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Skills to Advance Sustainability: Lessons Learned from Latin America and the Caribbean

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Inter-American Development Bank
Social Protection and Labor Markets Division
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Executive Summary

Latin America and the Caribbean (LAC) faces significant challenges as a consequence of climate change, but the region also holds a unique opportunity to lead the transition to more sustainable, low-carbon economies. To achieve this, it is essential to have a workforce capable of adapting to the demands of both emerging sectors and traditional ones undergoing transformation, to effectively contribute to the economic changes needed by the green transition. This document—primarily intended for policymakers—provides a roadmap for developing the human capital the region requires to succeed in the green transition.

Developing Talent for Greener Economies

Climate change presents major challenges, but it also opens the door to significant economic and social benefits for LAC. Driven by sectors such as renewable energy, sustainable agriculture and electromobility, the green transition is expected to generate up to 15 million net jobs by 2030 (Saget et al., 2020). Despite this potential, countries in the region face significant barriers due to the lack of specialized skills in the workforce.

The green transition is expected to generate up to 15 million net jobs by 2030, driven by sectors such as renewable energy, sustainable agriculture and electromobility.

For example, in Ecuador, the training offerings in sustainable mobility are insufficient and fragmented (TRNTARYET, 2022), while in Panama, nearly half of the companies in the solar sector lack qualified personnel (Prada and Rucci, 2023). This mismatch between the supply and demand for skills highlights the need for better targeted workforce strategies aligned with the goals of the green transition.

More broadly, global analysis shows that green transition-related job postings have grown by 23% between 2022 and 2023, while skill development increased by only 12% during the same period (LinkedIn, 2023). This lag is even more critical in strategic sectors in LAC, such as water resource management in Chile or clean energy production in Uruguay.

How to Design Human Capital Strategies for the Green Transition

To ensure they have the right talent to meet growing and urgent demands, countries in the region must quickly and effectively adapt their workforce skills to match the shifting labor needs of the green transition. However, there is currently a gap in knowledge on how to achieve this. As a response, this document offers evidence-based recommendations drawn from successful experiences. Policymakers will find in this guide a set of fundamental steps that have proven effective, helping them to develop and implement this strategy. Thus, this guide proposes four key steps:

In order for countries in the region to have the right human talent to meet these increasingly pressing needs, the supply of skills must adapt in a timely and efficient manner to the changes in labor demand associated with the green transition.

1) **Step 1: Select Strategic Sectors.** The first step is to identify and prioritize strategic sectors for the green transition. To do so, a prioritization methodology is proposed based on six criteria: (i) the sector's potential to contribute to the reduction of pollutant emissions; (ii) its vulnerability to climate change; (iii) its importance to the economy and employment; (iv) the need to train human capital; (v) investment in green transition technology; and (vi) strategic alignment with national plans and the institutional context. The methodology includes the construction of a performance matrix that allows for sector comparison using key indicators and weightings to determine priorities.

2) **Step 2: Design Learning Pathways and Training Content to Close Skill Gaps.** Once the strategic sectors have been selected, the second step is to design learning pathways[1] to address skill gaps and ensure that the training supply is aligned with labor market demands. To design these pathways, it is necessary to: (i) build the ecosystem of key stakeholders, including public, private, and educational sectors; (ii) identify gaps in occupations, skills, and training offerings; and based on that, (iii) design training solutions to reduce these gaps and contribute to achieving the goals of the green transition.

1. These pathways are a structured set of training solutions and learning experiences that map out clear advancement routes within an occupational field and enable individuals to progress along their career paths. They may include offerings ranging from technical and vocational secondary education, postsecondary degrees and programs, specializations, courses, micro-courses, and other training programs, all provided by the technical and vocational education and training (TVET) system, as defined in each country.

3) **Step 3: Implement Training Solutions.** The third step focuses on delivering training programmes tailored to participants' needs, using flexible formats (in-person, virtual, or hybrid) and modular certifications. Integrating these into technical and vocational education and training (TVET) systems is encouraged to ensure sustainability and scalability.

4) **Step 4: Ensure the Quality and Continuous Improvement of Training Solutions.** This fourth step emphasizes the importance of guaranteeing the quality of both the inputs and the processes involved in the strategy, as well as monitoring and evaluating the results to ensure that the training is relevant and effective. This involves, on the one hand, aligning with existing qualification frameworks, evaluation protocols and accreditation standards. On the other hand, it requires establishing monitoring and evaluation mechanisms that can identify strengths, achieved results, and areas for improvement—providing solid evidence to support informed decision-making and promote continuous improvement.

The Region is Already on the Move

This document also highlights a series of initiatives in Latin America and the Caribbean that are addressing the challenges of green transition through innovative human capital development strategies. In Chile, the RELINK platform uses artificial intelligence to identify gaps between workers' current skills and emerging labor market demands, connecting people with opportunities in strategic sectors such as green hydrogen.

The paper also highlights a number of initiatives in Latin America and the Caribbean that are addressing the challenges of the green transition through innovative human capital formation strategies.

Costa Rica for instance, has capitalized on its geothermal resources by developing technical training programs focused on the installation and operation of geothermal power plants, promoting the sustainable use of natural resources. In Paraguay, the government adopted a participatory approach to identify and prioritize strategic sectors—such as sustainable agriculture and renewable energy—ensuring that education policies align with labor market needs. Similarly, initiatives like Belize's renewable energy certification program and Uruguay's development of training pathways in electromobility illustrate how coordinated efforts among the public, private, and education sectors can produce relevant and sustainable training solutions. These examples show that, despite differing national contexts, skills development remains a critical driver of the green transition across the region.

In summary, the green transition presents significant challenges but also offers an unprecedented opportunity to transform the economies of Latin America and the Caribbean towards a more sustainable, inclusive, and labor-resilient model. The strategic development of human capital will be the catalyst for closing skills gaps, harnessing the potential of emerging sectors and ensuring that no one is left behind in this process. By implementing the recommendations proposed in this document, countries in the region will be able to strengthen their capacity to lead global change towards a greener and more equitable future.

1 • Opportunities and Challenges of the Green Transition

Climate change poses a profound global threat, with the potential to push over 100 million people into poverty by 2030 (Jafino et al., 2020). Its effects on health—stemming from limited access to clean water and sanitation, increased exposure to extreme heat, and frequent flooding, along with growing risks to food security—are key drivers of this projected rise in poverty. Crucially, climate change disproportionately harms the poorest communities, who have the fewest resources to adapt. This deepens existing inequalities and perpetuates a vicious cycle of poverty and vulnerability (Bagolle et al., 2023).

Climate change poses a significant threat to economic growth by disrupting all components of the production function: labor, capital, and total factor productivity. Each year, an estimated 23 million working life-years are lost globally due to natural hazards (ILO, 2018). By 2030, it is projected that over 2% of total global working hours will be lost as a result of excessive heat and the consequent reduction in work capacity and pace (Kjellstrom et al., 2019). Moreover, climate change undermines investment and erodes the capital stock essential for sustaining economic output (Blackman et al., 2025). Rising temperatures have also been shown to impair educational outcomes (Graff Zivin et al., 2018; Garg et al., 2020; Park et al., 2020) and public health—both of which are critical determinants of labor productivity, further compounding the adverse effects on long-term economic performance.

To manage climate change's impact on development, all countries must increase their climate resilience and significantly reduce greenhouse gas emissions (Cavallo et al., 2020). This requires profound transformations in production, distribution, and consumption systems, enabling societies to move towards a more sustainable and low-carbon model. This collective, complex and long-term process is known as the green transition (Blackman et al., 2025; Consoli et al., 2016; Porter and van der Linde, 1995; Sung and Park, 2018).

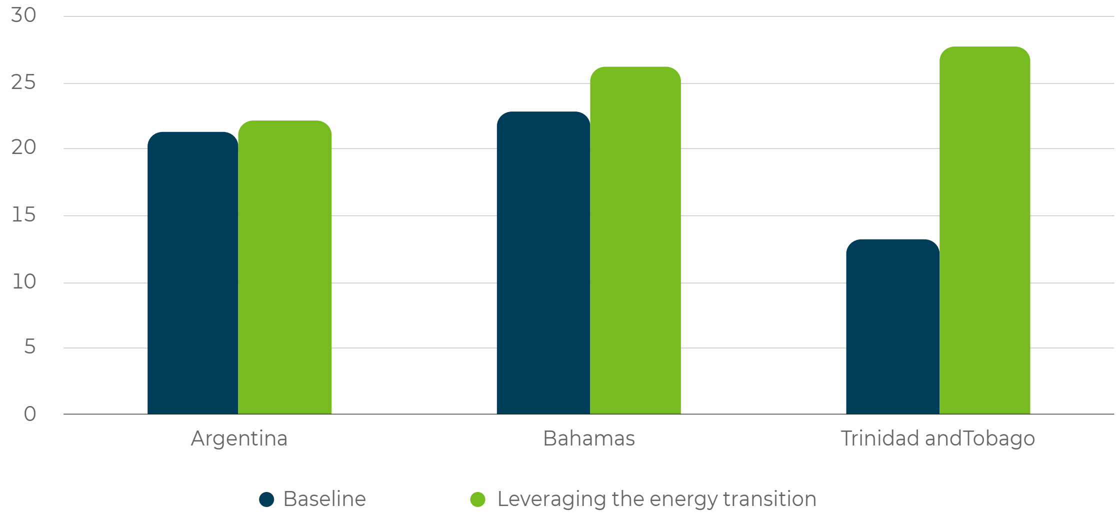
Embracing these transformations is not only critical for mitigating the risks of climate change but also offers significant economic opportunities. It is estimated that carbon neutrality could create $2.7 trillion in total net benefits for Latin America and the Caribbean by 2050 (Kalra et al., 2023). Key gains include $900 billion in fuel savings, $500 billion in avoided pollution-related costs, and $1 trillion in additional health, safety, and productivity improvements. These benefits far outweigh the estimated $1.3 trillion investment needed to achieve the transition (Kalra et al., 2023).

The green transition is also projected to accelerate economic growth in the region by over 1% annually (Vogt-Schilb, 2021) and create a net gain of 15 million jobs by 2030, an equivalent to approximately 4% of total regional employment (Saget et al., 2020). This net increase reflects the creation of 22.5 million new jobs alongside the loss of 7.5 million existing ones (Saget et al., 2020). While sectors such as fossil fuel-based electricity generation, animal-based food production, and fossil fuel extraction are expected to decline, these losses are expected to be more than offset by job growth in renewable energy, agriculture and plant-based food production, forestry, construction, and manufacturing (Saget et al., 2020).

The green transition also offers an opportunity to reduce the gap in the labor market between men and women, provided that gender-sensitive policies are adopted.

The green transition also offers an opportunity to narrow the gender gap in the labor market, if gender-responsive policies are implemented. To illustrate this potential, the possible reduction in the gender gap in the energy sector was estimated for three countries in the region: Argentina, the Bahamas, and Trinidad and Tobago. An extreme scenario was analyzed in which all new jobs created in the energy sector would be occupied exclusively by women. Although unlikely, this exercise highlights the potential impact of policies that promote female participation in traditionally male-dominated sectors. According to IRENA (2019), approximately 32% of jobs in the global renewable energy sector are held by women. Comparing this benchmark with estimates for Argentina, the Bahamas, and Trinidad and Tobago, the following was observed: In Argentina, if all the new projected job openings generated by the green transition (1,527 jobs in one year) were filled by women, female participation in the energy sector would increase from 17% to 21.26%, reducing the gap with the global average from 15 to 10.74 percentage points. In the Bahamas, this exercise projects the creation of 289 new jobs in one year due to the green transition. Since female participation in the energy sector is currently 22.80%, there is a 9.20 percentage point gap compared to the global average. If all new vacancies were occupied by women, female participation would increase to 26.20%, reducing the gap to 5.80 percentage points. For Trinidad and Tobago, projections show that 81 jobs could be created in one year due to the green transition. Female participation in the energy sector is currently 13.20%, with an 18.80 percentage point gap compared to the global average. If all new vacancies were occupied by women, female participation would increase to 27.70%, reducing the gap to 4.30 percentage points. (For more details, see Annex 1.)

FIGURE 1 • ANNUAL FEMALE PARTICIPATION IN THE ENERGY SECTOR WORKFORCE BY COUNTRY (IN PERCENTAGES



Source: Own elaboration.

Notes: The baseline gender gap for Argentina corresponds to 2019 and was extracted from Beaujon et al. (2022); for the Bahamas it corresponds to 2019 and was extracted from the Reporte - Fuerza Laboral (2019); and, for Trinidad and Tobago, it corresponds to 2023 and was extracted from the Energy Sector Labor Force Report (2023). The employment opportunities generated annually by the country correspond to those estimated on an aggregate basis using the methodology of Wei et al. (2010) described in Table A1.2.

LAC has comparative advantages for the green transition, which would enable it to reap the benefits associated with this process. This can be seen in at least three ways. First, the green transition requires phasing out the generation of electricity using fossil fuels and replacing it with renewable energies such as wind, solar, hydroelectric, and geothermal energy. LAC has a great diversity of natural resources for renewable energy generation. The region has optimal conditions for solar energy, with some of the highest levels of direct radiation in the world in northern Argentina and Chile, as well as in southern Peru and Bolivia (IEA, 2023). It also has a high potential for wind energy, especially in southern Brazil and Argentina, while countries such as Costa Rica and Guatemala have significant geothermal reserves. Additionally, LAC hosts 60% of the world's lithium reserves, a key input for energy storage and electromobility, mainly concentrated in Argentina, Bolivia, and Chile (Cepal, 2023). This positions the region strategically to leverage the benefits of an energy transition, such as job creation and increased energy security (Blackman et al., 2025; Saget et al., 2020). Furthermore, it would contribute to reducing dependence on fossil fuel imports: in the region, 15 countries are net importers of oil and natural gas (Balza, 2023).

The green transition also requires a shift towards healthier and more sustainable diets, partially replacing animal-based foods with plant-based alternatives. This change would help reduce pressure on deforestation and mitigate carbon emissions associated with livestock production (Saget et al., 2020). Latin America and the Caribbean well positioned in this area, as it holds one-quarter of the world's medium- to high-potential agricultural land (Saget et al., 2020) and is the world's largest net food exporter: the region supplies 40% of global food exports and produces enough to feed twice its population (FAO, IFAD, PAHO, WFP & UNICEF, 2023). It is estimated that the region will account for 61% of global soybean exports, 59% of sugar, 43% of corn, 40% of meat and fish oils, and 32% of poultry, reaffirming its strategic role in the global food supply chain (OECD & FAO, 2022). In this context, global decarbonization efforts could translate into significant benefits for the region.

Finally, the green transition requires the land to function as a carbon sink—meaning that it has the capacity to capture and store carbon dioxide from the atmosphere, thereby helping to mitigate climate change. Natural sinks include forests, soils, oceans, and wetlands. Latin America and the Caribbean countries are home to vast biodiversity: they contain one-fifth of the world's forest area and approximately 31% of the planet's freshwater resources (UNEP, 2010). This natural wealth gives the region a comparative advantage in carbon capture. In addition to supporting the green transition, the conservation and restoration of these resources ensures the provision of essential ecosystem services for human well-being. These ecosystems provide food, fuelwood, and fibers; contribute to water purification and flood control; and open opportunities for investment and economic development (MEA, 2005).

However, for the green transition to take place and for its associated benefits and opportunities to be realized, a human capital development strategy is needed to ensure that current and future workers possess the necessary skills.[2] As such, the objective of this report is to provide the foundation for countries to design and implement their human capital development strategy for the green transition.[3]

2. Predicting the skills that will be needed for the green transition is an achievable task. In contexts with strong institutions and reliable data, skill forecasts are more accurate, enabling the development of targeted workforce strategies. However, in rapidly evolving labor markets marked by uncertainty, anticipating medium-term changes becomes more challenging. In such cases, international agreements and existing policy commitments can offer valuable guidance, which should be supplemented by additional data sources. Where predictive capacity is limited, agile and responsive training systems become essential to quickly adapt to shifting labor market demands.

3. There are other ways in which education and training can contribute to the climate change agenda. In this note, we focus on the development of human capital strategies. Bos and Schwartz (2023) present a broader conceptual framework, which--in addition to knowledge and skills training for the green transition--includes the resilience of the education system to extreme weather events and the adoption of sustainable practices in educational infrastructure and services.

Shortages of workers with the necessary skills or “skills bottlenecks,” where supply does not meet demand, often become an obstacle to the green transition and to growth in general (Cedefop, 2015). Currently, there are signs that demand for green transition skills is outpacing supply. According to a LinkedIn study, the proportion of job openings requiring green transition-related skills grew by 23% between 2022 and 2023 globally, but the percentage of people with those skills only increased by 12% over the same period (LinkedIn, 2023). This mismatch is not recent: between 2018 and 2023, workers’ green transition skills increased by 5% per year, while job postings requiring these types of skills grew at a rate of 9% per year (LinkedIn, 2023).

A strategy implies a plan of action designed to achieve a goal. In this sense, a human capital development strategy for the green transition is a roadmap aimed at building the necessary skills within the workforce—both current workers and students—to meet the goals of the green transition. This strategy must provide education and training opportunities that include both the improvement of existing skills (upskilling) and the acquisition of new ones (reskilling), as well as the certification of knowledge. This will enable current and future workers to adapt to emerging labor market demands, improving their employability and productivity.

This strategy is also necessary to ensure that the green transition is just. This implies that, in addition to promoting sustainable growth, it will ensure social inclusion, equitable access to job opportunities and the creation of conditions that allow workers to adapt to transformations in labor markets. The green transition will reduce the demand for jobs in less sustainable industries (such as those based on coal energy), while generating new jobs in emerging green industries (such as renewable energies) and greening traditional occupations to align them with environmental protection criteria. The strategic development of the necessary skills in workers and students will be key for them to access quality jobs in growth sectors, and for displaced workers to reskill or upskill, find new opportunities, and adapt to changes in the labor market.

Although each country will need to adapt the strategy according to its stage in the green transition, available resources and local context, this document provides practical recommendations based on evidence and successful experiences. Policymakers will find in this guide a set of basic steps that have proven effective in helping them to develop and implement this strategy.

BOX 1 • WHAT IS A HUMAN CAPITAL DEVELOPMENT STRATEGY?

A human capital development strategy for the green transition is roadmap aimed at building the necessary skills within the workforce—both current and future workers—to meet the goals of the green transition. To achieve this, it is essential to design and implement training solutions that enable the acquisition of new skills (*reskilling*), the improvement of existing competencies (*upskilling*), and the certification of knowledge.

Without a clear strategy, there is no structured approach to developing the workforce talent needed for a successful green transition. This limits the region's ability to respond effectively to the challenges ahead, seize opportunities in emerging sectors, and ensure an inclusive transition that leaves no one behind.

Training Pathways

The set of defined training solutions and learning experiences that outline clear paths of advancement and allow people to progress along their career paths are known as *training pathways*. These pathways encompass the full range of educational offerings, including technical and vocational secondary education, post-secondary degrees and programs, specializations, courses, certificates, micro-courses, and other training programs, as provided by the technical and vocational education and training (TVET) system, as defined in each country. These training pathways are dynamic—because they must adapt to meet new skill demands as the green transition progresses—and continuous over time.

2 • Skills: A Key Piece for the Green Transition in the Region

To fully seize the opportunities offered by greener economies, countries in the region must go beyond expressing commitment to the green transition. They must also develop and implement clear and actionable strategies to achieve it.

Under the Paris Agreement, 195 countries outlined their near-term climate goals through Nationally Determined Contributions (NDCs), aiming to limit global temperature rise to well below 2°C, and ideally to 1.5°C, by the end of the century.[4] As of 2022, all 33 countries in Latin America and the Caribbean (LAC) had submitted their initial NDCs[5] in 20155, and 29 of them revised these in 2020 to include more ambitious mitigation targets.[6]

Fulfilling the commitments made in the NDCs requires countries to reduce net greenhouse gas (GHG) emissions (Kalra et al., 2023). While there are multiple pathways to carbon neutrality, three transformative changes are particularly critical. As outlined below, each of these shifts will depend heavily on the development of new workforce skills:

1) **Produce Electricity from Renewable Energy Sources.** Economy-wide fuel shifts can only reduce emissions if electricity and hydropower—the main substitutes for fossil fuels—are generated from renewable sources rather than fossil fuels. Notably, energy production currently accounts for 42% of CO_2-equivalent emissions from fuel combustion (International Energy Agency, 2023).
2) **Use Electricity Rather than Fossil Fuels to Power Transportation.** Fuel switching in the transportation sector can lead to emissions reductions even without major shifts in usage patterns. However, transportation remains one of the most challenging sectors for reducing greenhouse

4. Although the Paris Agreement does not specify a specific year for reaching these targets, these goals are intended to be achieved throughout this century. However, countries are expected to submit and update their Nationally Determined Contributions (NDCs) every five years to ensure continued progress towards these goals.
5. According to NDC Explorer, with data available and updated through February 2022, 29 countries in Latin America and the Caribbean have NDCs: Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, Uruguay and Venezuela.
6. Nationally Determined Contributions (NDCs) must be updated periodically, as one of the key principles of the Paris Agreement is that each country must step up its efforts every five years to reflect "the highest possible ambition". The vast majority of current LAC NDCs include a quantifiable emissions reduction target. One third explicitly mentions an absolute or relative target, and the rest rely on a fictitious "business as usual" scenario to specify their potential emission reductions. For more information, see: https://www.climatewatchdata.org/ndcs-explore.

gas emissions (GHG) due to its many emission sources, increasing demand for private vehicle use, and existing infrastructure that reinforces car-dependent travel behaviors.

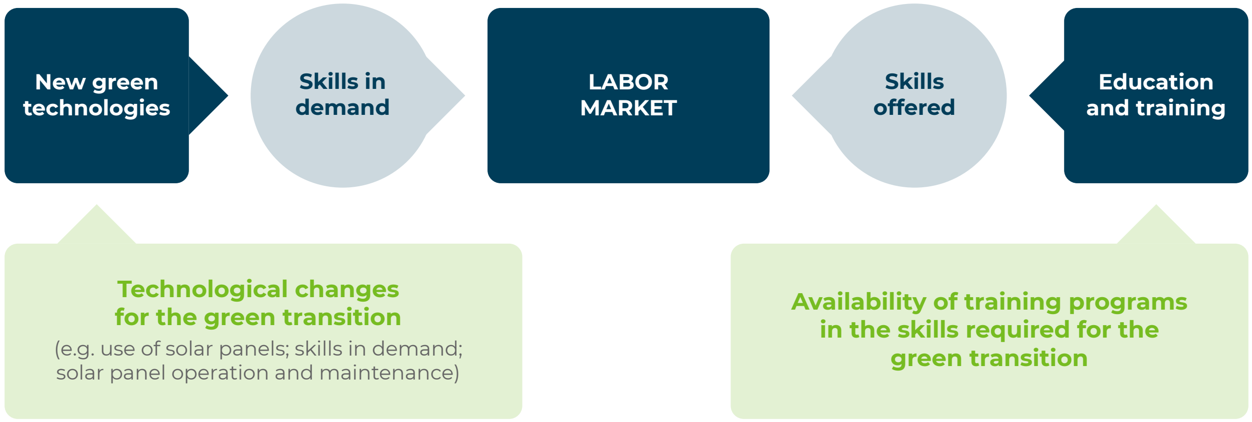
3) **Turning Land into a Carbon Sink.** Organic carbon in the soil helps to capture atmospheric carbon dioxide (CO_2), which contributes to mitigating climate change. Preserving and increasing organic carbon soil requires implementing sustainable agricultural practices, protecting forests, promoting afforestation and encouraging the consumption of lower-carbon foods.

Achieving these three transformative changes requires a workforce equipped with the necessary skills. To that end, countries must develop comprehensive human capital development strategies that define training pathways aligned with emerging labor market demands.

To better understand the relationship between the changes required to achieve the green transition, shifts in labor market dynamics, and the resulting human capital requirements, this analysis draws on the **task-based approach** developed by Vona (2021). This widely used framework offers valuable insights into how technological and structural shifts impact labor demand.

Figure 2 illustrates the relationship between climate change and skills development in the context of the labor market. This approach distinguishes between the tasks required in productive processes—and thus demanded by employers (skills in demand)—and the skills workers possess to perform these tasks efficiently, which they offer in the labor market (skills in supply).

FIGURE 2 • CONCEPTUAL FRAMEWORK BASED ON THE TASK-BASED PERSPECTIVE ADAPTED FOR THE GREEN TRANSITION



Source: Own elaboration.

The transition to a greener economy entails significant **changes in the labor market**, as the nature of tasks performed by workers evolves. These changes can be broadly categorized into three key trends: First, there is a decline in demand for occupations in less sustainable industries (such as those reliant on fossil fuels) accompanied by a shift toward greener sectors, including sustainable agriculture. Second, entirely new occupations are emerging, particularly in green industries like renewable energy. Third, existing roles in traditional sectors are being "greened," meaning they are evolving to align with environmental standards and regulations, for example, automotive technicians adapting to service electric vehicles.

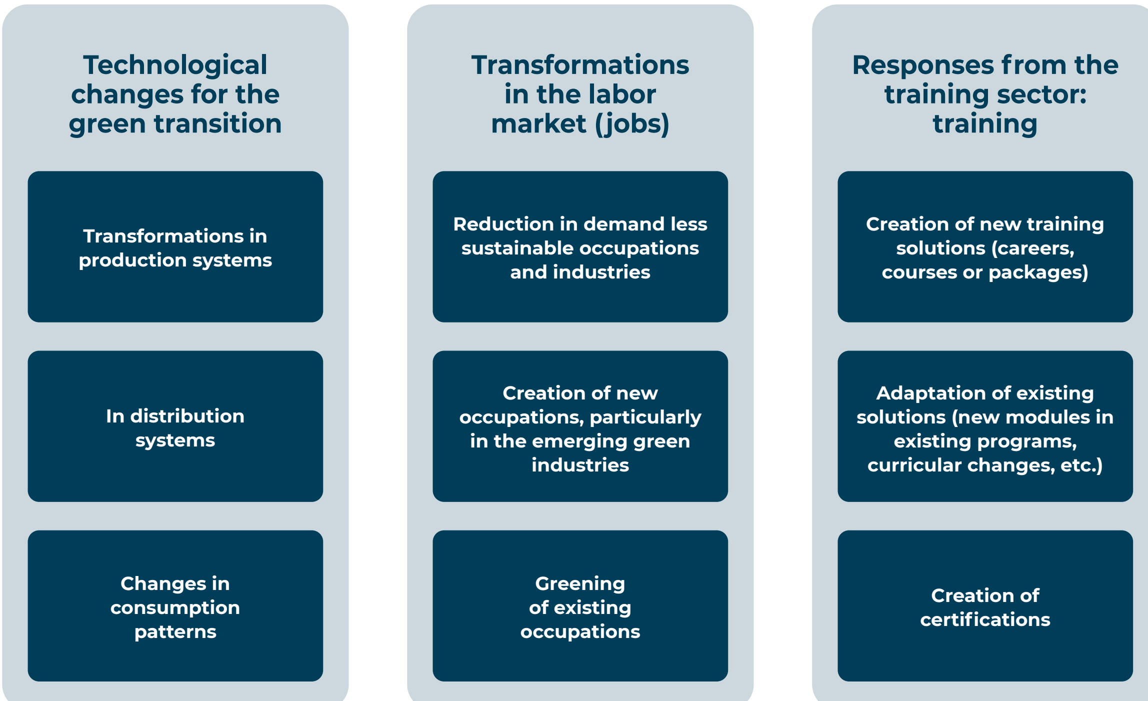
As the green transition shifts alter the tasks required of workers, it generates demand for new skills, many of which may not currently exist within the workforce, leading to a growing skills gap.

As the green transition changes the tasks workers must perform, a demand arises for new skills that may not be available in the current workforce, creating a skills gap.

To address this skills gap, it is essential to design structured training pathways that enable individuals to develop the competencies required for emerging occupational profiles. For instance, in the case of solar energy generation (see Table 1), workers must acquire new skills to operate, inspect, and repair solar panels. Similarly, in efforts to use land as a carbon sink (third example in Table 1), farmers are expected to make more efficient use of water resources. This requires irrigation technicians to develop a mix of technical, soft, and cross-cutting skills—such as problem-solving and risk prevention—that are not only applicable to their current roles but also transferable across sectors like solar panel manufacturing, electric vehicle maintenance, and green hydrogen battery production. These transferable skills open up broader employment opportunities for those who acquire them.

As illustrated in Figure 3, the design and implementation of training pathways generally involve three types of programmatic approaches: (i) **the creation of new training programs** tailored to the needs of emerging occupations, such as specialized technical degrees or short courses; (ii) the **adaptation of existing programs** to integrate newly required skills, which may include adding new modules, updating curricula, or revising course content; and (iii) the **establishment of new certifications** to formally recognize in-demand skills. These certifications can be linked to newly created or adapted training programs, stand-alone as independent credentials, or validate skills previously acquired through work experience or informal learning.

FIGURE 3 • IMPACTS OF THE GREEN TRANSITION ON EMPLOYMENT AND TRAINING: FROM TECHNOLOGICAL CHANGES TO TRAINING PATHWAYS



Source: Own elaboration.

Table 1 (on the following page) presents three concrete examples of the skills needed to support each of the three key transitions required for achieving carbon neutrality. It also outlines corresponding training options to help develop these skills.

TABLE 1 • EXAMPLES OF SKILLS NEEDED TO ACHIEVE THE THREE KEY CHANGES REQUIRED FOR THE GREEN TRANSITION

KEY CHANGE	EXAMPLE OF PRODUCTIVE TRANSFORMATIONS	EXAMPLE OF REQUIRED SKILLS	TRAINING OPTIONS
Producing electricity from renewable sources	• Electricity generation through wind farms, solar panels or green hydrogen.	• Engineering, quality assurance, product development and project management • Installation and maintenance of renewable energy systems. • Development and application of technologies in the energy sector.	• Development of **new training options**, such as the creation of new university degrees, for example, Renewable Energy Engineering, or new technical programs within the ETFP offer, such as Renewable Energy Technician. • **Updating** existing training options, e.g., adding specific modules on renewable energies in the Electrical Engineering degree program. • **Development of certification programs** in specific areas, such as installation and maintenance of renewable energy technologies.
Using electricity to power transportation	• Electromobility. • Electrification of public and private transportation (urban buses, railroads, automobiles, etc.).	• Design and manufacture of batteries and electric motors. • Installation and maintenance of charging stations and electrical systems in vehicles. • Use of digital technologies for the optimization of electric vehicles.	• Development of **new training options**, such as technical programs within the ETFP offer, for example, electric vehicle charging infrastructure technician. • **Updating** existing training options, e.g., adding modules on battery technology and energy storage and digital innovation to the Mechanical Engineering degree program. • **Development of certification programs** in, for example, battery management, electric vehicle diagnostics, maintenance and repair,
Turning the earth into a carbon sink	• Implementation of conservation agriculture, for example, through increased crop rotation and the use of no-till farming. • Increased productivity on agricultural land, which helps reduce pressure on forests and other land uses that sequester carbon. Examples of this are the use of technologies such as irrigation systems, no-till and crop monitoring tools.	• Field monitoring and management. • Planning skills and knowledge soil preparation, crop and water use. • Operation, maintenance of applied technologies (such as technical irrigation systems).	• Development of **new training options**, such as training programs in advanced technologies, within the VET offer. • **Updating** training options, such as including training workshops on the operation and maintenance of agricultural technologies or the use of technological tools (such as drones, software, etc.) in academic programs related to the sector. • **Develop certification programs**, for example, in agriculture.

Source: Own elaboration based on Kalra et al. (2023).

Skills development in the workforce is a prerequisite for the transition to greener economies.

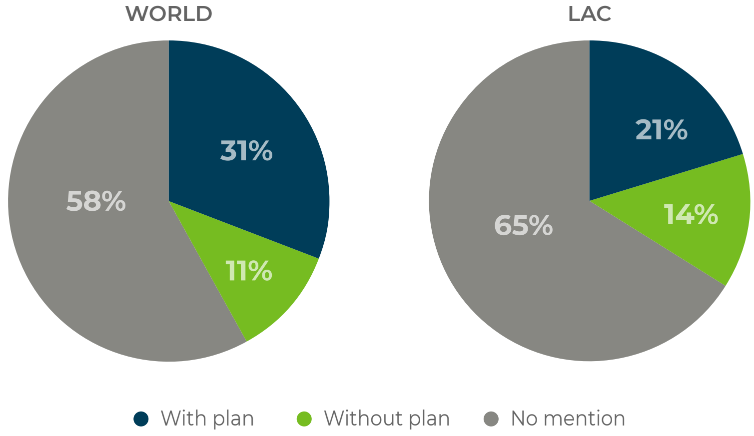
In summary, the development of skills in the workforce is a prerequisite for the transition to greener economies. This process will involve disruptions in economic sectors and labor markets, so it is also necessary for workers to acquire skills to adapt to these changes, not only to take advantage of new employment opportunities in sustainable sectors or to adapt to the demands of sectors undergoing sustainability, but also to facilitate the reinsertion of displaced workers in sectors intensive in natural resources or dependent on fossil fuels. Improving existing skills (upskilling) and acquiring new skills (reskilling) will be key to reducing the social costs of the green transition in terms of unemployment and social tensions. Likewise, skills development acts as a catalyst for innovation and can accelerate the adoption of sustainable technologies, guiding economies towards more sustainable growth trajectories (Tyros et al., 2023). In this context, skills development will play a fundamental role in facilitating the green transition, determining the pace of decarbonization, and helping people adapt to changes in the labor market by increasing productivity and reducing the social costs of the transition. In this regard, lessons from the past show that when human capital challenges are not addressed, public policy reforms can lead to long adjustment periods. For example, Brazil's productive transition following trade liberalization was slow, in part because workers faced difficulties in shifting between sectors (Dix-Carneiro, 2014).

The design of training pathways must be integrated into the implementation planning of commitments under the Paris Agreement and the Sustainable Development Goals (ILO, 2019). However, there is still a long way to go, as the connection between these international agreements and skills training responses remains poorly defined. While skills are increasingly recognized as essential for ensuring a just and sustainable transition, much remains to be done (ILO, 2025). According to data from the NDC Explorer[7], 58% of countries worldwide do not mention skills development or training in relation to climate change in their Nationally Determined Contributions (NDCs), and only 31% include a specific capacity development plan to support the required changes. In Latin America and the Caribbean, of the 29 countries that updated their NDCs in 2020, 65% made no reference to skills development. Only 21% included a plan to promote it, while the remaining 14% acknowledged the need for capacity building but did not outline a specific strategy (see Figure 4).[8]

7. The NDC Explorer is an online tool for analyzing and comparing countries' Nationally Determined Contributions (NDCs). It is based solely on the information contained in these documents. For more information, please consult:NDC Explorer.

8. The ILO (2025) proposes guiding questions to evaluate the integration of skills development in the NDCs and presents examples of countries that illustrate their incorporation. A prominent case is Costa Rica's NDC (2020), which proposes training programs for women, youth, Afro-descendants and indigenous peoples, with the aim of expanding their access to green jobs in sectors where their participation is limited, such as renewable energy, regenerative and precision agriculture, sustainable construction and waste recovery.

FIGURE 4 • **RECOGNITION OF THE ROLE OF SKILLS DEVELOPMENT IN NDCS GLOBALLY AND IN LAC (2020)**



Source: Own elaboration with data from NDC Explorer (IDOS, 2022).

Notes: The NCD is considered to include skills development if it references training related to green transition skills and outlines a plan to implement such training in the context of adaptation, mitigation, or both.

On the other hand, while recent literature has made progress in understanding the connection between skills development and the green transition, significant challenges remain in translating this knowledge into practice. Key questions persist: how can we bridge the gap between recognizing the need for specific skills and actually developing those competencies? How can we design effective training pathways, implement them successfully, and ensure their long-term impact? A review of documents published since 2015—following the Paris Agreement—that explicitly address this connection reveals a range of approaches to developing green transition skills (see Table 2). However, there is still no clear consensus on how to integrate these approaches into public policy in a coordinated and effective way. A step forward in this direction is the work of Baptista et al. (2024), which offers a conceptual framework for understanding the impact of climate change on labor markets and outlines policy options available to countries. The authors highlight that knowledge gaps remain regarding the most effective policy responses. This study builds on that foundation by offering a practical guide to support policymakers in designing and implementing human capital development strategies for the green transition drawing on successful experiences and key lessons learned.

TABLE 2 • IMPORTANCE OF SKILLS DEVELOPMENT FOR THE GREEN TRANSITION

RESEARCH	APPROACH/ARGUMENT	IMPLEMENTATION / METHODOLOGY	COUNTRY/REGION OF FOCUS
Cedefop (2018) *Skills for Green Jobs: European Synthesis (2018 update)*	The transition to green economies requires identifying the necessary skills and designing efficient strategies to address them.	Assessment and anticipation of green skills needs; design or upgrade of programs, diplomas or qualifications; provision of training at local and regional level; role of key actors (social partners and private sector).	European Union (focus on six member countries: Denmark, Estonia, France, Germany, Spain, Estonia, France and the United Kingdom).
Cedefop (2021) *The Green Employment and Skills Transformation*	Skills need to transcend key occupations and affect all economic sectors.	Systematic analysis of the impact of green employment and its implications on skills; forecasts on job creation and destruction; use of skills forecasts to prepare for changes.	European Union.
Cedefop and OECD (2022) *Apprenticeships for greener economies and societies*	Apprenticeship programs (dually model) link the education system with the labor market. The green transition changes skill needs and transforms these systems.	Greening processes of apprenticeship programs; culture analyses organizational skills among key stakeholders; identification of cross-cutting green skills.	Case study: Greek German cooperation for vocational training (GRÆDUCATION project).
UNESCO (2021) *Skills development and climate change action plans*	Assesses the current and potential contribution of TVET to national climate plans.	Review of NDCs, NCs and national adaptation policies; assessment of gaps and green skills needs through document review and interviews.	Global (includes 11 LAC: Bahamas, Brazil, Chile, Colombia, Costa Rica, Dominica, Grenada, Haiti, Jamaica, Mexico and Paraguay).
ILO (2017) *Advancing Green Human Capital*	With political commitment, the first step is to identify sectors and future skill needs.	Review of successful experiences; proposal of three key areas for decent work policies in Green Economy: market analysis, awareness raising and governance.	Conceptual approach and oriented to the design of public policies.
Vona et al. (2015) *Green Skills*	Identifies skills needed to operate and develop green technologies and how their demand responds to environmental regulation.	Creation of a Green Index based on O*NET; analysis of the relationship between green tasks and total tasks per occupation; methodology tested with U.S. data.	United States.
Sern et al. (2018) *Green Skills for Green Industry: A Review of Literature*	Literature review on green skills demanded by the green industry.	Documentary analysis. The ten most common skills include design, leadership, management, energy, urban planning, landscaping, communication, waste management, procurement and finance.	Developing Asia.

RESEARCH	APPROACH/ARGUMENT	IMPLEMENTATION / METHODOLOGY	COUNTRY/REGION OF FOCUS
Auktor (2020) *Green Industrial Skills for a Sustainable Future*	Skills are key to facilitating the green transformation of the industrial sector.	Development of a taxonomy of green jobs and skills; empirical evidence on green employment, green technology adoption and policy actions.	Developing economies.
Mininni and Hiteva (2023) *Place-Based Solutions for Net Zero: Gender Considerations on 'Green' Skills*	There is little evidence of fairness and equality in the distribution opportunities to develop green skills.	Academic and grey literature review (Nov. 2021 - Jan. 2023) and participatory observation (UK, Nov. 2021 - Feb. 2023).	United Kingdom. Conceptual approach.
OECD (2021) *The Inequalities-Environment Nexus*	An inclusive green transition must mitigate regressive impacts, invest in skills, address structural inequalities and ensure good governance.	Review of studies and recommendations on social inclusion, gender, aging, youth and workers affected by green policies.	Conceptual approach.
ADECCO (2021) *Skills for the Green Economy*	He highlights the need to invest in skills, with examples in the energy and automotive sectors.	In-depth conceptual and sectoral analysis; presents case studies in both sectors.	Conceptual approach. Examples from Poland and other EU countries.
LinkedIn (2023) *Global Green Skills Report*	Green skills are essential for green transition and human capital development.	Global data analysis on supply and demand for green skills; sectoral trends in 25 countries; regional examples (USA, Asia-Pacific, Europe); considers transition (gender, age, socioeconomic level).	Global.
World Bank (2024) *Choosing Our Future: Education for Climate Action*	Education is a powerful but underutilized tool for addressing climate change.	Analyzes the impact of climate change on education (loss of learning due to school closures); advocates for greater investment in education as a tool for adaptation and mitigation.	Global. Conceptual approach, broader than the green transition.
Bos and Schwartz (2023) *Education and climate change: how to develop skills for climate action at school age?*	To live sustainably, be agents of change, cope with the effects of climate change and access jobs in low-carbon economies. However, the available evidence indicates that children and youth are not acquiring these skills.	It proposes three main areas of action to develop students' climate-related knowledge, values, capacity for action and skills for green jobs.	Latin America. Broader conceptual approach than the green transition.
Alfonso et al. (2024) *Towards a Just Transition in Latin America and the Caribbean*	Emphasizes the importance of countries creating conditions conducive to the transition and, at the same time ensure that it is inclusive and fair.	It analyzes the social impacts of the green transition and proposes a set of actions that governments can take to ensure a just transition.	Latin America and the Caribbean. Conceptual approach. Examples for countries in the region, such as Chile and Ecuador.

Source: Own elaboration.

Note: The selection of documents is not exhaustive. It includes papers produced since 2015 (post-Paris Agreement) that explicitly detail the connection between skills development and green transition.

3 • From Theory to Practice: Eight Innovative Initiatives in Green Transition Skills Development

The transformations required for the green transition are profound and demand significant investment. While the ideal time to begin was long ago, the next best time is now. Failing to invest in the development of skills for the current and future workforce will slow progress toward the green transition, forgoing its potential benefits and opportunities while increasing social costs. Without the necessary skills, workers will be less able to adapt to and withstand changes in the labor market. Conversely, by actively promoting skills development, we can accelerate the transition and support the adaptation and resilience of both current and future workers to new labor market demands.

The transformations needed for the green transition are profound and require investment: although the ideal time to start was long ago, the second best time is now.

This section presents eight innovative examples of countries that, starting from diverse contexts, have made significant progress. These projects are grouped into two categories: (i) **Direct approach initiatives**, specifically designed to develop skills related to the green transition; and (ii) **Indirect approach initiatives,** originally created for other purposes but offering valuable lessons for building the skills needed in this process. The success of these experiences demonstrates that bridging the gap between current workforce skills and those required in a changing labor market is both feasible and effective. Figure 5 illustrates these projects and classifies them according to the type of approach adopted.

FIGURE 5 • GREEN TRANSITION SKILLS DEVELOPMENT INITIATIVES

GROUP 1

Direct approach

INCORPORATED SKILLS GAP IDENTIFICATION IN THE PROJECT

BELIZE
Renewable Energy and Energy Efficiency Certification Program

CHILE
Efficient irrigation training package for farmers

IDENTIFIED THE SKILLS GAP PRIOR TO THE START OF THE PROJECT

ECUADOR
Skills training for the national sustainable urban mobility and electromobility agenda solar energy and electromobility

PANAMA
Technical programs for electric mobility and solar energy

URUGUAY
Technical training in electromobility operation and management

GROUP 2

Indirect approach

ARGENTINA
Technology 4.0 courses for students in agricultural schools

COLOMBIA
Training in the agro-industrial value chain for sugar

CHILE
Online platform to guide workers and companies

* Projects that are not explicitly aimed at closing the green skills gap may nonetheless contribute to the green transition.

What Are the Eight Initiatives?

Before categorizing them by their approach—direct or indirect—in contributing to the green transition and highlighting key lessons learned, it is helpful to first provide an overview of the eight innovative initiatives presented in the figure above:

- In **Belize** the *'Renewable Energy and Energy Efficiency Certification Program'* established the country's first national certification in this field. The initiative features a two-year curriculum, a teacher training component, and a combination of virtual and in-person instruction. It supports both the green and blue economies through 32 stand-alone courses with student-centered learning materials tailored to meet the demands of these sectors.
- In **Chile**, the *'Efficient Irrigation Training Package for Farmers'* launched a pilot focused on water efficiency to address the urgent need to preserve water resources through innovative solutions. The initiative aims to create learning and employment pathways in sectors where water is a key input, particularly agriculture and water and sanitation, through collaboration

with the productive sector, training providers, and government. In its first year, the project developed a practical guide and methodology for identifying high-potential subsectors in the Southern Cone, conducted skills needs analysis for Chile's agricultural sector, and began reviewing core job profiles in the water and sanitation sector.

- In **Panama**, the 'Technical Program in Electric Mobility and Solar Energy' trains workers in electric mobility (EM) and distributed generation (DG) through a blended learning model that includes a mobile classroom. The program targets the reskilling and upskilling of workers from traditional energy sectors at risk of displacement due to new energy technologies. In 2023, it supported the second edition of the *Solar Champions* program, which trained Indigenous women in installing and maintaining solar systems in rural areas.
- In **Uruguay**, the *'Technical Training in Electromobility Operation and Management'* project established a technical roundtable involving government agencies and industry representatives to strengthen the country's skills system for its second energy transition. The initiative focuses on supporting decision-making and creating pathways for reskilling and upskilling in the electromobility value chain. To date, it has defined 9 professional profiles, 24 training modules, and 47 competencies.
- In **Ecuador**, the *'Skills Training for the National Sustainable Urban Mobility and Electromobility Agenda'* promotes accessible and progressive training for sustainable mobility and electromobility. Aimed at current and prospective workers in urban transport, the program provides both general and specific technical knowledge for certification and career advancement. Its curriculum covers sustainable urban mobility, electromobility, and urban rail transport, and includes hands-on modules to ensure effective learning.
- In **Argentina**, the *'Technology 4.0 Courses for Students in Agricultural Schools'* initiative supports the adoption of new technologies in agriculture by enhancing the skills of students and recent graduates from technical agricultural high schools. Participants receive virtual training in emerging food technologies and mentoring in technological innovation. They also engage in digital simulations of real-world production challenges and are connected with leading innovation ecosystems across the country.
- In **Colombia**, the *'Training in the Sugar Agro-Industrial Value Chain (Palmipilos)'* project developed five high-quality technical programs aligned with the sector's human capital needs. These programs integrate technical training with basic skills leveling, dropout prevention strategies, and the development of socioemotional and socio-labor competencies. Structured internships with local companies are included, allowing participants to work on productive projects tied to company needs. The program addresses youth unemployment and barriers to higher education by offering relevant training that facilitates labor market entry or continuation of studies through credit recognition from secondary education.
- In **Chile**, the 'RELINK' project developed a digital platform to support workers and companies in the face of changes in the labor market. This tool, which uses machine learning,

has established itself as a key resource for strengthening employability and professional development. Through identifying gaps between current skills and market demands, the platform suggests training pathways that facilitate effective job transitions. One of its main innovations is the focus on "occupational families", which highlights the transferability of skills across sectors and supports processes such as the green transition, by analyzing the demand for competencies and designing new skills acquisition pathways (reskilling). More than 8,000 people have used the platform to map their skills. The project has identified more than 170 occupations and 780 emerging skills in nine productive sectors and has developed more than 800 training modules to close the identified gaps. In addition, RELINK created the MapHa taxonomy, which classifies 3,000 occupations and 14,000 skills, establishing a common language among employers, unions, workers and the public sector.

3.1 • Direct Approach: Skills Development to Advance the Green Transition (Belize, Chile, Ecuador, Panama and Uruguay)

This includes five projects aimed at closing human capital gaps to advance the green transition. Each project addresses skills development in strategic sectors aligned with specific national goals:

- **Belize:** Generate 85% of the country's electricity from renewable sources by 2030 (Findlater et al., 2024).
- **Chile:** Improve water use efficiency in priority sectors such as agriculture, where water is a critical input (Chilean Ministry of Public Works, 2013).
- **Ecuador:** Promote sustainable urban mobility by 2050. As part of this objective, it is expected that by 2030, 100% of the new sustainable urban mobility infrastructure will meet climate change resilience criteria (Sustainable Urban Mobility Policy, 2023).
- **Panama:** Increase distributed solar energy generation capacity from 1% to 4.3% and increase the share of electric vehicles from 0.005% to 10% by 2024 (Prada and Rucci, 2023).
- **Uruguay:** Advance in its second energy transition by promoting electromobility in transportation as one of the priority sectors (Ministry of Industry, Energy and Mining of Uruguay, 2024).

These projects differ in their starting points. In Belize and Chile, although climate objectives were clearly defined, the necessary skills to achieve them had not been identified at the outset. The initial step, therefore, involved diagnosing gaps in occupations and profiles within the prioritized sectors, followed by the joint design and implementation of human capital development strategies to address those gaps.

In contrast, Ecuador, Panama, and Uruguay had already identified the skills gaps and occupational profiles needed in their selected sectors. In these cases, evidence showed that the lack of appropriate skills was a key barrier to advancing the green transition and fully capitalizing on its opportunities.

In Ecuador, training options in sustainable mobility were limited, and the existing educational offerings were fragmented, failing to cover all necessary skills (TRNTARYET, 2022). In Panama, 42% of the companies in the solar energy sector lacked personnel trained in the installation and maintenance of solar panels (Prada and Rucci, 2023). Additionally, 76% of car distributors did not have enough staff trained in diagnosing and maintaining electric vehicles to meet company demands (Prada and Rucci, 2023).

The starting point in Ecuador, Panama and Uruguay is clear: policymakers identified skills gaps and needed to design a strategy on how to close them.

In Uruguay, the Ministry of Industry, Energy and Mining highlighted the shortage of workshops specializing in electric vehicle maintenance as a major issue (Prada and Rucci, 2023). The situation in these countries was clear: policymakers had to identify critical skills gaps and recognized the need to develop strategies to address them. As a result, human capital development strategies were designed and implemented through broad consensus to close these gaps.

These five experiences share key elements in their strategy for human capital development:

1) **Stakeholder Collaboration.** Each initiative began by forming working groups composed of relevant ecosystem stakeholders, including representatives from technical-vocational education and training (TVET) systems as well as public and private sector employers. In Belize and Chile, a preliminary skills gap assessment was conducted to identify the occupational profiles and competencies needed to meet the goals of priority sectors. In Chile, this assessment was carried out through value chain analysis. Following this, all five countries reviewed existing training programs in these sectors to determine whether they sufficiently covered the required skills or needed adjustment or supplementation.

2) **Designing Targeted Training Pathways.** Based on the identified skills gaps, each country designed relevant training pathways to address them. Belize developed its first renewable energy and energy efficiency certification program (see Findlater et al., 2024; Prada and Rucci, 2023). Chile created a training package focused on irrigation skills for agricultural producers to promote efficient water use, including a curriculum on the maintenance and operation of irrigation equipment—technology that had been installed through government funding but was underutilized due to a lack of technical expertise among farmers. Ecuador designed two curricula comprising 21 courses on sustainable urban mobility and electromobility. Panama developed two technical training programs for reskilling and upskilling in electric mobility and distributed generation, delivered via a hybrid model (see Prada and Rucci, 2023). Lastly, Uruguay is in the process of designing a curriculum for electromobility operation and management.

3) **Modular Training Solutions.** The training programs are designed using a modular approach that complements and integrates with existing courses and career paths. They include learning certifications and target both specific job-related skills and broader transferable skills applicable across related occupations. Emphasizing practice-based learning, these pathways are developed collaboratively with stakeholders across the ecosystem, fostering strong partnerships with the private sector. This collaboration ensures that the training content aligns with industry needs and enhances graduates' employment prospects.

4) **Teacher and Trainer Development.** A key component of these training solutions is the preparation of teachers and trainers, equipping them with both technical expertise and effective pedagogical strategies. This is especially important in emerging green sectors such as energy, transportation, and agriculture, as it supports effective knowledge transfer and project scalability. Trainers are also empowered to train new trainers, ensuring the sustainability and continuity of the programs beyond the initial project lifespan (Prada and Rucci, 2023).

5) **Innovative Approaches.** Innovation is integral to training solutions. In Belize, this involves shifting from traditional basic trade training to advanced, learner-centered, inquiry-based, and problem-solving pedagogy. The country aims to become a leader in green energy skills training for the English-speaking Caribbean, supported by a digital platform and a community of practice (Prada and Rucci, 2023; Findlater et al., 2024). Chile's innovation focuses on practical, student-centered training integrated into an existing government technical assistance program for farmers, facilitating implementation and scalability. Panama uses virtual classrooms and a mobile classroom to reach rural areas effectively (Prada and Rucci, 2023). Ecuador's curriculum is delivered through flexible, sequential modules tailored to the specific needs of different localities. In Uruguay, the energy sector actively participates by providing trainers with environmental, technical, and pedagogical skills, enabling them to develop training programs for new instructors (Prada and Rucci, 2023).

3.2 • Indirect Approach: Skills Development to Advance Employment Pathways That Indirectly Contribute to the Green Transition (Argentina, Chile and Colombia)

Unlike the first group, this second set of projects was not originally developed with an explicit green focus. Their main goal is to enhance skills that improve access to quality jobs and support progress along employment pathways. However, they do build essential skills or provide useful mechanisms that contribute to the green transition. Three such projects were carried out in Argentina, Chile, and Colombia.

The projects in Argentina and Colombia focus on strengthening skills development for secondary school students in the agro-industrial sector. In Argentina, the aim is to equip students from agricultural schools with skills to apply Industry 4.0 technologies—such as robotics and sensors—in their productive activities. This involved integrating virtual learning modules into new technologies into the curriculum, alongside mentoring programs to encourage technological innovation in the field. Students also participated in digital simulations of production challenges and were connected with the country's main innovative ecosystems (Prada and Rucci, 2023).

In Colombia, the project offers technical training through five programs tailored to the sugar agro-industrial value chain. These programs blend technical content with foundational skill-building in areas like math, science, and language, while also developing socioemotional and socio-labor skills (Prada and Rucci, 2023). According to Cañizares et al. (2025), the program showed positive and statistically significant improvements in students' math and English skills. Both the Colombian and Argentinian projects include structured internships in local companies, fostering early labor market connections and improving employment prospects for high school graduates. In this way, these initiatives help create upward educational and career trajectories for future workers.

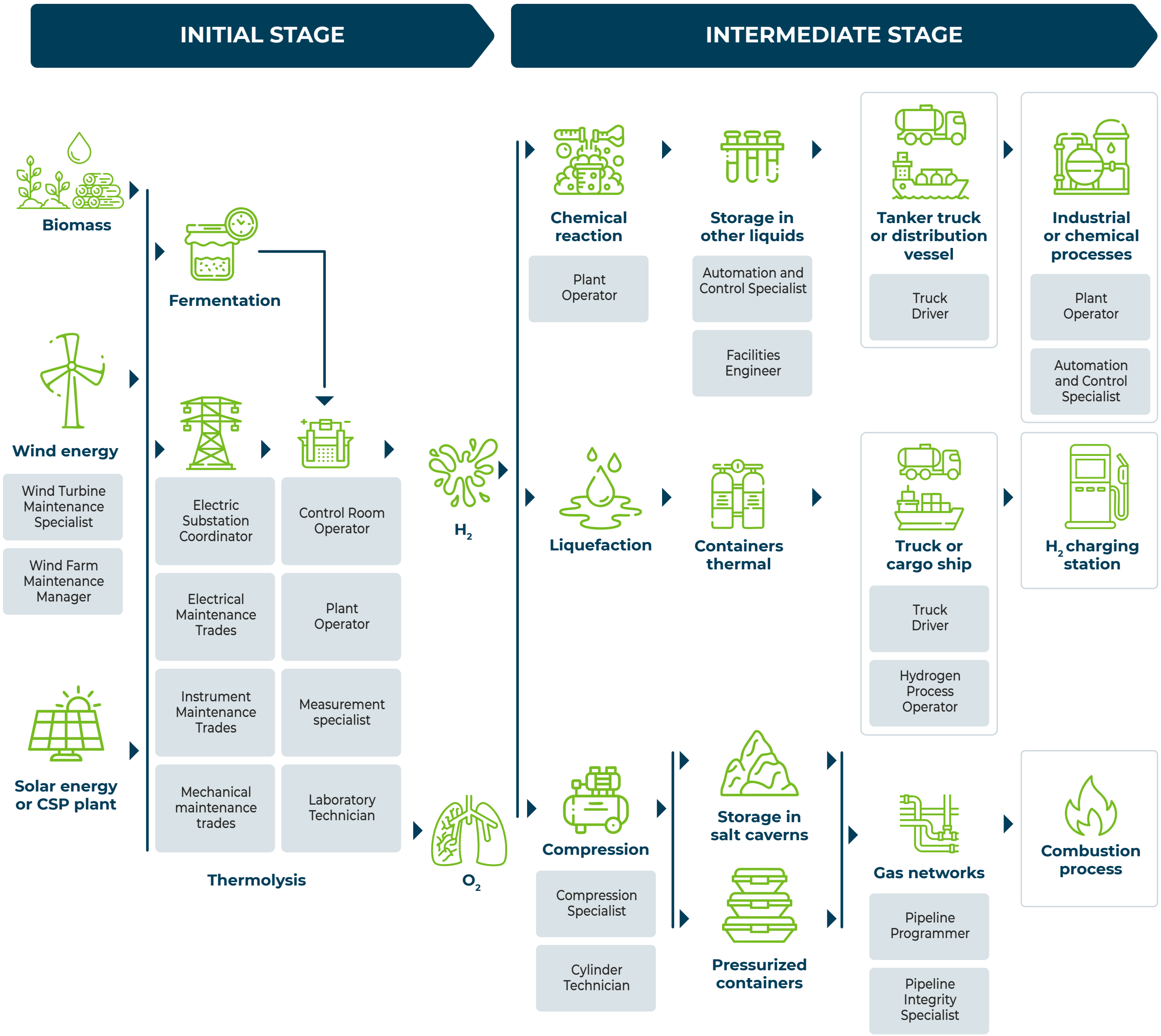
This second group of projects has not been developed with a green focus. Their main objective is to develop skills that improve access to quality jobs and promote progress in employment trajectories. However, they do develop necessary skills or useful mechanisms for the green transition.

Although these projects do not specifically target the development of technical skills linked to the green transition, they contribute to the transition by strengthening education systems and integrating modern technical training aligned with the needs of key sectors like agriculture. As noted earlier, the transition involves significant technological for example, to enhance soil carbon absorption, farmers need to adopt precision farming techniques and monitor soil moisture closely. The use of drones and sensors helps monitor critical factors such as soil moisture and site-specific requirements. However, effective implementation of these technologies requires farmers to have the right technical skills. Alongside technical expertise, socio-emotional skills—including leadership, management, adaptability, and change facilitation—are also essential and will become increasingly important as the green transition advances (OECD, 2023).

The third project, implemented in Chile, has a different approach. Its goal is to guide and support current and future workers, as well as companies, in navigating changes in the Chilean labor market. The initiative developed an online platform called RELINK, which uses machine learning to match workers' existing skills with emerging job demands from companies. Based on identified skill gaps, the platform suggests training options to help workers upskills and adapt to the evolving labor market (Prada and Rucci, 2023).

One of RELINK's key innovations lies in its approach to **skills diagnosis**. Rather than focusing on skills tied to a specific occupation, it groups skills by "occupational families." This recognizes that many cross-cutting skills are transferable across various jobs and sectors (RELINK, 2024). For example, energy management, electrical and electronic knowledge, and workplace safety are common competencies for renewable energy technicians working in solar, wind, or electromobility sectors. The platform also supports skills development to promote Chile's emerging green hydrogen industry. As part of this effort, the National Human Capital Roundtable was established, bringing together key public and private stakeholders—RELINK being one of them. Using RELINK's skills reconversion framework, 88 potential job profiles have been identified within the green hydrogen value chain, and their associated skills are currently under analysis. Figure 6 illustrates some of the occupational roles required at different stages of the value chain. For instance, at the initial stage, positions like wind farm maintenance manager and electrical maintenance technician are needed, while at the intermediate stage, roles such as pipeline integrity specialist and pipeline scheduler are essential.

FIGURE 6 • OCCUPATIONAL PROFILES DOWNSTREAM OF THE GREEN HYDROGEN VALUE CHAIN AND AT AN INTERMEDIATE STAGE



Source: SOFOFA (2024).

This project contributes to the green transition by providing tools to analysis the skills demand of various occupational profiles and identify potential training pathways. In doing so, it supports workers in reskilling or upskilling, enabling them to adapt and seize the opportunities presented by the transition.

3.3 • Lessons Learned: Real Experiences in Latin America and the Caribbean

The success of the initiatives presented in this section demonstrates that it is possible to establish a bridge between the available in the workforce and those demanded by the labor market to advance the green transition. This can be achieved without losing sight of the specific objectives of each initiative, the diverse contexts in which they are implemented, the productive sectors they target, their intended beneficiaries, and the characteristics of the training solutions they propose.

These initiatives share key that have contributed to their success and provide a foundation for designing and implementing a human capital development strategy for the green transition:

a) **Build an Ecosystem of Key Actors.** Creating an ecosystem that brings together representatives from various sectors—supported by mechanisms for interaction and ongoing coordination—has been a cornerstone of successful skills development efforts. When such mechanisms are designed from the outset with sustainability in mind, they tend to foster long-term collaboration, enabling the development of joint solutions that are responsive to labor market needs.

One effective way to build this **ecosystem** is by **establishing multi-sectoral working groups** that include actors from the TVET system and the public and private sectors. For example, in Panama, technical working groups were formed between the private sector and the National Institute of Vocational Education and Training for Human Development (INADEH) to co-develop courses on electric vehicles and distributed generation. This collaborative process included several working sessions and a field visit to jointly design learning materials. In Uruguay, the creation of a multi-sector board was the first step. This board spearheaded the country's first national workforce strategy on electromobility, identifying occupational needs and designing a curriculum aligned with industry demand. It continues to play a key role in updating sector needs and course content.

b) **Develop Training Solutions Aligned with Demand.** Successful initiatives begin by identifying gaps between current occupational profiles, skills requirements, and training availability. These gaps serve as a compass for human capital strategies, guiding whether to adapt existing programs or design new ones.

For example, in Belize, the country's first certification program in renewable energy and energy efficiency was developed and delivered through a public TVET institution, with support from the IDB. In Ecuador, 21 new courses were created focusing on sustainable urban mobility and electromobility. Uruguay is currently developing a curriculum focused on the operation and management of electromobility.

c) **Respond to Current and Future Demand.** The most forward-thinking projects not only address the needs of today's workers but also anticipate the demands of future labor markets.[9]

In Chile, the RELINK platform uses machine learning to identify gaps between workers' existing skills and emerging market demands, recommending training pathways to support career transitions. One of its key innovations is the focus on "occupational families," which highlights the transferability of skills across sectors and supports a more flexible and adaptable workforce.

d) **Structure Skill Development into Relevant Learning Pathways.** Skill development is most effective when organized into coherent, structured learning pathways rather than isolated courses. These pathways provide a clear progression for professional growth within an occupational family, often spanning from secondary technical and vocational education to post-secondary degrees, certifications, short courses, and micro-credentials. Successful models tend to be flexible, cumulative, and credentialed, allowing individuals to build their skills progressively and improve their labor market prospects over time.

e) **Incorporate a Holistic Approach to Skills Development.** The most effective training solutions combine technical skills with cross-cutting and transferable competencies—such as problem-solving, communication, and adaptability—which are essential in an evolving labor market. These initiatives go beyond focusing solely on occupation-specific technical knowledge; they also promote skills that are transferable across sectors. A strong example is Colombia's Palmipilos project, which combines technical training aligned with the human capital needs of the sugar agro-industrial value chain with the development of basic and socioemotional skills for secondary school students.

f) **Promote Quality Training.** These initiatives are designed with high standards and ambitious goals. They emphasize the importance of qualified teachers, modern pedagogical approaches, and optimal conditions for effective learning—such as well-equipped facilities, up-to-date technology, and training materials aligned with industry needs.

9. Predicting the skills required for the green transition is a complex but achievable task. Predicting the skills that will be needed for the green transition is a complex but feasible challenge. In contexts with robust mechanisms and reliable data, projections are more accurate, making it possible to draw a roadmap for skills development in the workforce. However, in dynamic labor markets with high uncertainty, anticipating specific medium-term changes is more difficult. In these cases, international commitments and existing treaties can provide clues about expected transformations, which can be complemented by other sources of information. When predictive capacity is limited, it is particularly important to have agile training systems capable of adapting quickly to changes in the labor market.

g) **Ensure the Availability of Qualified Teachers and Instructors.** A consistent finding across these experiences is that having instructors with both up-to-date technical expertise and strong pedagogical skills is critical for high-quality TVET delivery. This requires robust teacher selection processes and ongoing professional developments such as "train-the-trainer" models—to ensure instruction remains relevant and effective. While this is important across all training programs, it is especially crucial in TVET. In this context, the lack of qualified trainers can be a major barrier to success. The energy transition, in particular, demands a constantly evolving pool of skilled professionals. Therefore, it is essential to assess the needs of trainers and implement comprehensive solutions that support continuous capacity building for both current and future instructors (World Bank, UNESCO & ILO, 2023; OECD, 2023; UNESCO, 2020).

There are concrete examples in the region that embody this approach. In Ecuador, courses are offered in modular formats tailored to local needs. In Uruguay, a workplace-based model is used in which the energy sector itself takes part in training instructors. These trainers then pass on their knowledge to others, combining technical content with effective pedagogical methods. This enhances the quality of training and supports scalability, as trained instructors can train future teachers, ensuring the sustainability of programs beyond their initial phases (Prada & Rucci, 2023).

h) **Include Internships.** Several initiatives have successfully strengthened connections with the labor market and supported upward educational and employment pathways through the inclusion of internships in local businesses. For example, Argentina's I+T *(Innovation and Technology)* project offers virtual training in new food technologies, complemented by mentoring, digital simulations of real-world challenges, and integration with the country's leading innovation ecosystems (Prada & Rucci, 2023). These actions have supported 12,500 students from secondary agricultural technical schools across eight provinces in developing the technological and digital skills needed to compete in the sector. These actions have supported 12,500 students from secondary agricultural technical schools in eight provinces to develop the technological and digital skills needed to compete in the sector.

i) **Implement Quality Assurance Mechanisms at Every Stage.** Robust evaluation and monitoring systems have been essential in ensuring quality and enabling continuous improvement. These systems rely on data and feedback from both participants and employers to make timely adjustments. Additionally, offering nationally and internationally recognized certifications enhances the credibility of training programs in the labor market.[10]

10. Sometimes, these certifications are necessary so that companies themselves can certify their production processes and thus comply with international standards. In addition, a certification is a credible and visible signal to all companies - including potential future employers - about the skills a person possesses.

j) **Generate Opportunities for Inclusion.** While this document does not focus specifically on inclusion, the green transition presents important opportunities in this area. Evidence shows that training solutions designed for vulnerable groups—such as women, individuals with lower skill levels, and economically disadvantaged populations—can foster pathways to better jobs and long-term socioeconomic progress (Baptista et al., 2024; Remerscheid & Kotecha, 2024).

These lessons provide the foundation for the human capital development strategy outlined in the next section of this document.

4 • Guide: Designing a Human Capital Development Strategy for the Green Transition

A human capital development strategy for the green transition has two key objectives: first, to equip workers with the skills needed to meet the goals of the transition across productive sectors; and second, to ensure that these skills are effectively applied in the workplace, enhancing both productivity and employability. How can such a strategy be designed, and what steps are needed to develop an action plan for its implementation? This section presents a roadmap to guide policymakers, highlighting core principles and practical considerations.

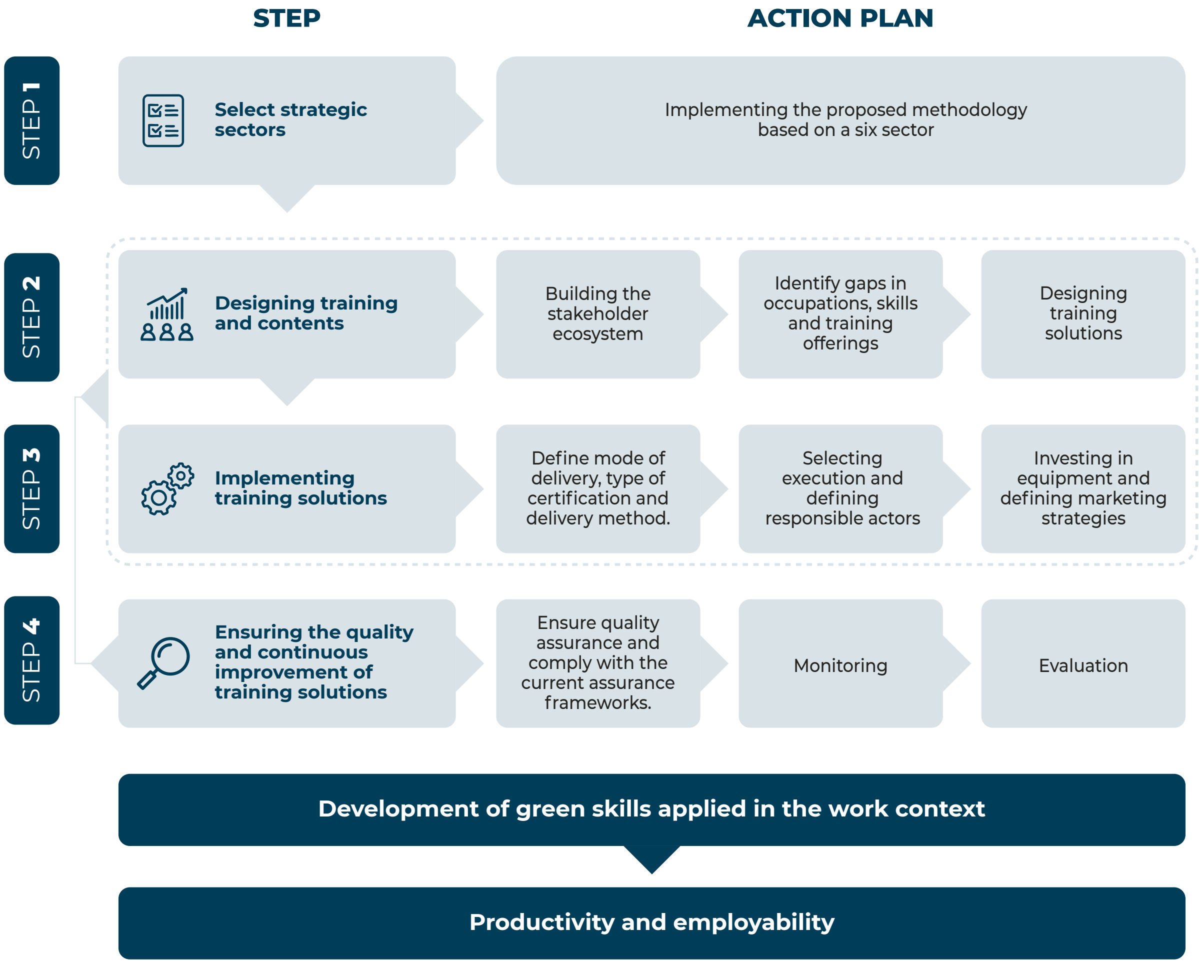
How can this strategy be designed and how can an action plan for its implementation be constructed? This section presents a roadmap to guide policymakers, emphasizing basic principles and practical considerations.

To this end, the strategy begins with the most fundamental steps and progresses to the key details necessary for designing and implementing a human capital development plan, considering the diverse realities of different countries. It is structured to be applicable at any stage of progress, whether a country is just beginning and has yet to identify the strategic sectors in which to close skills gaps for the green transition or is already actively implementing related policies.

The strategy is built around four essential steps (Figure 7), which, while necessary, are not sufficient for comprehensive skills development. The first step is to identify the strategic sectors where bridging skills gaps is the most urgent. The second step focuses on outlining training pathways and designing relevant training content. The third step involves the implementation of these training solutions, and the fourth ensures quality at every stage and across all processes.

Although these steps are broadly relevant to any skills development initiative, they have been specifically adapted here to meet the demands of the green transition. For each stage, a corresponding action plan is proposed, following a logical sequence that supports steady progress in the development of a comprehensive human capital strategy.

FIGURE 7 • STEPS IN DEVELOPING HUMAN CAPITAL DEVELOPMENT STRATEGY FOR THE GREEN TRANSITION



Source: Own elaboration inspired by OECD (2023).

The guidance proposed in this document is based on a sectoral approach, which facilitates the identification and analysis of occupational and skills needs for the green transition. Focusing on a specific sector simplifies the identification of key actors and the collaboration between the private sector, the public sector and training institutions, thus contributing to a more successful human capital development strategy. In addition, it allows for a gradual approach in the sectors, using them as case studies to build trust with stakeholders. The remainder of this section describes the four core steps.

4.1 • First step: Selecting Strategic Sectors

The first step in a human capital development strategy for the green transition is to identify strategic sectors and prioritize one or more of them based on prevailing criteria.[11] Some countries in Latin America and the Caribbean have already made progress at this stage. Belize, for example, has selected the energy generation sector as a priority and has set a target of 85% of energy produced from renewable sources by 2030 (Section 3.1 for other examples). However, other countries are still in the early stages of identifying and selecting priority sectors, making this the starting point for their strategy.

*The **first step** in a human capital formation strategy for the green transition is to identify strategic sectors and prioritize one or more of them according to the criteria that prevail.*

4.1.1 • The Search for a Methodology

Choosing priority sectors is a complex task. This roadmap offers a methodology that serves as a guide for prioritization, when needed. While there are multiple ways to approach this and no universal consensus on the best methodology, the one proposed here stands out for including human capital as a core criterion in sector prioritization.

Identifying priority sectors presents several challenges. First, there is no single, rigorous, and standardized method that can be applied across all countries or sectors. Although some studies, such as the OECD's (2011) methodology, have developed frameworks to assess progress toward green growth, these tools focus on evaluating a country's overall performance using broad indicators (e.g., resource efficiency or environmental footprint reduction). However, they are not designed to identify priority sectors within a specific national context. The lack of a sector-specific focus limits their utility in guiding targeted skills development strategies.

11. Prioritization of sectors can be approached in different ways, depending on the specific needs and circumstances of each country. In some cases, it may even be decided to work simultaneously in several sectors, without establishing a clear hierarchy among them.

Some studies have identified priority areas for advancing the green transition in Latin America and the Caribbean. The OECD (2023), for example, highlights energy transition, circular economy, sustainable water management, electromobility and sustainable tourism as strategic areas. However, these proposals often lack clear operational guidance for selecting specific sectors in which to implement human capital development strategies. Taking sustainable water management as an example, while there is a recognized need to improve resource efficiency, treatment, and wastewater reuse (OECD, 2023), precisely identifying the sectors requiring targeted human talent development remains a challenge.

Secondly, although several studies propose methodologies for selecting priority sectors for the green transition, no consensus exists on the most relevant or indispensable criteria to compare and prioritize sectors. Notably, many of these methodologies overlook a critical criterion: human talent development for the green transition. Among the methodologies reviewed, the one developed by UNDP (2010) stands out. It focuses on selecting strategic sectors for investment in green economy technologies by comparing sectors according to three criteria: (i) greenhouse gas (GHG) emissions; (ii) sector vulnerability to climate change, considering environmental, economic, and social impacts; and (iii) the impact of low-emission technology adoption on economic, social, and environmental development. After identifying priority sectors, this methodology recommends a detailed analysis of the technological needs within each sector to drive progress.

The Government of Paraguay adapted this same methodology to select priority sectors for investment in transition technology (OIKO, 2022).Their approach considers seven criteria: (i) alignment with national priority policies; (ii) vulnerability to climate change; (iii) economic importance, measured by GDP and employment; (iv) need for technological innovation; (v) social impact, including gender gaps and poverty; (vi) synergy between sectors; and (vii) political will or openness to climate adaptation strategies.

In contrast, the Government of Colombia has applied the methodology developed by the Global Green Growth Institute to select priority sectors for green growth in certain regions of the country (Parra et al., 2019). This approach evaluates sectors based on four criteria: (i) efficiency in resource use during production and consumption; (ii) preservation of natural resources; (iii) potential climate change impacts on production and consumption; and (iv) sectoral economic importance.

Thirdly, a persistent challenge in selecting priority sectors is defining appropriate indicators for each criterion and constructing them using reliable, timely sector-specific data. For some criteria, such as a sector's economic contribution, it is relatively easier to develop indicators and access data—such as gross value added or export figures—compared to more complex or qualitative measures.

However, this task is more complex for other criteria, such as assessing the potential effects of climate change on production. Additionally, the required information is often gathered from existing sources and through a participatory process involving relevant government departments—such as Industry and Trade—sector representatives, NGOs, and community members (UNDP, 2010). Some of this data may already be available, while other information will need to be collected. Given these information limitations, as well as the time, human, and financial resources required for data collection or generation, methodologies typically combine both qualitative and quantitative analyses.

Fourth, even when these challenges are addressed, developing a systematic approach to comparing criteria remains difficult. Some methodologies, like that of UNDP (2010), recommend assigning scores to each criterion to evaluate performance and defining weightings that reflect their relative importance. There is no single standard method for this process, as it depends heavily on the subjective judgments of the teams conducting the analysis. Typically, the definition of scores and weightings is carried out through a participatory process involving experts and stakeholders (UNDP, 2010).

The methodology proposed in this guide offers an alternative based on existing studies and what has worked in practice, based on the experience of this type of analysis in projects focused on skills development.

Considering the challenges outlined above, the methodology proposed in this guide acknowledges these difficulties and offers an alternative approach grounded in existing studies and proven practical experience, particularly from skills development projects like those described in Section 3. What sets this alternative apart is the explicit integration of human talent as a key criterion in sector prioritization.

The goal of this approach is to structure and organize the analysis of economic sectors by evaluating their most relevant characteristics and providing a clear rationale for selecting certain sectors over others. Rather than focusing on choosing a specific sector outright, the emphasis is on establishing a consistent process for comparing sectors. This process identifies the most relevant criteria for prioritization, recognizing that the final decision may depend on factors beyond this analysis, including the preferences of technical teams, policymakers, and the specific country context. For more details, see Annex 2.

4.1.2 • Six Criteria for Sector Prioritization

Given that, in general, LAC often lacks comprehensive data or face constraints in resources—such as time, personnel, and funding—to conduct thorough quantitative analyses, we propose a two-stage methodology. In the first stage, sectors are pre-selected based on three criteria: (i) their potential to reduce greenhouse gas (GHG) or other pollutant emissions; (ii) their vulnerability to climate change; and (iii) their importance for economic growth and employment. In the second stage, these pre-selected sectors are further analyzed using three additional criteria: (iv) the need to develop human capital for the green transition within the sector; (v) investment levels in green transition technologies; and (vi) strategic alignment with national plans and the broader institutional context. Figure 8 presents the full set of criteria guiding this two-stage prioritization process.

FIGURE 8 • SECTOR PRIORITIZATION PROCESS FOR GREEN TRANSITION

STAGE 1

INITIAL ANALYSIS

Criterion 1
Potential to reduce GHG emissions.

Criterion 2
Vulnerability to climate change.

Criterion 3
Importance for economic growth and employment.

STAGE 2

SPECIFIC ANALYSIS

Criterion 4
Need for human capital for the green transition.

Criterion 5
Investment in green technologies.

Criterion 6
Strategic alignment with national plans.

Source: Own elaboration.

The first criterion in the initial stage involves evaluating each sector's potential to reduce greenhouse gas (GHG) emissions and other pollutants, aiming to identify those with the greatest opportunities to drive the green transition. This assessment should consider factors such as current GHG emissions, water and air pollution, soil degradation, waste generation, and other environmental impacts. Importantly, the analysis should not only focus on sectors with high current emissions but also include sectors that could become significant emitters in the future if their production processes remain unchanged. Annex 2 provides detailed descriptions of each criterion, along with suggested indicators, data sources, and methodologies to guide the analysis.

The second criterion assesses the vulnerability of economic sectors to climate change, focusing on two key aspects. First, it evaluates each sector's exposure to climate-related events such as floods, droughts, storms, and heatwaves, considering both the frequency and severity of these phenomena. Second, it examines how these climatic changes impact the sector's operations and production processes. This requires understanding the role and use of natural resources within each sector to gain an overview of climate change's potential effects. For example, in agriculture, reduced water availability due to climate change can complicate irrigation, influence crop locations, lower yields, and affect livestock health.

The third criterion evaluates the relative importance of each sector in terms of economic activity and employment. The goal is to prioritize sectors that are not only environmentally strategic for the green transition but also significant drivers of economic growth and job creation, thus fostering a virtuous cycle of sustainable development, employment, and skills enhancement.

Based on these first three criteria (stage one), a shortlist of sectors is selected for further analysis in the second stage, where three additional criteria are considered. The fourth criterion focuses on identifying sectors with the highest priority for closing workforce skills gaps necessary to support the green transition. This involves determining which sectors face the greatest human capital training needs to implement sustainable practices effectively. For instance, construction workers may require less specialized green skills training compared to workers in renewable energy trades, who need expertise in installing, operating, and maintaining solar panels. This analysis considers factors such as production processes and technology use (see Annex 2 for more details). Ensuring workers have the right skills is crucial not only for their employment prospects in growing green sectors but also for encouraging company investments in green technologies (den Nijs and Tyros, 2023).

The fifth criterion examines the level of investment in green transition technologies within each pre-selected sector. It assesses the types of technologies currently in use, the scale of their deployment, and the sector's potential for future adoption of green innovations. This criterion links closely with the sector's ability to adapt operations amid climate change and the corresponding demand for skilled human capital, as effective technology investment requires trained workers who can operate and maintain new equipment efficiently.

Finally, the sixth criterion evaluates the strategic alignment of each sector with national plans and the institutional context, focusing on two main components: policy frameworks and relevant institutions.

The first component involves assessing how the pre-selected sectors align with government strategies and climate action plans aimed at reducing emissions and adapting to climate change. As noted in Section 2, many LAC countries have committed to climate mitigation, adaptation, and economic diversification plans. Therefore, the selection of priority sectors must correspond with these national objectives.

The second component examines the ecosystem of stakeholders to identify sectors with the greatest potential for forming alliances that facilitate the practical implementation of training and development solutions. To carry out this analysis, it is recommended to develop a set of comparable indicators tailored to the scale, type, and data availability of each sector. These indicators help assess current sector characteristics and future potential. Annex 2 provides detailed descriptions of the proposed indicators.

Since building these indicators requires timely, reliable data and technical expertise that may exceed the capacity of consulting teams or policymakers, it is advisable to combine information from existing sources (such as administrative data, reports, and academic research) with insights gathered through interviews or focus groups. Engaging key stakeholders, including public and private sector representatives, experts, researchers, and TVET system members—will enrich understanding of the unique challenges and opportunities within each sector. A mixed-methods approach combining quantitative and qualitative analyses is also recommended to ensure a comprehensive assessment.

4.2 • Second Step: Designing Training Pathways and Content

*The **second step** consists of designing the necessary training solutions so that the country develops the human capital required to meet sector goals.*

Once the priority sector has been selected and the goals for the green transition established, the next step is to design the necessary training solutions to develop the human capital required to meet these sector goals. The collection of defined training solutions and learning experiences that outline clear advancement pathways, enabling individuals to progress professionally, is referred to as "training pathways."

These pathways encompass the full range of educational offerings—from secondary technical-professional education and post-secondary programs to specializations, courses, certificates, micro-courses, and other TVET (technical and vocational education and training) programs, as defined within each country.[12] Training pathways are dynamic, adapting over time to meet evolving skill demands as the transition advances, and are continuous throughout an individual's professional development.

To design effective training pathways, it is essential to build a coordinated ecosystem of key actors, identify gaps in occupations, skills, and training supply, and then develop targeted training solutions to close these gaps and support the green transition objectives.

12. TVET in Latin America and the Caribbean encompasses a wide diversity of programs and training suites, ranging from secondary technical education offered by the formal sector to post-secondary technical education and various forms of job training. Over time, each country in the region has used different terms to refer to the components of what is now collectively referred to as "technical and vocational education and training" (TVET). Some examples include technical education, vocational education, technological education, technical-vocational education (TVE), occupational training (OT), vocational education and training (VET), professional and trade education, apprenticeship training, technical-scientific education careers (TSE), short post-secondary education and training modalities, workforce training, and on-the-job training, among others.

4.2.1 • The Stakeholder Ecosystem

According to the current consensus, building an ecosystem of key stakeholders and involving them to form a collaborative working group is key to designing and implementing a successful human capital development strategy (Amaral et al., 2017; Cedefop, 2018; Unesco, 2021).

The stakeholder ecosystem, which participates throughout all stages of the strategy, consists of a network of entities interested in workforce skills development. Each stakeholder both influences and is influenced by the others, creating a dynamic and evolving relationship. The key to success lies in cooperation, shared responsibility, and commitment among all relevant entities (European Commission, 2023).

Among the key actors are public sector bodies, represented by national ministries, government departments, and local governments. These include departments related to employment, production, and labor, as well as sector-specific agencies—such as agricultural development institutes responsible for promoting the efficient use of natural resources like water. Involving both national and local authorities is crucial, as effective collaboration across government levels is required (OECD, 2023).

The TVET system is another vital actor, comprising education and training institutions, research centers, and their representatives, including managers and teachers. The private sector also plays a central role, encompassing business associations, chambers of commerce, companies, and self-employed workers. Finally, workers (and their unions) and students engaged in training are equally important. This group is broadly defined to include not only those currently enrolled in TVET programs, but also individuals considering technical training before entering the labor market, as well as those seeking reskilling or upskilling, along with their families. Figure 9 summarizes the key actors in this ecosystem.

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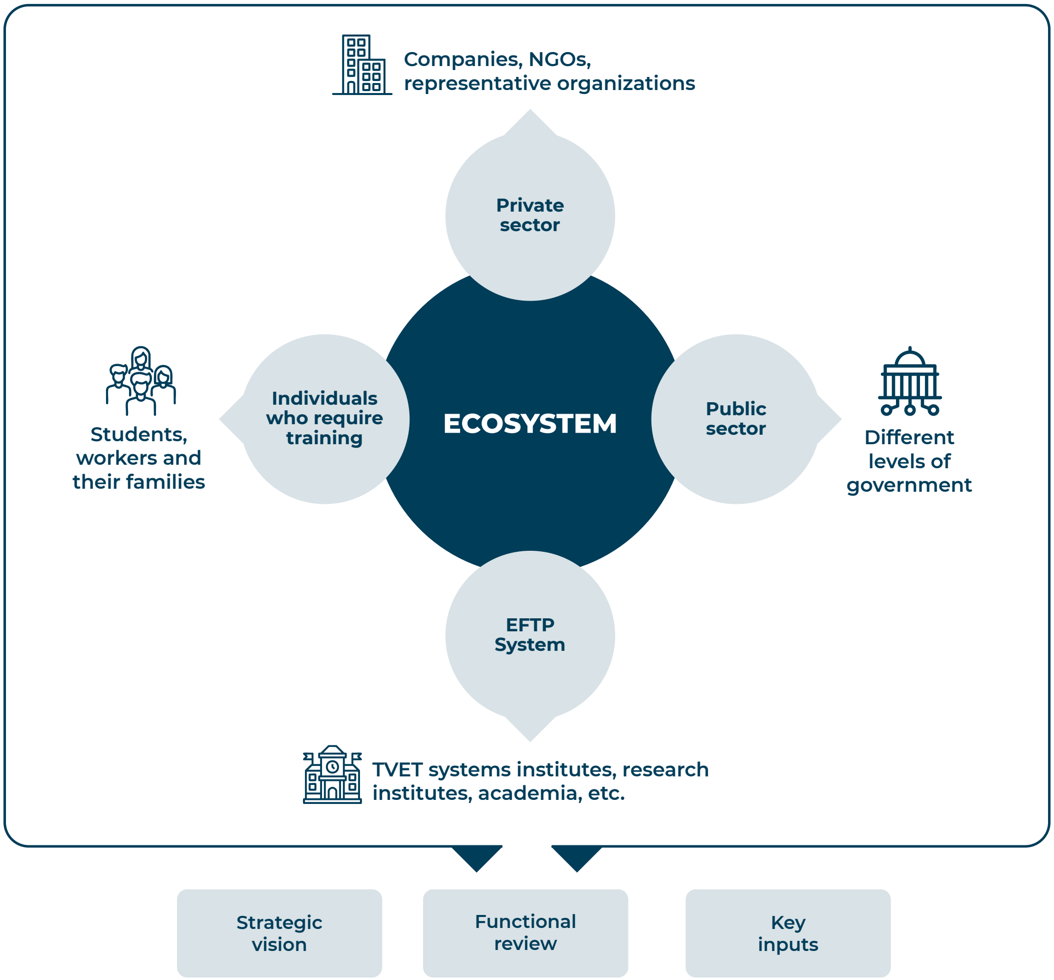
FIGURE 9 • ECOSYSTEM ACTORS



Source: Own elaboration based on European Commission (2023).

Forming an ecosystem of stakeholders helps to build a shared vision of the desired results of a human capital development strategy, to agree on the rules of operation among stakeholders and to provide key inputs for the design and implementation of this strategy.

It is crucial that all actors within the ecosystem share a clear understanding of the strategy's goals and the action plan to achieve them. Equally important is the agreement on coordination mechanisms and the definition of roles and responsibilities, which promotes effective collaboration and feedback between the private sector and training institutions. Rosas Shady et al. (2020) and the ILO (2021) offer methodological guides that assist in defining these roles and functions within such ecosystems.

MORE INFORMATION

Methodological guidelines for defining the roles and functions of ecosystem stakeholders:

- Sectorial competency councils: methodological guide.
- Sectoral councils to promote technology adoption.
- Ecosystem Map - Strategy Tools.

An ecosystem is also vital for coordinating and managing the supply of key inputs (Amaral et al., 2017; Rosas Shady et al., 2020). This includes generating and gathering information on specific economic sectors, as well as on current and future skill needs. Since stakeholders often have differing priorities and face information asymmetries—where each party may be unaware of the others' needs, it is essential to produce accurate information and foster collaborative work. This collaboration helps align labor market demand with supply, facilitating the identification of gaps in occupations and skills.

Sharing information about the existing training offerings and their relevance to private sector needs is equally important. It enables the development of targeted training solutions that are well-aligned with demand and allows for optimizing or adjusting current programs instead of creating new ones unnecessarily. Another crucial input is the collective experience and technical knowledge of ecosystem actors, which provides valuable insight into required skills and productive practices.

Financial resources also play a central role. Adequate financing is a key tool to ensure the human capital development strategy achieves its intended results. It is essential to identify, plan, and allocate the necessary resources for both the design and implementation of the strategy, as well as to define its sources of funding (Amaral et al., 2017).

Collaboration among ecosystem actors can take various institutional forms depending on the national context. These range from well-established organizations with robust structures, such as sectoral skills councils, to less formal arrangements like coordinating or human capital roundtables. The ILO (2021) provides numerous examples of such structures adopted by different countries. Additionally, Annex 3 presents several examples of stakeholder ecosystems focused on skills development for the green transition.

MORE INFORMATION

Examples of an ecosystem of actors for human capital in the green transition can be found in Annex 3.

In summary, following best international practices and lessons learned from the projects described above, the following considerations are recommended in order to build the stakeholder ecosystem:

- **Identify Key Stakeholders.** It is recommended to develop an "ecosystem map" that identifies potential stakeholders and outlines their roles. This map begins with the target group—the individuals who will receive the training—and then categorizes the various actors based on their importance to the development and implementation of the training program (European Commission, 2023). To complement this analysis, a chart can be created that places program participants at the center, positioning the most directly influential actors closest to the center. This visualization helps clarify the key players involved. A valuable tool for constructing such ecosystem maps can be found in the Ecosystem Map - Strategy Tools.
- **Define Rules of Interaction.** Interaction mechanisms should be formal enough to ensure participants commit time and resources, yet flexible enough to avoid unnecessary bureaucracy. Establishing effective coordination channels is essential to foster collaboration among actors and to guarantee representativeness across the full range of companies—regardless of size or sector. This ensures that the needs and perspectives of all stakeholders are heard and integrated into strategy design.
- **Establish Communication Strategies.** Effective communication strategies are essential to foster strong, fluid relationships among ecosystem stakeholders. Successful engagement depends on ongoing, two-way communication, the cultivation of long-term relationships, and continuous feedback among all parties involved.
- **Establish Goals and Commitments.** It is essential to define clear and realistic goals. In addition, a commitment must be made by the stakeholders that the decisions made in the ecosystem will influence the sector's policies and practices, and that they will be translated into concrete actions.
- **Plan Future Work and Define Responsibilities.** It is necessary to plan the activities of the ecosystem actors to achieve the goals and commitments, and to identify and assign the functions, roles and responsibilities of the ecosystem actors. It is also advisable to design a plan for financing the operation of the joint work. This document discusses the role of the participants of the sectoral competency councils in the development of the joint strategy between the State and the productive sector to generate quality education and foster the development of human capital.

MORE INFORMATION

Innovative options for financing training solutions:

- Public financing of job training through competitive funds: A promising option for Latin America and the Caribbean.
- Investors in Colombia: A study on the experience of investors hunder Colombia's Social Impact Bond Program.

4.2.2 • Gaps in Occupations, Skills and Training

Identifying gaps in occupations, skills and training related to strategic sectors is a complex process. The following stages are proposed to guide this analysis: (1) quantify and identify the required occupations; (2) analyze occupational profiles; (3) assess the existing training; and (4) identify gaps in occupations, skills, and training. Involving key stakeholders from the ecosystem throughout all stages of this process is essential. Figure 10 summarizes this process.

FIGURE 10 • STEPS FOR IDENTIFYING GAPS IN OCCUPATIONS, SKILLS, AND TRAINING

STAGE	SOURCES OF INFORMATION
1 OCCUPATIONS • Analyze the production process and the value chain. • Estimate the demand for occupations.	Surveys. Administrative data Big data. Sectoral reports. Reports on the training system. Observation in companies. Academic work. Interviews with ecosystem stakeholders.
2 OCCUPATIONAL PROFILE • Identify skills required in the occupations in demand.	
3 TRAINING SUITE • Analyze whether the training suite is aligned with the occupations and skills needed.	
4 GAPS • Identify gaps in occupations, skills and training.	

Source: Own elaboration.

The **first stage** involves understanding the sector's productive processes and value chain to estimate labor demand and identifying the occupational profiles needed to meet the green transition goals. This requires estimating the number and types of jobs needed at each stage of production to achieve these targets. Reliable and timely data, as well as valid analytical methods, are essential for assessing employment needs accurately.

One challenge is that data on occupations at detailed sectoral and sub-sectoral levels is often difficult to obtain (Cedefop, 2019). To gather information on occupational demand, a variety of sources can be used, including administrative records, sectoral reports, surveys of companies and trainees, direct observations within companies or plants, online vacancy data, and focus group insights. Collaboration among ecosystem actors is crucial to secure access to accurate, up-to-date, and high-quality data.

Common methods for estimating labor demand and anticipating future trends typically rely on quantitative approaches such as general equilibrium models, input-output models, and statistical forecasting. Each of these methods offers different levels of detail, time horizons, and update frequencies. Their suitability depends on factors like available financial and technical resources, the quality and granularity of sectoral data, and the specific characteristics of the sector being analyzed (Echeverría and Rucci, 2022).

MORE INFORMATION

Methods to estimate labor demand and anticipate changes.

- Summary of methodologies.
- Three examples of the use of job vacancies to collect information on labor demand.
  1) Job demand in Latin America: What can we learn from online vacancy portals?
  2) Green Jobs and Skills in Latin America: A Look at LinkedIn Data.
  3) What does data science add to the identification and anticipation of skills demand?
- Designing an employer skills survey: Notes on how to develop a survey to meet public policy issues related to skills demand and supply.
- Examples of efforts to identify gaps using conventional data and surveys of supply and demand representatives:
  1) Skills to Shape the Future: Employability in Belize.
  2) Identification, causes and consequences of Peru's skills gap.

Using publicly available information, Annex 1 presents a series of practical exercises as examples, examples to quantitatively approximate the employment effects resulting from changes in the energy matrix in Argentina, the Bahamas, and Trinidad and Tobago. These countries were selected due to differences in their energy transition goals and data availability. Argentina has well-defined sector goals integrated into its national policies and possesses simulations of renewable energy generation by technology under different scenarios. Although the Bahamas has not incorporated its energy commitments into national policies, it benefits from external studies estimating renewable energy potential by technology. In contrast, Trinidad and Tobago has neither integrated its NDC targets into national plans nor established its renewable energy generation potential.

Once the occupational demand at each stage of the production process is identified, the **second stage** involves analyzing the corresponding occupational profiles. This includes assessing the skills, competencies, and other attributes necessary for each job. A critical factor is the use of technologies that make production processes more sustainable, as their adoption is closely tied to workers' skill sets (Beaudry et al., 2010). Functional analysis is a useful tool here, where sector experts systematically analyze and document productive functions, occupations, and specific tasks within the sector (Echeverría and Rucci, 2022).

The **third stage** focuses on evaluating the current training suite related to the sector to determine whether it provides adequate training in the required skills and whether training pathways align with projected occupational, and skill demands. This is challenging in many LAC countries where TVET systems often have limited interaction with labor market demand (Correa et al., 2024; Findlater et al., 2024).

Beyond reviewing training offerings, it is essential to assess whether curricula and training programs align with green transition goals and sector needs. Effective alignment is difficult without mechanisms to accurately evaluate the skills demanded by specific occupations (OECD, 2023).

The **fourth stage** consists of identifying gaps in occupations, skills, and training suites to ensure alignment with current and future needs. This means assessing whether existing occupational profiles can satisfy projected demands, whether student flows into relevant profiles are sufficient, and whether current workers lack needed skills. Finally, it involves determining if the existing training suite is adequate or if new training programs or solutions are necessary to bridge gaps.

Annex 4 describes this process for the pilots implemented in Belize and Panama. Both countries developed and successfully implemented a human capital strategy: the former focused on the renewable energy sector and the latter on electromobility.

Finally, there are online tools that can help policymakers identify gaps in occupations, skills and training. One example is Cedefop, which provides data on labor market trends and future skill requirements. Although focused on European countries, its tools (such as Forecast, Skills Intelligence and Skills-OVATE) propose methodologies for collecting and analyzing data, which can serve as a guide for identifying key indicators and relevant trends in LAC.

In the regional context, the IDB Labor Observatory represents another very useful tool for policymakers, as it offers a wide range of indicators on the labor market in LAC countries, including specific data on skills, jobs and talent in sectors linked to the green transition.

MORE INFORMATION

Online tools that can help policymakers identify gaps in occupations, skills and training supply.

- Europe: Skills Forecast, Skills Intelligence and Skills-OVATE.
- Latin America: IDB Labor Observatory.

4.2.3 • Designing a Training Solution

Once the gaps in occupations, skills, and training have been identified, the next step is to design appropriate training pathways and content. This involves developing targeted training solutions to reduce or close these gaps. The process comprises several stages, which may vary depending on the structure of each country's TVET system, the strategic sector in focus, the occupational profiles in demand, and the specific skills to be developed. These stages are broadly summarized in Figure 11. While each stage should be guided by national and international best practices (OECD, 2023; World Bank, UNESCO, and ILO, 2023; UNESCO, 2020), the following sections offer key considerations that policymakers can tailor to their specific context.

FIGURE 11 • TRAINING SOLUTION DESIGN STAGES

STAGE	SOURCES OF INFORMATION
1 PARTICIPANTS AND TRAINING PATHWAYS • Analyze the starting point and design the profile.	Sources of information. Ecosystem stakeholders. Surveys. Information on the educational and technical and professional system. Experts. Review of successful case studies. Administrative data.
2 COURSE GRIDS • Design the courses that make up the training pathways.	
3 PEDAGOGY AND TRAINING RESOURCES • Develop pedagogical techniques and design training resources.	
4 TEACHER TRAINING • Develop technical and cross-cutting skills.	
5 CERTIFICATION GUIDELINES • Follow valid guidelines to achieve certifications.	
6 SYSTEM INTEGRATION • Coordinate with the educational and technical and professional system.	

Source: Own elaboration.

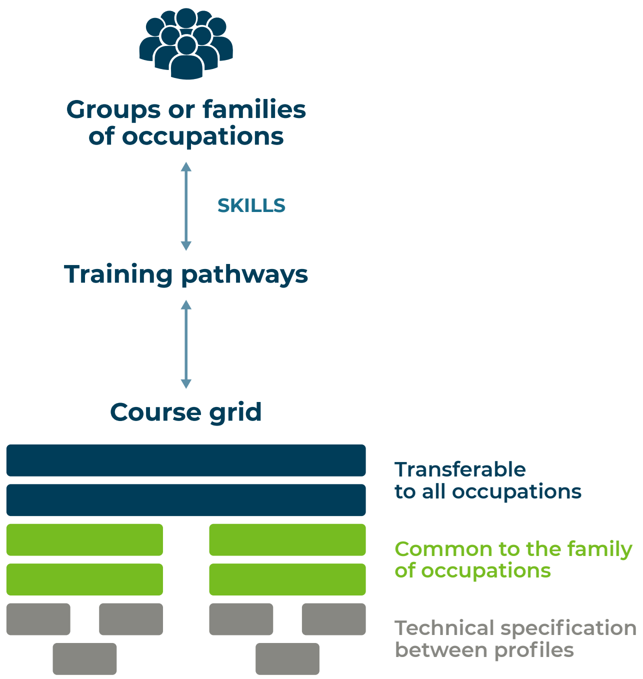
The **first stage** involves analyzing the profile of potential participants and defining the projected profile of program graduates. This requires assessing various characteristics of the target population, including age, the highest level of education attained, existing skill sets, work experience, and whether they belong to vulnerable groups. Understanding these factors is essential for designing relevant and inclusive training solutions tailored to participants' needs. This approach increases the likelihood of successful learning outcomes and supports sustained employment pathways.

The **second stage** involves designing the training solutions that comprise the training pathways. These solutions should be developed in a coordinated manner, forming what is commonly referred to as a “mesh” of courses or training packages structured set of learning experiences organized by sequence and complementarity to equip participants with the required skills. The format and structure of these courses may vary depending on the identified skills gaps, the availability of existing training programs, and the specific context and organization of each country’s technical and vocational education and training (TVET) system.

A core principle is that training solutions should not be developed in isolation or solely in response to the immediate needs of individual companies. Instead, they should be integrated into broader, upward mobile training and employment pathways. These pathways should allow individuals to progressively advance toward higher levels of specialization. The goal is not to establish rigid, linear routes, but rather to create dynamic and flexible learning pathways that accommodate a diverse range of learners (RELINK, 2024).

To be effective, the design of training solutions must be informed by both the needs of industry, particularly the skills required across the value chain to support the green transition—and the needs and characteristics of learners. A recommended approach is to design training for occupational groups or families, rather than for single job profiles. This approach acknowledges that some skills are transferable across multiple occupations, others are common within occupational families, and some are specific to individual roles. As such, the most effective training programs identify and leverage overlapping skill requirements to create modular and adaptable course offerings that serve a wide array of occupational profiles (RELINK, 2024). Figure 12 illustrates this approach.

FIGURE 12 • TRAINING SOLUTIONS TRANSFERABLE TO DIFFERENT OCCUPATIONS



Source: RELINK (2024).

An example that illustrates this approach is the overlap in skill requirements between the green hydrogen and electromobility sectors. While each sector requires specialized knowledge, they also share several foundational skills. For instance, both sectors demand expertise in efficient energy management: in electromobility, this involves optimizing the energy stored in electric vehicle batteries; in green hydrogen, it relates to the production and storage of energy required for hydrogen generation and utilization as a clean fuel. Similarly, safety and risk prevention skills are critical in both industries, highlighting the importance of shared competencies across occupational families.

The **third stage** in designing training solutions involves defining the pedagogical strategy and developing all associated learning resources. This includes materials for learners and instructors, instructional guides, infrastructure standards, appropriate learning environments, relevant technologies, and necessary equipment—ensuring high-quality learning experiences with a balanced integration of theory and practice.

It is recommended that pedagogical approaches emphasize hands-on, contextualized learning tailored to the characteristics of the target participants. Research shows that learner-centered, inquiry-based, and problem-solving instructional strategies significantly enhance outcomes, particularly in technical and vocational education (Näslund-Hadley et al., 2018).

In the case of courses that are offered to people who are working, learning-by-doing further promotes the application of acquired knowledge in everyday activities. This is especially important in the context of the green transition, because it increases the speed of adoption and use of new technologies by active workers.

In relation to training resources, there is a wide range of combinable options, from videos, animations and simulations to printed support material, models and real equipment or prototypes of current industry use, and so on. The choice of the most appropriate resources depends on the content of the courses, the skills to be developed and the profile of potential course participants. Relevant factors include age, familiarity with the use of technologies and the ability of participants to understand printed material, among others.

The **fourth step** is to ensure that teachers and instructors are prepared to train people, i.e., that they possess both the technical knowledge required for the courses they teach and the necessary pedagogical competencies (including practical skills and vocationally oriented teaching strategies). This requires an adequate selection of training personnel, as well as designing continuous training solutions that include opportunities for practical experience, enabling them to offer up-to-date and effective teaching.

While this is important in any type of training, it is especially critical in the case of TVET (World Bank, UNESCO and ILO, 2023) and becomes particularly relevant in the context of the green transition. This transition demands human capital capable of using new technologies, so the lack of trainers with the relevant skills can become an obstacle to the success of training pathways (OECD, 2023).

Consequently, it is recommended that the profile of trainers be analyzed to identify their needs and design comprehensive training solutions that guarantee the continuous improvement of their skills, both for current and future teachers (World Bank, UNESCO and ILO, 2023; OECD, 2023; UNESCO, 2020). This component is present in most of the pilot projects implemented in the region related to the development of human capital for the green transition. Training of trainers' models are fundamental in this process and should be adapted to the specific needs of each country and context. Several practical examples of implementation can be found in the compendium of skills training pilot projects presented in Prada and Rucci (2023).

The **fifth stage** involves following guidelines to obtain transparent certifications through the TVET system and those enabling certifications required by the relevant authorities (Amaral et al., 2017; Rosas-Shady et al., 2020).

Certifications support public recognition of acquired skills, enable people to exercise a trade or activity in accordance with the required standards and safety levels, and ensure transferability between occupations. They also contribute to guaranteeing the quality and relevance of competencies in a uniform and transparent manner. Skills certification is especially critical in the context of the green transition, as it is closely linked to the incorporation of new technologies and processes that demand clearly defined standards.

In some cases, workers must hold specific skill certifications so that companies can, in turn, certify their production processes and comply with international standards. However, if the TVET system does not offer this type of certification, it is possible to turn to other public bodies for certification—although, in such cases, the credibility of the issuing institution becomes decisive.

Finally, in a **sixth stage**, training pathways should be integrated in a structured manner into the different levels of the TVET system. The design of the courses should facilitate a fluid movement between secondary education, post-secondary training and the different modalities of technical and vocational training, as part of a lifelong learning process. This integration contributes to the scalability and sustainability of the courses developed, as well as to their efficient use by individuals.

A basic condition for ensuring the **relevance** of training solutions is to guarantee the active participation of the productive sector in all stages of training design. This means integrating inputs, processes, and outcomes that are aligned with the needs of the sector, involving all relevant ecosystem stakeholders. Training institutions must be equipped with modern infrastructure, updated materials, and an adequate learning environment. The diversity of training spaces (including industrial environments) enriches the educational process and provides students with more complete experience.

Close collaboration with industry enables the creation of meaningful and realistic learning opportunities, such as internship programs and structured apprenticeships that align with both educational and professional objectives. Training management should be efficient and in constant coordination with the productive sector to ensure that programs remain relevant and timely.

4.3 • Third step: Implementing Training Solutions

*The **third step** of this guide focuses on ensuring that training solutions are relevant and effective.*

The third step of the guide focuses on the effective delivery of training programs tailored to the needs of participants. This includes the use of flexible delivery modalities, such as in-person, virtual or hybrid classes, and the implementation of modular certifications that allow for progressive learning. In addition, this step promotes accessibility and social inclusion through innovative strategies, such as the use of mobile classrooms and digital platforms, to ensure that solutions reach diverse communities and effectively respond to the demands of the labor market associated with the green transition.

Training solutions differ in structure and format, so there is no single way to implement them. Table 3 presents the key components that policy makers should consider.

TABLE 3 • KEY COMPONENTS FOR THE IMPLEMENTATION OF TRAINING SOLUTIONS

COMPONENT OF IMPLEMENTATION	EXAMPLES OF OPTIONS
Mode of delivery	Classroom, virtual, hybrid.
Type of certification	Complete, modular and cumulative.
Form of delivery	Dual approach, mentoring with one-on-one mentoring, group mentoring-community practice, professionalizing internships, field day.
Spaces where the courses are held	Technical and vocational training centers, technical schools or high schools, companies, workplace, combinations of different options.
Actors responsible for running the courses	Teachers from the TVET system, external providers with training experience, combined schemes (cascade training).
Innovative means of content delivery	Platform, WhatsApp groups, specific applications, printed material.
Investment in equipment and infrastructure	Simulators, models, other equipment and technology, innovation laboratory.
Marketing and branding	Social networks, technical and professional training systems.

Source: Own elaboration based on Prada and Rucci (2023).

A key component in the implementation of training solutions is the mode of delivery—whether in-person, remote, or hybrid. For example, the renewable energy and electromobility program implemented in Panama adopted a hybrid teaching modality, combining virtual and in-person classes with the use of a traveling mobile classroom. This strategy enabled the delivery of practical training to rural communities that lack adequate facilities for this type of technical education. As a result, the program was able to broaden access to learning opportunities, reaching a more diverse and geographically dispersed population (for more details, see Annex 2).

Another key aspect of training implementation is the type of certification—whether it leads to modular or full certification. Courses can be structured as short, self-contained modules, allowing learners to progress at their own pace. Upon completion of each module, participants can obtain a partial certification, which supports progressive recognition of competencies and encourages continued engagement in the learning process.

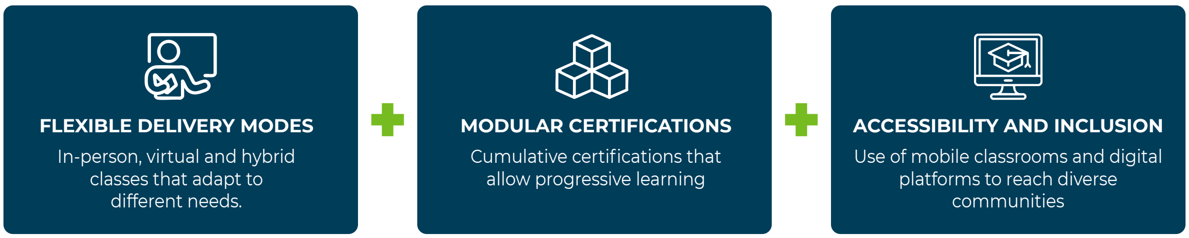
Some countries adopt a microlearning structure, which involves the creation of small content capsules focused on specific topics. These capsules are designed to be easily accessible from any electronic device, making them particularly convenient for a wide range of learners. This approach is often accompanied by micro-credentials, which grant credits for smaller blocks of learning. These credits can then be accumulated toward more comprehensive certifications and qualifications, without requiring learners to complete all components in a single sequence. More modular programs can help reduce dropout rates by offering flexible learning pathways.

Both the delivery mode and type of certification contribute to the flexibility of training solutions, allowing them to be tailored to participant needs. When selecting these components, it is essential to consider the characteristics of the target audience, ensuring that training is offered at accessible times and locations. This promotes more inclusive and effective learning, suited to diverse contexts and learner profiles. The form of course delivery must also be carefully considered. Evidence shows that learners benefit most from training experiences connected to real or simulated work environments (OECD, 2023). As such, various forms of workplace internships can be incorporated into training strategies. One effective model is dual learning, which combines classroom-based theoretical instruction with on-the-job training. Other possibilities include on-site mentoring or coaching, learning-by-doing workshops, field days, and structured internships (Prada and Rucci, 2023). The appropriate choice will depend on factors such as whether the participants are students or workers, their age, and the specific competencies to be developed. The learning venues (which may include TVET centers, schools, companies, or a combination of these) must be chosen accordingly.

Another key implementation component is defining the actors responsible for delivering the courses. These may include teachers from the TVET system or external providers, such as specialized institutions, private companies, NGOs, or consulting firms with expertise in specific training areas. A cascade training model may also be applied, whereby external providers train local trainers, who then deliver the content to learners.

A practical example of this is the renewable energy certification program in Belize. In its first stage, Nova Scotia Community College (NSCC) in Canada trained Belizean TVET instructors in renewable energy and energy efficiency, while also strengthening their pedagogical skills. In the second stage, these trained instructors delivered the courses directly to participants, ensuring that the knowledge was effectively transferred and adapted to the local context.

FIGURE 13 • **KEYS TO IMPLEMENTING TRAINING SOLUTIONS**



Source: Own elaboration.

The implementation of courses requires innovation in the means of delivering learning content. To ensure effective access for diverse populations, a variety of tools and methods are commonly used. These range from online platforms and mobile applications specifically designed for training, to WhatsApp groups, and combinations of synchronous and asynchronous formats, as well as the distribution of printed materials. The appropriate choice of delivery media will depend on the individual characteristics of participants, such as their digital literacy, access to devices, and internet connectivity. It will also be influenced by the duration, complexity, and objectives of the courses.

Another key element in implementing training solutions is investment in equipment and infrastructure. This includes identifying and providing the tools necessary for effective knowledge transfer, aligned with the skills to be developed. Depending on the nature of the training, this may involve:

- Simulators: Useful for recreating complex or hazardous work environments (such as those in the energy or manufacturing industries) without exposing participants to risk.
- Mock-ups and models: Help visualize and interact with physical systems. For example, agricultural training may use irrigation system models to teach efficient water use.
- Innovation workshops and laboratories: Offer spaces where learners can experiment with new technologies, apply theoretical knowledge, and practice problem-solving through hands-on activities.

It is essential that the choice of equipment is closely aligned with learning objectives and labor market demands, ensuring that the skills acquired are relevant and applicable in real-world settings. In addition, sustainability of investment must be considered. This means selecting equipment that can be used over time, is adaptable to evolving training needs, and includes plans for maintenance, upgrades, and instructor training. Ensuring that instructors are fully prepared to operate and teach with this equipment is critical for maintaining the quality and effectiveness of the training programs.[13]

Finally, marketing and branding strategies play an important role in the promotion and dissemination of training solutions to achieve higher enrollment rates. These strategies should not only focus on promoting the technical content of the courses, but also on communicating their relevance to the current context, such as their contribution to sustainable development and green transition. Clear communication about the accessibility and flexibility of the programs, including adaptable schedules, diverse modalities (virtual, in-person or hybrid), and locations, helps to attract a wider and more diverse audience. Complementing these strategies with success stories, testimonials from participants and strategic alliances with companies, organizations and governments strengthens the perception of legitimacy and quality of the programs, facilitating their acceptance in different sectors of society.

The implementation options discussed so far are conditioned by the governance and institutional framework in which the program is conceived. If the training solutions are developed from the beginning within the TVET system, the choice of aspects such as the modality, type of certification, form of course delivery, actors responsible for delivering the courses, among others, is conditioned by the rules and regulations of the VET system itself. In this case, there is less flexibility in the implementation options, since the courses must be adapted to existing frameworks. For example, in the technology training program in Argentina, training packages could not be included as part of the agricultural secondary school curriculum. Instead, they were incorporated as optional workshops in extracurricular schedules, which were chosen by most students (Prada and Rucci, 2023).

On the other hand, if training solutions are not framed within the TVET system from the beginning, there is greater flexibility in implementation decisions. However, once developed, the challenge of integrating these courses into the current training suite arises. This may require an additional validation and adjustment process to meet the standards of the TVET system. In this context, it is important to strategically plan how this integration will be carried out to ensure that the innovations and flexibility gained during the pilot phase are not lost when formalizing the courses within the TVET system. Partnerships between institutions of the TVET system and actors of the productive sector can facilitate this integration process, ensuring that the new training suites are formally recognized and can benefit a larger number of participants.

13. When making infrastructure decisions aligned to skill needs, it is advisable to also consider the potential of implementing solutions that are climate sustainable. Some examples of such solutions can be found in Bos and Schwartz (2023).

4.4 • Fourth step: Quality Assurance and Continuous Improvement of Training Solutions

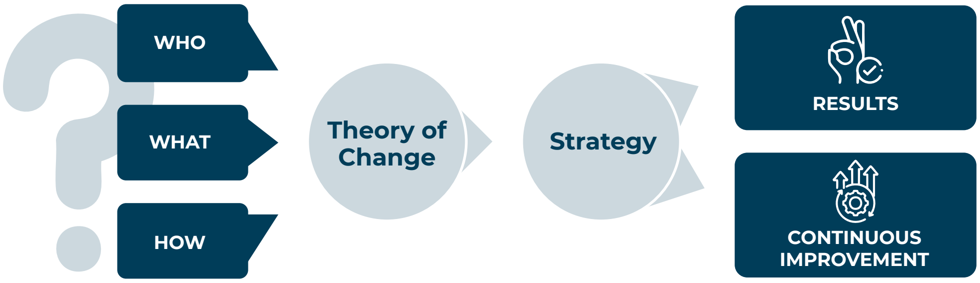
*The **fourth step** of this guide focuses on ensuring that training solutions are relevant and effective.*

The fourth step of this guide focuses on ensuring that training solutions are relevant and effective. A human capital development strategy should be oriented towards achieving end results. Although these results may vary according to the context, in general terms, they are focused on offering quality and relevant training, developing skills that are applied in productive activities, thus contributing to employment and productivity. It should also promote continuous improvement based on evidence. It is a dynamic process, where the generation of evidence-based information feeds back and empowers stakeholders to make informed decisions (World Bank, UNESCO and ILO, 2023).

The desired outcomes of a human capital development strategy are defined at the outset, at the design stage. "Theory of change" is a methodology that helps to describe how and why this strategy is expected to lead to a desired change: in this case, that the participants of the training suites learn new and better skills, which are applied in their workplaces, contributing to improvements in their productivity and employability. The theory of change helps to establish clear links between who the training strategy is aimed at (students or workers), what skills will be developed (technical, cross-cutting/transferable, socioemotional), how the learning will be delivered (type of training solution) and what are the inputs and processes needed to achieve the desired results (Figure 14). In other words, it helps to understand how a human capital development strategy plans to achieve its desired results.

The best time to apply the theory of change is at the beginning of a human capital strategy, as it brings stakeholders together to define a common vision, the desired outcomes and the path to achieve them.

FIGURE 14 • APPLICATION OF THE THEORY OF CHANGE



Source: Own elaboration.

The ability to achieve desired results and continuous improvement depends on multiple factors. One of them is the establishment of mechanisms to: (i) ensure the quality of the inputs and processes involved; and (ii) monitor and evaluate results. These mechanisms are particularly important for the development of skills in the context of the green transition. For one, rapid transformations in work tasks and skill demands during the transition require a human capital development strategy that responds in a timely and efficient manner. Quality assurance, monitoring and evaluation mechanisms help training solutions achieve excellence and relevance. As well, training solutions in the green transition often start as pilots. Monitoring and evaluation can identify strengths and areas for improvement, providing evidence to support informed decisions for further expansion or scalability.

Although there is no single pathway to establish these mechanisms, as it depends on several factors (including the VET system in each country, the governance of the institutions and the economic sector), this section suggests central steps and offers good practices to guide policy-makers in this process.

4.4.1 • The Quality Assurance System

A human capital development strategy must aspire to excellence. As such, in addition to designing training solutions with the highest quality standards, the strategy should be based on a quality assurance system that guarantees the quality: (i) of the educational and training institutions involved in offering training solutions; (ii) of workplace learning and its integration with learning acquired in other settings; (iii) of the accreditations, degrees and certifications offered in each type of training solution; and (iv) of the education, teaching and training processes (Amaral et al., 2017).

A human capital development strategy must be aligned with current quality assurance frameworks. These frameworks provide a set of guidelines and standards that guide the development and delivery of training solutions, ensuring predefined levels of quality, validity and effectiveness (Amaral et al., 2017; UNESCO, 2017). With different scopes, these comprise, principally: (i) qualifications frameworks, which organize the levels and types of academic and professional qualifications, and outline learning trajectories; (ii) protocols to ensure the credibility of skills assessments and certifications; and, (iii) accreditation standards to ensure the quality of training offered by training institutions (World Bank, UNESCO and ILO, 2023; Amaral et al., 2017; UNESCO, 2017).

Quality assurance frameworks differ across countries in multiple ways. Some have strong institutions and processes for quality assurance in the VET system, such as Australia, the United Kingdom, Germany and other countries in Europe (Amaral et al., 2017). One example is the European Quality Assurance Reference Framework for Vocational Education and Training (EQAVET), which is based on a four-stage quality assurance and improvement cycle (planning, implementation, evaluation/assessment and review/revision). It also uses indicators applicable to quality management at both the VET system and VET provider levels. This framework has prompted the development of various quality assurance approaches in European countries, adapted to their local needs and circumstances (European Commission, 2024).

Other quality assurance frameworks, rather than focusing on the quality of the TVET system, have focused on assuring the quality of training programs. One example is the Association for Career and Technical Education (ACTE) Quality Framework, used in the United States, which is designed for technical education programs at the secondary and postsecondary levels, both individual and local. It includes criteria and best practices for establishing quality standards in curricula, the learning process, and instructor training. In addition, it proposes criteria for evaluating students and ensuring that programs are aligned with labor market demands (ACTE, 2018).

A human capital development strategy also must rely on external validations through independent evaluators or evaluation committees composed of industry representatives and external training centers. After external validation, the agency issues an accreditation along with recommendations or necessary adjustments.

In the context of the green transition, agile certification management that develops criteria and standards that can be updated to reflect technological advances and best practices is a very relevant aspect. A distinction can be made between at least the following three types of certifications:

- **Certification of Acquired Knowledge:** Issued by the corresponding institution of the TVET system, it is a necessary condition in any training process, since it confirms the knowledge and skills acquired by the participants during their training.
- **Work Qualifying Certification:** Guarantees that the person is qualified to perform certain trades or activities, complying with the necessary standards to perform their work compe-

tently. For example, the certification of a gas fitter guarantees that the person is qualified to install, maintain and repair gas systems in a safe and efficient manner.

- **Green Certification:** Guarantees that individuals, companies or products comply with environmental sustainability criteria, such as the implementation of sustainable practices, efficient use of resources, compliance with environmental standards, and so on. These certifications are particularly useful when an existing workplace is modified to reduce the environmental damage of the activity. One example is certifications that ensure that products, such as agricultural eco-products, comply with environmental standards. Another is the certification of individuals to ensure that workers have the necessary knowledge and skills to perform their work in an environmentally sustainable manner, as in the case of green gas certification.

Green certifications are particularly important for the transition because they provide a signal to the market. They ensure, for example, that products can be differentiated in international and domestic markets, facilitating consumer choice and companies' access to certain market segments or niches. This recognition not only promotes sustainable practices but can also generate greater profits for companies by increasing their competitiveness in markets where sustainability is valued. Certifications are also important for workers, since they corroborate the skills acquired throughout their training and ensure the portability of skills to different occupations and economic sectors. Finally, certifications for trainers validate their knowledge, allowing them to become new trainers. This helps to scale the training packages and make them sustainable over time, even after the pilot project funding ends.

4.4.2 • Monitoring

Another pillar for a human capital development strategy to achieve its desired results and continuous improvement is monitoring. Monitoring consists of ensuring that the strategy is being designed and implemented in accordance with valid quality standards and according to planned procedures. It also allows corrective action to be taken in a timely manner in the event of deviations and promotes continuous improvement.

Figure 15 outlines the main stages of monitoring. The first is to develop the theory of change to identify key inputs and processes that are logically linked to achieve the desired results. One tool that can be used for this is the planning matrix, which describes in simple terms factors such as timing, risks and responsible parties for these inputs and processes (Siles and Mondelo, 2018). In this step it is also important to design a tool to identify and visualize the quality standards of the inputs and processes.

FIGURE 15 • STAGES OF THE MONITORING PROCESS

STAGE	SOURCES OF INFORMATION
1 THEORY OF CHANGE • Identify process and key inputs and quality standards.	Quality assurance frameworks. Internal information on strategy. International best practices and tools. Similar projects. Expert interviews. Baseline. Administrative data. Data collection during implementation (surveys, interviews, observations, etc.).
2 INDICATORS • Define milestone achievement indicators at key stages of implementation.	
3 SUPERVISION • Monitor the progress of these indicators and quality standards.	

Source: Own elaboration.

The second stage involves defining indicators to measure the progress of the strategy's key inputs and processes. A useful tool for this is the results matrix, developed during the strategy design phase, which uses a logic model to define the relationship between inputs, processes and indicators (Siles and Mondelo, 2018). Because formative solutions vary in their structure and format, indicators must be adapted to each case. Some core indicators are participant attendance, timely delivery of training resources, coverage of curriculum topics, number of certified individuals, among others. It is also necessary to verify that the training suites are relevant for the users. To this end, it is suggested to monitor the perception of trainers and individuals receiving training on the relevance of the training suites and resources, as well as their level of satisfaction.

In addition to identifying indicators, it is necessary to specify the sources of information, method and frequency of data collection. Sources include administrative data, surveys, interviews or focus groups with key stakeholders such as implementers and participants, among others (Gibson, 2021). As in the previous stages, collaboration among the different actors in the ecosystem is essential to take advantage of the availability of administrative data and collection instruments, which helps to reduce the economic and logistical costs of monitoring.

Finally, the third stage consists of monitoring or supervising these indicators and the quality standards as the implementation of the human capital strategy progresses.

4.4.3 • Evaluation

Evaluation seeks to measure the results achieved by a human capital development strategy, providing information on its effectiveness and contributing to informed decision making. The theory of change begins with identifying desired outcomes. While these outcomes may vary according to the context and the specific strategic sector, the main objectives are usually developing skills and learning, the ability of participants to apply what they have learned in their work contexts, and improvements in their performance, productivity and employability.

One challenge is to define the timing of the assessment. In the context of the green transition, the results will manifest themselves in the medium and long term. On the one hand, the application of new knowledge or techniques in daily activities is not immediate but requires a process of assimilation that may take time. On the other hand, training is expected to increase workers' productivity, which will be reflected in better job opportunities. This implies that they may be able to access positions of higher hierarchy or responsibilities in the same workplace, or that they may be able to adapt their skills to access new positions in other economic sectors. However, these processes do not usually occur immediately after completion of the training packages but take more time.

Figure 16 outlines the evaluations steps. The first involves using the theory of change to describe the causal logic of how and why a human capital development strategy is expected to achieve its desired results.

FIGURE 16 • STAGES OF THE EVALUATION PROCESS

STAGE	SOURCES OF INFORMATION
1 THEORY OF CHANGE • Establish how and why the training solutions are expected to achieve results.	Collaboration between ecosystem and experts. Similar case studies.
2 PERFORMANCE INDICATORS • Build learning and employability indicators to measure results.	
3 EVALUATION METHOD • Select the evaluation method.	
4 DATA COLLECTION • Design baseline and follow-up collection instruments.	Administrative data. Collaboration between ecosystem and experts.

Source: Own elaboration.

The second stage involves identifying the desired results and constructing performance indicators to measure them. These indicators focus on measuring participants' learning, the extent to which they apply new skills and knowledge in their work activities, and how the development of better and new skills contributes to increasing their productivity and employability.

The third step is to select the evaluation methodology or strategy. Different methodologies exist and their choice depends on various factors such as data availability and scale. In many cases, especially in the context of the green transition, formative solutions start as pilots with a reduced scale (for more details see the resources available on the IDB website). The evaluation should be carried out by a third-party external to the implementing organization to ensure independence and that results are credible.

Finally, the fourth stage involves designing instruments and mechanisms for collecting information. Regardless of the methodology selected, the evaluation involves at least two instances in which the information needed to measure the results is collected. These instances are at the beginning of the training, known as the baseline, and at the end of the training, known as follow-up. Both instruments collect the information needed to construct the outcome indicators and compare them before starting the training and at the end.

The baseline provides a starting point for measuring performance indicators at the beginning of the project and evaluating the changes achieved with the training and generating a particularly valuable diagnostic in the context of the green transition, where information on the skills of workers and trainers is often limited. It usually collects information on the characteristics of participants and trainers, their initial knowledge, production processes, work practices, use of technologies, and so on. Follow-up, meanwhile, collects information with which to measure the progress of results. Although follow-up is collected at the end of the training programs, it is possible to carry out additional follow-up lines of inquiry to evaluate the impact of the program on medium- and long-term results.

Monitoring and evaluation are not limited to the simple collection of isolated evidence (Alcazar and Rosas-Shady, 2019) but are integral processes that are applied at all stages of a human capital strategy, ensuring the quality of the training solutions and verifying the consistency between the results obtained and the established objectives (Alcazar and Rosas, 2019). Based on this process it is possible to extract lessons learned and use them for the improvement or expansion of the intervention in the future.

FIGURE 17 • SUMMARY STEPS GUIDING THE DESIGN OF A HUMAN CAPITAL DEVELOPMENT STRATEGY FOR THE GREEN TRANSITION

1 SELECT STRATEGIC SECTORS

1.1 **The search for a methodology:** Defining criteria, constructing indicators and establishing a performance matrix to prioritize sectors.

1.2 **Six criteria for prioritization:** Consideration of emissions, vulnerability, economic importance, human capital needs, technological investment and strategic alignment.

2 DESIGN TRAINING PATHWAYS AND CONTENTS

2.1 **Shape the stakeholder ecosystem:** Involve the public, private, educational and other stakeholders in collaborative working groups.

2.2 **Identify gaps:** Analyze occupations, skills and the existing training suite to develop relevant solutions.

2.3 **Design training solutions:** Create training pathways that combine specific, cross-cutting and transferable skills.

3 IMPLEMENT TRAINING SOLUTIONS

3.1 **Adapt modalities:** Incorporate flexible approaches (in-person, virtual, hybrid) and modular certifications.

3.2 **Promote accessibility:** Ensure social inclusion through strategies such as mobile classrooms and digital platforms.

4 QUALITY ASSURANCE AND CONTINUOUS IMPROVEMENT

4.1 **Establish quality standards:** Align with qualification and assessment protocols.

4.2 **Implement monitoring and evaluation:** Measure results, identify areas for improvement and adjust strategies based on evidence.

5 • What's Next? The Time to Act is Now

The green transition not only poses significant challenges in terms of economic, social and environmental transformation, but also opens a unique window of opportunity to rethink development in Latin America and the Caribbean. The guide presented here seeks to offer a practical roadmap adapted to the realities of the region, ensuring that countries can close the skills gaps necessary for this transformation.

The Role of Human Capital in the Transition

Developing workforce skills is an essential component to ensure the green transition is successful. From identifying strategic sectors to implementing inclusive and sustainable training solutions, each step outlined in this guide reinforces the idea that investing in human capital is not just a necessity, but an opportunity to boost competitiveness, reduce inequalities and build resilience to climate change impacts.

Lessons Learned and Recommendations

The examples described in this publication show that skills development can be a catalyst for accelerating the green transition and ensuring that economic and social benefits are broad and equitable. Key lessons include the importance of involving all stakeholders in the ecosystem, the need for flexible and modular training solutions, and the value of monitoring and evaluation systems to ensure continuous improvement.

Commitment to the Future

Ultimately, the success of the green transition will depend on the sustained commitment of governments, businesses, educational institutions and civil society to work together, design inclusive strategies and prioritize investments in education and training. These efforts will make it possible to build a sustainable future that combines economic growth with environmental protection and social welfare.

A Call to Action

This document is a first step towards designing effective strategies for the green transition. We invite policy makers, business leaders and other key stakeholders to adopt these recommendations and turn them into concrete actions. The time to act is now, and human capital development is the way to transform challenges into opportunities and ensure that the green transition is just, inclusive and sustainable for all.

Annex 1 • Potential for the Green Transition to Generate Employment Opportunities: An Example for LAC Countries

Identifying the necessary skills associated with the green transition is a highly specific process and depends on the country's context and the economic sector under analysis. However, a starting point for understanding skill requirements is to estimate the employment opportunities associated with the green transition.

Using publicly available information, exercises are carried out in this annex to quantitatively approximate the employment opportunities that would arise as a result of changes in the energy matrix in Argentina, Bahamas and Trinidad and Tobago. The selection of these three countries is based on the differences in terms of approaches and goals to achieve changes in the energy matrix, as well as the variability in the availability of public information.

For this analysis, the latest available update of the NDCs by country, available in the public NDC registry (Nationally Determined Contributions Registry) of the United Nations Climate Change Secretariat, was used as a reference. Since the NDCs are non-binding commitments, a complementary review of the integration of these commitments into national policies and plans was carried out through official documents by country concerning the energy transformation associated with compliance with the NDCs (Table A1.1).

TABLE A1.1 • **ENERGY TRANSFORMATION COMMITMENTS BY COUNTRY**

COUNTRY	NDC ENTRY INTO FORCE	TIME HORIZON	NDC TARGET: GHG EMISSIONS OR RENEWABLE ENERGY GENERATION	SCENARIOS FOR CALCULATING EMPLOYMENT OPPORTUNITIES	INTEGRATION WITH NATIONAL POLICIES AND PLANS
Argentina	02/11/2021 (3rd version)	10 years (between 2020 and 2030)	Reduction to 349 Mt CO_2 by 2030	Two scenarios: **REN20:** Energy transition with national capacities, reaching 20% renewable energy generation by 2030. **REN30:** Energy transition with national capacities, reaching 30% of renewable energy generation by 2030.	Resolution 1036-2021
Bahamas	07/11/2022 (2nd version)	10 years (between 2020 and 2030)	Reduction of greenhouse gas emissions by 30%. Incorporate 30% of renewable energies in the energy mix.	Two scenarios: **REN30:** 30% of energy with renewable technologies by 2030. **MAX:** If the maximum renewable energy generation potential per technology is reached.	N/A
Trinidad and Tobago	22/02/2018 (1st version)	17 years (between 2013 and 2030) Business as usual: 2013	Reduction of GHGs to 15% GHG levels of BAU emissions by December 31, 2030.	Two scenarios: **1 TECH:** Using renewable energy generation technology (wind) **2TECH:** Utilizing two renewable energy generation technologies (wind and solar)	N/A

Source: Own elaboration.

As shown in the table, Argentina incorporates the targets established in its NDC into national policies through a ministerial resolution and has developed its own simulations of renewable energy generation by technology under two different scenarios (REN20 and REN30). The Bahamas, however, has not integrated its commitments into national policies. Instead, external studies estimating renewable energy generation potential by technology serve as references for calculations. Finally, Trinidad and Tobago neither integrates its NDC targets into national policies and plans nor has known renewable energy generation potential. Additionally, its targets are expressed in terms of GHG emission reductions rather than energy mix composition.

A1.1 • Estimation of Direct Employment using Multipliers

As a first exercise, the direct employment opportunities per year were calculated for the detailed schedules by country. To perform these calculations, the direct employment multipliers detailed in Wei et al. (2010) were used, which allow for a simple calculation supported by academic literature.[14]

This methodology is extremely useful if a quick approximation of employment opportunities is required. In addition, it is based on energy transformation targets and allows disaggregating the results by renewable energy generation technology, which are shown in Table A1.2. Subsection 4 of this annex describes the methodology in more detail.[15]

TABLE A1.2 • ANNUAL DIRECT EMPLOYMENT OPPORTUNITIES BY TECHNOLOGY

TECHNOLOGY	ARGENTINA		BAHAMAS		TRINIDAD AND TOBAGO	
	REN20	REN30	REN30	MAX	1TECH	2TECH
Wind	214	391	71	104	68	19
Solar Photovoltaic	362	533	125	183		62
Biomass	82	82	1	2		
Thermoelectric	103	103				
Hydroelectric	416	416				
TOTAL	1178	1527	197	289	68	81

Source: Own elaboration.

Notes: REN20 = 20% of the country's energy mix in renewable energy by 2030; REN30 = 30% of the energy mix in renewable energy by 2030; MAX = Using the country's maximum renewable energy potential; 1TECH: Use of 1 single technology for renewable energy production (wind); 2TECH: Use of 2 technologies for renewable energy production (wind and solar). Employment estimates for each country reflect one worker employed full-time equivalent (FTE) for one year.

14. The steps for calculating these estimates are detailed in subsection A1.4.

15. As described in Subsection A1.4, to estimate these multipliers, Wei et al. (2010) collected data from different studies to construct the multipliers. The limitation of these multipliers is that they were estimated using studies with data from the United States and Europe as a reference.

A1.2 • Estimates of Direct Employment using Input-Output Models

As a next exercise, direct employment opportunities were estimated using the I-JEDI (International Jobs and Economic Development Impact) input-output models,[16] which allow the data to be customized, as well as distinguishing between direct employment opportunities for the construction and operation phases and even calculating indirect and induced employment levels. I-JEDI models can also be adapted to the context of the country under analysis, depending on the information available.

The distinction between employment opportunities by phase is key, as the construction phase generally involves a larger number of employment opportunities over a relatively short period while the operation phase, which begins once construction is complete, usually requires fewer workers with positions that are retained for the life of the project. Table A1.3 shows the estimated direct employment opportunities per year for the construction and operation phase for Argentina, Bahamas, and Trinidad and Tobago.[17]

TABLE A1.3 • DIRECT EMPLOYMENT OPPORTUNITIES PER YEAR DIFFERENTIATING BETWEEN CONSTRUCTION AND OPERATION PHASES

TECHNOLOGY	ARGENTINA				BAHAMAS				TRINIDAD AND TOBAGO			
	REN20		REN30		REN30		MAX		1TECH		2TECH	
	C	O	C	O	C	O	C	O	C	O	C	O
Wind	733	188	1,342	344	244	63	357	92	235	60	66	17
Solar Photovoltaic	230	65	338	96	277	79	116	33			39	11
Biomass	108	216	108	216	10	27	2	5				
Thermoelectric	57	2	57	2								
Hydroelectric	416	416	416	416								
TOTAL	1,543	887	2,260	1,074	531	168	475	130	235	60	105	28

Source: Own elaboration.

Notes: C = Construction phase; O = Operation phase. REN20 = 20% of the country's energy matrix in renewable energy by 2030; REN30 = 30% of the energy matrix in renewable energy by 2030; MAX = Using the country's maximum renewable energy potential; 1TECH: Use of 1 single technology for renewable energy production (wind); 2TECH: Use of 2 technologies for renewable energy production (wind and solar). Each employment opportunity reflects 1 worker employed full-time equivalent (FTE) for one year.

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16. The original model was developed for the United States (JEDI) and then expanded for international use (I-JEDI). The I-JEDI models are open access tools developed by the U.S. National Renewable Energy Laboratory (NREL) with support from the U.S. Agency for International Development (USAID) under the EC-LEDS (USAID Enhancing Capacity for Low Emission Development Strategies) program.

17. Note that these estimates of employment opportunities do not include personnel involved in the planning and procurement phases of projects.

A1.3 • Occupational Profiles Needed to Achieve the Energy Transition

Using the occupational patterns for renewable energy generation estimated by IRENA (International Renewable Energy Agency), it is possible to disaggregate the employment opportunities previously estimated with the I-JEDI input-output models by occupation, distinguishing between the construction and operation phases by technology. These occupational profiles are available for wind, solar photovoltaic and hydroelectric technologies. However, the calculation assumes that employment will be generated uniformly over the time horizon, rather than gradual growth over time. To this end, a final target is established and distributed equally across the project period, under the assumption that employment generation will reach its maximum potential immediately, without a progressive phase of adoption. This approach simplifies the analysis and makes it possible to establish initial estimates which, although they do not take into account variations over time, are useful for projecting the potential impact in the long term.

For the construction phase (Table A1.4), employment opportunities are mostly composed of builders, technical personnel, as well as unskilled labor (workers who help with lifting/loading and assisting in construction activities). For example, for a wind power plant, approximately 48% of construction employment opportunities are focused on preparing the installation area and civil work, and 30% on assembling the equipment, while, for a solar plant, these percentages are 56% and 24%, respectively (IRENA, 2017a, 2017b and 2023).

TABLE A1.4 • DIRECT EMPLOYMENT OPPORTUNITIES BY OCCUPATION AND TECHNOLOGY FOR THE CONSTRUCTION PHASE BY YEAR

TECHNOLOGY	ARGENTINA		BAHAMAS		TRINIDAD AND TOBAGO	
	REN20	REN30	REN30	MAX	1 TECH	2TECH
Wind	733	1,342	244	357	235	66
· Logistics experts	7	13	2	4	2	1
· Environmental experts	15	27	5	7	5	1
· Health, safety and quality control experts	29	54	10	14	9	3
· Engineers and construction foremen	51	94	17	25	16	5
· Workers who operate cranes, trucks, etc.	66	121	22	32	21	6
· Construction workers and technical personnel	564	1033	188	275	181	51
Solar Photovoltaic	230	338	277	116		39
· Environmental experts	2	3	3	1		0
· Quality control	2	3	3	1		0
· Construction workers and technical personnel	207	304	249	104		35
· Engineers and construction foremen	14	20	17	7		2
· Health and safety experts	5	7	6	2		1
Hydroelectric	416	416				
· Administrative machinists and financial personnel	21	21				
· Contracts, procurement and local logistics staff	29	29				
· Drivers	8	8				
· Project managers	8	8				
· Draftsmen, design engineers, site engineers and surveyors	50	50				
· Unskilled labor	220	220				
· Machinists	12	12				
· Technicians and electricians	12	12				
· Community mobilizers and village electrification committee personnel	42	42				

Source: Own elaboration.

Notes: The proportion of employment opportunities by occupation were estimated using as reference IRENA (2017a) for wind power generation, IRENA (2023)for hydroelectric power generation taking as standard a 500Kw plant; and for energy the proportions for solar photovoltaic energy from IRENA (2017b) were used as reference. Since the ratios used by IRENA to estimate occupations by technology are approximations and integers are used to represent workers/opportunities, in some cases it is possible that the sum of a number greater or less than 1 may add up to the total.

Regarding the operation phase (Table A1.5) there is greater heterogeneity among occupations by technology compared to the construction phase. According to IRENA (2017a, 2017b and 2023), for hydroelectric power plants technical personnel make up the largest share of employment opportunities (40%). Similarly, 47% of the operational employment opportunities for wind power generation are concentrated in technicians and operators. However, in the case of solar photovoltaic power plants, technical personnel account for only about 16%, as employment opportunities are mostly focused (48%) on construction workers tasked with cleaning solar panels.

TABLE A1.5 • DIRECT EMPLOYMENT OPPORTUNITIES BY OCCUPATION AND TECHNOLOGY FOR OPERATION PHASE

TECHNOLOGY	ARGENTINA		BAHAMAS		TRINIDAD AND TOBAGO	
	REN20	REN30	REN30	MAX	1TECH	2TECH
Wind	188	344	63	92	60	17
· Management	4	7	1	2	1	0
· Environmental experts	6	10	2	3	2	1
· Lawyers, experts in energy regulation	6	10	2	3	2	1
· Administrative accounting staff	9	17	3	5	3	1
· Security experts	10	19	3	5	3	1
· Technical staff	10	19	3	5	3	1
· Construction workers	15	28	5	7	5	1
· Operators	77	141	26	38	25	7
· Engineers	51	93	17	25	16	5
Solar Photovoltaic	65	96	79	33		11
· Administrative and accounting personnel	1	1	1	0		0
· Lawyers, experts in energy regulation and management	1	1	1	0		0
· Construction workers	31	46	38	16		5
· Security experts	12	18	15	6		2
· Industrial, electrical and telecommunications engineers	10	14	12	5		2
· Operators	5	8	6	3		1
· Technical staff	5	8	6	3		1
Hydroelectric	416	416				
· Administrative and financial personnel	17	17				
· Contracts, procurement and local logistics staff	54	54				
· Drivers	1	1				
· Project managers	8	8				
· Design and site engineers	29	29				
· Unskilled labor	29	29				
· Machinists, electricians, technicians, operators, masons and skilled laborers	241	241				
· Community mobilizers and village electrification committee personnel	37	37				

Source: Own elaboration.

Notes: The proportion of employment opportunities by occupation were estimated using as reference IRENA(2017a) for wind power generation, IRENA (2023) for hydroelectric power generation taking as standard a 500Kw plant; and for solar, biomass and thermoelectric power the proportions for solar photovoltaic power from IRENA (2017b) were used as reference. Since the ratios used by IRENA to estimate occupations by technology are approximations and integers are used to represent workers/opportunities, in some cases it is possible that the sum of a number greater or less than 1 may add up to the total.

The results obtained for the operation phase show that, regardless of the technology employed, renewable energy generating plants require specific technical skills for their operation and maintenance. Whether as operators, technical personnel, skilled labor, or construction workers associated with plant maintenance, these occupations demand job skills associated with the technology in question.

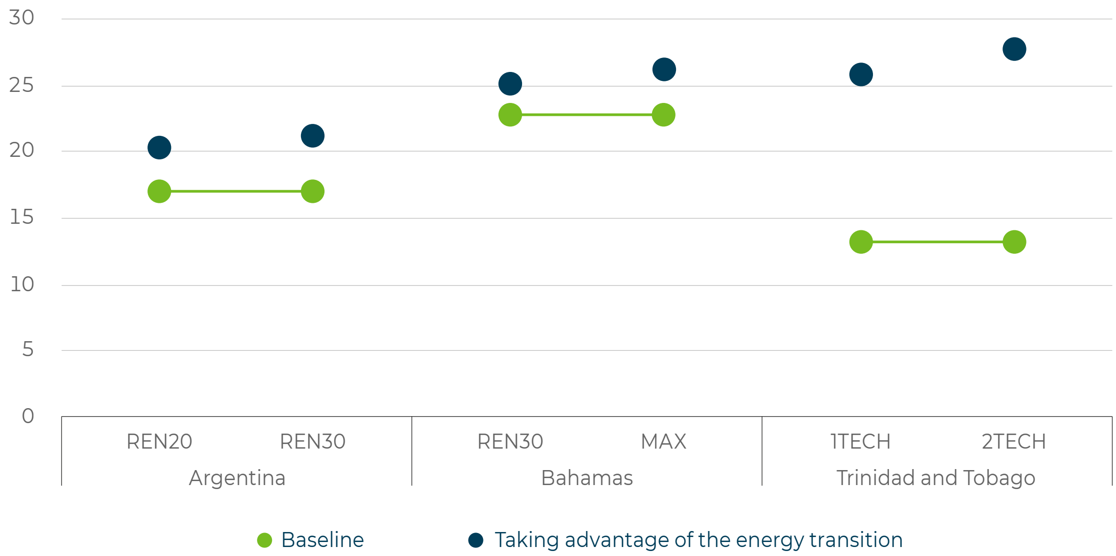
For this reason, it is essential to include the development of job skills as a strategy to take advantage of the opportunities that the green transition offers the region. In this scenario, technical and vocational education and training is a cornerstone because of its flexibility, capacity for innovation and connection with the productive sector.

A1.3 • Potential for Reducing the Gender Gap

In addition, an illustrative exercise was carried out on the potential of employment generated to reduce the gender gap. To this end, we calculated how much the gender gap in the energy sector could be reduced by country and scenario, under the assumption that all new direct employment opportunities generated annually would be filled exclusively by female labor participation.

The results of this exercise are shown in Figure A1.1. It is estimated that the energy transition in Argentina could generate 1,527 new jobs in one year. If these were filled exclusively by women, female labor participation in the energy sector would increase from 17% to 22.21%, reducing the gender gap by up to 4.26 percentage points (pp). In the Bahamas, the energy transition could create 289 jobs in one year. Similarly, if these were filled exclusively by women, female participation in the energy sector would increase from 22.78% to 26.16%, reducing the gender gap by up to 3.38 pp. In Trinidad and Tobago, the energy transition would have the potential to generate 81 new jobs per year. If these were occupied exclusively by women, female participation in the energy sector would increase from 13.18% to 27.74%, reducing the gender gap by up to 14.56 pp.

FIGURE A1.1 • ANNUAL FEMALE PARTICIPATION IN THE EMPLOYED LABOR FORCE IN THE ENERGY SECTOR BY COUNTRY AND SCENARIO (IN PERCENTAGES)



Source: Own elaboration.

Notes: The baseline gender gap for Argentina corresponds to 2019 and was extracted from Beaujon et al. (2022); for the Bahamas it corresponds to 2019 and was extracted from the Report - Workforce (2019); and for Trinidad and Tobago it corresponds to 2023 and was extracted from the Energy Sector Workforce Report 2023). The employment opportunities generated annually by the country correspond to those estimated on an aggregate basis using the methodology of Wei et al. (2010) described in Table A1.2.

A1.4 • Methodological Note: Estimating Employment Opportunities to Achieve Changes in the Energy Matrix

The techniques and processes used to obtain the results presented in this appendix are described below.

To calculate the annual energy generation potential needed to meet the renewable energy generation targets by country and scenario, the country targets usually expressed in MW (megawatts) were converted to GWh (gigawatt hours) using the following formula, where FC indicates the capacity factor:

$$GWh = \frac{MW * 24 * 365 * FC}{1000}$$

The plant is assumed to operate 24 hours a day, 365 days a year. Because the amount of electricity a power plant generates depends on its electrical generating capacity and the amount of time the plant's individual generators operate at a specific capacity, one measure of electrical generating capacity in relation to electricity generation is the capacity factor (EIA). For our calculations, the capacity factors shown in Table A1.6 were used.

TABLE A1.6 • CAPACITY FACTORS BY POWER GENERATION PLANT

TECHNOLOGY	CAPACITY FACTOR	PLANT LIFE
Biomass	85%	40 years
Wind	35%	25 years
Hydroelectric	55%	40 years
Solar photovoltaic	40%	25 years
Thermoelectric	90%	40 years

Source: Wei et al. (2010).

Based on this information, the expected generation potential by technology was determined for each country and scenario (Table A1.7). Estimates were made on an annual basis assuming that the energy generation potential is reached from the beginning of the project. In other words, once the energy generation target was established, it was divided by the years of the target's time horizon, which is usually by 2030.

TABLE A1.7 • ANNUAL POWER ADDITIONS BY TECHNOLOGY IN GWH TO MEET RENEWABLE ENERGY GENERATION GOALS

TECHNOLOGY	ARGENTINA		BAHAMAS		TRINIDAD AND TOBAGO	
	REN20	REN30	REN30	MAX	1TECH	2TECH
Biomass	1258	2303	418.4	613.2	402.7	113.3
Wind	416	613	143.5	210.2		70.9
Hydroelectric	393	393	5.2	7.4		
Solar photovoltaic	414	414				
Thermoelectric	1540	1540				

Source: Own elaboration.

To determine employment opportunities, the first exercise used the direct employment multipliers detailed in Wei et al. (2010). These multipliers (Table A1.8) enable the calculation of employment opportunities expressed in the number of full-time equivalent workers needed during a year by type of technology.

To estimate these multipliers, Wei et al. (2010) collected data from 15 different studies and standardized the information as the average number of job opportunities per unit of energy generated in GWh over the lifetime of the facilities combining the construction, installation and maintenance phases, and the operation, maintenance and fuel procurement phases. The limitation of these multipliers is that they were estimated using studies with data from the United States and Europe as a reference.

TABLE A1.8 • AVERAGE DIRECT EMPLOYMENT MULTIPLIERS BY TECHNOLOGY

TECHNOLOGY	AVERAGE DIRECT EMPLOYMENT MULTIPLIER PER GWH
Biomass	0.21
Wind	0.17
Hydroelectric	0.27
Solar photovoltaic	0.87
Thermoelectric	0.25

Source: Wei et al. (2010).

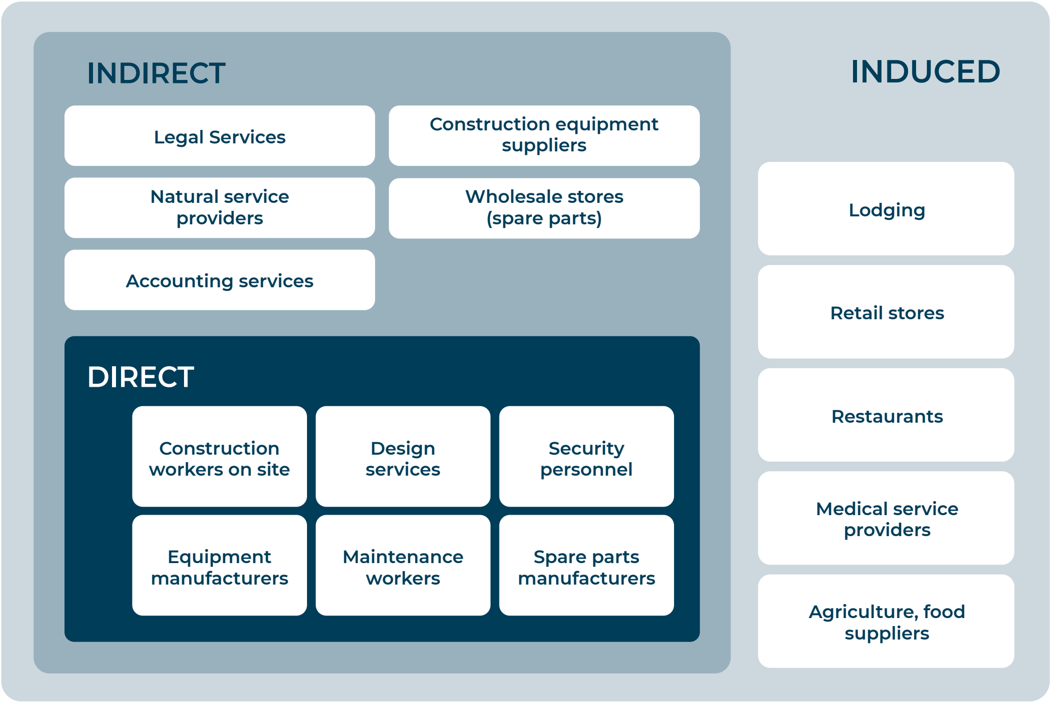
In order to disaggregate employment opportunities between the construction and operation phases, in addition to using a tool more in line with the reality of the region, the economic development and employment impact models known as I-JEDI (International Jobs and Economic Development Impact) were used.[18] These open access models are tools developed by the U.S. National Renewable Energy Laboratory (NREL) with support from the U.S. Agency for International Development (USAID) under the EC-LEDS (USAID Enhancing Capacity for Low Emission Development Strategies) program.

I-JEDI models aim to estimate the economic and employment impacts of wind, solar, biomass and geothermal power generation projects. This is achieved through investment profiles linked to both the construction and operation phases of these projects, using input-output models (Keyser et al., 2016). These models are flexible enough to be implemented in any country, due to the option to personalize inputs, in addition to the existence of pre-designed profiles for two countries in the region (Colombia and Mexico). The estimates presented in the previous subsections were made using Mexico's profile, which was adapted by the Ministry of Energy and the State Utility Company to incorporate costs and specific characteristics of the local context.

The I-JEDI models allow estimating employment opportunities in three different categories (Figure A1.2), the direct impacts, the indirect impacts resulting from potential economic activity among industries as a result of project expenditures; and finally, the induced impacts that are generated through potential activities derived from household expenditures with workers' earnings as a result of direct and indirect impacts. Only direct impacts in terms of employment opportunities were considered for the estimates. However, these models could be used to consider indirect and induced employment opportunities if necessary.

18. The original model was developed for the United States (JEDI) and then expanded for international use (I-JEDI).

FIGURE A1.2 • TYPES OF IMPACT ON EMPLOYMENT OPPORTUNITIES - I-JEDI MODELS



Source: Elaboración propia con base en Keyser et al. (2016).

A limitation of this methodology is the inability to differentiate between new and existing employment opportunities. Therefore, the results reflect a total count of employment opportunities resulting from the energy matrix change regardless of whether the jobs are new or reallocations.

A1.5 • Reflections on Employment Opportunities to Achieve Changes in the Energy Matrix

The examples presented in this annex illustrate the potential of the green transition to generate employment opportunities and highlight the importance of incorporating job skills development as a strategy to take advantage of these benefits in the region.

It is evident that employment opportunities in the energy sector are not limited to workers with specialized tertiary education in renewable technologies. There are requirements from entry-level positions and onwards, with a critical demand for skilled technicians, who represent a significant part of the required workforce. In this context, while experts with tertiary education, such as engineers, can be more easily "imported," technicians, who are often drawn from the local labor force, represent an opportunity to strengthen the national labor market through skills development.

It is also important to consider that the green transition involves not only the generation of new employment opportunities, but also their displacement. That is, new jobs are not necessarily created in the same places where employment is lost, nor are the skills demanded automatically transferable (IEA, 2021). Therefore, the development of skills in renewable technologies, as well as upskilling and reskilling, are essential to achieve a successful green transition.

Annex 2 • Guide for Selecting Strategic Economic Sectors

This annex proposes a methodology to identify strategic sectors to implement a strategy for human capital development in green skills. The objective of this methodology is to structure and organize the analysis of economic sectors, evaluate their most relevant characteristics and provide a rationale for the selection of certain sectors over others. Instead of focusing on the selection of a specific sector, the purpose is to establish a consistent process of comparison between sectors, which enables identification of relevant prioritization criteria. This is because the final decision to prioritize certain sectors may not depend solely on this analysis, and some aspects may receive different weight depending on the preferences of the technical team or policy makers and the context of each country.

The proposed methodology is divided into two stages of analysis (see Figure A2.1). In the first stage, a pre-selection of sectors is made considering three criteria: (i) the sector's potential to contribute to reducing GHG or other pollutant emissions; (ii) vulnerability to climate change; and (iii) the sector's importance for economic growth and employment. To do so, it is suggested that weights be assigned to each criterion, adequately justified and a scoring system be defined to classify the sectors into different categories (e.g., "high", "medium" and "low", with 3 points for "high", 2 for "medium" and 1 for "low"). By combining the weights and scores, it is possible to calculate a total score that ranks the sectors and prioritizes the most relevant ones. As a result of this stage, a reduced set of sectors will be selected and analyzed in greater depth in the second stage.

In a second stage, the pre-selected sectors are analyzed based on three other specific criteria: (iv) the need to train human capital for the green transition in the sector; (v) investment in technology for the green transition; and (vi) strategic alignment with national plans and institutional context. To rank the sectors, as in the first stage, one option is to assign and justify the weights for each criterion, as well as to establish a score to classify the sectors into categories. The combination of these weights and scores provides a calculation of a total score, facilitating the prioritization of sectors according to their strategic relevance.

FIGURE A2.1 • **METHODOLOGY FOR SELECTING PRIORITY SECTORS**

Stage 1	**Analysis**	Sector analysis based on three criteria: 1) Potential to contribute to reducing pollutant emissions 2) Vulnerability to climate change 3) Importance for economic growth and employment
	Score	• Assignment of categories (e.g. low, medium and high) for each criterion in each sector • Assignment of the score corresponding to the categories; and assignment and justification of the weightings for each criterion. • Obtaining a total score by sector
	Result	Selection of a reduced set of economic sectors
Stage 2	**Analysis**	Analysis of pre-selected sectors based on three criteria: 1) The need to train human capital for the green transition in the sector 2) Investing in technology for the green transition 3) Strategic alignment with national plans and institutional context
	Score	• Assignment of categories (e.g. low, medium and high) for each criterion in each sector • Assignment of the score corresponding to the categories; and assignment and justification of the weightings for each criterion. • Obtaining a total score by sector
	Result	Selection of priority economic sector(s)

Source: Own elaboration.

These criteria are described below, along with suggestions for indicators, sources of information and methodologies for conducting the analysis.

First Stage of Analysis

I) Potential of the sector to contribute to reducing GHG or other pollutant emissions

This criterion involves assessing the potential of each sector to reduce GHG or other pollutant emissions, in order to identify the sectors with the greatest opportunities to advance the green transition. Pollutant emissions refer to GHG emissions, water pollution, air pollution, soil degradation and solid waste generation. It is important to evaluate not only current pollutant emissions, but also future emissions if changes in production processes are not implemented.

Table A2.1 presents a series of indicators to guide this analysis, classified as quantitative and qualitative. This list is not exhaustive but serves as an illustrative guide; the relevance of each indicator may vary according to the context and sector analyzed. Among the indicators included are the amount of GHG emissions or carbon footprint,[19] carbon dioxide emissions (CO_2), the rate of soil erosion, the content of harmful materials in the soil (e.g., organic matter, heavy metals such as lead and mercury), salinization, tons of heavy metals, solvents, and other wastes that pollute water and the generation of solid waste by economic sector. To evaluate future pollutant emissions from the sectors, it is recommended that information on projections of these indicators be collected.

Possible sources of information are Our World in Data, Climate Watch Data databases, OECD, FAO, national agencies, sectoral reports and academic publications.

19. The carbon footprint measures the greenhouse gas emissions associated with production.

TABLE A2.1 • SUGGESTED INDICATORS TO GUIDE THE ANALYSIS

CRITERIA	INDICATOR	QUANTITATIVE	QUALITATIVE
Potential of the sector to contribute to the reduction of pollutant emissions	Amount of GHG emissions	X	
	Amount of CO_2 emissions	X	
	Generation of municipal solid waste	X	
	Plastic waste generation	X	
	Future pollutant emissions		X
Vulnerability to climate change	Soil erosion rate	X	
	Content of harmful materials in the soil	X	
	Soil salinization	X	
	Tons of heavy metals, solvents, and other waste contaminating water	X	
	Tons of solid waste generated	X	
	Water use (million m^3)	X	
	Blue water footprint	X	
	Use of fossil fuels (coal, oil, gas)	X	
	Effects of climate change on the sector's production		X
Importance for economic growth and employment	Gross Value Added (GVA)	X	
	Sector share in gross domestic product (GDP)	X	
	Exports	X	
	Sales in the domestic market	X	
	Number of employees	X	
	Number of employees in relation to GVA	X	
	Production linkages	X	X
	Growth projections		X
Need to train human capital for the green transition	Analysis of skills required in production processes		X
	Analysis of current workforce skills		X
	Analysis of the current training suite		X
Investing in technology for the green transition	Number of technologies for green transition used in production	X	
	Characterization of green transition technologies		X
	Percentage of companies using these technologies	X	
Strategic alignment with national plans and institutional context	The number of times the sector is mentioned in national documents	X	
	Institutions aligned with the interests of a human capital development strategy		X
	Institutions with expertise to collaborate in the implementation of a human capital development strategy		X

Source: Own elaboration.

II) Vulnerability to Climate Change

This criterion evaluates the vulnerability of economic sectors to climate change, considering two components. The first is the exposure of each sector to climate phenomena such as floods, droughts, storms and heat waves, evaluating the frequency and severity of these events. The second focuses on how these climatic changes affect operations and production in each of the sectors. The analysis begins by examining the production process in its different stages and identifying where and how natural resources intervene.

Next, it is recommended to evaluate the sector's dependence on natural resources, quantifying their use. For this, the indicators proposed in Table A2.1 can be applied, which include water consumption, the blue water footprint[20] and the use of fossil fuels (coal, oil and gas) in production.

In the following, it is advised to identify the main effects of climate change on production in the different economic sectors. This analysis is expected to provide an overview of possible impacts of climate change on production. For example, in agriculture, climate change decreases water availability, which reduces average yield and agricultural production. In the fisheries sector, for example, ocean acidification and warming are factors that will exacerbate stress on already vulnerable marine ecosystems due to pollution and overfishing.

For this analysis, it is recommended to use existing assessments and documents, which are often found in national climate change communications and plans. In most countries, information on climate change impacts is already available. For example, in their national development strategies, several countries have described their vulnerability and/or adaptive capacity with respect to future climate change impacts. Studies by development banks, NGOs and academia can also be used. For example, studies such as those by Prager et al. (2020) and the World (WMO, 2024) Meteorological Organization analyze the effects of climate change on agricultural production in several Latin American countries. The team in charge of this analysis can evaluate this information and discuss it with stakeholder groups. If a country-specific assessment is not available, studies from other contexts can be used, taking into consideration the relevant caveats. It is advisable to analyze available information on climate change impacts in conjunction with stakeholders, and to consult researchers, sectoral experts and environmental consultants to obtain accurate data.

20. The water footprint measures the volume of fresh water appropriately and is not returned to the system, taking into account the volumes of water consumed and polluted.

III) Importance of the Sector for Economic Growth and Employment

This criterion evaluates the relative importance of each sector in **economic activity and employment**. It is preferable that pre-selected sectors not only be strategic for the green transition from an environmental perspective but also contribute to economic growth and employment generation. The objective is to create a virtuous cycle of sustainable growth, employment and skills development.

Table A2.1 shows indicators to guide the analysis, including gross value added (GVA), the sector's share of gross domestic product (GDP), the sector's exports, the level of sales in the domestic market, among others. To complement this analysis, it is suggested to evaluate GVA and employment growth projections for each sector, as well as trade prospects at both national and international levels.

The information needed for this analysis comes from various sources, such as reports and databases published by government institutions (particularly the Ministries of Finance, Productive Development and Foreign Affairs), chambers of commerce and industry, development banks, research centers and academic articles.

It is also recommended to analyze backward and forward value chains, which describe the interdependence between the different sectors of an economy. These linkages reveal the role of each sector within the value chain and its relationship with other productive processes, in terms of the goods or services it demands from other sectors.[21] The analysis of these linkages is generally carried out using input-output matrices (IOM), which detail the transactions between the different economic sectors. These matrices make it possible to calculate key indicators such as technical coefficients, production and employment multipliers, as well as backward and forward linkage indexes. To obtain these indicators, it is advisable to consult sectoral reports that have made these estimates.

21. There are two main types of value chain production linkages: backward and forward. Backward linkages identify which sectors provide the goods and services that a sector uses as inputs, reflecting the capacity of a to boost production in other sectors through its demand for inputs. Forward linkages describe how a sector transfers its products to other sectors, which use them as intermediate inputs in their own economic activities.

Second stage of analysis:

In this stage, the analysis focuses on the reduced group of pre-selected economic sectors by evaluating the following criteria.

IV) Human Capital Needs for the Green Transition

This criterion requires analyzing which sectors face the greatest human capital training needs to advance the green transition, given that a workforce with the necessary talent is required to efficiently apply sustainable practices. Skills training for the green transition may represent a more significant barrier for some sectors than for others, so this criterion seeks to determine which sectors have the highest priority in that regard. For example, construction workers may need less training in green transition skills than workers in specialized trades, such as renewable energy, who need specific skills to install, operate or maintain solar panels. In analyzing skill requirements, it is advisable to consider, among other factors, production processes and the use of technology (see Annex 1 for more details).

Training should be analyzed in terms of production processes, the use of technology and the current supply of training in the sector. Table A2.1 proposes indicators that can guide this analysis.

Regarding sources of information, it is recommended that interviews be conducted with key actors in the selected sectors, including representatives of the public sector, the private sector, technical vocational training institutions and experts in the sector. It is suggested that this information be combined with sectoral reports and academic studies.

It is also recommended to analyze the learning ecosystem in the pre-selected sectors, identifying the available training suite and its alignment with the skills required for the green transition in each sector.

Box A.2.1 illustrates aspects of this analysis by highlighting the training needs identified in the agricultural sector during a pilot aimed at developing skills for more efficient water use in Chile.

BOX A2.1 • WATER USE SKILLS IN CHILE'S AGRICULTURAL SECTOR

One of the main challenges facing agriculture in Chile is to improve water use efficiency, especially in a context of increasing water scarcity (Odepa, 2018). In addition, the sector faces other challenges related to sustainability, such as implementing responsible agricultural practices and adopting advanced technologies for automated and precise agriculture (Odepa, 2018).

Regarding water management, interviews with key actors in the sector reveal significant gaps between the availability of technologies and their practical implementation (Bofill and Maino, 2024). This situation coincides with the recommendations of governmental sectoral reports. For example, the report of the Mesa Nacional del Agua (2022) highlights efficiency loss in irrigation systems shortly after their installation. Among the main reasons are farmers' lack of knowledge about the economic benefits of a more efficient use of water and about basic maintenance and operation issues of this equipment, as well as the lack of formal training.

Interviewees stress the importance of developing skills to use new technologies to better cope with water scarcity and climate change. Given that the agricultural sector is mainly composed of older workers, it is essential to keep constantly updated on technological advances and new skills required (Bofill and Maino, 2024).

In addition, the precarious labor conditions in the sector, the high rate of informality and the low educational level of workers represent both a challenge and an opportunity. This suggests the need to develop strategies focused on training and knowledge transfer to improve water use efficiency.

V) Investment in Green Technologies

This criterion seeks to identify the technologies used for the green transition in each pre-selected subsector. It proposes to categorize these technologies according to their application in production processes, their scale, the type of technology used (such as renewable energy systems, technical irrigation or drought-resistant seed varieties, among others) and their purpose. It also proposes to evaluate the sector's potential for adopting green technologies in the future. This dimension is closely related to the sector's capacity to adjust its practices and operations to climate change, as well as to the employment and human capital required, since investment in technology is more effective when it is accompanied by training to enable efficient use and maintenance of equipment.

Table A2.1 provides indicators to guide this analysis, including the estimated percentage of companies using these technologies. To carry out this analysis, it is recommended to use surveys on the dynamics of investment in innovation and business development and other types of surveys published by the public sector, the private sector or expert consultants, as well as sectoral reports and academic publications. It is advisable to complement this information with interviews with key actors, such as entrepreneurs, chamber representatives and experts in each pre-selected sector.

Box 2 presents a simple example of the analysis of this criterion, applied to technologies that promote efficient water use in two pre-selected sectors: mining and agriculture. This example is part of a pilot aimed at developing skills to promote more efficient water use in Chile.

BOX A2.2 • THE USE OF TECHNOLOGY TO IMPROVE WATER USE EFFICIENCY IN THE AGRICULTURAL AND MINING SECTOR IN CHILE

The mining sector in Chile stands out for making significant investments in technology. Among the most relevant is water recycling and reuse. Mining companies have implemented advanced recycling and wastewater treatment systems to reuse water in their operations (Bofill and Maino, 2024).

Another important technological advancement in water use in this sector is real-time measurement and monitoring technologies. These tools have become essential for efficient control and water use management in the industry (Bofill and Maino, 2024). This includes the installation of sensors and telemetry systems to monitor water flows and quality conditions. Also, the big data and artificial intelligence management that mining companies have adopted to collect and analyze large volumes of information related to water use allow data-driven decisions to be made to optimize water consumption and reduce waste. According to Accenture (2022), 41% of executives of large mining companies claim to use artificial intelligence and the Internet of Things in their businesses. In addition, due to the structure of the sector, which is composed of a few companies with market power, knowledge is transferred internally within companies, thus ensuring that technology is used in production processes.

In the agricultural sector, technology has advanced rapidly to offer tools for more efficient water management, and there are several initiatives and suppliers of intelligent irrigation systems such as drip, sensor-controlled sprinklers and precision irrigation in the country. In addition, there is a local supply of devices such as sensors and monitoring systems to measure soil moisture and weather conditions that facilitate more precise irrigation management. On the other hand, in coastal and water-scarce areas, desalination technologies are being researched and adopted, albeit incipiently.

Drip irrigation (or micro-irrigation) is the most widely used irrigation system in Chile and the world (CNR, 2023), so technological advances for its use are relevant. Pre-irrigation is less prevalent, although it has notable advantages in water use efficiency.

Finally, progress is being made in the reuse and recycling of wastewater, with agricultural companies that have implemented wastewater treatment systems to recover and reuse this resource in their operations, reducing the demand for fresh water and contributing to the conservation of water resources and complying with environmental regulations.

The agricultural sector has small and medium-sized producers who have access to efficient technology, largely thanks to public co-financing, but they are not accompanied by training in the skills needed to optimize its use (Bofill and Maino, 2024). For this segment, it is necessary to offer training in skills that can enhance and complement these investments in technology, seeking to achieve greater efficiency in the use of water resources.

VI) Strategic Alignment with National Plans and Institutional Context

This criterion evaluates two components: the strategic alignment of the sector with national plans for advancing the green transition; and the relevant institutions in the sector. The first component consists of analyzing how the pre-selected sectors are aligned with government plans and strategies for the green transition. As mentioned in Section 2 of the paper, many LAC countries have committed to developing climate action plans to reduce emissions and adapt to the effects of climate change, including adaptation measures and economic diversification plans to reduce GHG emissions. Therefore, the selection of strategic sectors should be aligned with national climate change mitigation and adaptation plans. To analyze the alignment of the pre-selected sectors with these plans, a review of the national climate change, plans and communications, as well as the documents that identify the sectors prioritized by the government strategies is recommended with the objective of promoting a sustainable economy. As a result of this analysis, it is expected that the sectors will be ordered according to their prioritization in the national documents. Table 1 outlines indicators to guide this analysis.

The second component focuses on analyzing the ecosystem of actors to prioritize sectors with the greatest potential to form partnerships that facilitate the implementation of training solutions in the field. This analysis is not intended to provide an exhaustive description of all the institutional actors, as this will be addressed in the second step of the human capital development strategy in the selected sector (see Section 4.2 of the paper). Instead, it focuses on identifying the relevant stakeholders and assessing whether their interests are aligned with the strategy.

To conduct this analysis, it is recommended to first **identify and categorize** the relevant stakeholders, including governmental organizations, companies, NGOs and VET system institutions. It is important to collect information on each stakeholder, including their mission and areas of interest. Subsequently, it is recommended to analyze whether these actors show **interest in the implementation of a human capital development strategy** in the sector and to evaluate their **experience** in previous collaborations to determine their willingness and **capacity to collaborate with the implementation** of this strategy in the region.

Suggested methods include consulting reports and documents on these institutions, reviewing their websites to identify their interests and past experiences, and conducting semi-structured interviews with key actors to obtain direct information on their capabilities and interests.

From the analysis of these two criteria in this second stage, a list of pre-selected sectors is generated and classified, for example, into low, medium, and high categories according to each criterion. Subsequently, as in the first stage, it is advisable to assign and justify weights for each criterion and define the scores corresponding to each category, maintaining consistency with the previously used methodology. By combining these weights and scores, a total score will be generated to rank and prioritize the sectors.

Annex 3 • Stakeholder Ecosystem for Human Capital Development in the Green Transition: Selected Examples of Institutional Arrangements

Countries have adopted various institutional arrangements to facilitate collaboration among key ecosystem actors in the design and implementation of human capital development strategies for the green transition. According to the ILO (2018), two main approaches can be identified. The first consists of the creation of new bodies or councils specifically dedicated to skills development for the green transition, known as green skill councils or roundtables. The second approach incorporates green skills development into existing capacity building mechanisms in general.

The way in which these institutions are established varies between countries. According to a review of regulations and policies related to skills for green transition in 27 countries at different levels of development, the ILO (2018) notes that, while in developed countries these institutions are already consolidated, in several developing or emerging economies they have not yet been implemented, have been established recently or operate only in the framework of donor-funded projects with a specific sectoral focus.

In Germany, for example, the German Council for Sustainable Development has been established as an interdisciplinary team with representatives from civil society, the business sector, the scientific community and the public sector. This council focuses on the 17 Sustainable Development Goals (SDGs), including the promotion of technical and vocational education and training (GIZ, 2022).

In 2011, Ireland established the Irish Green Building Council (IGBC), comprising public sector bodies, organizations and companies from across the construction value chain, including architects, engineers, contractors, universities, professional institutes, NGOs, local authorities and energy companies. The aim of the IGBC is to promote sustainable practices in the sector. The body has developed a roadmap to decarbonize construction, with an action plan to halve the sector's emissions by 2030 and achieve carbon neutrality by 2050. Among its main activities is the creation of training programs on sustainability in the sector's production processes, as well as training on issues such as green building certification and life-cycle carbon analysis (European Union, 2023).

In 2015, India established the Skill Council for Green Jobs, composed of representatives from government ministries, business associations, companies and academic experts. This council acts as a national coordinating body for green skills development.

Its mandate includes identifying skills gaps in industry, developing national occupational standards, and developing curricula and certifications for trainers, students and workers in the green economy. Its areas of intervention cover sectors such as renewable energy, transportation, waste management, construction and water management (ILO, 2024).

Another example is Uruguay, which, recognizing electromobility as a key sector in its second energy transition, created a roundtable in 2022 to promote the development of the necessary skills in this area. The effort is particularly focused on the electrification of transportation and the management and use of batteries. The roundtable is made up of the Ministry of Industry, Energy and Mining, the Universidad del Trabajo de Uruguay (UTU), the National Institute of Employment and Vocational Training (INEFOP), the Uruguayan-German Chamber of Commerce and the Inter-American Development Bank (IDB). Its goal is to create a space for dialogue and collaboration among key actors to design a consensus-based training curriculum aligned with the specific needs of the electromobility sector. It also seeks to establish a clear pathway of competencies and skills that allow for linkages between credentials (diplomas, degrees, certifications, etc.) with learning achievements and labor market participation (Correa et al., 2024).

Each actor has a specific role at the table. The Ministry coordinates the different parties; UTU acts as the technical education provider, leading the pedagogical design, implementation and coordination of courses at the upper secondary and tertiary levels, as well as complementary programs, and also provides the necessary training facilities. INEFOP and the private sector participate in the design and development of the training modules, taking into account the training needs identified by the sector and the profiles required to promote technologies linked to electromobility. In addition, the roundtable plays a role in the quality assurance of the programs designed (Correa et al., 2024). To date, nine professional profiles and 24 training modules have been defined. Some examples of these profiles include: public transport electrical maintenance technician, minor electric vehicle electrical maintenance technician and battery manager (Correa et al., 2024).

Similarly, Chile has recently established a roundtable for employment and skills development in the green hydrogen sector. This body is made up of SOFOFA (a trade federation that brings together companies and guilds in the industrial sector), the Chilean Hydrogen Association (H2 Chile), the Ministry of Labor, the Ministry of Energy, the Chilean Chamber of Construction, and is supported by the IDB. Its objective is to align public and private efforts to estimate the future demand for employment, develop and implement initiatives that generate job opportunities, and promote the skills necessary for the growth of this sector.

Finally, in Barbados, strong collaboration among key stakeholder groups is driving the transition to a green economy. These actors include government agencies (such as ministries, the Barbados TVET Council and national training institutions), private sector companies, international organizations and NGOs (ILO, 2018).

Annex 4 • Training Pathways Design for Pilots in Belize and Panama

Belize

The Government of Belize has initiated a transition to a more sustainable energy matrix, with the goal that by 2030, 85% of the country's electricity will come from renewable sources. This ambitious goal represents not only a milestone in the field of clean energy, but also an opportunity for job creation and the establishment of a more sustainable future for the country (Findlater et al., 2024).

As a starting point, Belize identified the energy sector as a priority within its human capital development strategy for the green transition. However, achieving this goal (and the widespread adoption of sustainable technologies and practices) depends largely on having the necessary skills in the workforce. Therefore, the next step was to design appropriate training content to close the identified gaps.

To this end, an ecosystem of key stakeholders was formed, comprised of the Nova Scotia Community College (NSCC), the Belize City TVET Institute, the Ministry of Education, Culture, Science and Technology (MoECST) and representatives of the private sector. This group played a central role in the identification of gaps in occupations, skills and training offerings, as well as in the design of relevant training pathways.

The joint analysis revealed training needs in areas such as installation, operation and maintenance of renewable energy infrastructure and energy efficiency (Findlater et al., 2024). In terms of training, the need for technical certifications in renewable energy was identified, as well as the need to strengthen the technical-pedagogical approach of TVET.

In response, stakeholders collaborated closely. The NSCC led the development of the country's first renewable energy certificate program, ensuring that its contents responded to industry needs and enhanced employment opportunities for graduates. This two-year program combines theoretical and practical training, with active participation of companies in the sector throughout its implementation.

For its part, the Belize City TVET Institute and MoECST worked together with the NSCC to strengthen institutional capacities and ensure the sustainability of the pilot program, incorporating it into the regular programing of the TVET system. Given that this is an emerging sector in the country and that there is a need for transformation of the technical-vocational educational model towards a more applied and student-centered approach, an intensive 1.5-year training program for teachers and trainers was also designed. This program seeks to strengthen both the technical knowledge and the pedagogical skills of the teaching staff.

The private sector participated actively in the design and execution of the program, helping to align the courses with the needs of local industry and exploring opportunities for training in the work environment to increase the employability of graduates.

With its small population size, Belize represents a favorable scenario for the development of scalable, adaptable and transferable courses in the field of renewable energies to other Caribbean countries. The project seeks to capitalize on this experience and share best practices at the regional level by launching a digital platform and establishing a community of practice (Prada and Rucci, 2023; Findlater et al., 2024).

Panama

The Government of Panama has made progress in the development and implementation of its strategic energy transition agenda, establishing specific goals in the areas of renewable energies and electric mobility. It set out to achieve an installed capacity of 4.3% in distributed solar energy generation for installations of up to 2 MW, compared to 1% at the time of the assessment. In the case of electric mobility, the country had only 30 units in circulation, representing a penetration of 0.005%. The goal was to raise this figure to 10% by 2024.

To achieve these goals, it is essential to close the existing skills gaps in the energy sector workforce. In this context, the Government of Panama, in coordination with the National Institute of Vocational Education and Training for Human Development (INADEH) and with support from the Inter-American Development Bank (IDB), established a sectoral roundtable to identify training needs. This body analyzed both the proposed goals and the existing training suite, with the aim of developing relevant training packages.

The diagnosis showed that the labor force lacked key knowledge for the diagnosis and maintenance of electric vehicles, which limited the capacity to respond to the growing demand in this field. It also identified the need to train technicians in safety measures associated with electrical failures, batteries and electric motors. At the same time, there was a shortage of personnel trained in the installation and maintenance of solar distributed generation systems, the demand for which is increasing, particularly in the private sector (Prada and Rucci, 2023).

Based on this analysis, the sectoral roundtable designed two technical training programs focused on: (i) the reskilling/upskilling of automotive mechanics in electric vehicle diagnostics and maintenance; (ii) technician training for the installation and maintenance of solar systems and chargers for electric vehicles (Prada and Rucci, 2023). A mixed training method was chosen, combining virtual classes with the use of a mobile classroom that travels through rural areas to provide practical training. In addition, the possibility of including company internships was considered, to improve learning and strengthen the employability of the participants.

In conjunction, training of trainers' programs were designed and implemented for INADEH's teaching staff, focusing on technical content related to the energy transition. This initiative seeks to ensure the sustainability of the program beyond the initial financing.

Each actor at the table played a key role in the process. INADEH led the design of the programs, implemented the training and integrated them into its institutional educational offerings. The National Energy Secretariat (SNE) provided technical support and facilitated dialogue between the public and private sectors. The private sector collaborated in curriculum design and supported the implementation of the first cohort of training programs (Prada and Rucci, 2023).

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