider the relationship between final demand and the structure of the global economy. This section provides an overview of the methodology used to estimate this employment-trade link and is followed by the main findings.

4.1 Methodology

The multiregional input-output model can be shown using the following subset of matrices and vectors, starting from the expenditure side:

1. $x = Ze + F$

Where $\boldsymbol{x}$ is the vector of gross output values, $\boldsymbol{Z}$ is the matrix of intermediate uses, $\boldsymbol{e}$ is a row vector of ones and $\boldsymbol{F}$ is the matrix of final demand.

After the algebraic steps of dividing and multiplying the elements of the matrix $\boldsymbol{Z}$ by the gross output, it is possible to reformulate the equation (1), such that:

2. $x = Ax + F$

where $\boldsymbol{A}$ is the input-output coefficient matrix describing the units of intermediate inputs needed to produce one unit of gross output.

Finally, by passing elements from one side of the equation to the other, the following expression is derived:

3. $x = (1 - A)^{-1}$

The matrix $B = (1- A)^{-1}$ is the so-called Leontief matrix, or total requirements matrix. Each element of B represents the direct and indirect requirements of input *i by* activity *k,* in country *n from* partner *m.*

To calculate how much employment is generated directly and indirectly by green exports, it is necessary to recover the diagonal matrix Θ, whose elements contain the labour to output coefficients.

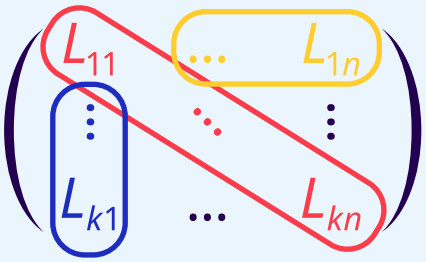
Finally, multiplying the matrix Θ by $\boldsymbol{B}$ and the gross green exports matrix, $\boldsymbol{E}$, yields the matrix $\boldsymbol{L}$. The subscript n refers to the country, while k indicates the activity.

4.
$$\begin{pmatrix} L_{11} & \dots & L_{1n} \\ \vdots & \ddots & \vdots \\ L_{k1} & \dots & L_{kn} \end{pmatrix} = \begin{pmatrix} \Theta_{11} & \dots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \dots & \Theta_{kn} \end{pmatrix} \begin{pmatrix} 1 - a_{1,1} & \dots & -a_{1,n} \\ \vdots & \ddots & \vdots \\ -a_{k,1} & \dots & 1 - a_{k,n} \end{pmatrix}^{-1} \begin{pmatrix} E_{11} & \dots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \dots & E_{k,n} \end{pmatrix}$$

The matrix $\boldsymbol{L}$ provides all of the necessary information for estimating employment linked to sustainable goods gross exports. Using a classification similar to the value-added analysis outlined by Aslam (Aslam et al. 2017), it is possible to estimate the domestic labour input (DLI), the exported labour input (DLX) and the foreign labour input (FLI). Those factors are highlighted in figure 11 as distinct parts of the $\boldsymbol{L}$ matrix. The diagonal elements of the $\boldsymbol{L}$ matrix, shown in red, constitute the DLI. The sum of the off-diagonal elements in each column, highlighted in blue, corresponds to the FLI indicator, while the sum of the off-diagonal elements in each row, highlighted in yellow, corresponds to the DLX indicator.

This analysis focuses on the DLI indicator for each country. It is shown in the diagonal elements of the $\boldsymbol{L}$ matrix and represents the domestic labour content embedded in the gross exports of green goods and, by definition, excludes the foreign labour content of exports in the FLI indicator. Furthermore, the DLI includes both direct and indirect employment related to green trade. This means that the results are influenced by national vertical integration, as well as minor domestic value that is repatriated through imports and double-counted exports produced domestically (Aslam et al. 2017).

▶ **Figure 11. Labour content of exports matrix**



Source: Author elaboration.

4.2 Results

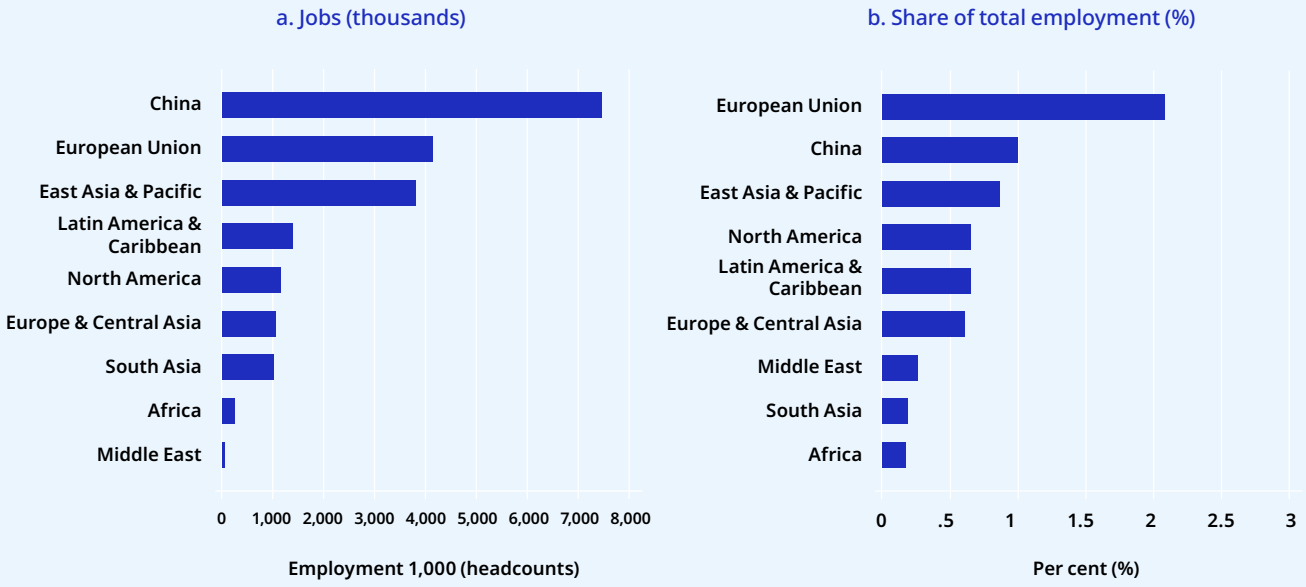
In this section aggregate figures on employment sustained by green trade are presented using the matrix calculations described in the previous section. The aggregate results indicate that approximately 21.4 million jobs were sustained by green exports in 2019 globally, representing 0.68 per cent of total employment for that year.

Figure 12a illustrates that China had the highest number of green jobs in absolute terms of approximately 7.4 million, followed by the combined European Union and East Asia and Pacific countries of approximately 4 million jobs. The figure also shows that the values for Middle Eastern and African countries were almost negligible.

In Figure 12b, the impact of green trade is shown as a share of total employment. The European Union exceeded 2 per cent, leading the other regions, while China and the East Asia and Pacific countries followed at 1 per cent and

0.9 percent, respectively. North America, Latin America and the Caribbean, and Europe and Central Asia were at approximately 0.6 per cent. In the remaining countries, the share was below 0.2 per cent. The figure indicates that, while green goods are becoming increasingly relevant in world trade, their impact on employment remains relatively limited.

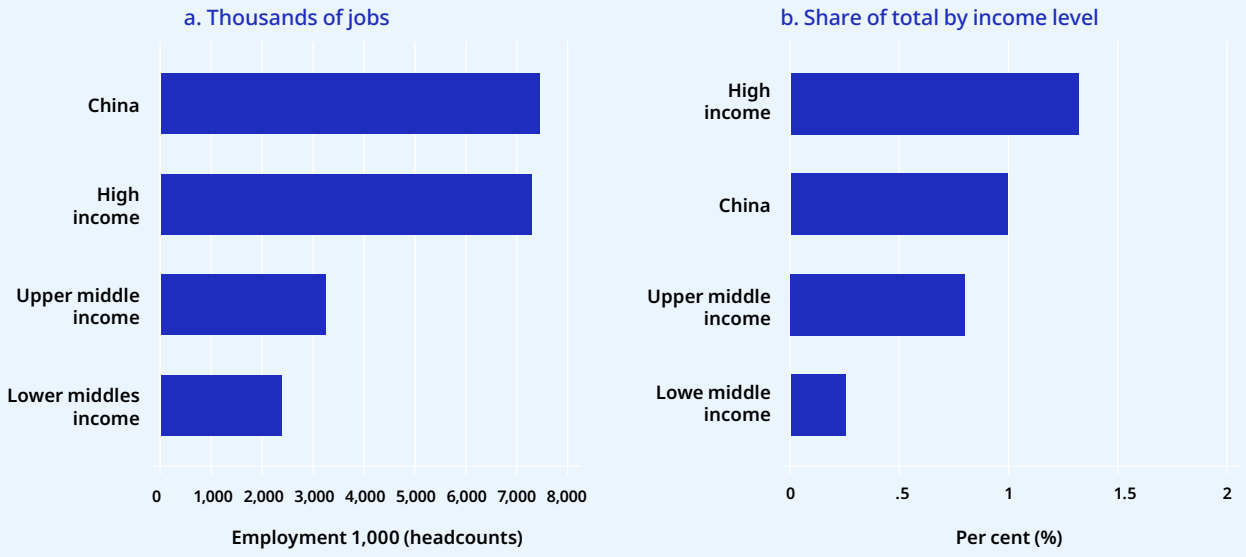
▶ **Figure 12. Employment supported by green goods exports by region, 2019**



Source: Author estimates, 2019.

Figure 13 illustrates the impact of green goods exports on employment based on region and income. As shown in Figure 13a, China and high-income countries accounted for the largest number of green export-related jobs at approximately 7.4 million, while the combined total for middle-income countries was around 5.7 million. When viewed in relative terms, high-income countries and China accounted for 1.3 per cent and 1.0 per cent of total jobs, while middle-income countries had a share of approximately 0.7 per cent and lower-middle income countries recorded about 0.25 per cent of employment as being supported by green goods.

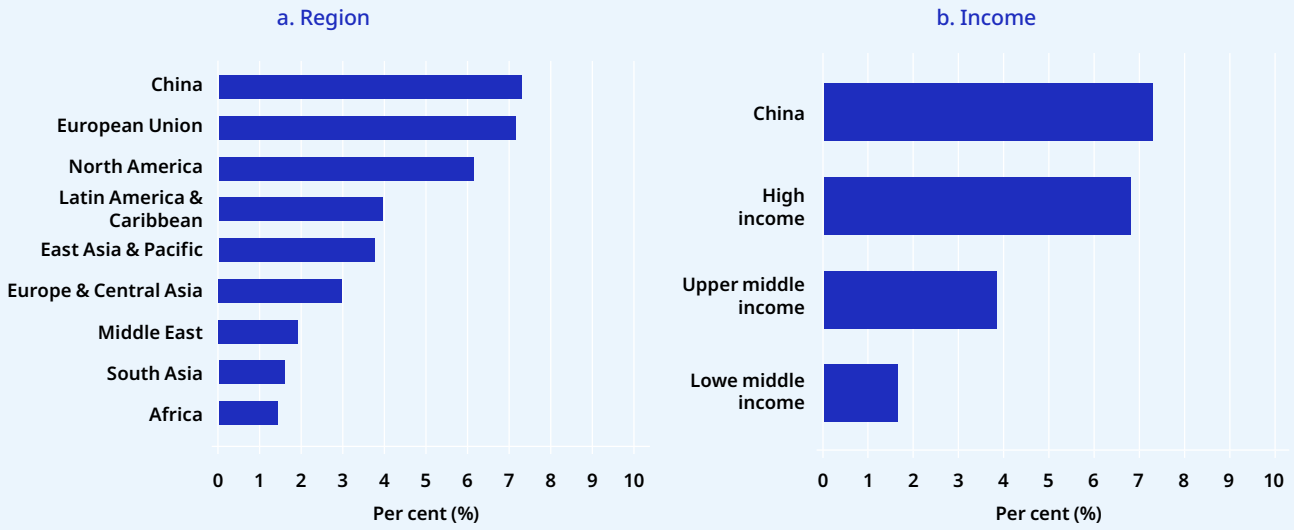
▶ Figure 13. Employment supported by green goods exports by income, 2019



Source: Author estimates, 2019.

Figure 14 provides an alternative view of the same data, with the denominator comprised of total employment (direct and indirect) sustained by total exports. The figure indicates that in China and high-income regions, including North America and the European Union, employment sustained by green goods exports was around 7 per cent, nearly double the rate of middle-income countries. It can be concluded that, even if green export-related jobs represented a small portion of total employment in 2019, relatively speaking they were an important portion of direct and indirect jobs related to total exports.

▶ Figure 14. Employment supported by green goods exports as a share of employment sustained by total exports, 2019

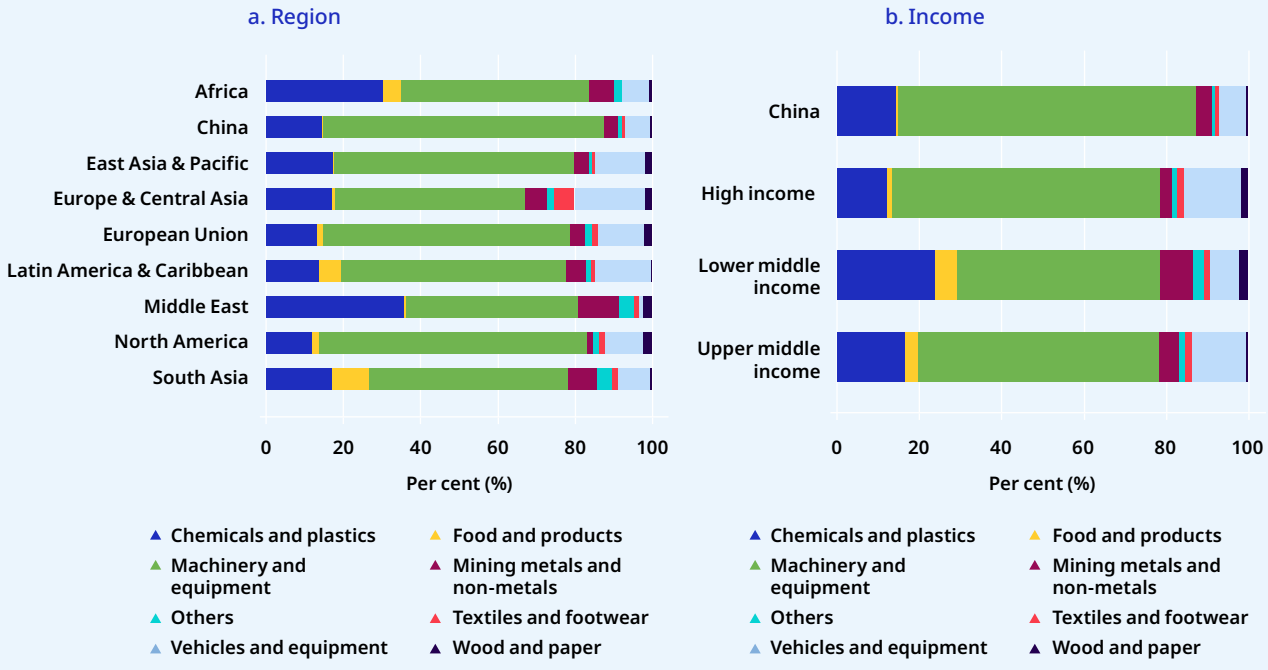


Source: Author estimates.

Figure 15 illustrates the sectoral decomposition of employment by region and income. The 45 activities in the MRIO model were condensed into seven sectors and one category of "others". The charts show that the machinery and equipment sector was the most significant contributor overall, with approximately 60 per cent of total employment supported by green trade, albeit with some regional and income level variations. Chemicals and plastics, vehicles and equipment, and mining metals and non-metals were the next largest contributors and demonstrated the following regional specificities: China and North America had a higher relative share in the machinery and equipment sector while Eastern Europe and Central Europe had a higher relative share in vehicles and equipment; the chemicals and plastics sector was a larger share of the economy in the Middle East as compared with other regions.

Figure 15b highlights the influence of country income. The results showed that the machinery and equipment share was higher for China and high-income countries, while lower-middle-income countries had a higher relative share in the chemicals and plastics sector and in mining metals and non-metals. Lastly, vehicles and equipment played a larger role in the exports of high- and upper-middle-income countries. It should be noted that the results did not capture the recent emergence of China as a producer and exporter of electric vehicles (Michelena et al. 2023).

▶ Figure 15. Employment supported by green goods exports by sectoral decomposition, 2019



Source: Author estimates.

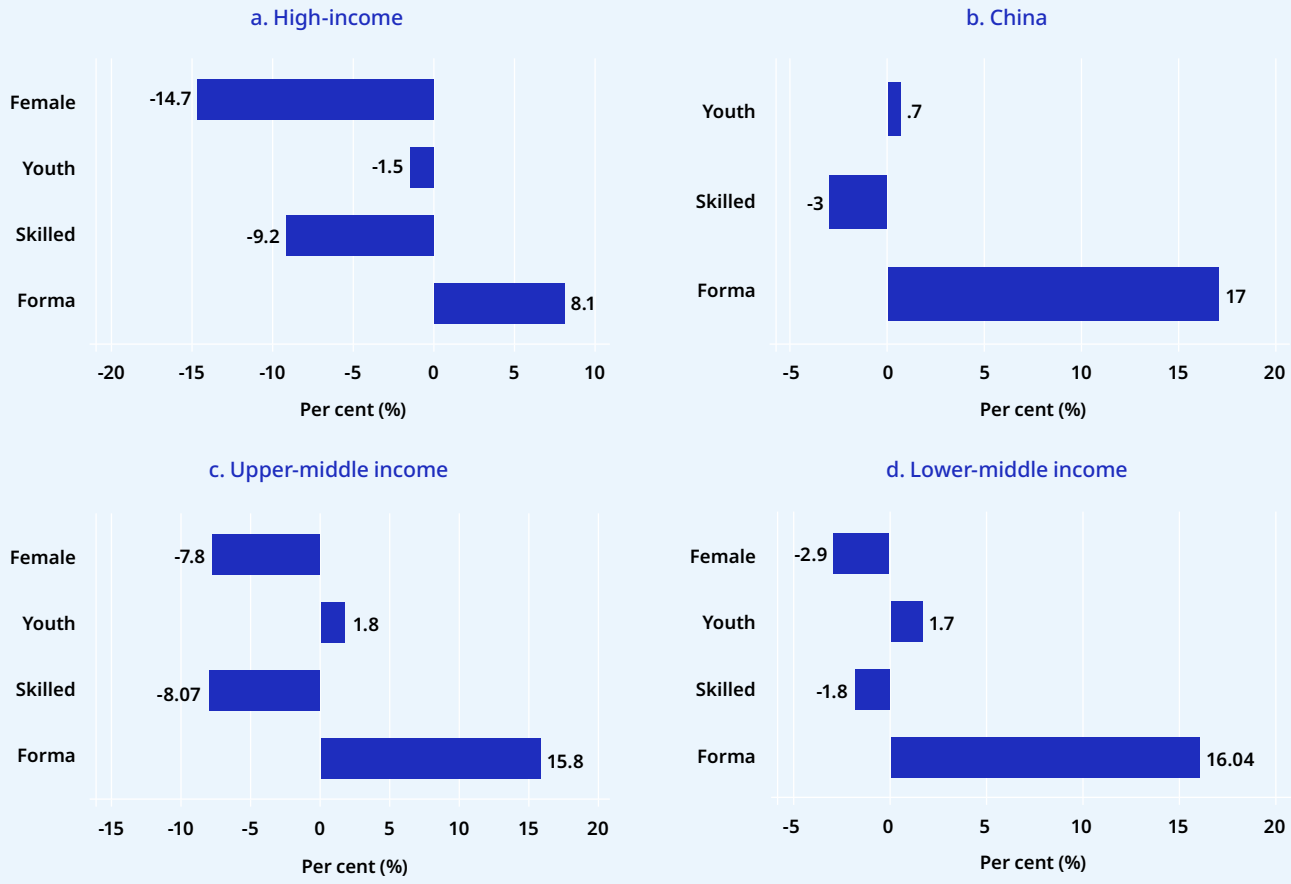
Figure 16 illustrates the observed bias across different employment groups, including gender, age, skill and formality status. The bias was defined as the percentage point (pp) difference between the observed share of a group of reference supported by green trade and the economy-wide average of that group. For example, if female employment in green trade-related jobs was 51 per cent and the economy average was 50 per cent, the estimated bias was 1pp. This type of analysis is useful for assessing distinctive characteristics of green trade-related employment.

$$\textbf{5. } bias_i = \frac{\sum_j x_{(j/i=1)}^{green}}{\sum_j x_j^{green}} - \frac{\sum_j x_{(j/i=1)}}{\sum_j x_j}$$

Figure 16 provides a breakdown of the aforementioned bias by labour characteristic. The results for high-income countries and China are presented in charts a. and b., while charts c. and d. show the results for upper-middle- income and lower-middle-income countries. Across all country groups, there was a positive bias towards formal employment.

Another noteworthy finding was a negative bias toward high-skilled and female employment in green trade-related sectors, a bias that was on average, less prevalent in lower-middle-income countries. Lower-middle-income countries including Indonesia, the Philippines and Viet Nam, had high rates of female participation in manufacturing and exports, while high-income countries such as Germany, Japan and the United States of America had much lower rates of female employment related to green exports than the economy average. The gender gap in China could not be estimated due to data gaps. The analysis shown in figure 16 demonstrated a positive bias for youth employment, although it was not significant. The exception to this was in high-income countries, where the bias was slightly negative.

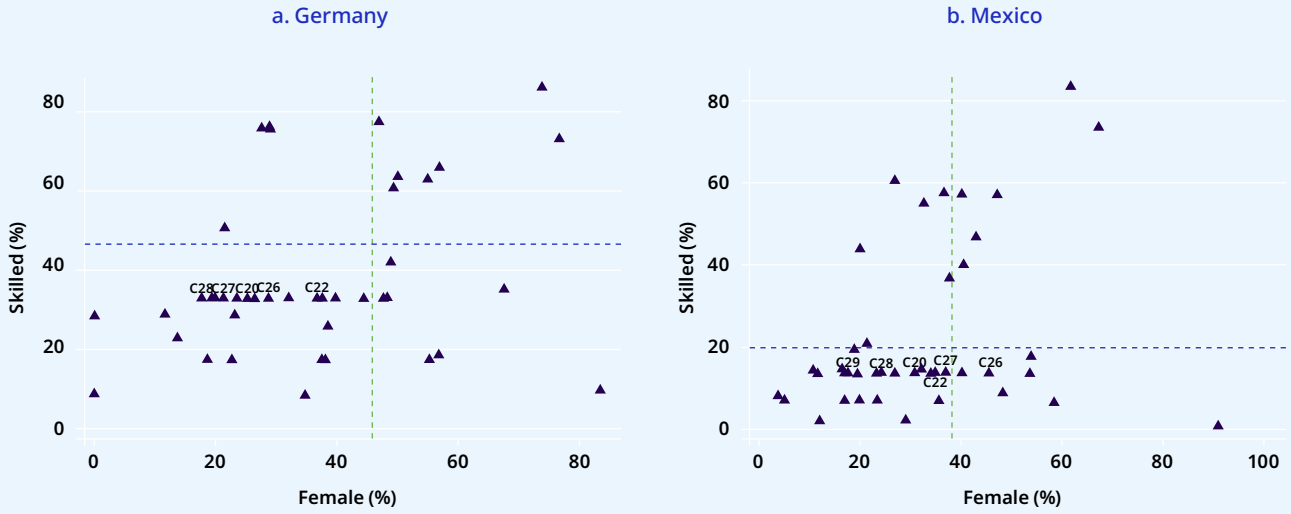
▶ Figure 16. Bias by gender, age, skill and formality status, 2019



Source: Author estimate.

Figure 17 illustrates the correlation between skill and gender representation in 2019 in Germany and Mexico, two of the most dynamic green export economies. The axes in both chart a and chart b show average values nationally. Therefore, any data point in the lower left quadrant indicates a negative skill bias and a negative gender bias. The size of the bubble is proportional to the logarithm of employment, while the core industrial sectors driving green exports are labelled by colour. In both countries, important green export sectors exhibited a skill share that was below each national average, and a female share that was below national levels in each country. It should be noted that in figure 17b the only exception to the female worker bias was the electronic equipment sector, where the bias was slightly positive. The difference may be explained by the large share of women employed in manufacturing and exports in Mexico (Michelena 2022).

▶ Figure 17. Employment bias in Germany and Mexico by gender and skill level, 2019



Source: Author estimate.

5

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5. Conclusion

This report presents a comprehensive analysis of green trade flows and their associated employment impacts, using a MRIO model. Valuable insight into the impact of green exports on job creation was gained by collecting and analysing labour data from ILOSTAT, the IMF green goods list, and OECD Inter-Country Input-Output tables.

The results suggest that high-income countries and China have a disproportionate influence on green exports and imports, while low-income countries have markedly lower rates of participation and influence in that area. However, the increase of green exports from middle-income countries between 2012 and 2022 was remarkable, paralleling that of China and exceeding growth in high-income economies. That phenomenon could be attributed to an increasing preference for high-quality goods as income levels rise and to the improvement of technological capabilities required for producing those goods.

The findings of the report highlight significant regional disparities and sectoral variations in employment opportunities generated by green exports. High-income countries and China had the highest proportion of green export-oriented employment in 2019, while lower middle-income countries had low participation rates in green exports. That pattern was in line with the findings of Copeland (2012) and Wiedmann and Lenzen (2018) regarding an imbalance of benefits globally stemming from environmental trade. At over 2 per cent of total employment, the European Union had the highest proportion of green export employment, which was almost triple the estimated world average of 0.68 per cent.

The empirical results also suggest that the majority of jobs linked to green exports are in the formal sector, as compared with the economy-wide average. It is, moreover, noteworthy that the proportion of female and high- skilled employment in green export sectors was lower than national averages in total employment over the period in question.

In terms of sectors, machinery and equipment, chemicals and plastics, and automobile industries represented the most significant employers in the area of sustainable exports. That trend reflects the relevance of capital goods in the production of technology and equipment for environmental sustainability. Income-based analysis revealed a higher share of machinery and equipment in China and high-income countries, whereas lower-middle-income countries were more concentrated in chemicals and plastics and the mining metals and non-metals sectors. In addition, vehicles were a particularly important part of the economy in high- and upper-middle-income countries.

Future research should focus on in-depth sectoral analysis, which would enable a clearer understanding of the employment and productivity drivers in key industries related to green trade, including the circular economy, electric vehicles, bio-trade, organic food and renewable energy. Detailed analysis of those sectors could provide valuable insights into specific challenges and could help inform the development of public policies to support trade. There are also opportunities for further research into the occupational aspects of green trade. The present report offers an initial analysis of labour associated with green exports, but further research could provide greater insight by examining occupational structures and skill demand in individual countries and examining their specific interactions within international trade dynamics. Such research could help identify how countries can adapt their labour forces and human capital to enhance their productive capacity and reap the benefits stemming from the green transition taking place within the global economy. Furthermore, incorporating data on green jobs into research and analysis is critical for understanding the broader implications of green trade on labour markets. As global economies transition to low-carbon modalities, assessing how green jobs contribute to economic transformation, evaluating their quality and their potential to drive structural transformation will prove essential.

6

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6. Annex

Table 1. The most traded green goods exports, 2022

Product	Global exports in US$ (millions)	Main exporter	Main exporter's share of total green exports (%)
Vehicles, for transport of persons (other than those of heading no. 8702 not classified in heading no. 8703)	171 405	Germany	21
Electric accumulators, lithium-ion, including separators that may or may not be rectangular (including square)	72 289	China	58
Electrical apparatus, photosensitive, including photovoltaic cells, that may or may not be assembled in modules or made up into panels, light-emitting diodes (LED)	66 220	China	49
Plastics, other articles not elsewhere classified in chapter 39	62 603	China	29
Boards, panels, consoles, desks and other bases, for electric control or the distribution of electricity, (other than the switching apparatus of heading no. 8517), for less than 1000 volts	57 947	China	17
Taps, cocks, valves and similar appliances, for pipes, boiler shells, tanks, vats or similar products, including thermostatically controlled valves	45 825	China	22
Electrical machines and apparatus having individual functions, not specified or included elsewhere in this chapter and not elsewhere classified in heading no. 8543	42 984	China	35
Machines and mechanical appliances with individual functions not elsewhere classified or included in this chapter	36 746	Germany	15
Biodiesel and biodiesel mixtures containing less than 70 per cent of petroleum oils or oils obtained from bituminous minerals by weight	29 495	Netherlands	22
Engines, parts for internal combustion piston engines (excluding spark ignition)	27 298	Germany	21
Engines, parts suitable for use solely or principally with spark-ignition internal combustion piston engines (for use other than for aircrafts)	25 792	Germany	16

Product	Global exports in US$ (millions)	Main exporter	Main exporter's share of total green exports (%)
Machinery for filtering or purifying gases, excluding intake air filters for internal combustion engines	25 062	Germany	13
Instruments, appliances and machines for measuring or checking not elsewhere classified in chapter 90	22 891	Germany	15
Regulating or controlling instruments and apparatus that are automatic, excluding hydraulic or pneumatic	19 563	United States of America	15
Electric motors and generators, parts suitable for use solely or principally with the machines of heading no. 8501 or 8502	18 196	China	27
Machines and mechanical appliances, parts that have individual functions	17 924	Germany	17
Pumps and compressors for air, vacuum or gas not elsewhere classified in heading no. 8414	17 573	China	19
Petroleum oils and oils from bituminous minerals and containing biodiesel, not crude or waste oils; preparations not elsewhere classified that contain 70 per cent or more of petroleum oils or oils from bituminous minerals by weight	17 519	Germany	21
Plastics, plates, sheets, film, foil and strip (excluding self-adhesive) of polymers of ethylene, non-cellular and not reinforced, laminated, supported or similarly combined with other materials	16 393	Germany	12
Turbines, parts of gas turbines (excluding turbo jets and turbo propellers)	15 817	United States of America	32

Source: Author estimate.

▶ Table 2. Main exporters of green goods, 2022

Country	Exports in US$ (millions)	Main product	Main product as a share of total green exports (%)
China	299 033	Electric accumulators, lithium-ion, including separators, that may or may not be rectangular (including square)	14
Germany	185 026	Vehicles, for transport of persons (other than those in heading no. 8702) and not elsewhere classified in heading no. 8703	19
United States of America	148 792	Vehicles, for transport of persons (other than those in heading no. 8702) and not elsewhere classified in heading no. 8703	10
Japan	101 733	Vehicles, for transport of persons (other than those in heading no. 8702) and not elsewhere classified in heading no. 8703	18
Republic of Korea	57 994	Vehicles, for transport of persons (other than those in heading no. 8702) and not elsewhere classified in heading no. 8703	23
Italy	48 354	Taps, cocks, valves and similar appliances for pipes, boiler shells, tanks, vats or similar products, including thermostatically controlled valves	8
Mexico	47 577	Boards, panels, consoles, desks and other bases; for electric control or the distribution of electricity, (other than switching apparatus of heading no. 8517), for a voltage not exceeding 1000 volts	13
France	41 450	Vehicles, for transport of persons other than those in heading no. 8702 and not elsewhere classified in heading no. 8703	16
Netherlands	36 642	Biodiesel and biodiesel mixtures that contain less than 70 per cent by weight of petroleum oils or oils obtained from bituminous minerals	17
United Kingdom	36 410	Vehicles, for transport of persons other than those in heading no. 8702 and not elsewhere classified in heading no. 8703	19
Poland	32 783	Electric accumulators, lithium-ion, including separators that may or may not be rectangular (including square)	23
Belgium	30 876	Vehicles, for transport of persons other than those in heading no. 8702) and not elsewhere classified in heading no. 8703	33
Malaysia	28 492	Electrical apparatus, photosensitive, including photovoltaic cells, including photovoltaic cells, that may or may not be assembled in modules or made up into panels, light-emitting diodes (LED)	21

Country	Exports in US$ (millions)	Main product	Main product as a share of total green exports (%)
Spain	27 099	Vehicles, for transport of persons other than those in heading no. 8702 and not elsewhere classified in heading no. 8703	26
Canada	25 486	Vehicles, for transport of persons other than those in heading no. 8702 and not elsewhere classified in heading no. 8703	7
Czechia	24 369	Vehicles, for transport of persons other than those in heading no. 8702 and not elsewhere classified in heading no. 8703	23
Hungary	20 125	Electric accumulators; lithium-ion, including separators that may or may not be rectangular (including square)	21
Thailand	18 547	Electrical apparatus, photosensitive, including photovoltaic cells, including photovoltaic cells, that may or may not be assembled in modules or made up into panels, light-emitting diodes (LED)	17
Sweden	17 477	Vehicles, for transport of persons other than those in heading no. 8702 and not elsewhere classified in heading no. 8703	22
Switzerland	16 992	Machines and mechanical appliances with individual functions and not elsewhere classified or included in this chapter	7

Source: Author estimate.

▶ Table 3. Green goods export-related jobs, 2022

Country	Green employment (thousands of jobs)
China	7 475
Germany	1 276
Japan	1 075
Mexico	963
United States of America	952
India	912
Republic of Korea	562
Malaysia	502
Viet Nam	493
Italy	447
Thailand	413
Indonesia	396
Poland	393
France	341
United Kingdom	322
Brazil	285
Turkey	266
Czechia	227
Russian Federation	218
Canada	212

Source: Author estimate.

▶ Table 4. IMF list of green goods, 2021 (based on World Customs Organization Harmonized System (HS) categories, 2017)

HS2017	Description	HS2017	Description
2201.10	Mineral and aerated waters	841911	Instantaneous gas water heaters
2207.10	Undenatured ethyl alcohol, by volume of 80% vol. or higher	841919	Other non-electric water heaters
2207.20	Ethyl alcohol and other spirits, denatured, of any strength	841939	Dryers, non-domestic
2521.00	Limestone flux	841940	Distilling plant, non-domestic
2522.20	Limestone flux; limestone and other calcareous stone, of a kind used for the manufacture of lime or cement.	841950	Heat exchangers
2523.90	Other hydraulic cements	841960	Air/gas liquefying machinery
2530.90	Mineral substances not elsewhere specified or included.	841989	Other temperature treatment machinery
2710.20	Petroleum oils and oils obtained from bituminous minerals (other than crude) and preparations not elsewhere specified or included, containing by weight 70 % or more of petroleum oils or of oils obtained from bituminous minerals, these oils being the basic constituents of the preparations, containing biodiesel, other than waste oils	841990	Parts for heat exchange equipment
2801.10	Chlorine	842119	Other centrifuges
2805.19	Other	842121	Water filtering/purifying machinery
2814.10	Anhydrous ammonia	842129	Other liquid purifying machinery
2815.10	Sodium hydroxide (caustic soda)	842139	Gas purifying machinery
2815.12	In aqueous solution (soda lye or liquid soda)	842191	Parts for centrifuges
2816.10	Hydroxide and peroxide of magnesium	842199	Parts for filtering machinery
2818.30	Aluminium hydroxide	842220	Bottle cleaning machinery
2820.10	Manganese dioxide	842381	Weighing machines, <30kg
2820.90	Other	842382	Weighing machines, 30-5000kg
2824.10	Lead monoxide (litharge, massicot)	842389	Other weighing machines
2825.20	Lithium oxide and hydroxide	842490	Parts for sprayers
2826.90	Other	845620	Ultrasonic machine-tools
2827.39	Other	845640	Plasma arc machine tools
2832.10	Sodium sulphites	845650	Water-jet cutting machine tools
2832.20	Other sulphites	847420	Crushing/grinding machines

HS2017	Description	HS2017	Description
2835.10	Phosphinates (hypophosphites) and phosphonates (phosphites)	847439	Mixing/kneading machines
2835.22	Of mono- or disodium	847780	Rubber/plastic working machinery
2835.24	Of potassium	847982	Mixing/grinding machines
2835.25	Calcium hydrogenorthophosphate («dicalcium phosphate»)	847989	Appliances, having individual functions
2835.26	Other phosphates of calcium	847990	Parts for mechanical appliances
2835.29	Other	848110	Pressure reducing valves
2836.91	Lithium carbonates	848130	Check valves
2847.00	Hydrogen peroxide, whether or not solidified with urea	848140	Safety valves
2853.10	Cyanogen chloride (chlorcyan)	848180	Other valves/taps
2905.11	Methanol (methyl alcohol)	848340	Gears and speed changers
3209.10	Based on acrylic or vinyl polymers	848360	Clutches and shaft couplings
3209.90	Other	8501.61	AC generators, of an output not exceeding 75 kVA
3802.10	Activated carbon	8501.62	Of an output exceeding 75 kVA but not exceeding 375 kVA
3802.90	Other	8501.63	Of an output exceeding 375 kVA but not exceeding 750 kVA
3815.11	With nickel or nickel compounds as the active substance	8501.64	Of an output exceeding 750 kVA
3815.12	With precious metal or precious metal compounds as the active substance	8502.31	Wind-powered
3815.19	Other	8502.39	Other
3815.90	Other	8503.00	Parts suitable for use solely or principally with the machines of heading 85.01 or 85.02
3826.00	Biodiesel and mixtures thereof, not containing or containing less than 70 % by weight of petroleum oils or oils obtained from bituminous minerals.	8504.90	Parts
3906.90	Other	8505.90	Other, including parts
3914.00	Ion-exchangers based on polymers of headings 39.01 to 39.13, in primary forms.	8506.50	Lithium
3920.10	Of polymers of ethylene	8506.80	Other primary cells and primary batteries
3920.20	Of polymers of propylene	8507.10	Lead-acid, of a kind used for starting piston engines
3923.21	Of polymers of ethylene	8507.20	Other lead-acid accumulators

HS2017	Description	HS2017	Description
3924.90	Other	8507.30	Nickel-cadmium
3926.90	Other	8507.40	Nickel-iron
4418.73	Of bamboo or with at least the top layer (wear layer) of bamboo	8507.50	Nickel-metal hydride
4706.20	Pulps of fibres derived from recovered (waste and scrap) paper or paperboard	8507.60	Lithium-ion
4707.10	Unbleached kraft paper or paperboard or corrugated paper or paperboard	8507.80	Other accumulators
4707.20	Other paper or paperboard made mainly of bleached chemical pulp, not coloured in the mass	8507.90	Parts
4707.30	Paper or paperboard made mainly of mechanical pulp (for example, newspapers, journals and similar printed matter	8514.10	Resistance heated furnaces and ovens
4707.90	Other, including unsorted waste and scrap	8514.20	Furnaces and ovens functioning by induction or dielectric loss
4805.24	Fluting paper - Weighing 150 g/m^2 or less	8514.30	Other furnaces and ovens
4805.25	Weighing more than 150 g/m^2	8514.90	Parts
5603.14	Nonwovens, whether or not impregnated, coated, covered or laminated. Weighing more than 150 g/m^2	8516.29	Other
5801.90	Of other textile materials	8531.20	Indicator panels incorporating liquid crystal devices (LCD) or light- emitting diodes (LED)
6806.10	Slag wool, rock wool and similar mineral wools (including intermixtures thereof), in bulk, sheets or rolls	8532.24	Ceramic dielectric, multilayer
6806.90	Other	8537.10	For a voltage not exceeding 1,000 V
6810.99	Other	8539.31	Fluorescent, hot cathode
7008.00	Multi-walled insulating units of glass	8539.50	LED lamps
7019.31	Mats	8541.40	Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes (LED)
7019.39	Other	8543.70	Other machines and apparatus
7019.90	Other	8543.90	Parts
7308.20	Towers and lattice masts	8601.20	Powered by electric accumulators
7309.00	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment.	8702.20	With both compression-ignition internal combustion piston engine (diesel or semi-diesel) and electric motor as motors for propulsion

HS2017	Description	HS2017	Description
7310.10	Of a capacity of 50 l or more	8702.30	With both spark-ignition internal combustion reciprocating piston engine and electric motor as motors for propulsion
7310.21	Cans which are to be closed by soldering or crimping	8702.40	With only electric motor for propulsion
7310.29	Other	8703.40	Other vehicles, with both spark-ignition internal combustion reciprocating piston engine and electric motor as motors for propulsion, other than those capable of being charged by plugging to external source of electric power
7321.11	For gas fuel or for both gas and other fuels	8703.50	Other vehicles, with both compression-ignition internal combustion piston engine (diesel or semi-diesel) and electric motor as motors for propulsion, other than those capable of being charged by plugging to external source of electric power
7321.90	Parts	8703.60	Other vehicles, with both spark-ignition internal combustion reciprocating piston engine and electric motor as motors for propulsion, capable of being charged by plugging to external source of electric power
7324.90	Other, including parts	8703.70	Other vehicles, with both compression-ignition internal combustion piston engine (diesel or semi-diesel) and electric motor as motors for propulsion, capable of being charged by plugging to external source of electric power
7325.10	Of non-malleable cast iron	8703.80	Other vehicles, with only electric motor for propulsion
7611.00	Aluminium reservoirs, tanks, vats and similar containers, for any material (other than compressed or liquefied gas), of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment.	8708.92	Silencers (mufflers) and exhaust pipes; parts thereof
7612.90	Other	8711.60	Motorcycles (including mopeds) and cycles fitted with an auxiliary motor, with or without side-cars; side-cars, with electric motor for propulsion
7806.00	Other articles of lead	9001.90	Other
8402.19	Other vapour generating boilers, including hybrid boilers	9002.90	Other
8402.90	Parts	9013.20	Lasers, other than laser diodes
8404.10	Auxiliary plant for use with boilers of heading 84.02 or 84.03	9013.80	Other devices, appliances and instruments
8404.20	Condensers for steam or other vapour power units	9013.90	Parts and accessories
8404.90	Parts	9015.80	Other instruments and appliances

HS2017	Description	HS2017	Description
8405.10	Producer gas or water gas generators, with or without their purifiers; acetylene gas generators and similar water process gas generators, with or without their purifiers	9025.11	Liquid-filled, for direct reading
8406.81	Of an output exceeding 40 MW	9025.19	Other
8406.90	Parts	9025.80	Other instruments
8409.91	Suitable for use solely or principally with spark-ignition internal combustion piston engines	9026.10	For measuring or checking the flow or level of liquids
8409.99	Other	9026.20	For measuring or checking pressure
8410.11	Hydraulic turbines and water wheels: Of a power not exceeding 1,000 kW	9026.80	Other instruments or apparatus
8410.12	Of a power exceeding 1,000 kW but not exceeding 10,000 kW	9026.90	Parts and accessories
8410.13	Of a power exceeding 10,000 kW	9027.10	Gas or smoke analysis apparatus
8410.90	Parts, including regulators	9027.20	Chromatographs and electrophoresis instruments
8411.81	Other gas turbines, of a power not exceeding 5,000 kW	9027.30	Spectrometers, spectrophotometers and spectrographs using optical radiations (UV, visible, IR)
8411.82	Other gas turbines, of a power exceeding 5,000 kW	9027.50	Other instruments and apparatus using optical radiations (UV, visible, IR)
8411.99	Other	9027.80	Other instruments and apparatus
8412.90	Parts	9027.90	Microtomes; parts and accessories
8413.20	Hand pumps, other than those of sub-heading 8413.11 or 8413.19	9028.10	Gas meters
8413.50	Other reciprocating positive displacement pumps	9028.20	Liquid meters
8413.60	Other rotary positive displacement pumps	9030.10	Instruments and apparatus for measuring or detecting ionising radiations
8413.70	Other centrifugal pumps	9031.49	Other
8413.81	Pumps	9031.80	Other instruments, appliances and machines
8414.10	Vacuum pumps	9031.90	Parts and accessories
8414.30	Compressors of a kind used in refrigerating equipment	9032.10	Thermostats
8414.40	Air compressors mounted on a wheeled chassis for towing	9032.20	Manostats
8414.80	Other	9032.81	Hydraulic or pneumatic
8414.90	Parts	9032.89	Other

HS2017	Description	HS2017	Description
8415.81	Incorporating a refrigerating unit and a valve for reversal of the cooling/heat cycle (reversible heat pumps)	9032.90	Parts and accessories
8417.80	Other	9033.00	Parts and accessories (not specified or included elsewhere in this Chapter) for machines, appliances, instruments or apparatus of Chapter 90.
8417.90	Parts	9603.10	Brooms and brushes, consisting of twigs or other vegetable materials bound together, with or without handles
8418.61	Heat pumps other than air conditioning machines of heading 84.15	9603.50	Other brushes constituting parts of machines, appliances or vehicles
8418.69	Other	9603.90	Other

Source: IMF (2021)[5].

5 https://www.arcgis.com/sharing/rest/content/items/7ae2c28c03f14887adfa4caa7cb7bfad/data

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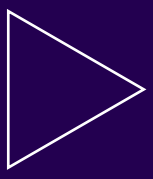

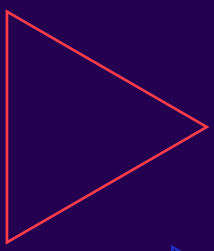

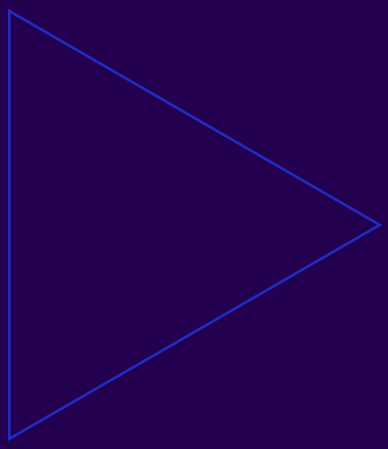

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