



LABOR MARKET INTELLIGENCE REPORT

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LABOR MARKET INTELLIGENCE REPORT

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HOT in here

Adapting to Climate Change:

WORKFORCE TRENDS AND OPPORTUNITIES IN THE GLOBAL MARKET

Executive Summary

Climate change is a worldwide concern that has been acknowledged since the 1980s. The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 to tackle global warming resulting from anthropogenic activities such as fossil fuel use and deforestation. Milestones such as the Rio Earth Summit, Kyoto Protocol, and Paris Agreement exemplify global dedication to addressing climate change. The 2023 Global Stocktake confirmed that the world remains off course to achieve the Paris Agreement's objectives, with an anticipated global temperature increase of 2.4°C to 2.6°C by the century's end.

The IPCC's Sixth Assessment Report (AR6) underscores sector-specific strategies to mitigate global emissions. Key sectors encompass Agriculture, Forestry, Other Land Use (AFOLU), energy systems, industry, transportation, and structures. The potential for mitigation is considerable, with options to decrease emissions by terrestrial activities such as ceasing deforestation, adopting renewable energy, and enhancing energy efficiency in the industrial and transportation sectors.

Being highly susceptible to climate change, the Philippines confronts increasing temperatures, altered weather patterns, and recurrent natural catastrophes such as typhoons. The climatic profile reveals yearly temperature rises and seasonal variations in precipitation and tropical cyclone occurrences. PAGASA, the meteorological office of the Philippines, forecasts a sustained increase in temperatures and a spike in extreme weather occurrences by 2050. The nation's susceptibility is exacerbated by its economic dependence on agriculture, which is directly affected by climate-induced disturbances.

In relation to TESDA's mandate, aligning with these global and national climate priorities, it is imperative for TESDA to integrate climate resilience and green skills into its training programs. By focusing on skills development in renewable energy, energy-efficient construction, and sustainable agriculture, TESDA can contribute to the country's transition to a low-carbon economy. Moreover, supporting sectors such as agriculture and energy through tailored programs will prepare the Filipino workforce for emerging jobs, ensuring a just and equitable transition to climate resilience. Several recommendations have been made on how TESDA can provide the necessary skills and competencies needed by the workforce.

I. Introduction

In the 21st Century, the global community recognized the urgent necessity of tackling climate change. Extensive research and empirical evidence from scientists worldwide have conclusively demonstrated that climate change is a pressing issue that requires global intervention.

As early as the 1980s, signs of the earth's rapid shift became apparent through studies that predicted the collapse of Antarctic ice sheets, resulting in a catastrophic increase in sea levels. Ice cores extracted from Antarctica have shown that carbon dioxide (CO₂) levels and temperature have fluctuated in tandem over the past 150,000 years. Additionally, the identification of an ozone hole above Antarctica in 1985 further highlighted the issue of climate change on the global stage.

The Intergovernmental Panel on Climate Change (IPCC) was formed in 1988 through a collaboration between the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO). The IPCC was established with the purpose of serving as the United Nations body responsible for evaluating the scientific aspects of climate change. Additionally, it offers periodic evaluations of the scientific foundation of climate change, its consequences, and potential future hazards, as well as strategies for adapting to and reducing its effects.

Climate Change, as defined by the IPCC, refers to a persistent change in the condition of the climate. This change can be identified by statistical tests that examine variations in the average and/or the variability of its characteristics. This transition frequently persists for multiple decades or even an extended period. Furthermore, climate change involves any alteration in extended weather patterns, which can arise from either natural variations or human activities.

Discussions between world leaders on how to tackle the challenges posed by climate change were initiated following the discoveries. The following are significant milestones in the global initiatives to address climate change (taken from the Council on Foreign Relations) :

- 1992: The Rio de Janeiro Earth Summit resulted in the first international agreements on climate change, one of which was the United Nations Framework Convention on Climate Change that aimed to prevent “dangerous” human interference in the climate system, acknowledged that human activities contribute to climate change, and recognized climate change as an issue of

global concern. Although the document did not have any legally binding obligations to the signatories, it required frequent meetings between the ratifying countries, known as the *Conference of the Parties or COP*.

- 1997: COP3, held in Japan, adopts the Kyoto Protocol, a legally binding treaty requiring developed countries to reduce emissions by an average of 5% below 1990 levels. It also established a system to monitor countries' progress and created a carbon market for countries to trade emissions units and encourage sustainable development, a system known as "cap and trade."

In 2000, the talks on the implementation details of the protocol collapsed, and the United States withdrew in March 2001. In July 2001, a breakthrough was reached in Bonn, Germany, on green technology, emissions trading, and compromise on accounting for carbon sinks. Countries agreed on the rules for meeting targets set by the Kyoto Protocol in October 2001.

- 2005: The Kyoto Protocol took effect and was ratified by a sufficient number of countries, representing at least 55% of global emissions. However, it was noted that the United States did not participate in the ratification process. During the period from 2008 to 2012, which coincided with the expiration of the agreement, countries were required to decrease their emissions according to the quantities they had committed to.
- 2007: Spurred by the report published by the UN Intergovernmental Panel on Climate Change (IPCC), which strongly emphasized that global warming was "most likely" caused by human activity, the upcoming COP3 in Bali, Indonesia, began discussions on a stronger successor to the Kyoto Protocol.

A hurdle became evident in the discussions when the United States objected to a widely supported proposal that called for all industrialized nations to cut greenhouse gas emissions (based on specific targets). U.S. officials argued that developing countries also make the same commitments. The U.S. later backed down, and the Bali action plan was adopted, establishing the goal of drafting a new agreement by 2009.

Another hurdle in the finalization process was seen at COP15 in Copenhagen, which resulted in a non-binding document that was noted but not adopted. The Copenhagen Accord essentially acknowledges that global temperatures should

not increase by two °C (3.6°F) above pre-industrial levels, though representatives from developing countries sought a target of 1.5°C (2.7°F).

The following COP16, held in Mexico (2010), was conducted in the shadow of the Copenhagen failure and NASA's announcement that 2000-2009 was the warmest decade ever recorded. This put pressure on the delegation to reach a consensus at the conference. This resulted in the commitment of approximately 80 countries, including China, India, and the United States, as well as the European Union, to keep global temperature increases below 2°C. The Green Climate Fund, a \$100 billion fund to assist developing countries in mitigating and adapting to climate change, is also established.

- 2011: Representatives including China, India, and the United States agreed to work towards drafting a new, legally binding agreement in 2015, different from the Kyoto Protocol that will apply to both developed and developing countries. The Kyoto Protocol was also extended until 2017, which was then extended again until 2020 at COP18.

Furthermore, a notable accomplishment of COP18 was the Doha Amendment, which entails developed nations committing to supporting developing countries in their efforts to prevent and adapt to the impacts of climate change. The accord also establishes delegates on the path towards a new treaty.

The COP19 (2013) was marked by a walkout of 77 developing countries (G77) when the G77's lead negotiator opposed China's proposed funding mechanism to help vulnerable countries deal with "loss and damage" caused by climate change. Eventually, the talks resumed, and the government agreed to a mechanism that notably fell short of what developing countries wanted. Countries also agreed on how to implement an initiative to end deforestation known as Reducing Emissions from Deforestation and Forest Degradation (REDD+).

The "+" signifies the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks (Conservation Organization, 2019).

- 2015: The Paris Agreement, a landmark agreement between 196 countries, was approved. The accord requires that countries, both developed and developing, establish goals for reducing emissions. Nevertheless, nations have the independence to determine their objectives, and there is a lack of methods to

compel compliance with these targets. According to the agreement, countries must provide targets for nationally determined contributions (NDCs).

The agreement's objective was to limit the increase in global temperature to less than 2°C and attempt to keep it below 1.5°C. This was followed by countries agreeing on the rules for implementing the Paris Accord in COP24 (2018) in Poland.

- 2021: President Alok Sharma asserted that the promises made during COP26 have effectively preserved the objective of the Paris Agreement to restrict global warming to 1.5°C. The Glasgow Climate Pact, the final agreement, requires nations to reduce their reliance on coal and fossil fuel subsidies, marking a "first" in UN climate agreements. Additionally, it asks governments to provide more aggressive targets for reducing emissions by the conclusion of 2022. Furthermore, delegates ultimately adopt regulations for a worldwide carbon market. Smaller groups of countries sign significant bilateral agreements about deforestation, methane emissions, coal, and other related matters.
- 2023: The United Nations has published the technical findings from the first Global stocktake. The global stocktake, undertaken every five years, evaluates countries' progress in implementing the Paris Agreement. During a two-year period, countries sent their information to the United Nations, which assessed their efforts to reduce emissions and respond to climate-related emergencies. The technical assessment indicates that the world is not making sufficient progress to achieve the targets established in the Paris Agreement. However, present policies have mitigated the most extreme projection of global warming by 2100, reducing it from a range of 3.7°C to 4.8°C (6.7°F to 8.6°F).

The projected temperature rise is now estimated to be between 2.4°C and 2.6°C (4.3°F and 4.6°F); however, it could potentially decrease to as low as 1.7°C to 2.1°C (3.1°F to 3.8°F) if countries effectively accomplish their net-zero emissions goals.

As stated earlier, on December 12, 2015, at the UN Climate Change Conference (COP21) in Paris, France, 196 Parties adopted the legally binding Paris Agreement, which came into effect on November 4, 2016. In order to achieve the key goal of the accord, which is to prevent the global average temperature from rising more than 2°C above pre-industrial levels, and to aim for a more ambitious target of limiting the temperature increase to 1.5°C above pre-industrial levels, the accord revolves around a five-year

cycle of progressively more ambitious climate action. Since 2020, governments have submitted their nationally determined contributions (NDCs), which outline the climate action goals of each country. Successive NDCs are intended to demonstrate a progressively more significant ambition than prior iterations. Countries receive financial, technical, and capacity-building assistance as part of the agreement.

In 2015, another significant policy was implemented by adopting the 2030 Agenda for Sustainable Development. Figure 1 illustrates the 17 Sustainable Development Goals, which serve as a universal call to action for countries across the globe, regardless of their level of development. These goals emphasize the importance of a global partnership in addressing pressing issues. They understand the importance of addressing poverty and other deprivations alongside efforts to enhance health and education, decrease inequality, promote economic growth, combat climate change, and protect our oceans and forests. Table 1 describes each of the 17 SDGs.

Figure 1. The Seventeen Sustainable Development Goals



Source: sdgs.un.org/goals

Based on this, there is a specific goal related to climate change, this is SGD no. 13 “Climate Action” which “takes urgent action to combat climate change and its impacts” (SDGs, n.d.). Additionally, other SDGs are also interlinked with SDG 13’s goal, as Sustainable Development means the interconnectedness of the economic, social, and environmental objectives of the all 17 different SDGs.

Table 1. United Nations 2030 Sustainable Development Goals

Goal	Title	Description
1	No Poverty	End poverty in all forms
2	Zero Hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
3	Good Health and Well-Being	Ensure healthy lives and promote well-being for all at all ages
4	Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5	Gender Equality	Achieve gender equality and empower all women and girls
6	Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all
7	Affordable and Clean Energy	Ensure access to affordable, reliable, sustainable and modern energy for all
8	Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all
9	Industry; Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10	Reduce inequality within and among countries	Reduce inequality within and among countries
11	Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient and sustainable
12	Responsible Consumption and Production	Ensure sustainable consumption and production patterns
13	Climate Action	Take urgent action to combat climate change and its impacts.* <i>* Acknowledging that the United Nations Framework Convention on Climate Change is the primary</i>

Goal	Title	Description
		<i>international, intergovernmental forum for negotiating the global response to climate change.</i>
14	Life below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15	Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems; sustainably manage forests; combat desertification; halt and reverse land degradation; and halt biodiversity loss
16	Peace, Justice, and Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable and inclusive institutions at all levels
17	Partnership of the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Source: *United Nations Website*

One important factor in the implementation of the SDGs is the way each goal synergizes and interacts to achieve their individual targets. The Blueprint for SDG Leadership Action Platform of the United Nations Global Compact emphasizes that recognizing and addressing these connections will enable businesses to develop comprehensive and systematic solutions that enhance progress and reduce negative effects. It outlines the various ways in which taking a leading role in SDG 13, climate change action, can impact the other Sustainable Development Goals (SDGs), as seen below.

- *Maximize the Likelihood of Positive Impact on:*

- *SDG 2*
- *SDG 3*
- *SDG 6*
- *SDG 7*
- *SDG 8*
- *SDG 11*
- *SDG 12*
- *SDG 14*
- *SDG 15*
- *SDG 16*

- *Minimize Risk Of Negative Impact On:*
 - *SDG 2*
 - *SDG 8*
 - *SDG 10*
 - *SDG 15*

Source: Blueprint for SDG Leadership Action Platform of the United Nations Global Compact SDG 13

Each Sustainable Development Goal includes specific targets and their respective indicators that are used to monitor the progress of each goal. The specific targets and indicators for SDG 13 are seen in Table 2.

Table 2. Sustainable Development Goal 13 Targets and Indicators

Target No.	Descriptions	Indicator No.	Description
13.a	Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible	13.a.1	Amounts provided and mobilized in United States dollars per year in relation to the continued existing collective mobilization goal of the \$100 billion commitment through 2025
13.b	Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women,	13.b.1	Number of least developed countries and small island developing States with nationally determined contributions, long-term strategies, national adaptation plans and adaptation communications, as reported to the secretariat of the

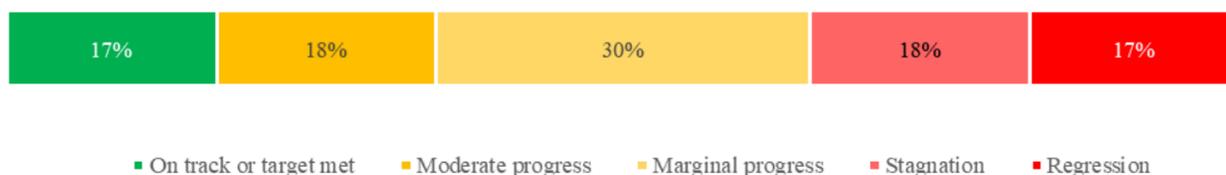
	youth and local and marginalized communities		United Nations Framework Convention on Climate Change
13.1	Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries	13.1.1	Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population
		13.1.2	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030
		13.1.3	Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies
13.2	Integrate climate change measures into national policies, strategies, and planning	13.2.1	Number of countries with nationally determined contributions, long-term strategies, national adaptation plans, and adaptation communications, as reported to the secretariat of the United Nations Framework Convention on Climate Change
		13.2.2	Total greenhouse gas emissions per year
13.3	Improve education, awareness-raising, and human and institutional capacity on climate change mitigation, adaptation, impact reduction, and early warning.	13.3.1	Extent to which (i) global citizenship education and (ii) education for sustainable development are mainstreamed in (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment

Source: sdgs.un.org/goals

The United Nations Secretary General compiles and presents an annual document called the SDG Progress Report, which includes updates on the targets for all SDGs as well as data on the progress of different nations.

The recent progress assessment published in 2024 found that the global community is significantly straying from its efforts to accomplish the 2030 target. Figure 2 illustrates that among the 135 targets, just 17% are progressing as expected to be accomplished by 2030.

Figure 2. Overall Progress Assessment across targets with trend data, 2024



Source: 2024 SDG Progress Report

With regard to SDG 13, the results are described to have “shattered” 2023 climate records as communities around the world suffer from the effects of extreme weather. Below are some of the important outcomes of the SDG 13 target taken from the 2024 SDG progress report:

- Target 13.1: By 2023, a total of 129 nations had reported the implementation and enforcement of national disaster risk reduction policies, which marks a significant increase from the 55 countries that had done so in 2015. Out of these countries, 122 have declared that they are actively supporting coordinated policies and compliance with the Sustainable Development Goals (SDGs) and the Paris Agreement as a crucial component of their strategy.
- Target 13.2: According to the World Meteorological Organization, the year 2023 surpassed all climate indicators and established a new record as the hottest year on record. The global temperatures increased to 1.45°C, reaching a level that is perilously close to the lower limit of 1.5°C set by the Paris Agreement on climate change.
- Target 13.3: An analysis conducted in 2023 on over 530 curricula for grade 9 scientific and social science subjects revealed that 69% of them did not include any mention of climate change, while 66% did not address the concept of sustainability. Nevertheless, a significant majority of countries have indicated

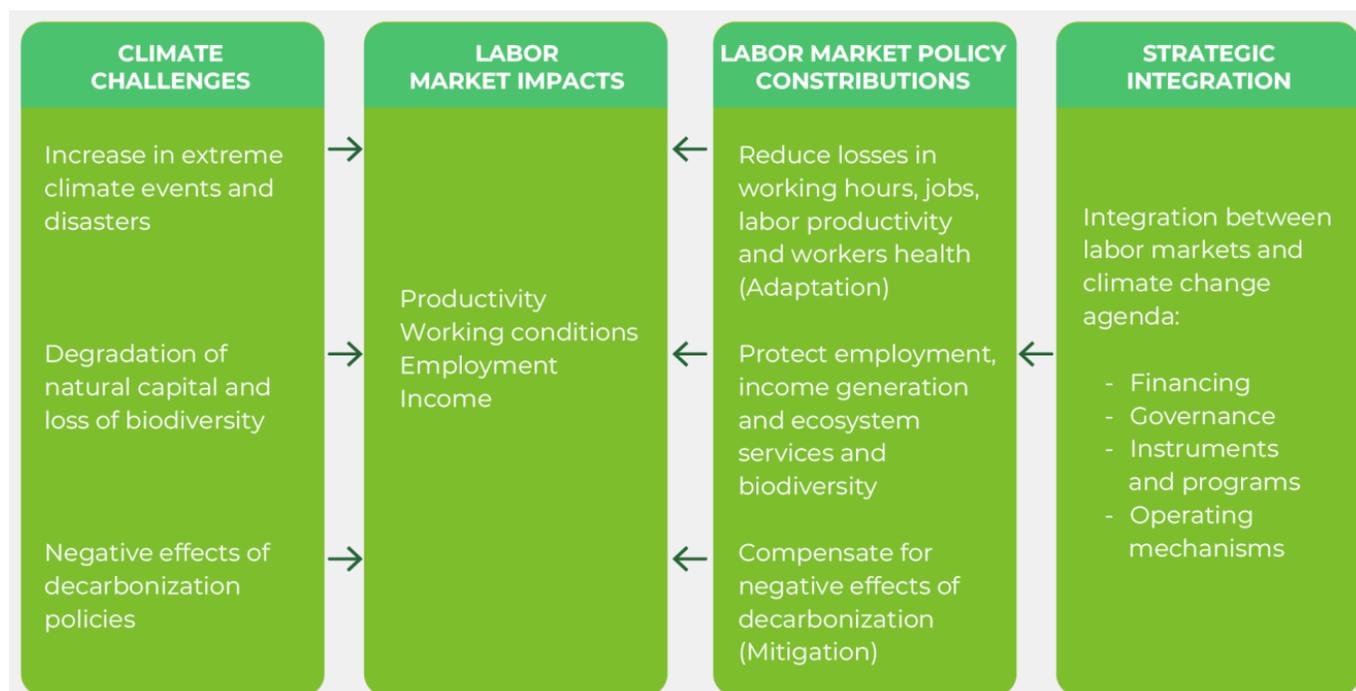
their intention to modify their educational programs within the next three years in order to prioritize the subjects of climate change and sustainability.

- Target 13.a: The amount of climate finance has grown steadily at a compound annual growth rate of 5% between 2015 and 2020, reaching a total of \$41 billion. As of 2021, the \$100 billion per year goal has not been achieved due to varying estimations and a lack of consensus on the accounting methodology. Nevertheless, there has been significant advancement in the allocation and use of climate money, totaling \$89.6 billion in 2021.

II. Labor Markets and Green Jobs

With renewed attention on tackling climate change in the aftermath of the Covid-19 pandemic, the conversation has shifted back to the adaptations that Labor Markets policies must make to meet the challenges posed by climate change across various economic sectors. The Inter American Development Bank (IDB) developed a theoretical framework on the challenges of climate change and the role of the Labor Market Policies, Figure 3.

Figure 3. Theoretical Framework on the Challenges and the Role of Labor Market Policies



Source: Inter American Development Bank 2024

The reports list the effects of climate change on the labor market, particularly in the Caribbean and Latin Americas. These are:

- Rising temperatures, extreme weather events, and pollution: impacts on jobs, working hours, the health of workers, and labor productivity;
- Degradation of natural capital and loss of biodiversity: threats to jobs that rely on natural resources;
- Policies to decarbonize the economy: creation, substitution, elimination, and transformation/redefinition of jobs;
- Projected temperature increases will make heat stress more common, reducing working hours globally by 2% by 2030; and
- Labor productivity in various cognitive tasks drops by about 2% per degree Celsius over a threshold of 25°C.

The importance of the continued push for the transition to net zero was reported to have a large impact in the Latin American Countries (LACs) labor markets, with impacts on jobs such as:

- About 13% of the workers in LAC could be part of the green economy;
- The transition to a more sustainable economy can create up to 15 million net jobs in LAC by 2030, and
- Upskilling and reskilling policies will be particularly important to ensure a just transition in the region.

With this, the IDB proposes policies that can be adopted to tackle climate change through labor market initiatives. In Figure 4, it can be seen that there are two types of policies that can be adopted, which are:

- Active Labor Market Policies: policies that seek to increase the employability of workers through measures such as labor intermediation, training, employment subsidies, and entrepreneurship programs.
- Passive Labor Market Policies: these aim to protect the incomes of workers through social benefits or income transfers to unemployed workers looking for a job. These include unemployment insurance, temporary employment programs, and unemployment support policies.

Additionally, it categorizes these policies that could support countries in advancing their adaptation, conservation, and decarbonization policies, considering various aspects of responses to given climate events.

A temporary employment program would be the most pertinent policy for rapid action in reaction to major climate events and disasters, as it would both limit job losses and facilitate the rehabilitation of social and economic infrastructure. Labor intermediation and training are the most pertinent responses to the loss of biodiversity and the degradation of natural capital because they allow for a more seamless transition to new, greener jobs and make it easier for job seekers and potential employers to connect.

Figure 4. Proposed Labor Market Policies to Tackle Climate Change Challenges, proposed by the Inter American Development Bank, 2024

Type of policies	Main Strategies		
	Extreme climate events and disasters	Degradation of natural capital and biodiversity loss	Decarbonization policies
Active policies (PAML)	<ul style="list-style-type: none"> - Labor intermediation - Training - Subsidies for employment in companies - Entrepreneurship programs 	<ul style="list-style-type: none"> - Labor intermediation - Training - Subsidies for employment in companies - Entrepreneurship programs 	<ul style="list-style-type: none"> - Labor intermediation - Training - Subsidies for employment in companies - Entrepreneurship programs
Passive policies (PPML)	<ul style="list-style-type: none"> - Temporary employment - Unemployment insurance - Other passive labor market policies (tax credits, moratorium on social security payments, etc.) 	<ul style="list-style-type: none"> - Temporary employment - Unemployment insurance 	<ul style="list-style-type: none"> - Temporary employment - Unemployment insurance

Source: Inter American Development Bank 2024

The report also provides an explanation of Labor Intermediation. The intervention, conducted through rapid livelihood assessment, takes into account the shifting nature of labor markets and the need for social protection. This enables the relocation of workers from climate-affected areas to employment opportunities in emerging green sectors or in regions that are less affected by climate change. Several countries have adopted labor intermediation policies, including temporary migration programs for agricultural workers from Mexico to the U.S.A. and Canada. Another program is the Disaster Dislocated Workers Grant program, which offers labor intermediation services to workers who have been impacted by natural disasters and have had to move to a different location.

These policies are closely aligned to the global community's creation of new types of occupations, also known as Green Jobs. The International Labor Organization (ILO) said that “24 million new jobs will be created globally by 2030, provided sustainable practices are adopted and implemented” (ILO, 2018). The concept of green jobs was included together with the introduction of sustainable development goals and was further highlighted in the 1990s and 2000s as climate change became a global issue. To date, both the ILO and the United Nations Environment Programme (UNEP) have continued to advocate and promote the importance of green jobs as well as the continued transitions to a green economy.

The IDB report highlights the different approaches and definitions of Green Jobs and Green Skills by various agencies based on their respective criteria, Table 3 and 4 respectively.

Table 3. Overview Of Various International Organizations' Definitions Of Green Jobs Based On Their Own Criteria And Accompanying Examples.

Approach	Criteria	Example
Output and process (US Bureau of Labor Statistics)	Jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources, and 'workers' duties involve making their establishment's production processes more environmentally friendly or using fewer natural resources	Workers in a factory that produces solar panels, and workers in a retail shop that uses solar panels.
Industry (Eurostat)	Products and services that are directly related to natural resource protection and conservation	Workers in a factory that produces solar panels, but not workers in the retail shop that uses solar panels.
Effect of greening (O*NET)	Any occupation affected by greening, whether via increased demand, changes in work or worker requirements, or the creation of unique worker requirements	Workers in a factory that produces solar panels, workers in a retail shop that uses solar panels.
Preservation and conservation (ILO)	Jobs that contribute to preserving or restoring the environment, be they in traditional sectors such as manufacturing	Workers in a factory that produces solar panels, but not

Approach	Criteria	Example
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Effect of greening (O*NET)	Any occupation affected by greening, whether via increased demand, changes in work or worker requirements, or the creation of unique worker requirements	Workers in a factory that produces solar panels, workers in a retail shop that uses solar panels.
	and construction, or in new, emerging green sectors such as renewable energy and energy efficiency. Green jobs help to improve efficiency in the use of energy and raw materials, limit greenhouse gas emissions, minimize waste and pollution, protect, and restore ecosystems, and support adaptation to the effects of climate change.	workers in the retail shop that uses solar panels

Source: IDB 2024

Table 4. Overview of Green Skills Definitions by International Organizations

Approach	Definition
European Centre for the Development of Vocational Training (CEDEFOD)	The knowledge, abilities, values, and attitudes needed to live in, develop, and support a sustainable and resource-efficient society.

The Organization for Economic Cooperation and Development (OECD)	Skills needed in a low-carbon economy will be required in all sectors and at all levels, in the workforce, as emerging economic activities create new (or renewed) occupations.
International Labour Organization	Skills that are necessary for the successful performance of tasks for green jobs (see the definition above) and to make any job greener. That includes both core and technical skills and covers all types of occupations that contribute to the process of greening products, services, and processes, not only in environmental activities but also in brown sectors.
O*NET	It does not include a definition of green skills per se but uses the approach of “greening” of occupations (i.e., occupation refers to a group of jobs, found at more than one establishment, in which a common set of tasks are performed or are related in terms of similar objectives, methodologies, materials, products, worker actions, or worker characteristics) to refer to the extent to which green economy activities and technologies increase the demand for existing occupations, shape the work and worker requirements needed for occupational performance, or generate unique work and worker requirements.

Source: IDB 2024

The IDB report underlined the disconnect between the two policy areas (Active and Passive). Latin American countries have not adequately considered the importance of labor market policy in tackling climate change issues and assisting workers and businesses in their efforts to adapt, restore, and mitigate the impacts of climate change. Meanwhile, the labor market policies in the region are lacking in strategies, policies, financing, governance mechanisms, and operational tools needed to effectively align labor market conditions with the climate agenda.

Table 5 presents an overview of the proposed options for adapting labor market policies and promoting greater integration between the labor market agenda and the response to climate change. It analyzes three key areas of labor policy:

- a. Building stronger labor market policies in the face of rising temperatures, increased extreme weather events, and pollution;
- b. Building stronger labor market policies in advancing the conservation and restoration of natural capital and biodiversity; and

- c. Building stronger labor market policies in support of decarbonization processes and facilitating a just transition to net zero

Furthermore, within these three (3) areas, the IDP provides recommendations to strengthen labor market policies' strategic and operational aspects and align them to the LAC's climate goals in terms of financing, governance, instruments and programs, and operational mechanisms.

Table 5. Overview of the proposed options and recommendations by labor policy area and actions

Actions	Labor Market Policy Areas		
	Building stronger labor market policies in the face of rising temperatures, increased extreme weather events and pollution	Building stronger labor market policies in advancing the conservation and restoration of natural capital and biodiversity	Building stronger labor market policies in support of decarbonization processes and facilitating a just transition to net-zero
Financing	Develop quick and actionable contingency funds for labor market policies in the event of emergencies.	Finance innovative labor market interventions through existing international and national climate funds supporting conservation and restoration of natural capital.	Finance compensation measures through environmental tax reform and recycling revenues to reduce labor costs.
Governance	Create governance mechanisms with organizations with expertise in disaster preparedness, response, and recovery to develop frameworks and processes that enable planned and orderly use of labor market policies in response to shocks and disasters.	Enhance governance mechanisms to promote coordination between ministries of labor, employment agencies, and environmental agencies to integrate conservation and restoration plans with labor market policies.	Establish governance mechanisms with public institutions, social partners and private sector to coordinate decarbonization, economic, and employment goals as well as various public agendas in labor market policy design and implementation ensure just transition.
Instruments and	Integrate information	Pilot and evaluate	Labor market policies

<p>programs</p>	<p>and tools on labor markets on post-disaster assessment frameworks. Invest in adapting and strengthening labor market policies and improving institutional frameworks that can be used to respond to climate shocks. Assess the effectiveness of shock-responsive labor market policy investments.</p>	<p>interventions that combine labor and environmental objectives.</p> <p>Develop skills training programs for sustainable resource management.</p>	<p>are crucial in addressing decarbonization challenges. This involves broadening coverage, utilizing both passive and active policies, creating analytical tools for informed decisionmaking, conducting ex-post evaluations, and assessing the impact of investments in labor market policies.</p>
<p>Operational mechanisms</p>	<p>Strengthen and adapt operating mechanisms to respond to climate emergencies, including social-information systems and payment-transfer systems, broaden the coverage of beneficiary registries, incorporating informal workers and unemployed. Implement innovative strategies and utilize social networks for rapid and inclusive delivery of support in climate emergencies.</p>	<p>Strengthen labor market information systems to identify and promote job opportunities that prioritize natural capital and biodiversity conservation.</p> <p>Develop new operating mechanisms to scale up labor market policies seasonally and with the flexibility required to adapt to changing economical and labor market conditions.</p>	<p>Strengthen labor market information systems to guide workers and employers navigating the green transition. Ensure that support is available during the green transition, the methods for income support and subsidy payments must be expanded using the most effective mix of face-to-face and digital payments.</p>

Source: IDB 2024

Although focusing on Latin American Countries (LAC's), the report's proposed frameworks, policy instruments, and recommendations can be adopted by other regions with similar profiles and challenges. Another aspect that is interlinked with the fight against climate change is the development of the green and blue economy concepts. Furthermore, both concepts also address the need for sustainable practices that align with environmental stewardship, which incorporate green jobs.

The Green Economy concept essentially focuses on reducing carbon emissions, enhancing energy efficiency, and promoting the sustainable use of resources. According to the UNEP, the green economy leads to enhanced human well-being and social fairness, while substantially mitigating environmental hazards and ecological shortages. This strategy incorporates climate change mitigation by shifting from fossil fuels to renewable energy sources, advocating for energy efficiency, and endorsing sustainable practices in agriculture and forestry.

The Blue Economy mirrors the principles of the green economy concept and extends it to marine and coastal environments. Its main objective is the sustainable management of oceanic resources, ensuring an equitable balance between economic advancement and the preservation of marine ecosystems. The blue economy, as defined by the World Bank, pertains to the responsible and sustainable utilization of oceanic resources to promote economic development, enhance living standards, and create employment opportunities, all while safeguarding the overall health and integrity of marine ecosystems. By implementing sustainable fisheries, marine conservation efforts, and the advancement of renewable ocean energy, the international community can help decrease the ocean's capacity to absorb carbon and preserve it from the negative effects of climate change.

Both concepts have a link to the global effort to address climate change. Collectively, they represent a holistic strategy for promoting economic progress that prioritizes the preservation of our planet's future. This acknowledges the crucial role of a stable climate in facilitating long-term and sustainable economic expansion.

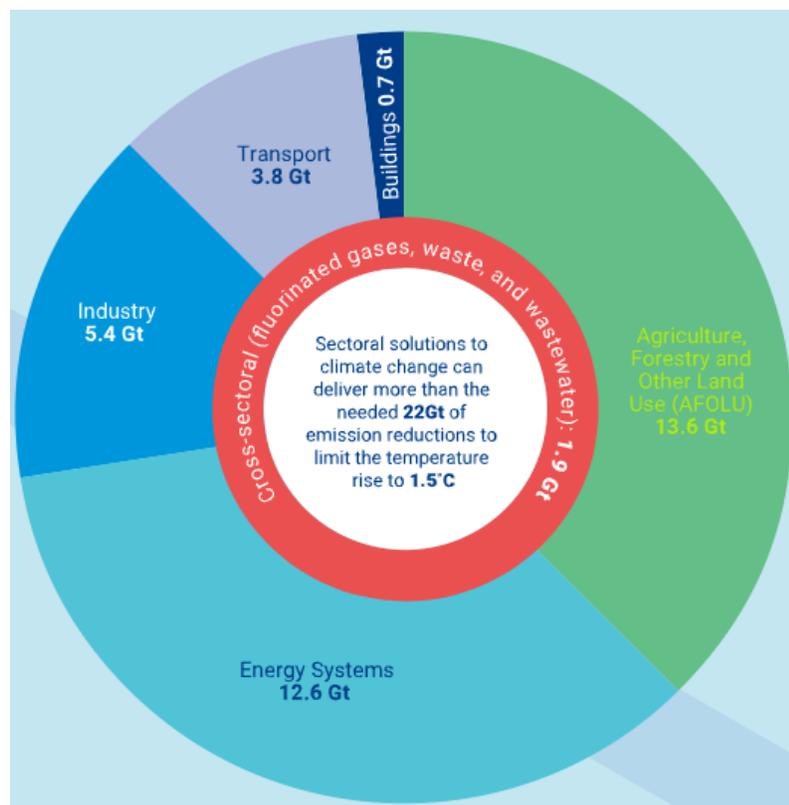
III. Global Sectoral Solutions

In 2023, the Intergovernmental Panel on Climate Change (IPCC), a United Nations (UN) body assessing the science related to climate change, published the Synthesis Report (SYR) of the IPCC Sixth Assessment Report (AR6). It summarizes the state of knowledge of climate change, its widespread impacts and risks, and climate change mitigation and adaptation. It is based on contributions from the three Working Groups

of the three Working Group Assessment Reports: WGI—The Physical Science Basis; WGII—Impacts, Adaptation, and Vulnerability; WGIII—Mitigation of Climate Change; and the three Special Reports: Global Warming of 1.5°C, Climate Change and Land, and The Ocean and Cryosphere in a Changing Climate.

The AR6 SYR confirms that global warming is caused by unequal energy and land use, as well as fossil fuel burning, leading to a 1.1°C increase in surface temperature between 2011 and 2020. In order to address the issue of human-induced global warming, the report recommends to completely eliminate carbon dioxide emissions. Taking prompt action to address climate change within the next decade would have significant benefits for both humans and ecosystems. It would lead to improved air quality and better health outcomes. Delaying these initiatives may result in the development of infrastructure with high emissions, assets that become stranded, increased costs, and larger losses.

Figure 5. The Sectoral Solutions to Climate Change



Source: United Nations Environment Programme (UNEP), 2023

The United Nations Environment Programmes (UNEPs) website integrated the findings from both the AR6 SYR and the Emissions Gap 2022 in its website titled "The Sectoral Solution to Climate Change." The potential solutions are categorized into sectors, namely Agriculture, Forestry and other land-based businesses (AFOLU), Energy Systems, Industry, Transportation, and Buildings. Each sector presents recommendations for action at various levels: government, commercial, and public. Furthermore, the summary indicates that there is potential for reducing greenhouse gas emissions by over 22 Gt (Gigatonnes), which may contribute to the goal of limiting the temperature increase to 1.5 degrees Celsius.

Agriculture, Forestry, and Other Land Use (AFOLU)

The sector contributes approximately 22% of total emissions and possesses an annual emission reduction potential of 13.6 gigatonnes, with agriculture representing an average of 91% of these emissions. The report states that global emissions can be mitigated by halting deforestation, addressing ecosystem degradation and implementing ecosystem restoration practices. These measures would enhance air quality, strengthen food and water security, and support rural economies. Investments in land, freshwater, and marine ecosystems play a critical role in enhancing climate resilience, a process often referred to as ecosystem-based adaptation.

The AR6 report indicates that despite the implementation of various policies, including REDD+, sustainable forest management, and joint mitigation and adaptation strategies, there remains a considerable funding gap between these initiatives and the scale required to achieve the 1.5 °C or 2.0 °C targets. The outlook indicates that 50% of the investments in Forestry Actions will be allocated to Latin America, while 13% will be directed towards Southeast Asia and 17% towards Sub-Saharan Africa. A mere 2.5% of climate mitigation funding is allocated to land-based mitigation options, significantly lower than the potential proportional contribution that could be achieved. A notable decrease in investment has been observed in agricultural projects compared to forestry projects aimed at reducing net carbon emissions. However, since 2000, the Organisation for Economic Co-operation and Development (OECD) and the economy in transition parties have achieved a reduction in their net emissions by implementing carbon storage techniques in cropland soils. Countries with developing economies have implemented policy initiatives aimed at reducing agricultural emissions or enhancing carbon sequestration, exemplified by Brazil's subsidy program and Indonesia's REDD+ initiatives.

The report established the interrelationship between biodiversity, ecosystem services, human well-being, and sustainable development. The document emphasizes that the loss of biodiversity and ecosystem services can adversely affect human well-being, quality of life, and the principles of sustainable development. It is anticipated that in the forthcoming decades, climate change will have a substantial impact on biodiversity loss, with commercial forestry and bioenergy production also being pivotal factors. Additionally, population growth, rising incomes, and changes in consumption and dietary patterns will exert considerable pressure on land and other natural resources.

Recent assessments also indicate that approximately 75% of terrestrial surfaces have undergone substantial human-induced modifications, while 66% of marine areas are facing escalating cumulative effects, and more than 85% of wetland regions have been depleted. Land-use change is affected by agriculture, forestry, infrastructural development, and urbanization, all of which can result in localized pollution in air, water, and soil. Over one-third of the world's land area and nearly 75% of available freshwater resources are designated for agricultural or livestock production.

The subsequent points outline key findings from the reports within the industry sector.

- From 2020 to 2050, most of the economic potential for AFOLU mitigation is attributed to mitigation measures in forests and natural ecosystems, with agriculture and demand-side measures following as secondary contributors. Forests, peatlands, coastal wetlands, savannas, and grasslands possess the capability to mitigate emissions. Agriculture accounts for the second largest portion of mitigation potential, contributing 4.1 GtCO₂-eq yr⁻¹ through practices such as cropland and grassland soil carbon management, agroforestry, biochar application, enhanced rice cultivation techniques, and optimized livestock and nutrient management strategies. Demand-side measures encompass transitioning to sustainable and healthy dietary practices, minimizing food waste, and utilizing wood, biochemicals, and bio-textiles in construction. The majority of mitigation options are accessible and prepared for implementation, enabling emissions reductions to be achieved in a timely manner, while carbon dioxide removal necessitates initial capital investment.
- Bioenergy and various bio-based alternatives play a vital role in addressing climate change challenges. Projections indicate that the bioenergy potential from technical sources by 2050 ranges from 5 to 50 EJ (exajoule) per year for residues, and from 50 to 250 EJ per year for dedicated biomass production systems. Nevertheless, inadequate planning in the deployment of biomass production and afforestation initiatives can lead to conflicts with sustainability

objectives. The estimated global potential for carbon dioxide reduction through Bioenergy with Carbon Capture and Storage (BECCS) is 5.9 GtCO₂ per year, with 1.6 GtCO₂ per year accessible at a cost of less than USD100 per ton of CO₂. Bioenergy and other bio-based products can contribute to mitigation efforts by substituting fossil fuels, including wood utilized in construction applications. The agriculture and forestry sectors have the potential to implement management strategies that facilitate biomass production and energy utilization in conjunction with food and timber production, thereby alleviating the conversion pressure on natural ecosystems.

- Mitigation measures in the AFOLU sector have been comprehensively analyzed for many years; however, their implementation has been sluggish, and current emissions trends indicate a lack of satisfactory advancement. Although the AFOLU sector has played a positive role in reducing global emissions, its overall impact on net mitigation has been limited, with previous policies achieving approximately 0.65 GtCO₂ per year in mitigation from 2010 to 2019. Forestry measures accounted for over 80% of the total emission reductions. Nonetheless, the implementation of AFOLU measures faces significant challenges due to insufficient institutional backing, ambiguity regarding long-term additionality and trade-offs, inadequate governance structures, fragmented land tenure, and unpredictable permanence outcomes. In light of these challenges, AFOLU mitigation options demonstrate efficacy and possess the potential to facilitate swift emission reductions across a majority of nations.

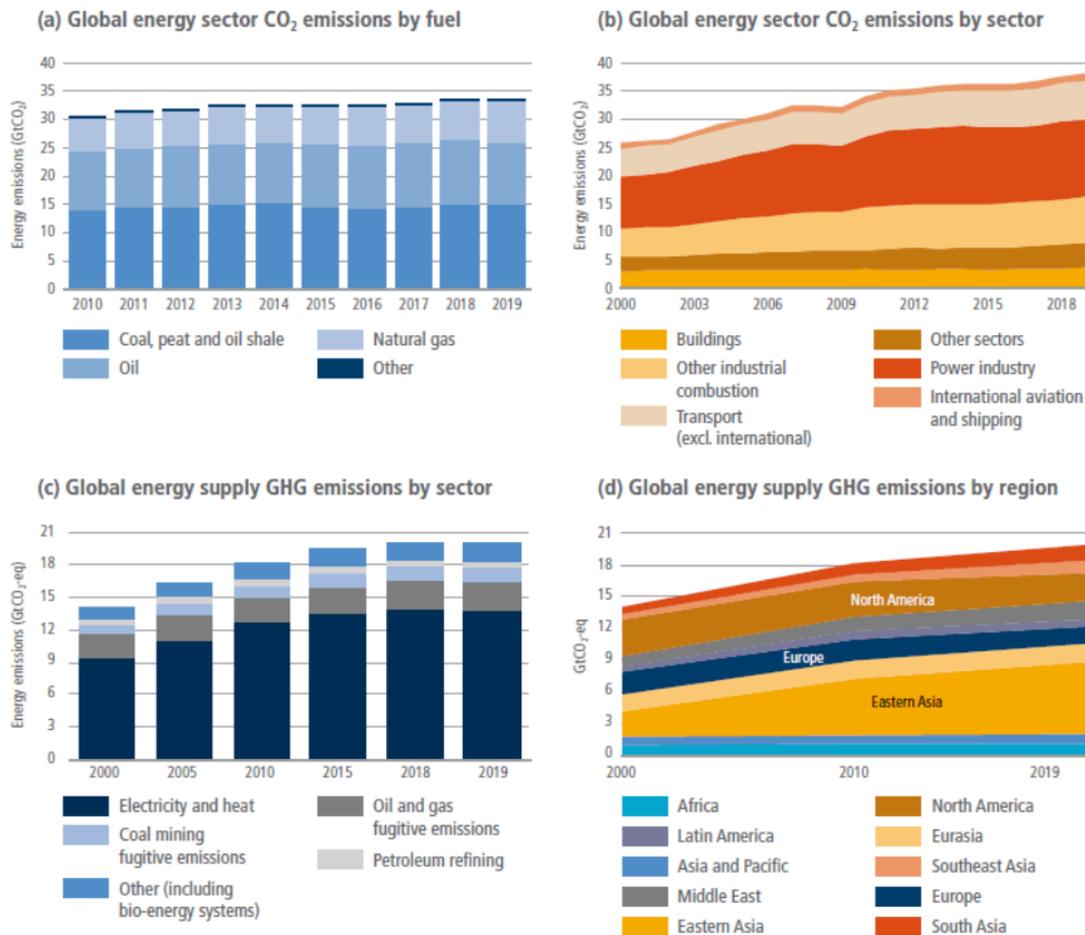
Energy Systems

The worldwide energy supply, which includes electricity and heat generation, is the most major source of greenhouse gas emissions, producing 20 gigatonnes of CO₂-e each year. The global economy has the ability to reduce emissions from this sector by 12.6 gigatonnes per year. This can be accomplished partially through the enhancement of renewable energy capacity and the optimization of energy efficiency measurements. The suggested transition is crucial for addressing climate change, roughly comparable to removing 7 billion passenger vehicles from circulation. The anticipated transition is expected to generate millions of employment opportunities, enhance air quality, reduce electricity costs for consumers, and broaden access to electricity for populations globally. The advancement of clean energy technologies is essential for effectively addressing the challenges posed by climate change. Clean energy can be attained through the implementation of various renewable energy sources, which can also assist in mitigating potential disruptions caused by climate impacts and ensuring a stable energy supply.

Energy systems comprise both physical and societal components, incorporating the infrastructure and equipment utilized for the extraction, transformation, transportation, transmission, and conversion of energy to provide energy services. Human societies utilize energy for various applications, including transportation, heating, cooling, lighting, cooking, and the production of goods and services. Consumers have the capability to optimize their energy consumption by acquiring technology that minimizes their energy requirements, whereas businesses and governmental entities allocate resources towards technology for the generation, conversion, and distribution of energy. Energy systems operate within a structured framework of laws, regulations, and institutional guidelines established by both the private sector and the government. This framework encompasses protocols for trading emissions permits, standards for electricity generation technologies, water management practices, and regulations related to CO₂ injection and waste disposal. The mitigation of energy systems may result in the elimination of certain jobs while simultaneously generating new employment opportunities.

The report indicated that, based on current energy emission trends, it will not be possible to limit global temperature changes to well below 2.0 °C. From 2019 to 2025, the fossil fuel CO₂ emissions from the global energy system increased by 4.6%, representing roughly two-thirds of the annual global emissions produced by human activities, despite a decrease in emissions observed in 2020 (Figure 5). Between 2015 and 2019, coal emerged as the predominant source of CO₂ emissions within the energy sector, representing approximately 44% of the sector's total CO₂ emissions in 2019. Oil represented approximately 34% of CO₂ emissions in the energy sector, while natural gas contributed around 22%.

Figure 6. Global energy sector CO₂ emissions and global energy supply GHG emissions



Source: IPCC Sixth Assessment Report—Working Group III: Mitigation of Climate Change, 2023

Additionally, over the past decade, the energy system has seen significant changes, with a 6.6% increase in total primary energy supply (TPES) and major changes in energy sources. From 2015 to 2019, TPES grew by 6.6%, with natural gas consumption growing the most quickly. Coal, oil, and oil products grew at annual rates of 0.23% and 0.83%, respectively. Renewables grew at an annual rate of 12%, but their share remains marginal. Bioenergy accounted for 9.4% of TPES. Oil products used for transportation accounted for 41% of TFC in 2019. Non-fossil fuel penetration remains marginal despite the growth of electric vehicles. Coal accounted for 9.5% of TFC in 2019, dropping from 11.7% in 2015. Electricity share increased modestly, from 18.6% in 2015 to 20.2% in

2019, reflecting increasing access in developing countries and residential sector use. Heat accounts for approximately 3% of TFC. Biofuels and waste accounted for 10.4% of TFC in 2019.

The documents emphasize the reduced costs associated with renewable technologies in recent years, which are driving major changes in electricity production and transportation. These advancements are closely linked to climate and various environmental considerations. Recent developments in photovoltaic cells can be attributed, in part, to proactive deployment strategies driven by energy security, climate considerations, and various environmental issues. The decreasing costs of batteries, particularly lithium-ion batteries, have enhanced the competitiveness of electric vehicles.

The increasing dependence on weather patterns in future low-carbon electricity systems amplifies the potential impacts of climate change. Nonetheless, the report emphasizes that the global impacts of climate change on electricity generation, encompassing *hydro, wind, and solar power potentials*, should not undermine climate mitigation strategies.

Hydropower

- Hydropower generation is affected by factors such as water availability, seasonal variations, temperature fluctuations, and the intensity of precipitation. Enhanced precipitation contributes to greater water availability and boosts hydropower generation; however, it may also impact dam integrity, influence vegetation development, and lead to reservoir sedimentation. Climate change is likely to result in elevated air temperatures, increased surface evaporation, and a reduction in equipment efficiency. The rising demand for water in irrigation and industrial applications can impact the availability of hydropower resources. Climate change has the potential to modify water usage requirements, which could result in disputes regarding water allocation.
- The report presented regional variations in hydropower, indicating increases of 5–20% in most high latitude regions, while areas facing intensified drought conditions may experience reductions between 5–20%. Projections indicate a steady rise in streamflow and hydropower generation by 2080 in high-latitude regions of the northern hemisphere and certain tropical areas, such as central Africa and southern Asia. Conversely, a decline is anticipated in the USA, southern and central Europe, Southeast Asia, and southern South America, as well as in Africa and Australia. There are indications of reduced hydropower

production in regions including parts of North America, central and southern Europe, the Middle East, central Asia, and southern South America. Research findings vary regarding the alterations in hydropower generation in China, central South America, and, to some extent, southern Africa.

Wind Energy

- Long-term projections for global wind energy resources indicate stability under anticipated future climate scenarios, accompanied by consistent alterations in atmospheric jet positioning. The observed shifts could lead to a reduction in wind power potentials within the mid-latitudes of the Northern Hemisphere, while simultaneously enhancing potentials in tropical regions and the Southern Hemisphere. However, the reliability of climate models in accurately replicating historical wind resources raises concerns.
- Intra-annual variations are projected to rise by 2100, primarily driven by natural multi-decadal variability. Climate change has the potential to result in more uniform wind speeds, which could subsequently elevate system integration costs and diminish the advantages associated with wind generation transmission. By the conclusion of the 21st century, Europe might require a slight augmentation in backup energy resources. Nonetheless, the influence of climate change is less significant than interannual variability, and it is probable that European electricity systems can manage the effects of climate change on wind power effectively. Variability in wind generation has been observed in North America, resulting in minor effects on the operation of the electricity system.

Solar Energy

- The influence of climate change on global solar insolation is expected to be minimal, which is essential for facilitating low-carbon transitions. Models indicate differing levels of solar insolation across specific regions, influenced by trends in cloud cover, aerosol presence, and water vapor concentrations. Elevated surface temperatures lead to a decrease in solar power output and a decline in the efficiency of photovoltaic panels. In certain scenarios, these increases are offset by a significant rise in surface air temperatures. The rise in aerosol concentrations is likely to diminish solar resource availability and elevate maintenance expenditures.
- The impact of temperature-induced efficiency losses on solar PV is less significant compared to the influence of changes in solar insolation resulting from fluctuations in water vapor and cloud cover. Upcoming photovoltaic

technologies are anticipated to achieve enhanced efficiency, potentially compensating for declines associated with temperature variations. Forecasts indicate a reduction in cloud cover within the subtropical regions, accompanied by slight growth in solar photovoltaic capacity by the century's conclusion.

Bioenergy

- Climate change can directly impact biomass resource potential through changes in suitable range and yield, and indirectly through land availability. Increases in CO₂ concentration can increase biomass yield, while climate changes like temperature and precipitation can either increase or decrease yield and suitable range. Climate change will shift bioenergy's suitable range towards higher latitudes, but the net change in total suitable area is uncertain. Studies show northward shifts in bioenergy's suitable range in the northern hemisphere, but the net effect varies by region, species, and climate model.
- The influence of climate change on bioenergy potential remains vague, primarily due to the uncertainties surrounding CO₂ fertilization, which enhances photosynthesis as a result of elevated atmospheric CO₂ levels. Research indicates that the absence of CO₂ fertilization leads to a 16% decrease in global bioenergy potential, whereas the presence of CO₂ fertilization results in a 45% increase. Recent research conducted in the USA indicates a minimal impact of CO₂ fertilization on the yield of switchgrass. Estimating bioenergy potential across various climate and crop models involves significant uncertainty.

Thermal Power Plants

- Climate change is anticipated to affect thermal power plants by modifying ambient conditions such as temperature, humidity, and water availability. The modifications have a negligible effect on coal-fired and nuclear power facilities; however, gas-fired plants could see substantial reductions in thermal efficiency and overall power generation. Drought conditions can result in reduced availability of cooling water, thereby heightening the risk of surpassing regulatory limits, which may ultimately lead to decreased production or operational shutdowns. The utilization of global thermal power exhibits a reduction of 3.8% during drought years, with projections indicating that climate change will likely result in additional declines in the capacity of thermal power plants.

- Existing thermal power plants have the potential for retrofitting to mitigate climate impacts through the redesign of cooling systems; however, the associated costs could be substantial. Dry cooling can result in reduced efficiency and may expose plants to increased temperature risks. Closed-circuit cooling exhibits reduced sensitivity to variations in water temperature. Adjusting water and heat emissions policies can contribute to alleviating plant reliability issues; however, it may have repercussions for other water users and the surrounding ecology. Enhancements in water utilization, thermal efficiency, and transmission capabilities across extensive geographical areas

Industrial Sector

This sector encompasses multiple subsectors, including ores and mineral extraction, manufacturing processes, construction activities, and waste management operations. The report proposes that the sector has the potential to reduce its emissions by 5.4 gigatonnes a year. The sector represents the most significant contributor to global greenhouse gas and carbon dioxide emissions. The report focuses on heavy industry, particularly the basic materials sectors that are defined by elevated temperature heat and process emissions. The contribution of these industries accounts for 65% of industrial greenhouse gas emissions and exceeds 70% of industrial carbon dioxide emissions, not including waste factors. The implementation of near-zero emissions technologies in this context presents greater challenges due to the capital intensity and longevity of the equipment involved, in contrast to other manufacturing sectors. The shift of heavy industries towards zero emissions necessitates the enhancement of the conventional strategies of energy and process efficiency, fuel switching, electrification, and power decarbonization. This should be enhanced by overseeing material end-use demand and efficiency, implementing a circular economy, employing fossil-free feedstocks, and integrating carbon capture and utilization (CCU) alongside carbon capture and storage (CCS) technologies. Energy efficiency was comprehensively examined in AR5 and remains an essential mitigation strategy. The report examines recent options and advancements since the last assessment report (AR5), highlighting the essential actions required throughout the entire value chain to attain zero emissions in the production of primary materials.

The subsequent points outline key findings from the reports within the industry sector.

- The global material intensity, particularly the in-use stock of manufactured capital per capita, has been on the rise, exhibiting a growth rate that surpasses

GDP per capita since 2000. Since then, the extraction and production of resources have increased, leading to quicker growth in industrial emissions. These emissions, which make up 24% of all direct anthropogenic emissions in 2019, are produced by the burning of fuel, emissions from processes, waste, and product consumption. With 34% of all emissions in 2019 coming from the industrial sector, it is a major emitter.

- the year 2000. Nonetheless, per capita material stocks in developed nations have ceased to increase, suggesting a decoupling from GDP per capita.
- Industrial emissions have grown faster after 2000 as a result of increasing resource extraction and production. These emissions are created by burning fuel, process emissions, trash, and product consumption. In 2019, these emissions accounted for 24% of all direct anthropogenic emissions. The industrial sector is one of the biggest emitters in 2019, accounting for 34% of all emissions.
- Carbon plays a vital role in the composition of organic chemicals, fuels, and materials. Reaching net zero CO₂ emissions necessitates the closure of use loops for carbon and carbon dioxide. This can be accomplished through enhanced circularity, optimized utilization of biomass feedstock in conjunction with low GHG hydrogen, and the potential implementation of direct air capture of CO₂ as an innovative carbon source.
- Low to zero emissions Steel technology necessitates the implementation of integrated material efficiency, recycling strategies, and production decarbonization policies. Optimizing material efficiency has the potential to decrease steel demand by as much as 40%. Additionally, it is essential to enhance secondary production through high-quality recycling processes. Carbon reductions in production require the retrofitting of current facilities to enable partial fuel switching, carbon capture and utilization (CCU), and carbon capture and storage (CCS). This process is followed by the implementation of very low and zero emissions production methods, utilizing high-capture CCS or direct hydrogen technologies.
- The emissions associated with cement and concrete are prevalent, attributed to their cost-effectiveness, longevity, and extensive application in various sectors. To mitigate emissions, it is essential for producers, users, and regulators to engage in education, foster innovation, and implement effective commercialization policies. Employing high-quality concrete judiciously and exclusively in necessary applications can lead to a reduction in emissions by 24-50% due to decreased clinker demand. The substitution of cementitious materials with alternatives such as ground limestone and calcined clays has the potential to decrease process calcination emissions by as much as 50%. Until a commercially viable low - GHG emissions alternative binder to Portland cement is

developed, the Cement Control System (CCS) will play a critical role in mitigating emissions from the limestone calcination process involved in clinker production, which currently accounts for 60% of GHG emissions in the most advanced technology plants.

- Decarbonization of industrial feedstock chemicals and their derivatives can be achieved through a range of technological solutions, though the associated costs differ significantly. Feedstocks derived from fossil fuels are cost-effective and devoid of carbon emissions, whereas alternatives based on biomass and electricity tend to incur higher costs. The chemical sector utilizes fossil feedstock to manufacture a wide array of chemicals, resulting in the production of thousands of derivatives. Hydrogen, biogenic or air-captured carbon, and plastic waste have the potential to mitigate emissions; however, the availability of biogenic carbon feedstock is constrained by competing land uses.
- Light industry and manufacturing can achieve substantial decarbonization through the adoption of low greenhouse gas fuels and electricity sources. Nonetheless, the prevailing low prices of fossil methane and coal present a significant obstacle. The pulp and paper sector exhibits considerable biogenic carbon emissions while demonstrating minimal fossil fuel emissions. Pulp mills have the capability to utilize biomass residues and byproducts for electrification purposes. As the demand for wood substitutes in building materials and petrochemicals rises, competition for feedstock is expected to intensify. The sector can serve as a source of biogenic carbon dioxide and carbon for organic chemical feedstock, as well as for carbon dioxide removal through carbon capture and storage technologies.
- The degree of policy development and experience demonstrates significant variability among the mitigation options, with a high level of confidence in this assessment. Energy efficiency represents a mature policy domain, characterized by extensive experience gained through voluntary and negotiated agreements, regulatory frameworks, energy auditing practices, and demand-side management (DSM) initiatives (refer to AR5). Conversely, the understanding and policy addressing of material demand management and efficiency are insufficiently developed. Barriers to recycling that policy could address are frequently related to the distinct material loops, such as copper contamination affecting steel and the absence of technologies or unfavorable economics impacting plastics, as well as the waste management systems in place. The current emphasis on electrification and fuel switching has predominantly focused on innovation and the development of technical supply-side solutions rather than stimulating market demand.

- Industry has so far largely been sheltered from the impacts of climate policy and carbon pricing due to concerns for competitiveness and carbon leakage (high confidence). New industrial development policy approaches needed for realizing a transition to net zero GHG emissions are emerging. The transition requires a clear direction toward net zero, technology development, market demand for low-carbon materials and products, governance capacity and learning, socially inclusive phase-out plans, as well as international coordination of climate and trade policies. It requires comprehensive and sequential industrial policy strategies leading to immediate action as well as preparedness for future decarbonization, governance at different levels (from international to local), and integration with other policy domains.

The report highlights that deep decarbonization pathways for energy-intensive industries, including materials efficiency, circular economy, and new primary processes, are underrepresented in climate change scenario modeling and integrated assessment models, and no agreement is reached between bottom-up and top-down studies on the effectiveness and costs of many promising mitigation options. A significant shift is needed from marginal and incremental changes to transformational change, where there is limited knowledge of how to implement such change effectively.

It was also seen that there is a knowledge gap on comparable, comprehensive, and detailed quantitative information on costs and potentials associated with mitigation options for deep decarbonization in industry. Cost estimates are often not comparable due to regional or country focus, differences in cost metrics, currencies, discount rates, and energy prices across studies and regions. The report recommends that additional knowledge is needed to understand sectoral interactions in the transformation processes, and industrial climate mitigation policy is supplemental to many other policy instruments developed to reach multiple industrial goals, affecting decision-making processes and the behavior of stakeholders.

Transportation Sector

The sector is described in the report as having the greatest dependence on fossil fuels compared to all other sectors. The sector accounts for 8.7 gigatonnes of emissions, constituting 15% of the global total emissions. Its projected emissions are anticipated to double, exhibiting a growth rate surpassing that of any other sector. A significant portion of this increase is expected to occur in nations that are already experiencing disproportionate impacts from elevated petroleum prices. The report indicates that approximately 2.8 gigatonnes of emissions could be mitigated each year through the

adoption of electric vehicles, enhanced utilization of public transit, and improved urban design that minimizes the need for travel among residents. Furthermore, transitioning to locally produced low carbon electricity in place of fossil fuels for motorized transport will lead to a decrease in fuel import expenses, enhance energy security, and contribute to local value generation. The integration of climate risk and vulnerability assessments into the planning, design, construction, and operation of transport infrastructures is essential for ensuring resilience against extreme weather conditions.

Since the IPCC's Fifth Assessment Report, there has been a growing recognition of the need for demand management solutions and new technologies, such as electromobility for land transport and advanced biofuels and hydrogen-based fuels for shipping and aviation. This has led to a need for systemic infrastructure changes that enable behavioral modifications and reduced transport service demand, ultimately reducing energy demand. The COVID-19 pandemic has demonstrated the transformative value of telecommuting and local active transport, highlighting the need for strategies to drive behavioral change and support new transport technology adoption.

The subsequent points outline key findings from the report within the transportation sector.

- Achieving climate mitigation objectives necessitates major changes within the transport sector, given that direct greenhouse gas emissions from this sector represented 23% of global energy-related CO₂ emissions in 2019. Seventy percent of these emissions originated from road vehicles, whereas rail, shipping, and aviation accounted for 1%, 11%, and 12%, respectively. Emissions from shipping and aviation are increasing at a significant rate, with developing regions showing more pronounced growth compared to Europe or North America.
- Dematerialization has the potential to decrease the need for material transportation, whereas online shopping with expedited delivery options can lead to an increase in freight transport demand. Teleworking has the potential to decrease travel demand, whereas ridesharing may lead to an increase in vehicle kilometers traveled.
- Battery electric vehicles (BEVs) exhibit reduced lifecycle greenhouse gas emissions compared to internal combustion engine vehicles (ICEVs) when powered by low-carbon electricity sources. These technologies are being swiftly integrated into micromobility solutions, transit infrastructures, and personal transportation vehicles. Battery Electric Vehicles (BEVs) have the potential to enhance grid operations. The widespread market presence of advanced lithium-ion batteries has driven this expansion.

- Decarbonization plans for the shipping and aviation sectors require research and development efforts; however, advanced biofuels, ammonia, and synthetic fuels are surfacing as feasible alternatives. Natural gas-derived fuels may not suffice to achieve decarbonization objectives, leading to the development of high energy density, low-carbon alternatives. Advanced biofuels have the potential to deliver low-carbon jet fuel. Additionally, synthetic fuels produced from low-carbon hydrogen combined with CO₂ captured via direct air capture or bioenergy with carbon capture and storage can serve as jet and marine fuels. Ammonia generated using low-carbon hydrogen has the potential to function as marine fuel; however, its implementation necessitates a decrease in production expenses.
- The Paris Agreement may need amendments to incorporate low-carbon aviation and shipping fuels within its emissions reduction objectives. The current agreement lacks specific provisions for emissions originating from international shipping and aviation, thereby placing the responsibility on individual countries to make determinations. The International Civil Aviation Organization (ICAO) and International Maritime Organization (IMO) have established emissions reduction targets, concentrating on enhancing fuel efficiency and curtailing demand. Certain authors contend that the incorporation of these sectors within the Paris Agreement may promote enhanced decarbonization initiatives in these areas.
- Climate strategies are currently being executed across all levels of government, with the objective of promoting both demand- and supply-side transport mitigation efforts. Local legislation has the potential to enhance transport plans that promote sustainable behavior by leveraging institutional commitments and innovative artistic approaches. Examples consist of initiatives such as bike-to-work campaigns, the provision of free transport passes, the implementation of parking charges, and the removal of car benefits. Community-driven initiatives such as solar sharing and communal charging infrastructure can significantly enhance the prospects for low-carbon transportation systems. Legislation at both regional and national levels may encompass standards for vehicle and fuel efficiency, support for research and development, and substantial investments in low-carbon transportation infrastructure.

Buildings

This sector includes the construction and operations of the world's buildings and is responsible for 12 Gt of greenhouse gas emissions annually. It is also responsible for 34% of global energy demand and 37% of energy and process related carbon dioxide

(CO₂) emissions. According to the ASR 6 report, the sector has an emission reduction potential of 0.7 gigatonnes for direct emissions and 2 Gt for direct and indirect emissions (electricity and heat). When further assessed in the report, the building sector mitigation policies can reduce greenhouse gas (GHG) emissions by up to 90% in developed countries and up to 80% in developing countries. This can translate to helping lift up to 2.8 billion people in developing countries out of energy poverty.

The report also highlights the construction industry's considerable promise for addressing climate change, playing a crucial role in the decarbonization of worldwide energy frameworks, and fulfilling the objectives set forth in the Paris Agreement and the Sustainable Development Goals. Mitigation interventions in buildings exhibit considerable variation across multiple dimensions, encompassing building components, services, types, sizes, functions, and climate zones. Variations exist between developed and developing nations regarding the types of mitigation interventions. Developed countries encounter challenges in renovating existing buildings, while developing countries necessitate the expedited construction of new ones.

The subsequent points outline key findings from the reports within the industry sector.

- Technological advancements have created new design opportunities, with 3D printing presenting a viable option for achieving faster, more cost-effective, and sustainable construction methods. Although it is unlikely to supplant traditional architectural construction, it has the potential to enhance production and assembly efficiencies through the adoption of innovative sustainable construction methods and tools. Nonetheless, 3D printing remains a field under development, characterized by considerable potential and swift progress.
- To achieve the best possible balance of comfort and energy consumption, energy-efficient air conditioning systems must be installed. Recent improvements include ice refrigeration, solar photovoltaic electricity, and thermal storage systems. Building design requires adequate ventilation, since natural ventilation plays an important role in reducing energy use in warmer areas. Recent advances in refrigeration systems include solar thermoelectric cooling methods and the use of nanoparticles. Building services are usually assessed in a reductive fashion; however, the increased usage of technology such as Building Information Modeling (BIM) allows for more exact calculations and the creation of more complete models. Recent assessments of building services in light of climate change emphasize the importance of embodied energy.

- While there are significant benefits to decarbonizing buildings, hurdles such as knowledge, financing, market dynamics, and behavioral factors continue to limit progress in this sector. Potential options include allocating resources toward technical breakthroughs and implementing lifestyle changes. The development of sufficiency must be prioritized through effective legislation and widespread information transmission, as relying exclusively on technology solutions is insufficient. Building decarbonization cannot be achieved via a single policy approach; rather, a combination of regulatory measures, market-based instruments, and informational tactics is required to effectively pursue this goal. Access to financing is critical for the growth of energy efficiency technologies and the deployment of on-site renewable energy solutions. The successful implementation of policy ideas requires robust governance and strong institutional capability.

The report underscored the necessity of addressing and regulating emissions of fluorinated gases (F-gases), which include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF₆), and nitrogen trifluoride (NF₃), given their widespread impact across all identified sectors. Additionally, the summary recommendation provided in Table 6 complements the findings from the AR6 and Emissions Gap Report, addressing it to all levels across the specified sectors.

Table 6. Overview of the recommendations identified in the UNEP Sectoral Solutions Page by Sector and Level

Sector	Level		
	Government	Private	Public
Agriculture and Food	<ul style="list-style-type: none"> • Adopt legislation at the national level that requires large retail businesses to implement a scheme to deal with their food waste. Measure food loss, create waste baselines, and implement strategies to reduce food waste, especially at the retail and household levels. • Reform national dietary guidelines to help citizens make healthier and more sustainable food choices. Inform consumers and producers about food choices and how to reduce food loss and waste. Leverage educational programs, reform labeling guidelines, and government-sponsored campaigns. • Incentivize nature-positive and climate-resilient agricultural practices, including through the repurposing of agricultural subsidies, to encourage the adoption of sustainable practices and technologies. • Increased investments in public infrastructure such as crop storage and waste management facilities to reduce food waste emissions and to add value to compostable products. 	<ul style="list-style-type: none"> • Design for circularity. Integrate food loss and waste reduction strategies into business models ; make it easier for consumers and employees to minimize food and packaging waste. • Review packaging and integrate biodegradable packaging options where appropriate; provide clear storage and freezing guidance; eliminate 'display until' dates; and clarify best before/use-by dates. • Set up processes for surplus food rescue to transfer healthy, uneaten food to services that can distribute it to those in need. • Decarbonize the food supply chain, starting at the field level through the adoption of healthy soil practices. Integrate innovative technologies to further reduce emissions at the processing, packaging, transport, retail, and waste management phases. • Improve food production efficiency at the farm level by integrating healthy soil practices, changing the 	<ul style="list-style-type: none"> • When possible, support local farmers by eating seasonally and locally. Embrace 'ugly' fruit and vegetables, and compost food scraps. • Meal plan; write shopping lists, cook more at home, save leftovers, and shift towards a more plant-rich diet. • To maximize freshness, store food, including freezing it when possible. • Donate excess food to services or charities that can distribute it to the needy. • Ask grocery stores, restaurants, and hotels about their plans to tackle food loss and champion those who lead the way. • Urge politicians to propose ambitious policies, infrastructure, and services for waste reduction and reuse. • Get involved with non-governmental

Sector	Level		
	Government	Private	Public
	<ul style="list-style-type: none"> • Integrate food production, distribution, and retail into city planning to enhance equitable and affordable access to healthy food choices. • Promote healthy soil practices to enhance ecosystem restoration and invest in outreach services to strengthen local capacity. Increased water retention and reduced soil erosion will not only boost agricultural productivity but also help communities adapt to changing precipitation patterns and water scarcity. Increase research and investment in the development of drought-resilient and flood-resilient crop strains and make these accessible to smallholders. • Encourage the diversification of crops and reintroduction of indigenous species, which are well adapted to local conditions, to bolster climate resilience. 	<p>composition of animal feeds and breeds, improving the management of manure and crop nutrients, measuring and water usage, and increasing rainwater harvesting. Integrate forecast-based recommendations into planting and harvesting schedules to minimize losses.</p> <ul style="list-style-type: none"> • Incorporate climate forecasts into planting schedules and fishing schedules. 	<p>organizations (NGOs) to advocate and organize fundraising events in favor of waste reduction and environmentally friendly agriculture.</p>
Forestry	<ul style="list-style-type: none"> • Enact and enforce laws that prohibit illegal logging and deforestation and incentivize sustainable forestry practices. • Establish and expand protected areas, national parks, and forest reserves to conserve vital ecosystems and prevent 	<ul style="list-style-type: none"> • Work with suppliers to find collaborative solutions to minimize ecosystem impacts across the supply chain. Consider overlaps between making your supply chain climate-resilient and restoring forests and ecosystems - and make it 	<ul style="list-style-type: none"> • Learn from nature and see where it fits in with your life; discover more about the systems that sustain us—like where your food comes from—and make more informed choices.

Sector	Level		
	Government	Private	Public
	<p>deforestation.</p> <ul style="list-style-type: none"> • Allocate funds to support local communities and indigenous groups engaged in sustainable forest management and include them, recognized as the best guardians of forests, within state structures to secure their interventions and the creation of sound policies to guarantee their rights. • Participate in regional and global initiatives and programs, aiming to stop deforestation and financially reward countries for forest conservation and sustainable forest management efforts. • Implement state-of-the-art monitoring systems to track, monitor, report, predict, and verify deforestation in real-time, and implement safeguards systems that ensure high social and environmental integrity and facilitate leveraging carbon finance from forests. • Restore and protect ecosystems on a large scale to provide natural defenses against the impacts of climate change (i.e., ecosystem-based adaptation). 	<p>happen.</p> <ul style="list-style-type: none"> • Invest in landscape conservation and restoration and deforestation-free supply chains as part of net-zero emission efforts; investments must meet high social and environmental standards. • Invest in high-quality forest carbon credits and ensure transparency and integrity in the use of forest carbon credits as offsets. • Ensure private investments in commercial forestry are directed towards sustainable forest management practices. • Internalize ecosystem services into cost-benefit analyses for land-use plans. 	<ul style="list-style-type: none"> • Be mindful and proactive about the impacts of your interactions with nature. Spend more time connecting with nature and natural spaces. • Urge your politicians to propose ambitious regulations to prevent deforestation and encourage nature restoration. • Attend or arrange events or communities against deforestation and for nature restoration. • Join a local or national organization supporting forest habitat conservation and restoration. Whenever possible, neutralize your carbon footprint by donating to groups that conserve and restore forests and peatlands. • Make conscious decisions to buy products from companies that adhere to deforestation-free supply chains, such as products with certified sustainable labels,

Sector	Level		
	Government	Private	Public
			<p>and consider adopting deforestation-free diets, making conscious choices to consume products that don't contribute to deforestation.</p> <ul style="list-style-type: none"> Actively push for and support policies that discourage deforestation and encourage forest protection and restoration, demonstrating personal commitment to the cause.
Energy Systems	<ul style="list-style-type: none"> Commit to more ambitious, nationally determined contributions and support market-based strategies that speed the transition to renewable energy and improvements in energy efficiency. Set national and subnational decarbonization and net-zero carbon targets. Remove fossil fuel subsidies in a socially acceptable manner, stop the expansion of fossil fuel infrastructure, and plan for a just fossil fuel phase-out. Remove barriers to the more rapid expansion of renewables; adapt the electricity system's market rules; allow 	<ul style="list-style-type: none"> Set decarbonization and net-zero carbon targets for your companies, divest holdings in fossil fuel companies, and phase out unabated coal and gas generation. Monitor and reduce your company's energy usage and take action to improve energy efficiency. Steeply accelerate the share of zero-carbon power in electricity generation; it should be between 65 and 92 percent by 2030 and between 98 and 100 percent by 2050. Adapt grid/storage and demand management. 	<ul style="list-style-type: none"> Reduce your energy consumption by applying simple changes: seal windows and doorsteps, avoid thermic bridges, install double glass glazing, use LED bulbs, and invest in high-inertia radiators. Produce your own energy if possible by installing small-scale installations such as solar panels to power your home. If possible, choose utilities and operators committed to decarbonization and energy

Sector	Level		
	Government	Private	Public
	<p>production for own use; accelerate planning and provision of sites; remove bureaucratic hurdles; regulate grid access and connection; and educate workers.</p> <ul style="list-style-type: none"> Utilize a diverse variety of renewable energy sources. 	<ul style="list-style-type: none"> Ensure reliable energy access for all. Currently, 10 percent of the world's population has no access to electricity, and over 40 percent has unreliable access. 	<p>efficiency.</p> <ul style="list-style-type: none"> Urge your politicians to propose and vote for ambitious policies for renewable energy and energy efficiency. Investigate national, regional, and local incentive programs (rebates, tax incentives, low interest rate loans) for renewable energy and energy efficiency. Advocate that investments or pension funds move towards clean energy and consider disinvestment from those not taking action.

Sector	Level		
	Government	Private	Public
Industry	<ul style="list-style-type: none"> • Plan a just transformation at the national level and ensure regional planning and regulation. • Incentivize and mandate less emissions of greenhouse gases, including cutting methane leaks. • Promote the use of efficient and renewable heating, cooling, electrification, and circular material flow. • Support zero-carbon industrial processes and ensure the standards used in the design of infrastructure are robust in the face of future climate change impacts. • Support alternative carbon pricing mechanisms, low-carbon products, research, and innovation. • Promote climate-resilient industry practices through tools such as regulatory standards and vulnerability maps, combined with a strong communication drive to ensure the private sector is aware of climate risks, projections, and uncertainties. 	<ul style="list-style-type: none"> • Scale up research and development to create new options for low-carbon industrial processes, use new fuels, and develop innovative solutions. • Understand new market opportunities arising from climate change that allow companies to develop a first-mover advantage over competitors. • Audit the energy use and resource efficiency of your operations to identify cost-effective high-impact reductions, understand your exposure to climate risk, and take precautions. Incorporate climate vulnerability assessments into business plans and future investments. • Reduce demand and enhance access to energy-efficient, material-efficient, and carbon-neutral materials; scale up energy efficiency. • Increase water-use efficiency to protect water resources and thereby enhance adaptation. 	<ul style="list-style-type: none"> • Rethink your needs and aspirations: Consider what you need and what impacts your purchases have on the planet, and buy products that will last longer, be used multiple times, and are intended to be in use for as long as possible before being remanufactured or recycled. • Avoid consuming products that use excessive amounts of water in the production process. • Recommend and buy from companies that provide spare parts to repair, that offer take-back services, or that use recycled materials in production. • Ask companies and governments for information about how they produce and source both goods and services; read up on their commitments to sustainable production and practices; and support the ones that adopt

Sector	Level		
	Government	Private	Public
			sustainable and circular practices.
Transportation	<ul style="list-style-type: none"> • Develop policy frameworks and establish national strategies to switch to low-emission road transport systems including the promotion of non-motorized transport, improved public transportation and low-carbon electric mobility. • Invest in and remove barriers to non-motorized mobility infrastructure, like protected bicycle lanes or paths for pedestrians. • Promote the significant public health benefits of low-carbon transport policies, including from reduced air pollution, improved safety and more active mobility. • Set mandates to switch to zero emissions road vehicles by specific dates, regulate and incentivize zero-carbon fuels for aviation, and invest in zero-emission transport infrastructure. • Adjust taxation /pricing schemes to increase tax burden for polluting modes of transport and incentivize use of low-emission transport. • Adopt integrated land-use planning to avoid 	<ul style="list-style-type: none"> • Switch passenger and freight transport road fleets to electric vehicles and set targets to complete transformation to zero-emissions vehicle technologies for cars, vans, buses and trucks. • Switch to low-carbon fuels for ships and planes in combination with the latest energy efficiency measures. • Switch to rail for the transportation of goods. • Make investments in, and establish pricing for the shift towards low-carbon modes of transport (trains, public transport, cycling). • Reduce air travel and offset for carbon emissions. • Arrange for flexible and staggered working arrangements. 	<ul style="list-style-type: none"> • Prioritize people-powered transportation for short trips. • Use public and shared transport and join bike-, scooter- or car-sharing services. • Reduce the need for motorized transport and rethink air travel, choose rail over air. • Buy electric vehicles and smaller cars that use cleaner fuels. • Urge your politicians to propose support for non-motorized transportation, public transport and electric mobility. • Support local government initiatives to introduce better mass transit and non-motorized mobility infrastructure. • Advocate for e-mobility and non-emission transport in your

Sector	Level		
	Government	Private	Public
	<p>transport needs by prioritizing moving people and improving transport access over private cars.</p> <ul style="list-style-type: none"> • Embody an integrated approach that combines emission reduction with strategies to bolster resilience against climate impacts. Climate risk and vulnerability assessments should be incorporated into planning the design, construction and operation of transport infrastructure, thereby ensuring that roadways, rail systems, and ports can withstand extreme weather conditions. 		<p>organization. Attend or arrange events or communities for sustainable transport.</p> <ul style="list-style-type: none"> • Reduce your commute by working from home. • Hold meetings over videoconference.
Buildings	<ul style="list-style-type: none"> • Through regulations and incentives, encourage the construction of buildings with a zero-carbon footprint, integrate low-emissions requirements in urban planning, and establish building regulations to ensure buildings can withstand climate-related disasters. • Prioritize an integrated approach to both adaptation and mitigation in the buildings and construction sector. Buildings designed with climate adaptation can contribute to reduced energy consumption. • Ensure climate resilience of buildings through tools such as regulatory standards 	<ul style="list-style-type: none"> • Make and implement zero-emissions plans with zero-carbon building materials if the business model relies on carbon-intensive raw materials and high-energy buildings. • Ensure that building owners make their building stock zero-carbon without overburdening tenants, and ensure that companies that own or rent buildings for their operation, e.g., offices, shops, make their building stock zero-carbon. • Develop tailored financial products to promote access to technologies 	<ul style="list-style-type: none"> • Get informed on the energy requirements and impact of your building. Choose sustainable materials and practices when renovating and fixing your home. • Reduce your energy consumption by applying simple changes: seal windows and doorsteps, avoid thermic bridges, install double glass glazing, use LED bulbs, and invest in high-inertia radiators. • Change habits: open the

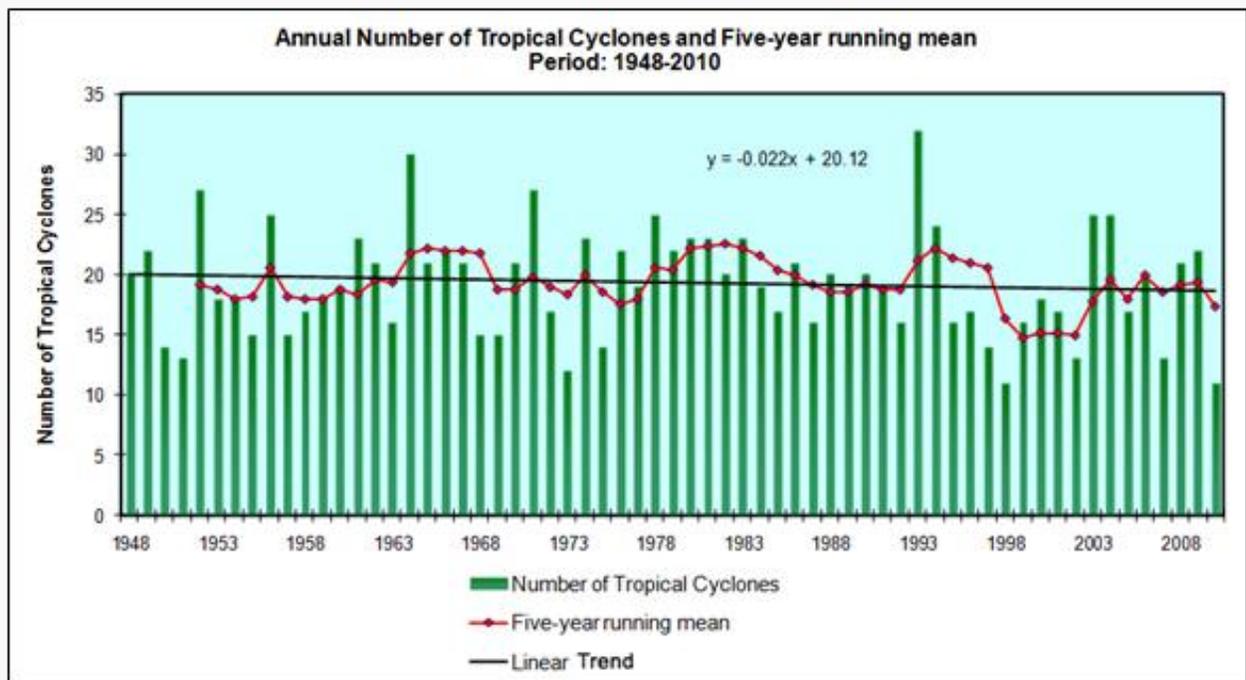
Sector	Level		
	Government	Private	Public
	<p>like building codes and spatial planning frameworks such as vulnerability maps.</p> <ul style="list-style-type: none"> • The integration of nature-based solutions, like urban green spaces, can help buildings and communities adapt to increasing temperatures and extreme weather events. • Explore innovative financing mechanisms, such as a revolving loan scheme, to free up resources to make buildings more resilient to climate change. 	<p>and encourage retrofitting of private structures to improve resilience.</p> <ul style="list-style-type: none"> • Incorporate climate change projections into construction plans to avoid future costs to infrastructure from climate impacts. • Review strategies and align investment criteria with zero-carbon building stock. This includes the high need for long-term, low-interest loans for zero-carbon buildings with their higher upfront investment and lower operating costs. 	<p>curtains for natural light, close shades in hot climates, cover pans when boiling, spend less time in the shower, compost organics, collect rainwater, and reuse it for gardening, toilets, and washing machines.</p> <ul style="list-style-type: none"> • Produce your own energy if possible by installing small-scale installations such as solar panels to power your home. • Invest in rainwater harvesting systems to increase climate resilience to the impacts of drought.

Source: UNEP: The Sectoral Solution to Climate Change—Extracted from the IPCC Synthesis Report and Data Gathered from the Emissions Gap Report 2022

IV. Philippine's Climate Change Initiatives

Climate change is becoming an increasingly serious global issue, with negative consequences at the regional, national, and local levels. Since 1990, the IPCC has released scientific assessment reports on climate change, with the most definitive declaration being in 2007, which said that the warming of the climate system is unequivocal and mostly due to human activity. The significant increase in global mean temperature since the mid-twentieth century has sparked widespread concern, particularly among economically disadvantaged developing countries like the Philippines, which are especially vulnerable to the negative effects of even minor temperature fluctuations. Since 1970, the North Atlantic has seen an increase in the frequency of powerful tropical cyclones, which appears to be linked to higher tropical sea surface temperatures. Nonetheless, shifts exist both within and within regions, as seen in Southeast Asia, which experiences temperature swings and changes in rainfall patterns. The Asia Pacific region demonstrates significant geographic coherence in the development of hot days and heat waves; yet, there is no obvious trend in rainfall changes across the region.

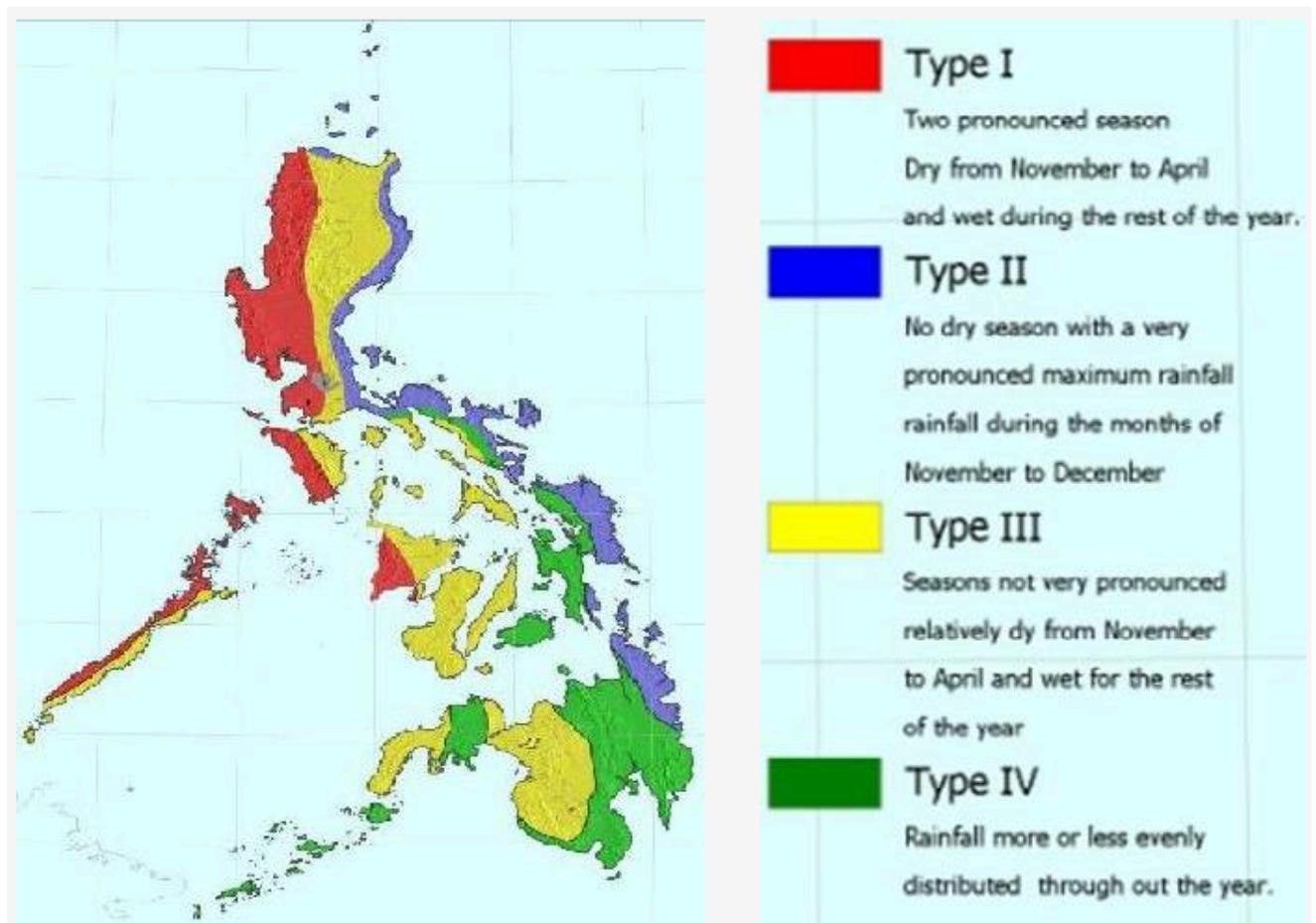
Figure 7. Tropical Cyclone occurrence Passages within the Philippine Area of Responsibility during the 1948–2010 period.



Source: *The Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAG-ASA)*

Temperatures in the Philippines, like much of the world, have been rising. A review of patterns of tropical cyclone incidence or passing within the Philippine Area of Responsibility (PAR) reveals that 20 tropical storms develop and/or traverse the PAR each year. The trend has shown a significant level of unpredictability throughout the decades, but there is no evidence that the frequency is increasing. During the El Niño period, there is a modest increase in the number of tropical cyclones with maximum sustained winds of 150 kph or higher (typhoon category) (see Figure 7).

Figure 8. Classification of Climate Types in the Philippines



Source: *The Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAG-ASA)*

PAG-ASA also offered forecasts for seasonal temperature rise, rainfall change, and overall frequency of severe events based on mid-range scenario outputs. It compares these figures to high- and low-range scenarios for 2020 and 2050. All expected changes are compared to the baseline climate (1971-2000). For example, a projected 1.0 C rise in

a province in 2020 indicates that the expected mean temperature is calculated by adding 1.0 C to the province's baseline mean temperature. The climatic categorization is based on the Corona's four climate categories (Categories I–IV) and the monthly rainfall received over the year. A province's climate is classified as Type I if there is a distinct dry and wet season, Type II if there is no dry time throughout the year, Type III if there is a brief dry season, and Type IV if rainfall is nearly uniformly distributed throughout the year.

PAG-ASA's climate projections yielded the following results:

- *Seasonal Temperature Change:*
 - Warming is expected in all parts of the Philippines, particularly during the comparatively mild summer months. Mean temperatures in all parts of the Philippines are anticipated to rise by 0.9 to 1.1 degrees Celsius in 2020 and 1.8 to 2.2 degrees Celsius in 2050. Similarly, all seasonal mean temperatures will rise over these time periods, and these increases will be very uniform across the country. The most significant temperature increase is expected during the summer (MAM) season.

- *Seasonal Rainfall Change:*
 - Most sections of the country will have less rainfall during the summer season. Rainfall is also expected to rise throughout the southwest monsoon season until the transition season in most regions of Luzon and Visayas, as well as during the northeast monsoon season, notably in provinces/areas with Type II climates in 2020 and 2050. However, rainfall in Mindanao is gradually decreasing, particularly by 2050.
 - The quantity and direction of rainfall variations between 2020 and 2050 show a variety of tendencies. The estimates clearly show that the southwest and northeast monsoons in areas exposed to these climatic controls will perform better when they predominate over the country. Furthermore, the normally rainy seasons get wetter while the normally dry seasons become drier, potentially leading to an increase in floods, dry spells, and droughts.

- *Extreme Temperature Events*
 - Hot weather will continue to grow more common in the future. Based on the climate projections, the number of days with a maximum temperature above 35 degrees Celsius (the value used by other nations in the Asia

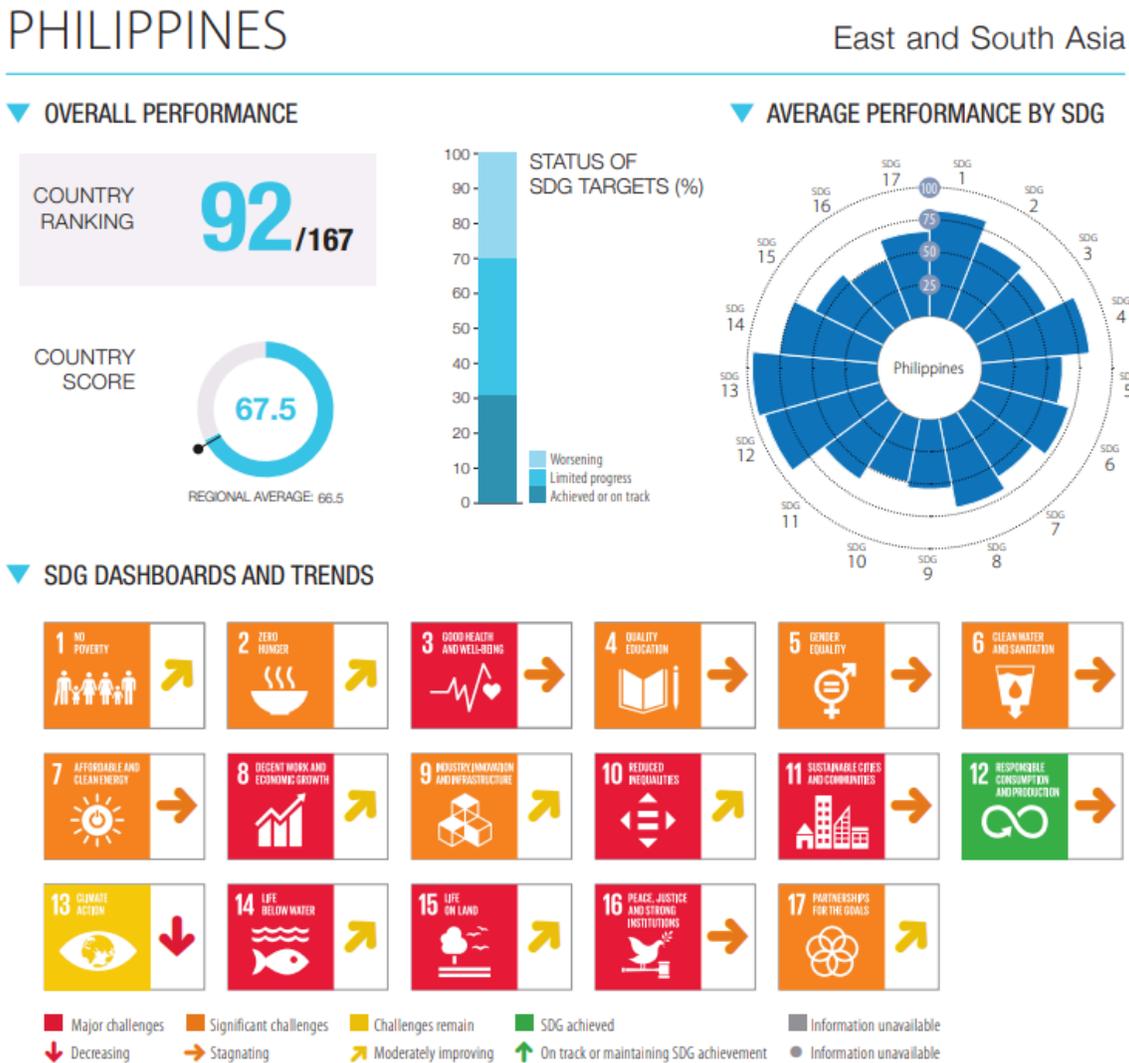
Pacific area in severe event analysis) will continue growing between 2020 and 2050.

- Extreme Rainfall Events
 - Heavy daily rainfall is likely to rise in Luzon and Visayas exclusively, whereas the number of dry days is expected to grow across the country in 2020 and 2050. The expected increase in the number of dry days (defined as rainfall less than 2.5 mm) and the number of days with excessive rainfall (defined as daily rainfall greater than 300 mm) relative to the observed (baseline) values.

- Climate Projections for Provinces
 - Heavy daily rainfall will become more common; severe rainfall is likely to increase only in Luzon and Visayas, while the number of dry days is expected to increase across the country in 2020 and 2050. The forecasts indicate an increase in the frequency of dry days (defined as rainfall less than 2.5 mm) and days with severe rainfall (defined as daily rainfall greater than 300 mm) when compared to the observed (baseline) values.

According to the PAG-ASA forecasts, the country's climate would undergo significant changes, which will also occur in other industrialized and developing nations. The projections were one of several studies that demonstrate Earth is likely to continue and accelerate warming unless significant global mitigation measures are implemented. Under the UNFCCC, Country Parties share the common responsibility of protecting the climate system but have different responsibilities. Developed countries must reduce greenhouse gas emissions and provide assistance to developing countries to adapt to climate change impacts.

Figure. 9. Overview of the Philippines' 2024 Sustainable Development Goal (SDG) Profile



SDG DASHBOARDS AND TRENDS

1 NO POVERTY ↑	2 ZERO HUNGER ↑	3 GOOD HEALTH AND WELL-BEING →	4 QUALITY EDUCATION →	5 GENDER EQUALITY →	6 CLEAN WATER AND SANITATION →
7 AFFORDABLE AND CLEAN ENERGY →	8 DECENT WORK AND ECONOMIC GROWTH ↑	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE ↑	10 REDUCED INEQUALITIES ↑	11 SUSTAINABLE CITIES AND COMMUNITIES →	12 RESPONSIBLE CONSUMPTION AND PRODUCTION →
13 CLIMATE ACTION ↓	14 LIFE BELOW WATER ↑	15 LIFE ON LAND ↑	16 PEACE, JUSTICE AND STRONG INSTITUTIONS →	17 PARTNERSHIPS FOR THE GOALS ↑	

■ Major challenges
 ■ Significant challenges
 ■ Challenges remain
 ■ SDG achieved
 ■ Information unavailable
↓ Decreasing
 → Stagnating
 ↗ Moderately improving
 ↑ On track or maintaining SDG achievement
 ● Information unavailable

Source: SDG Index Dashboard 2024

The 2024 Sustainable Development Goals (SDGs) Report indicates that the Philippines holds an SDG Index Rank of 92 out of 162, alongside an SDG Index Score of 67.47. These data points collectively inform the overall assessment of progress toward achieving all 17 SDGs. After analyzing the country's progress status of achievements relative to the Sustainable Development Goals (SDGs), it emerged that about 39.2% exhibited limited progress, while 29.7% were categorized as declining. In contrast, 31.1% of the country's SDG targets appeared to be on course for achievement. At present, the country's progress on several initiatives aimed at meeting Sustainable Development Goal (SDG) targets indicates moderate improvement for SDGs 1, 2, 8, 9, 10, 14, 15, and

17. Conversely, SDGs 3, 4, 5, 6, 7, 11, 12, and 16 appear to be stagnating, while SDG 13 is the sole goal exhibiting a downward trend.

Specifically on the SDG 13, its indicators (as seen in Table 2) for the country were described as follows:

- CO₂ emissions from fossil fuel combustion and cement production
 - This indicator is marked as “Achieved” in the latest SDG report; however, its projected trend is either stagnating or increasing at a rate that is less than 50% of what is required.
- GHG emissions embodied in imports
 - The current situation indicates that there are challenges being encountered, which consequently suggests a decline in the trajectory towards fulfilling its commitments.
- CO₂ emissions embodied in fossil fuel exports
 - Although the report indicates that this indicator has remaining challenges, its trend is currently unavailable in the report.

The overall progress results of the Philippines offer a mixed picture, indicating a pressing need for intensified efforts from all stakeholders. It is essential to support government actions and leverage the critical roles of civil society and the private sector. Collaboration with development partners is crucial in crafting a viable blueprint to collectively realize the country's agenda.

One strategy being used to overcome the obstacles faced by numerous initiatives, particularly in tackling climate change, is more private sector participation and investment. This is due to the private sector's capacity to be flexible and its vast number of network connections, as well as providing innovative funding options for SDG efforts. As a result, the United Nations Development Programme (UNDP) Philippines created the SDG Investor Map. These materials are "market intelligence tools," designed to assist the private sector in identifying investment themes in developing economies with great potential to promote the global objectives.

Figure 10. Summary of Investment Opportunity Areas (IOAs) by Sustainable Development Goal (SDG)



Source: UNDP Philippines SDG Investors Map 2024

Specific to SDG 13, three opportunity areas were identified to be related to the development goal: Bulk Water Supply (IOA4), Solid Waste Management (IOA5), Hydropower Infrastructure (IOA6), and Solar Power Infrastructure. (IOA7) Additionally, these IOAs are also identified as interconnected with other SDGs, as these IOAs may impact and affect not only one SDG.

The following is an overview of the IOAs that relate to the beneficial impact on SDG 13.

IOA4: Bulk Water Supply Infrastructure for Underserved Areas

Other SDGs related to IOA4: SDG 1, 5, 6, and 9

According to the 2020 Annual Poverty Indicators Survey, Filipino households predominantly use water piped into their homes (54.1%), protected wells (21.5%), communal sources such as public faucets, and developed springs (16.0%). Around 10% rely on potentially hazardous sources such as unprotected wells or precipitation. *The Bulk Water Supply Infrastructure for Underserved Areas* seeks to offer sanitized water for everyday needs while lowering the risk of disease transmission through water. This may

assist, as El Niño will significantly affect 16 regions, especially palay farmers. Large firms such as Ayala Corporation and San Miguel have identified water security issues as a serious issue as a result of the effects of climate change. The bulk water supply system provides more control over water consumption and saves waste. The IOA4 is projected to require an investment of under USD 10 million, with an anticipated market size ranging from USD 100 million to USD 1 billion. The indicative return is estimated at 10%–15%, with a long-term payback period exceeding 10 years. The project involves constructing and operating Bulk Water Supply Infrastructure in government-recognized areas, requiring support and initial studies. Investment may be through direct investment or project financing, with an expected return through bulk water charges.

The proposed project may contribute to achieving universal access to safe water and basic sanitation by 2030 in the Philippines. Additionally, improve the quality of access to water sources for families across the income spectrum. It may also help in reducing cases and death rates from water-borne diseases. There are laws, government agencies, and decisions that may also support and facilitate the execution of IOA4. These include:

- Republic Act 6716. An Act Providing for the Construction of Water Wells, Rainwater Collectors, Development of Springs, and Rehabilitation of Existing Water Wells in all Barangays in the Philippines declares this national policy to provide adequate potable water supply to each barangay in the country;
- LWUA Board Resolution No. 147, Series of 2009, amended the Guidelines for the Formation of Water Districts in Communities without Existing Water System;
- The National Water Resources Board is mandated to administer and enforce provisions of the Water Code of the Philippines, which provides guidelines for the proper appropriation and utilization of water sources.
- The National Water Resources Board (NWRB), Department of Environment and Natural Resources (DENR), Local Water Utilities Administration (LWUA), and Department of Public Works and Highways (DPWH) provide standards for bulk water supply infrastructures in underserved areas in the Philippines.
- The government provides financial and technical support for these projects through institutions like the National Irrigation Administration (NIA) and the Development Bank of the Philippines (DBP).
- The Philippines' financial environment for bulk water supply infrastructures consists of private sector investments, international aid grants, and loans from government financial institutions such as the Development Bank of the Philippines and the Land Bank of the Philippines. Tax incentives are offered to

the development of public utilities in less-developed areas, totaling 100% of its essential and significant waterworks.

- The Philippines' financial environment for bulk water supply infrastructures consists of private sector investments, international aid grants, and loans from government financial institutions such as the Development Bank of the Philippines and the Land Bank of the Philippines. Tax incentives are offered to the development of public utilities in less-developed areas, totaling 100% of its essential and significant waterworks.

Additional evidence is presented in case studies conducted by agencies and private enterprises through various public-private partnerships aimed at delivering water supply solutions to underserved regions. Illustrative projects encompass the Negros Occidental Bulk Water Supply Project, the Baggao Water Supply Project, and the Honaira Water Supply and Sanitation Project, funded by the Asian Development Bank. The Negros Occidental Bulk Water Supply Project is currently under review for approval, as it is a solicited initiative aimed at enhancing bulk water supply in the province of Negros Occidental. The initiative encompasses the financing, design, construction, operation, and maintenance of new bulk water supply facilities, with water being sourced from the Malogo River Basin. The Baggao Water Supply Project represents an unsolicited Build-Operate-Transfer (BOT) proposal aimed at the long-term development of water sources for Metro Manila. The process encompasses the design, financing, construction, testing, operation, and maintenance of a Level III Water Supply System. The estimated expenditure stands at approximately USD 3.8 million.

IOA5: Effective Infrastructure for Solid Waste Management

Other SDGs related to IOA4: SDG 1, 3, 6, 9, 11, 12, 14, and 15

Despite legislation requiring village-level segregation, the Philippines produces more than 21 million metric tons of garbage per year. This waste causes infections, pollution, and drainage obstructions, which contribute to flooding. Proper waste management is critical for sustainable development because it reduces pollution, conserves resources, encourages sustainable consumption, protects public health, and reduces socioeconomic disparities. The government intends to build 300 additional sanitary landfills through public-private partnerships over the next two years. The investment might be done directly or through project financing, with the expected return derived from bulk water rates. Invest in effective solid waste management infrastructure, such as sewage treatment plants and sanitation facilities, focusing on high-demand areas identified by local governments.

Investment in the IOA5 has the potential to generate multiple advantages for both the country and the community. Effective waste management practices, as evidenced by research, can significantly mitigate the risk of exposure to disease-causing agents and contaminants detrimental to public health. Effective management of solid waste can also create business opportunities and employment, potentially resulting in economic advantages for the community. Another advantage that may be observed is the decrease in air, water, and soil pollution, which subsequently aids in safeguarding biodiversity and preventing the degradation of ecosystems.

At present, there are established government agencies, along with a framework of laws and regulations, that can facilitate the project's implementation and provide support in terms of financial incentives. Republic Act 11898, known as the Extended Producer Responsibility Act of 2022, mandates that establishments develop or implement a phased EPR program for plastic packaging. This initiative aims to manage plastic packaging waste and associated manufacturing activities more effectively. The legislation stipulates that expenses related to Extended Producer Responsibility (EPR) are deemed essential deductions from gross income. Republic Act 8749, known as the Philippine Clean Air Act of 1999, establishes a framework for air quality management, sets forth regulations governing emissions from vehicles and industrial sources, and advocates for the adoption of cleaner technologies, thereby facilitating the development and functioning of solid waste management systems. The resolutions issued by DENR offer additional guidelines that the project may utilize as references, specifically DENR Administrative Orders No. 2018-19 and 2019-21. DENR AO No. 2018-19 outlines the protocols for the environmentally responsible management of hazardous wastes, whereas DENR AO No. 2019-21 delineates the framework for the creation and functioning of materials recovery facilities (MRFs) within local government units (LGUs), contributing to the nation's solid waste management initiatives.

Comparable smaller initiatives could serve as a benchmark for the proposed IOA5, specifically the General Santos City Sanitary Landfill and the Quezon City Integrated Solid Waste Management Facility Project. The General Santos City Sanitary Landfill was initiated as a proposed public-private partnership (PPP) project designed to extend the operational lifespan of the General Santos City Sanitary Landfill (SLF) and enhance its capacity, commencing in the early 21st century. East Asia Sheng Tai, which includes East Asia Solutions Technology Corporation, Sheng Tai Energy Technology Company, and Dr. Lin Shing-Chou, has submitted an unsolicited proposal to manage and operate the sanitary landfill for at least 25 years, with an estimated investment of around USD 1.76 million. The initiative involves the administration, maintenance, and conversion of

waste materials. The Quezon City Integrated Solid Waste Management Facility Project, launched in 2018, represents a public-private partnership between the Quezon City government and Metro Pacific Investments Corp. The initiative seeks to design, finance, construct, operate, and maintain a waste treatment facility with the capacity to process 3,000 metric tons of municipal solid waste per day while generating 36 megawatts of electric power, thereby offering a sustainable and economically viable waste disposal solution.

IOA6: Hydropower Infrastructure for Underserved Areas

Other SDGs related to IOA4: SDG 5, 7, 9, and 11

The depletion of the country's Malampaya natural gas reserves is anticipated by 2027. This has led to an increase in electricity costs and a frequency of power disruptions. A forecasted reduction in the budget by P12.536 billion could lead to power outages affecting more than 800,000 households throughout the Philippines, especially in the regions of Luzon, Visayas, and Mindanao. The Philippines boasts one of the highest residential rates in Southeast Asia, trailing only Singapore.

To mitigate these impacts, IOA6 suggests developing and operating hydropower energy infrastructure in conjunction with local governments to serve rural and neglected communities. This project may enhance energy availability, adding to the 95.4% of inhabitants who already have access, increasing generation capacity and contributing to electricity cost reduction. This initiative is also part of the overall path of the country towards attaining a "clean energy future," as laid out in the Philippine Energy Plan (PEP) 2020-2040, which is the "second comprehensive energy blueprint supporting the government's long-term vision known as Ambisyon Natin 2040" (UNDP, 2024).

Several laws can help with the development of IOA4, notably Republic Act 9513, also known as the Renewable Energy Act of 2008. This statute provides cash-generating incentives to renewable energy providers interested in missionary electrification. The incentive is calculated per kilowatt hour and equals 50% of the Universal Charge necessary to meet the energy demands of missionary areas. The Electric Power Industry Reform Act (EPIRA) of 2001 demonstrates the nation's commitment to increasing power generation. This Act seeks to enhance the Philippine energy market by boosting competition, privatizing state-owned utilities, and increasing efficiency and dependability. Additional government initiatives and regulations that could support the project include EO 30 s. 2017, which established the Energy Investment Coordination Council (EICC) to facilitate a more efficient and streamlined process for energy projects

from planning to implementation; and the Net Metering Program, which allows consumers who generate their own electricity, typically via solar panels or wind turbines, to sell surplus power back to the grid and receive credits on their

Other similar hydroelectric infrastructure development projects have been executed in the country, which may act as a potential indicator of the success of IOA4. The San Roque Multi-purpose Hydroelectric Powerplant, situated in San Manuel and San Nicolas, Pangasinan, functions within a Build-Transfer-and-Operate model. The National Power Corporation (NPC) is implementing this initiative in partnership with a consortium that includes Marubeni Corporation, Sithe Philippines Holdings, Inc., and Italian-Thai Development Public Company Limited. The Bakun A/B and C Hydroelectric Power Plant, a 70 MW run-of-river initiative located in the Central Cordillera Mountains, has begun operations and is presently owned by Luzon Hydro Corporation. The initiative resulted in an overall spending of USD 83 million and was carried out within the Build-Operate-Transfer (BOT) model. The Ifugao Ambangal mini hydro power plant in the Philippines, with a capacity of 200 kW, operates as a run-of-the-river project, providing clean and renewable electricity to the agricultural community of Kiangan, Ifugao. This initiative plays a significant role in improving livelihoods by supporting rice farming practices in the region. The facility generates around 1,200 MWh of reliable electricity annually, resulting in an approximate contribution of 70,000 USD to the conservation fund.

IOA7: Solar Power Infrastructure for Underserved Areas

Other SDGs related to IOA4: SDG 5, 7, 9, and 11

As stated in the IOA4, the Philippines' electricity profile needs to be revitalized as the country looks into increasing its renewable energy profile. Abra, Albay, Masbate, Basilan, Sulu, Tawi-Tawi, and Lanao Del Sur have a high number of unenergized homes, which are supplied by struggling and inefficient electric cooperatives (EC). While about 95% of the Philippines' population has access to electricity, the Philippine Development Plan for 2023 to 2028 recognizes that the country continues to confront significant obstacles in guaranteeing universal access to this critical utility. The plan aims to triple renewable energy capacity by 2030, demanding an additional 14,900 MW, primarily from solar power, despite the challenges faced by declining current energy sources and inadequate connection to the major grid.

Similar to IOA6, the initiative's goal is to build and operate solar energy infrastructure through public-private partnerships with local and national governments, allowing for

off-grid and on-grid solutions in remote areas. The laws and regulations that may assist and enable the implementation of IOA6 are also applicable in enabling the implementation of IOA7.

The SINOSAUR solar project and the Tumingad Hybrid Solar-Diesel Powerplant are two notable examples of collaborative building and operation of solar generating facilities in the nation. The Philippine National Electrification Administration (NEA) has launched the SINOSAUR solar project to provide sustainable basic energy to 3,100 off-grid families. The effort aims to deliver sustainable energy solutions to 25,000 off-grid families nationwide, cementing SINOSOAR's leading position in the Philippines' off-grid solar industry. Sunwest Water & Electricity Co. created the Tumingad Hybrid Solar-Diesel Powerplant, which has a capacity of 7.5 MWp. The plant is intended to store excess solar energy in its battery system, with diesel generators used to supplement the power supply when the stored electricity is exhausted.

With the launch of the SDG Investor Map, the prospect of tapping huge profitable markets has grown. The SDG investors map demonstrates that a strong relationship between the government (national and local) is required to implement impactful projects fully. Furthermore, the business and public sectors must account for potential risks in project development, such as relocation and land rights issues, corruption, regulatory instability, cultural disruptions, and other negative community consequences. Thus, adequate planning and engagement with the communities in which these projects will be built should exist.

Other Philippine Government Initiatives on Climate Change

The Philippines has also implemented other climate-change-related initiatives to address adaptation and mitigation challenges. The government has prioritized efforts to protect ecosystems, reduce carbon emissions, and strengthen community resilience. Several of these initiatives stand out as best practices due to their innovative approaches, integration of science and technology, or strong community engagement. These programs contribute to national climate goals and align with international agreements like the Paris Agreement. Below are some of the Philippine government's climate initiatives recognized as best practices.

Enhanced National Greening Program (ENGP)

The Enhanced National Greening Program (ENGP) is a significant environmental initiative spearheaded by the Philippine government, initially launched in 2011 and

expanded in 2015 under Executive Order No. 193. Its primary objective is to rehabilitate the country's degraded forestlands, enhance biodiversity, sequester carbon, and offer sustainable livelihood opportunities for rural communities. The program was extended until 2028 to reforest an additional 1.2 million hectares. This extension continues the government's efforts to counter deforestation, restore ecosystems, and reduce greenhouse gas emissions. ENGP promotes the sustainable management of forests and agroforestry, focusing on critical areas such as watersheds, coastal zones, and protected regions, striking a balance between environmental conservation and economic development.

The ENGP had successfully rehabilitated over 2 million hectares of forestlands as of 2024, nearing its 2028 goal of 2.1 million hectares. It has planted approximately 1.5 billion seedlings of various species, including native and agroforestry types, contributing to increased carbon sequestration and ecosystem resilience. The program has impacted climate change mitigation by creating carbon sinks, in line with the Philippines' international climate commitments. Additionally, ENGP has provided jobs for over 650,000 individuals, particularly in upland and rural areas, supporting sustainable livelihoods through seedling production, reforestation, and forest management. The program's contributions extend beyond environmental restoration, as it also plays a vital role in biodiversity conservation and poverty alleviation.

Manila Bay Rehabilitation Program

The Manila Bay Rehabilitation Program is a comprehensive environmental project established by the Philippine government to address pollution, ecological deterioration, and water quality concerns in Manila Bay. The effort, which was mandated by the Supreme Court in 2008 through a writ of continued mandamus, regained traction under the Duterte government in 2019, with the Department of Environment and Natural Resources (DENR) leading it. The program's primary purpose is to restore Manila Bay's water quality to a safe level for contact recreation and to rehabilitate and conserve the area's coastal and marine ecosystems. The effort focuses on three important areas: cleaning up and enhancing the bay's water quality, restoring and safeguarding ecosystems like mangroves and coral reefs, and assuring the rehabilitation's long-term viability through efficient waste management and public awareness initiatives. The program requires coordination among several government agencies, local government units (LGUs), and corporate sector partners.

As of 2024, the Manila Bay Rehabilitation Program has achieved substantial progress. One of its most notable triumphs has been lowering fecal coliform levels in Manila Bay waters, particularly near famous tourist destinations like the Baywalk. This has been accomplished by increased waste management activities, such as constructing sewage treatment plants and organizing periodical cleanup campaigns involving government employees and volunteers. The initiative has also restored elements of the coastal and marine ecosystems, such as mangrove replanting and marine habitat restoration, which are critical to biodiversity. Furthermore, stricter enforcement of environmental rules has resulted in the closure of establishments deemed to violate environmental regulations, helping to improve the bay's water quality. Public awareness initiatives have increased community engagement in regular cleanups and proper garbage disposal, ensuring rehabilitation activities' long-term viability. While obstacles exist, the program is considered a critical step toward long-term restoration and protection of Manila Bay's ecological health.

Project NOAH (Nationwide Operational Assessment of Hazards)/ NOAH Center

The Philippine government initiated Project NOAH (Nationwide Operational Assessment of Hazards) in 2012 to address the growing demand for more precise and real-time weather monitoring and hazard mapping to reduce disaster risks nationwide. The program, led by the Department of Science and Technology (DOST), sought to develop a responsive and comprehensive system to equip communities better to mitigate the effects of natural catastrophes such as typhoons, floods, and landslides. Project NOAH used cutting-edge technologies such as satellite data, weather monitoring systems, and flood modeling to deliver real-time hazard warnings. The system included publicly accessible tools, including flood danger maps, weather predictions, and real-time updates, allowing local governments and communities to make data-driven disaster preparedness and response decisions.

In January 2017, the Philippine government announced the discontinuation of Project NOAH (Nationwide Operational Assessment of Hazards) due to funding issues, with operations scheduled to end on March 1, 2017. The Department of Science and Technology (DOST), which had been managing the project, indicated that the budget allocated for Project NOAH would only last until February 28, 2017. However, in response to this announcement, the University of the Philippines (UP) intervened on February 23, 2017, deciding to adopt the project and ensure its continuation beyond its termination by DOST. Subsequently, on June 20, 2017, UP relaunched Project NOAH under the UP Resilience Institute, rebranding it as the NOAH Center. This transition allowed the initiative to persist in its critical role of enhancing disaster preparedness

and risk reduction efforts by providing real-time weather data and hazard mapping, essential for assisting communities in mitigating the impacts of climate-related risks.

To date, the NOAH Center has considerably increased catastrophe risk reduction in the Philippines. Its most remarkable achievement is the creation of high-resolution, localized hazard maps for the entire country. These maps show flood, landslip, and storm surge threats, allowing communities to understand their vulnerability better and prepare for future disasters. The project has also received recognition for its real-time flood forecasting technology, which is critical in lowering mortality during significant typhoons. Local governments have used NOAH Center's data and tools to construct early warning systems and evacuation plans, thereby increasing disaster response and preparedness overall. Despite funding and administrative obstacles, the project's legacy continues to shape the country's disaster management methods. The success of Project NOAH sparked other advances in catastrophe science and technology, encouraging collaboration among scientists, local authorities, and the general public.

Philippine Climate Change Action Program (PCAP)

The Philippine Climate Change Action Program (PCAP), namely Subprogram 1, was launched as part of the government's overall effort to address climate change consequences in the country. This initiative focuses on developing and implementing national policies and strategies to mitigate climate change while increasing resilience in various sectors. Subprogram 1 emphasizes the relevance of climate change adaptation, capacity building, and incorporating climate factors into local government planning and decision-making. It strives to improve the adaptive ability of communities and local governments by disseminating knowledge, engaging stakeholders, and implementing climate-resilient practices. One of the program's strategies is its focus on cross-sectoral integration of climate change policies and reforms, promoting sustainability and green investments.

The initiative has successfully facilitated the integration of climate change into local government (LGU) development plans, with many municipalities now including climate adaptation measures in their comprehensive land use plans. Training programs and workshops have been held to help thousands of local officials and community members improve their ability to recognize and manage climate risks. Subprogram 1 has also formed agreements with several national and municipal authorities, NGOs, and international organizations to promote best practices and strengthen collaboration in climate action. The initiative has also helped to produce the National Climate Change Action Plan, which specifies priority activities for climate adaptation and mitigation

across several sectors, reinforcing the Philippines' commitment to international climate agreements.

Community-Based Forest Management Program (CBFMP)

The Philippine government's Community-Based Forest Management Program (CBFMP) promotes sustainable forest management while empowering local people. Established in 1995, the initiative aims to combat deforestation and forest degradation while improving the livelihoods of those who live in and around forests. CBFMP encourages participatory techniques, empowering local communities to sustainably manage and use forest resources. It highlights the significance of community rights to land and resources, encouraging active engagement in reforestation, conservation, and sustainable livelihoods through agroforestry and other environmentally friendly techniques.

As of 2024, the CBFMP has made substantial progress toward its objectives. The program has successfully produced over 1,300 Community-Based Forest Management Agreements (CBFMAs) that cover over 1.6 million hectares of forest property across the country. These agreements enable local populations to participate in forest management activities, leading to increased forest cover and biodiversity conservation. The CBFMP has also fostered various capacity-building programs, providing community people with the skills to manage forest resources sustainably. The initiative has promoted new practices that improve community resilience to climate change by combining traditional knowledge with scientific methodologies. Furthermore, CBFMP programs have helped alleviate poverty by giving alternative livelihood possibilities such as ecotourism and non-timber forest products, allowing communities to achieve economic stability while supporting environmental sustainability. Overall, the CBFMP has shown to be an effective model for participatory forest management, matching the country's sustainable development goals and climate change adaptation.

The Philippines has made significant strides in addressing climate change through innovative and community-oriented initiatives. These programs also yielded some best practices for implementing other similar initiatives effectively. They also reflect the government's commitment to meet its climate goals and enhance its vulnerable populations' resilience. By integrating science, technology, and local knowledge, these programs serve as effective models for sustainable development and climate action. The country's proactive approach demonstrates that inclusive strategies and partnerships can lead to meaningful progress in combating climate change, providing valuable lessons for other nations facing similar challenges.

V. Policy Gaps

The Philippines has developed a robust policy framework to address its significant vulnerabilities to climate change and to foster sustainable development. However, despite these efforts, critical gaps remain in aligning these policies with the Technical and Vocational Education and Training (TVET) system to adequately prepare the workforce for the challenges posed by climate change. By addressing these gaps, TVET can serve as a vital driver in translating policy ambitions into actionable outcomes, equipping individuals with the skills needed to build resilience, promote sustainability, and contribute to economic transformation.

Table 7. Summary of Policy Gaps Identified related to the Philippine’s Climate Initiatives

Policy/ Laws	Policy/Law Focus	TVET Related Gaps
Climate Change Act of 2009 (RA 9729)	Establishes a framework for mitigation, adaptation, and resilience strategies across all sectors	Limited TVET focus on disaster resilience skills and climate adaptation for high-risk communities.
Philippine Disaster Risk Reduction and Management Act (RA 10121)	Requires environmental assessments for projects to mitigate environmental degradation and climate risks.	
Renewable Energy Act of 2008 (RA 9513)	Promotes renewable energy development and energy security.	Lack of comprehensive TVET training for renewable energy technologies like solar, wind, and hydro systems.
Ecological Solid Waste Management Act (RA 9003)	Mandates sustainable waste reduction, reuse, and recycling.	Limited inclusion of skills for recycling technologies, waste management, and circular economy practices.
Clean Air Act of 1999 (RA 8749)	Aims to reduce air pollution through the regulation of emissions from various sources.	Lack of TVET programs focusing on air quality monitoring, pollution control, and emission reduction systems.
Clean Water Act of 2004 (RA 9275)	Provides a framework for the protection,	Minimal integration of skills training in water

	preservation, and rehabilitation of water resources.	treatment, resource conservation, and watershed management.
Expanded National Integrated Protected Areas System Act of 2018 (RA 11038)	Protects critical biodiversity areas and ecosystems vital for climate resilience.	TVET programs lack focus on biodiversity conservation, sustainable tourism, and natural resource management.
Philippine Environmental Impact Statement System (PD 1586)	Requires environmental assessments for projects to mitigate environmental degradation and climate risks.	Insufficient inclusion of environmental impact assessment (EIA) training in TVET standards.
National Climate Change Action Plan (NCCAP)	Identifies priorities such as food security, water sufficiency, and climate-smart industries.	Insufficient integration of climate-smart agricultural practices and water conservation into TVET programs.

The **Climate Change Act of 2009 (RA 9729)** establishes a comprehensive framework for climate mitigation, adaptation, and resilience strategies across all sectors. However, it does not explicitly address the role of workforce development in achieving these goals. This omission creates a significant gap in equipping communities—particularly those in high-risk areas—with critical skills to adapt to and mitigate climate impacts. TVET institutions can play a transformative role by introducing specialized training programs in climate-resilient construction, disaster preparedness, and emergency response. Such initiatives can empower local communities, enabling them to better respond to the increasing frequency and intensity of climate-related disasters while fostering long-term resilience.

The **Philippine Disaster Risk Reduction and Management Act (RA 10121)** emphasizes risk reduction and resilience building, yet TVET programs rarely offer comprehensive training in disaster management, recovery efforts, and post-disaster livelihood restoration. By incorporating these skills into TVET curricula, institutions can ensure that the workforce is not only prepared to respond to immediate hazards but also capable of supporting long-term recovery and reconstruction efforts.

Similarly, the **Philippine Environmental Impact Statement System (PD 1586)** mandates environmental assessments for development projects to minimize degradation and climate risks. Despite its importance, training in Environmental Impact Assessment (EIA) remains largely absent in TVET programs. Including EIA-focused courses would

enable workers to support sustainable project planning and ensure compliance with environmental standards, strengthening the implementation of this policy.

Environmental policies like the **Clean Air Act of 1999 (RA 8749)** and the **Clean Water Act of 2004 (RA 9275)** underscore the need for pollution reduction and resource conservation. However, TVET training does not adequately cover areas such as air quality monitoring, emission control, water treatment, or watershed management. Expanding TVET offerings in these areas would equip the workforce to actively contribute to preserving air and water quality, ensuring sustainable resource use, and addressing industrial and urban environmental challenges.

The **Expanded National Integrated Protected Areas System Act of 2018 (RA 11038)** protects biodiversity and critical ecosystems that are vital for climate resilience. Yet, TVET programs seldom focus on skills in biodiversity conservation, natural resource management, or sustainable tourism. Incorporating these competencies into TVET curricula would create a workforce capable of managing and protecting these valuable ecosystems while promoting eco-friendly economic opportunities.

The **National Climate Change Action Plan (NCCAP)** highlights food security, water sufficiency, and sustainable industries as key priorities for climate resilience. However, TVET's integration with these objectives remains limited. The agricultural sector, for instance, is particularly vulnerable to climate change, yet training in climate-smart agricultural practices—such as agroforestry, drought-resistant farming techniques, and efficient irrigation systems—is insufficient. Embedding these skills into TVET curricula would directly enhance productivity and sustainability in agriculture, aligning the workforce with NCCAP's objectives.

The **Renewable Energy Act of 2008 (RA 9513)** promotes the transition to sustainable energy sources such as solar, wind, and hydroelectric power. Despite the demand for skilled workers in the renewable energy sector, TVET programs inadequately address technical training in areas like solar panel installation, wind turbine maintenance, and bioenergy systems. By strengthening TVET offerings in these fields, institutions can help meet the Act's renewable energy targets, create green jobs, and reduce the country's carbon footprint.

Finally, the **Ecological Solid Waste Management Act (RA 9003)** calls for sustainable waste reduction, reuse, and recycling. However, TVET programs often lack training in advanced recycling technologies, composting, and circular economy practices. Developing these skills within TVET would not only support the implementation of this policy but also foster innovation and entrepreneurship in waste management solutions.

When relating TVET to climate change policies, it can be deduced that it does not only pertain to "green skills" as seen in Table 7, although green skills are a significant component. TVET and climate change policies intersect across sectors that include various skills and approaches beyond just "green" skills. Skills below should also be

prioritized as they also relate to climate change:

- Disaster Resilience and Emergency Preparedness
 - Training individuals in disaster response, risk reduction, and community resilience to cope with climate-induced events like typhoons, floods, and droughts.
- Sustainability-Oriented Skills
 - These include green skills but also extend to broader concepts such as promoting sustainable consumption, resource efficiency, and circular economy practices.
- Adaptation and Mitigation Skills
 - Skills for adapting livelihoods and behaviors to changing climate conditions. This includes skills for actively reducing carbon emissions. This includes transitioning to drought-resistant farming techniques or alternate fishing tactics for climate-affected populations, as well as installing renewable energy systems or increasing industrial energy efficiency.
- Digital Skills for Climate Action
 - Climate change challenges often require innovative technological solutions. Training in Geographic Information Systems (GIS) for climate data mapping, early warning systems, and precision agriculture.
- Entrepreneurial Skills for Climate-Friendly Businesses
 - Encouraging innovation and entrepreneurship in sectors like renewable energy, sustainable tourism, and eco-friendly product design. Example of these are Courses in starting small-scale solar businesses or eco-tourism ventures.
- Sector-Specific Climate Resilience Training
 - Training construction workers in climate-resilient building techniques, teaching fisherfolk about marine conservation, or educating miners on sustainable extraction methods.
- Social and Behavioral Skills
 - Educating the workforce on climate literacy and fostering sustainable workplace habits.
- Health and Safety Skills in Climate Contexts:
 - Addressing occupational health concerns exacerbated by climate change, such as heat stress in outdoor jobs or the health impacts of pollution. Skills for managing workplace risks in a warming environment or handling

eco-friendly but hazardous materials safely.

By addressing these gaps, the Philippine TVET system can play a pivotal role in advancing the country's climate change policies. Integrating targeted and relevant skills training into TVET programs would empower individuals and communities to actively contribute to climate resilience, sustainable development, and the transition to a cleaner economy.

VI. Skills Needs

As seen in the discussions, infrastructure projects that use innovative and "green" technology can help the global community alleviate the consequences of climate change in various industries. These new technologies and infrastructures are also projected to create jobs requiring technical skills, and including green practices necessitates incorporating these practices into the workplace.

According to the World Economic Forum's 2023 report, technology adoption will remain a key driver of company change over the next five years. Firms are more likely to increase the adoption of new and frontier technologies, and the growth of digital access is a major factor in sparking transformation inside their enterprises. Most organizations have indicated that they want to deploy these technologies during the next five years. The data also shows the impact of the digital transformation on commerce and trade. Digital platforms and apps are the technology that enterprises are most likely to adopt, with 86% expecting to integrate them into their operations within the next five years.

Using the 2023 World Economic Forum findings and the IPCC Sixth Assessment Report (AR6), a list of potential occupations and skills required across various industries and the TESDA qualifications related to the occupations can be identified.

Table 8. Occupations Projected to be Needed in the Next Five Years by Industry/Sector and Related Qualifications

Industry/Sector	Occupation	Qualifications
Agriculture, forestry, and fishing	Agricultural Equipment Operators	Rice Machinery Operations NC II
		Agricultural Machinery Operations NC II
	Graders and Sorters, Agricultural Products	No Equivalent Qualification

Industry/Sector	Occupation	Qualifications
	Business Development Professionals	No Equivalent Qualification
	Farmworkers and Laborers	Sugarcane Production NC II
		Aquaculture (Hatchery Operation) NC II
		Animal Production (Poultry-Chicken) NC II
		Animal Production (Ruminants) NC II
		Agricultural Crops Production NC II
		Bamboo Production NC II
	Nursery and Greenhouse Workers	Seaweeds Production NC II
		Rubber Production NC II
		Agricultural Crops Production NC II
		Bamboo Production NC II
	General and Operations Managers	No Equivalent Qualification
	Assembly and Factory Workers	No Equivalent Qualification
Agricultural Inspectors	No Equivalent Qualification	
Accounting, Bookkeeping and Payroll Clerks	Bookkeeping NC III	
Business Services and Administration Managers	No Equivalent Qualification	
	AI and Machine Learning Specialists	No Equivalent Qualification
	Project Managers	No Equivalent Qualification

Industry/Sector	Occupation	Qualifications
Advanced manufacturing	Business Development Professionals	No Equivalent Qualification
	Managing Directors and Chief Executives	No Equivalent Qualification
	Technical Specialists	No Equivalent Qualification
	Industrial and Production Engineers	No Equivalent Qualification
	General and Operations Managers	No Equivalent Qualification
	Mechanics and Machinery Repairers	Land-based Transport Refrigeration Servicing NC II
		Plant Maintenance NC I
	Sales Representatives	Customer Services NC II
	Assembly and Factory Workers	No Equivalent Qualification
	Administrative and Executive Secretaries	No Equivalent Qualification
Data Entry Clerks	Data Encoding and Management Level II	
Energy technology and utilities	Renewable Energy Engineers	No Equivalent Qualification
	Human Resources Specialists	No Equivalent Qualification
	Electrotechnology Engineers	No Equivalent Qualification
	Project Managers	No Equivalent Qualification
	Technical Specialists	No Equivalent Qualification
	Mechanical Engineers	No Equivalent Qualification
	General and Operations Managers	No Equivalent Qualification
	Accountants and Auditors	No Equivalent Qualification

Industry/Sector	Occupation	Qualifications
	Accounting, Bookkeeping, and Payroll Clerks	Bookkeeping NC III
	Administrative and Executive Secretaries	No Equivalent Qualification
	Data Entry Clerks	Data Encoding and Management Level II
Automotive and Aerospace	AI and Machine Learning Specialists	AI and Machine Learning Specialists
	Mechanical Engineers	No Equivalent Qualification
	Ship and aircraft controllers and technicians	No Equivalent Qualification
	Industrial and Production Engineers	No Equivalent Qualification
	General and Operations Managers	No Equivalent Qualification
	Assembly and Factory Workers	No Equivalent Qualification
	Accounting, Bookkeeping, and Payroll Clerks	Bookkeeping NC III
	Business Services and Administration Managers	No Equivalent Qualification
	Administrative and Executive Secretaries	No Equivalent Qualification
	Data Entry Clerks	Data Encoding and Management Level II
Material-Recording and Stock-Keeping Clerks	Warehousing Services NC III	
Infrastructure	Business Development Professionals	No Equivalent Qualification
	Architects and Surveyors	No Equivalent Qualification

Industry/Sector	Occupation	Qualifications	
	Civil Engineers	No Equivalent Qualification	
	Assembly and Factory Workers	No Equivalent Qualification	
	Construction Laborers	Carpentry NC II	
		Carpentry NC III	
		Masonry NC I	
		Masonry NC II	
		Masonry NC III	
		Construction Painting NC II	
		Construction Painting NC III	
		Tile Setting NC II	
		Pipefitting (Metallic) NC II	
		Plumbing NC I	
		Plumbing NC II	
		Plumbing NC III	
	Technical Specialists	No Equivalent Qualification	
	Managing Directors and Chief Executives	No Equivalent Qualification	
	General and Operations Managers	No Equivalent Qualification	
	Accountants and Auditors	No Equivalent Qualification	
	Accounting, Bookkeeping and Payroll Clerks	Bookkeeping NC III	
	Data Entry Clerks	Data Encoding and Management Level II	
Administrative and Executive Secretaries	No Equivalent Qualification		

Industry/Sector	Occupation	Qualifications
Mining and Metals	Civil Engineers	No Equivalent Qualification
	Industrial and Production Engineers	No Equivalent Qualification
	Business Development Professionals	No Equivalent Qualification
	General and Operations Managers	No Equivalent Qualification
	Mechanical Engineers	No Equivalent Qualification
	Assembly and Factory Workers	No Equivalent Qualification
	Technical Specialists	No Equivalent Qualification
	Mechanics and Machinery Repairers	Land-based Transport Refrigeration Servicing NC II
		Plant Maintenance NC I
	Accountants and Auditors	No Equivalent Qualification
	Administrative and Executive Secretaries	No Equivalent Qualification
Supply chain and transportation	Business Development Professionals	No Equivalent Qualification
	Heavy Truck and Bus Drivers	Driving (Passenger Bus/Straight Truck) NC III
		Driving (Articulated Vehicle) NC III
	Light Truck or Delivery Services Drivers	Driving NC II
	Managing Directors and Chief Executives	No Equivalent Qualification
	Supply Chain and Logistics Specialists	Warehousing Services NC III

Industry/Sector	Occupation	Qualifications
	General and Operations Managers	No Equivalent Qualification
	Accountants and Auditors	No Equivalent Qualification
	Business Services and Administration Managers	No Equivalent Qualification
	Accounting, Bookkeeping and Payroll Clerks	Bookkeeping NC III
	Administrative and Executive Secretaries	No Equivalent Qualification
Other Sectors	Sustainability Specialist	No Equivalent Qualification
	Business Intelligence Analysts	No Equivalent Qualification
	Information Security Analysts	No Equivalent Qualification
	Fintech Engineer	No Equivalent Qualification
	Data Analysts and Scientists	No Equivalent Qualification
	Robotics Engineers	No Equivalent Qualification
	Big Data Specialists	No Equivalent Qualification
	Digital Transformational Specialists	No Equivalent Qualification

Source: Future of Jobs Report 2023

Occupations included under “other sectors” are also identified as the fastest-growing jobs affected by the three key drivers, which are the Green Transition, Technology and Economic Outlooks. For skills, the table below shows the Top 10 skills of 2023 and the Top skills projected to rise in the upcoming years.

Table 9. Skills identified in the Future of Jobs Reports in the year 2023

Top Skills in 2023	Top Skills On the Rise
Analytical Thinking	Creative Thinking
Creative Thinking	Analytical Thinking

Resilience, Flexibility, and Agility	Technological Literacy
Motivation and Self-Awareness	Curiosity and lifelong learning
Curiosity and lifelong learning	Resilience, Flexibility, and Agility
Technological Literacy	Systems Thinking
Dependability and attention to detail	AI and Big Data
Empathy and active listening	Motivation and Self-Awareness
Leadership and Social Influence	Talent Management
Quality Control	Service Orientation and Customer Service

Source: Future of Jobs Report 2023

It should be noted that the occupation, Technical Specialist, has been identified in multiple industries. This qualification has multiple definitions, and thus there is a need to further specify the skills needed by the occupation per industry/sector.

The report anticipates that 23% of current jobs will undergo transformation over the next five years. By 2027, the proportion of machine-related jobs is expected to rise to 43%, reflecting a 9% increase compared to the situation in 2022. It is anticipated that within the next five years, 44% of workers will experience a transformation in their core skills. The findings indicate the presence of labor, while job markets are in a state of perpetual flux driven by ongoing technological innovation.

It should also be emphasized that the list of talents is recognized in a macro sense, and when analyzed per sector, many more careers would be found as important. Furthermore, jobs not listed in the table may also be experiencing increased demand, but not as significantly .

VII. TVET Capacity

Given Table 8's list of critical occupations and their corresponding TESDA qualifications, Tables 10 and 11 illustrate the existing TVET capacity and infrastructure for the related qualifications.

Table 10 shows the overall enrolment and graduation numbers organized by qualifications related to the skills and jobs required in the indicated industries. The

qualifications with the highest enrolment, graduation, assessment, and certification figures are Driving NC II, Agricultural Crops Production NC II, Bookkeeping NC III, Rice Machinery Operations NC II, Carpentry NC II, Masonry NC II, Tile Setting NC II, Animal Production (Poultry-Chicken) NC II, Masonry NC I, Plumbing NC II, and Driving (Passenger Bus/Straight Truck) NC III. In contrast, the programs Masonry NC III, Agricultural Machinery Operations NC II, Seaweeds Production NC II, Sugarcane Production NC II, Aquaculture (Hatchery Operation) NC II, Land-based Transport Refrigeration Servicing NC II, Plant Maintenance NC I, and Construction Painting NC III have a low enrolment, graduation, assessment, and certification (EGAC) numbers.

Table 10. Total Number of Enrolled, Graduated, Assessed and Certified (EGAC) by Qualification identified as of June 2024

Qualifications	As of June 2024			
	Enrolled	Graduated	Assessed	Certified
Rice Machinery Operations NC II	3,668	3,030	2,536	2,452
Agricultural Machinery Operations NC II	0	0	0	0
Sugarcane Production NC II	0	0	0	0
Aquaculture NC II	47	34	353	350
Aquaculture (Hatchery Operation) NC II	0	0	0	0
Animal Production (Poultry-Chicken) NC II	2,126	1,965	3,688	3,425
Animal Production (Ruminants) NC II	746	719	986	931
Agricultural Crops Production NC II	6,359	5,183	12,459	12,048
Bamboo Production NC II	124	149	65	65

Qualifications	As of June 2024			
	Enrolled	Graduated	Assessed	Certified
Seaweeds Production NC II	0	0	25	25
Rubber Production NC II	100	100	0	0
Bookkeeping NC III	5,613	5,538	11,369	6,076
Land-based Transport Refrigeration Servicing NC II	0	0	0	0
Plant Maintenance NC I	0	0	0	0
Customer Services NC II	25	116	486	453
Data Encoding and Management Level II	-	-		
Warehousing Services NC III	-	-	20	20
Carpentry NC II	3,455	3,941	6,466	6,341
Carpentry NC III	16	16	37	36
Masonry NC I	1,236	1,891	1,726	1,715
Masonry NC II	3,220	3,138	3,938	3,888
Masonry NC III	0	0	40	36
Construction Painting NC II	877	1,026	913	911
Construction Painting NC III	0	0	0	0

Qualifications	As of June 2024			
	Enrolled	Graduated	Assessed	Certified
Tile Setting NC II	2,391	3,565	3,371	3,285
Pipefitting (Metallic) NC II	489	506	1,027	1,019
Plumbing NC I	631	1,007	1,043	1,003
Plumbing NC II	1,173	949	1,709	1,605
Plumbing NC III	25	0	0	0
Driving (Passenger Bus/Straight Truck) NC III	1,111	1,361	3,469	3,271
Driving (Articulated Vehicle) NC III	128	140	1,119	1,077
Driving NC II	24,749	30,783	39,909	37,844

Source: TESDA-ICTO | Data as of June 2024

In Terms of the TVET Infrastructure, it is noticeable that the information in Table 9 is related to the number in the EGAC (Table 8). It shows that low number in the TVET infrastructure (Assessment Centers, Competency Assessors, Registered Programs and Trainers) directly affects the TVET capacity. This is seen in the TVET infrastructure for Seaweeds Production NC II, Agricultural Machinery Operations NC II, Aquaculture (Hatchery Operation) NC II, Land-based Transport Refrigeration Servicing NC II, Sugarcane Production NC II, Warehousing Services NC III, Construction Painting NC III, Plant Maintenance NC I which also have low numbers in their respective EGACs. It should also be noted that TESDA has prioritized the development of Solid Waste Management as a program.

Table 11. Total Number of Assessment Centers, Competency Assessors, Registered Programs and Trainers Qualification identified as of June 2024

Qualification	As June 2024			
	No. of Assessment Centers	No. of Competency Assessors	Registered Programs	Trainers
Rice Machinery Operations NC II	46	84	93	261
Agricultural Machinery Operations NC II	2	0	1	0
Sugarcane Production NC II	1	1	0	4
Aquaculture NC II	5	16	9	75
Aquaculture (Hatchery Operation) NC II	2	0	0	0
Animal Production (Poultry-Chicken) NC II	70	152	0	721
Animal Production (Ruminants) NC II	31	67	149	258
Agricultural Crops Production NC II	178	318	62	1,552
Bamboo Production NC II	5	5	7	19
Seaweeds Production NC II	2	1	0	0
Rubber Production NC II	4	14	4	027
Bookkeeping NC III	357	300	490	28
Land-based Transport Refrigeration Servicing NC II	1	2	0	1
Plant Maintenance NC I	0	0	0	0
Customer Services NC II	14	19	14	6
Warehousing Services NC III	0	0	0	19

Carpentry NC II	146	217	249	766
Carpentry NC III	11	9	7	59
Masonry NC I	61	92	87	0
Masonry NC II	139	173	6	635
Masonry NC III	8	5	3	58
Construction Painting NC II	31	51	49	169
Construction Painting NC III	0	0	0	2
Tile Setting NC II	91	129	151	402
Pipefitting (Metallic) NC II	13	32	16	67
Plumbing NC I	40	28	46	0
Plumbing NC II	68	74	98	272
Plumbing NC III	3	3	1	9
Driving (Passenger Bus/Straight Truck) NC III	94	149	55	354
Driving (Articulated Vehicle) NC III	39	50	8	102
Driving NC II	434	773	776	3,047

Source: TESDA-ICTO | Data as of June 2024

VIII. Recommendations

With support from the United Nations and other international agencies in not only promoting but also assisting developing countries in meeting their national climate change mitigation targets, the country must now accelerate and expand its initiatives and projects to not only keep its targets on track but also outperform other countries in meeting their NDCs and SDG pledges. Highly competent workers are in great demand due to their necessity for proficiency in emerging technologies that will be utilized in the next few years.

The following are the recommendations from TESDA:

For the Partnerships and Linkages Office (PLO)

- **TESD needs to be strategic with its Partnerships and Agreements**

As seen in the discussions, the government needs to engage with the private sector to participate in possible initiatives requiring additional investment. For TESDA, partnerships have always been integral to the agency's core pillar. TESDA should leverage the country's push for a closer relationship with the private industry to better position itself and promote its accomplishments to a larger industry audience. These partnerships must also involve initiatives for skills development related to renewable energy, energy-efficient construction, sustainable agriculture, and other key sectors.

- TESDA, through the PLO, should consider forging Memorandums of Understanding/Agreements and partnerships with prominent private industries as a strategy. This would help TESDA expand its networks with other possible industry partners and highlight the agency through industry-led collaborations. An example of these high-profile agreements is the MOA signed with the San Miguel Corporation (SMC) to provide skills training, upskilling, and re-skilling of Filipino human resources, including displaced workers, returning overseas Filipino workers, senior citizens, people with disabilities, and other qualified clients.
- With the assistance of these private sector partners, the agency can better identify new and emerging skills, prioritize skills resulting from innovation and application of new technologies, increase its pool of possible technical experts, and encourage partnership as possible training and program providers.
- The PLO should also strengthen its coordination with relevant government entities and establish intergovernmental collaborations to maximize the administration's objectives. This includes access to experts, essential labor insights, and critical industry-relevant events.
- Collaboration with international organizations should also be strengthened. TESDA's collaboration with organizations such as the ILO, UNDP, and other international agencies has resulted in outstanding accomplishments such as developing the Workplace and Skills Satisfaction Survey Manual, collaboration on the Skills for Prosperity program, prioritization of the electric vehicle industry, and many more.

Further participation with the organizations can help TESDA highlight its activities in the global community and have access to foreign incentives that can support its future projects.

For the National Institute for Technical Education and Skills Development (NITESD) and Qualifications and Standards Office (QSO)

- **Continue with the Embedment of the Green and Emergings Skills to Existing Qualifications**

As noted in the Future of Jobs Report, new skills are in demand in global labor markets, and companies are expected to seek these skills in their workforce in the future. TESDA, through the NITESD and QSO, is integrating the 21st Century Skills and Green Skills into its existing Training Regulations (TRs) and Competency Standards (CS), incorporating the latter into over 30 TRs. However, the rapid innovation in the global industry is driving the demand for additional new skills in the workforce, such as AI and Big Data. Thus, TESDA needs to be attentive to new shifts in the labor markets and reactively capitalize on information to improve its present pool of programs.

- TESDA must embed and incorporate crucial skills for sectors like renewable energy, energy-efficient construction, and sustainable agriculture into their respective qualifications. This may better prepare future graduates with in-demand skills, making them more competitive in the local and global employment markets. Table 8 can be used to identify new skills not yet included/embedded in the qualifications.

For the Planning Office (PO) and Qualifications and Standards Office (QSO)

- **Continue to Prioritization of Higher-Level Qualification Development**

As a result of the many actions taken by the global community to tackle climate change, the advent of new technologies is causing a significant shift in the job market. Table 7 shows that a considerable proportion of positions in the above mentioned sectors require higher education, followed by technical-related occupations. This transition might be viewed as a benefit for TESDA since it plans to develop new higher-level qualifications. Furthermore, with the implementation of the joint memorandum circular with the Commission on Higher Education (CHED) regarding the Philippine Credit Transfer System, TESDA will be able to promote higher-level qualifications as a means of gaining

an advantage in employment and as a means of continuing the trainees' academic path to a college diploma.

- The development of higher-level qualifications must be consistent with the agency's prioritization process. Additionally, TESDA's Planning Office has consistently promoted its consultation results with numerous industries and Skills Needs Anticipation Workplace Skills and Satisfaction (SNA: WSS) Survey Reports for different sectors. Using these as references, TESDA can determine if previous consultations and/or surveys indicated any high-level jobs that should be prioritized.
- Existing qualifications with higher-level occupations identified in the functional mapping process may also be reviewed to check whether the high-level jobs can be prioritized into TESDA qualifications.
- Program development in sectors such as renewable energy, energy-efficient building, and sustainable agriculture should be prioritized, as these areas are where most innovations arise and are most impacted by climate change.
- Planning Office to continue its prioritization process to further evaluate the the skills needed to be developed into progrms. Skills identified in the policy gaps should also be considered, these are:
 - Disaster Resilience and Emergency Preparedness
 - Sustainability-Oriented Skills
 - Adaptation and Mitigation Skills
 - Digital Skills for Climate Action
 - Entrepreneurial Skills for Climate-Friendly Businesses
 - Sector-Specific Climate Resilience Training
 - Social and Behavioral Skills
 - Health and Safety Skills in Climate Contexts
- It is also recommended that the QSO review existing climate change related programs. Potential programs should be reviewed and embedded with the above mentioned skills as a unit of competency.
- The PO and QSO are recommended to collaborate on the review of additional criteria of climate change related program standards. Possible programs should include competencies in environmental impact assessment. Other needed compencies should be air quality monitoring, emmission reduction practices, resource conservation, biodiversity conservation, natural resource management.

For the National Institute for Technical Education and Skills Development (NITESD) and Certification Office (CO)

- **Improve Existing TVET Infrastructure and Capacity**

Based on the results of Tables 9 and 10, there are significant gaps in TESDA's TVET Capacity and Infrastructure. Some qualifications have little to no Assessment Centers, Competency Assessors, Registered Programs, and/or Trainers. This gap in the infrastructure directly affects the TVET Capacity, seen in the qualifications such as Agricultural Machinery Operations NC II, Aquaculture (Hatchery Operation) NC II, Sugarcane Production NC II, Plant Maintenance NC II, Warehousing Services NC III, and Land-based Transport Refrigeration Servicing NC II, which churns out low numbers of enrolled, graduate, assessed, and certified trainees.

- TESDA, through the NITESD and CO, must address the shortage of Assessment Centres, Competency Assessors, Registered Programs, and Trainers for some of the indicated qualifications. The report shows that most of the qualifications are from priority sectors, indicating a current demand in the country. TESDA may encourage private enterprises and organizations to become training providers for these qualifications through promotion and arrangements. TESDA may also consider promoting the industry through cooperation and/or agreements on arrangements such as providing training facilities and/or assessment centers.
- In addition, TESDA must expand its network of regional lead trainers and assessors. Having experienced and qualified trainers nationwide ensures no gaps in training program scheduling, delivery, and implementation.

For the Planning Office (PO) and the Regional and Provincial Offices (ROPOs)

- **Enhance the implementation and monitoring of the Area-Based and Demand-Driven (ABDD) TVET Strategy**

With the Area Based and Demand Driven (ABDD) TVET as the agency's central strategy, TESDA Provincial and Regional Offices have submitted their respective skills priorities reports. Based on the latest submissions, the various sectors identified in Table 7 are included in most of the region's priority sectors.

- Using the results of the Area-Based skills priorities and the ABDD Guidelines for the development of Area-Based qualifications, it is recommended that TESDA Regional and Provincial Offices review their respective skills priorities and determine whether any of the qualifications

listed in Table 8 can be considered for Area-Based qualification development.

- The TESDA Planning Office has already published Labour Market Intelligence Reports on Green TVET and the Circular Economy, which should have been used as inputs to the Regional and Provincial skill priorities. Suppose jobs related to sustainability, green technology, or the circular economy are identified in the skills priorities but do not have corresponding qualifications. In that case, these should be considered for area-based qualification development (based on ABDD-IG provisions).
- As identified in the discussions, climate change affects the whole country but there are areas who have a higher risk of being affected by climate change. Through the ABDD Strategy the following regions with their respective provinces can initiate with the development of climate change related programs identified in their respective R/PTESDP Action programming.
 - National Capital Region (NCR)
 - Ilocos Region (Region I)
 - Cagayan Valley (Region II)
 - Central Luzon (Region III)
 - MIMAROPA (Region IV-B)
 - Eastern Visayas (Region VIII)
 - Davao Region (Region XI)
 - Caraga (Region XIII)
 - Bangsamoro Autonomous Region in Muslim Mindanao (BARMM)
- The identified ROs are also recommended to strengthen its respective TVET infrastructure for climate related programs. To efficiently and effectively implement the programs and provide the community with the needed competent personnel.
- Another recommendation to the ROPOs is to strategize, and collaborate with concerned LGUs on ways to assist and mitigate possible effects of climate change, such as typhoons, extreme El Niño and La Niña. Though updated monitoring of graduates, TESDA ROPOs maybe able to provide them with the needed workers as well as schedule implementation of the climate change related programs when needed.

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