GREEN PRODUCTIVITY AND CIRCULAR ECONOMY

Complementary Approaches to Sustainable Development

APO

The Asian Productivity Organization (APO) is an intergovernmental organization that promotes productivity as a key enabler for socioeconomic development and organizational and enterprise growth. It promotes productivity improvement tools, techniques, and methodologies; supports the National Productivity Organizations of its members; conducts research on productivity trends; and disseminates productivity information, analyses, and data. The APO was established in 1961 and comprises 21 members.

APO Members

Bangladesh, Cambodia, Republic of China, Fiji, Hong Kong, India, Indonesia, Islamic Republic of Iran, Japan, Republic of Korea, Lao PDR, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Turkiye, and Vietnam.

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CONTENTS

FOREWORD

The APO introduced the Green Productivity (GP) concept in 1994 as a response to the renewed global commitment to environmental preservation. GP was formulated as a holistic strategy to simultaneously enhance productivity and environmental performance while contributing to sustainability and advancing socioeconomic development. It strengthens the belief that a healthy environment and competitive economies are mutually dependent.

In the past decade, in efforts to mitigate the negative impacts of climate change, resource depletion, and environmental degradation, the global sustainability focus has incorporated evolving concepts, ideas, and philosophies. Sustainable development is regarded as the overarching goal by many countries worldwide, and green policies are high on government agendas. Among the green initiatives being promoted, GP and the Circular Economy (CE) cover important parts of the sustainability maps in APO members.

While GP is a recognized firm- and industry-level strategy, the CE concept promotes the conservation and efficient utilization of resources. Even though GP and CE are well accepted at different levels, efforts to synergize GP and CE into daily practices at firm, industry, and national levels will yield better results in sustainable development agendas. The APO conducted research to identify complementarities between GP and CE principles with the aim of assisting its members in combining the two approaches to achieve their sustainability goals. Green Productivity and Circular Economy: Complementary Approaches to Sustainable Development is the result of that research, and the publication also contributes to the strategic objective in the APO Vision 2025 of promoting robust, proactive GP initiatives.

The efforts of the team of experts who conducted the research and wrote this publication are very much appreciated. The APO expects that Green Productivity and Circular Economy: Complementary Approaches to Sustainable Development will serve as a useful guide for readers in member governments to align GP more closely with the latest global environmental efforts to address emerging issues. Ensuring the continued relevance of GP in synergy with the CE concept will help sustainability goals become a reality.

Dr. AKP Mochtan
Secretary-General
Tokyo, August 2022

EXECUTIVE SUMMARY

In 2021, while the Asian Productivity Organization (APO) celebrated its 60th anniversary, the unexpected colossal damage caused by COVID-19 pushed the world towards a new era of economic restructuring. With the world staring at threats like climate change, resource depletion, and environmental degradation, countries began to consider sustainable development as their ultimate goal for future development. The global trend towards the adoption of green policies, especially in the recent decade, has also led to new green initiatives and measures to combat the danger.

Responding to the need for a new green era, the APO initiated a study to understand the initiatives taken up by its members and chalk out the roadmap for future goals and programs for Green Productivity. Circular Economy, an old campaign with newly defined functions and formats, is the approach under our investigation, including a comparison with GP. Even though CE as an initiative with a specific focus on resource conservation and efficient utilization is well accepted, there is a need to put more effort into integrating it as part of routine economic practice in any society. Compared with GP, a paradigm aiming at the efficient production process to create high economic outputs while maintaining the environment under safe and prosperous conditions, CE should be applied to all dimensions of the economy, including consumption, disposal, manufacturing, etc.

The APO research project examines the complementarities between GP and CE principles to update and strengthen the GP strategy, aligning with the UN SDGs and the latest global environmental preservation trends. The APO also aims to increase its contribution towards the efforts made by its members in meeting their sustainability goals. The result of this research is expected to contribute towards enriching and elevating GP initiatives, ensuring its continued relevance in addressing the emerging and pressing global issues through the current development of GP 2.0.

A group of experts was assigned to examine and map out national CE principles and policies being evolved by the APO members and analyze complementarities between CE principles and GP strategies of the APO. Given these analyses, recommendations were made to upgrade and strengthen GP to effectively address emerging global challenges through alignment and synergies with national CE frameworks.

The following points were noted based on the contributions from twelve national experts, the chief expert, and the APO Secretariat in the second half of 2021.

1. Among the initiatives discussed and advocated, the UN SDGs for countries or societies and Environmental, Social, and Corporate Governance (ESG) for corporates or firms are the two most recognized initiatives by all parties.

2. In practice, since energy efficiency is directly related to the cost of operation of a corporate and climate change issues are under the spotlight of global discussion,

energy efficiency is more noticeable than resource efficiency as the sustainability activities for corporates to be engaged with.

3. Among the APO members, GP has been more accepted and practiced since international environmental management systems for it are in place while fewer corporates realize the CE concept. However, some CE practices, such as using secondary materials for manufacturing, have been utilized.

4. CE in aspects other than manufacturing, such as consumption, logistics, commerce, and final disposal of products, is not much of a concern partially because there are several other initiatives, including GP, at the manufacturing stage. Besides, people are more used to looking at sustainability at the manufacturing stage. Also, the innovation of business models for CE, a driving force and key variable in CE development, is not well-considered and created.

5. The development of CE requires appropriate guides, tools, training, and innovative business models, which are presently lacking. The survey result shows that training the workforce and transfer of technology top the list of assistance desired by the corporates in the APO members.

6. Corporate with different attributes have different needs for green transformation. For example, green finance and networking are regarded more seriously as a priority for green transformation in the service sector rather than in the industry and agriculture sectors.

Sustainable development can be interpreted as a two-dimensional matrix. While the first axis represents different sustainability issues, such as environmental quality, resource utilization, energy consumption, biodiversity maintenance, human rights, social equity, prosperity, etc., the second axis includes human activities such as resource exploitation, design, production, consumption, transportation, final disposal, education, commerce, etc. All green initiatives, protocols, and agreements are created to deal with issues in one or several activities, just as a set of jigsaw puzzles to fill out the map of sustainability development.

Among those green initiatives, GP and CE cover part of the sustainability map with key functions to upgrade the capacity of the APO members.

The rest of the document is organized as follows. Section 2 describes the methodology of the study. Section 3 introduces the concepts of GP and CE. The overall status of GP and CE implementation at the corporate level among the APO members is detailed in section 4. Nation-level GP and CE policy-related implementations are mapped out in section 5. Case examples of practices of GP and CE are described in section 6. Finally, section 7 presents recommendations and strategies for enhancing the application of GP and CE among the APO members.

THE METHODOLOGY

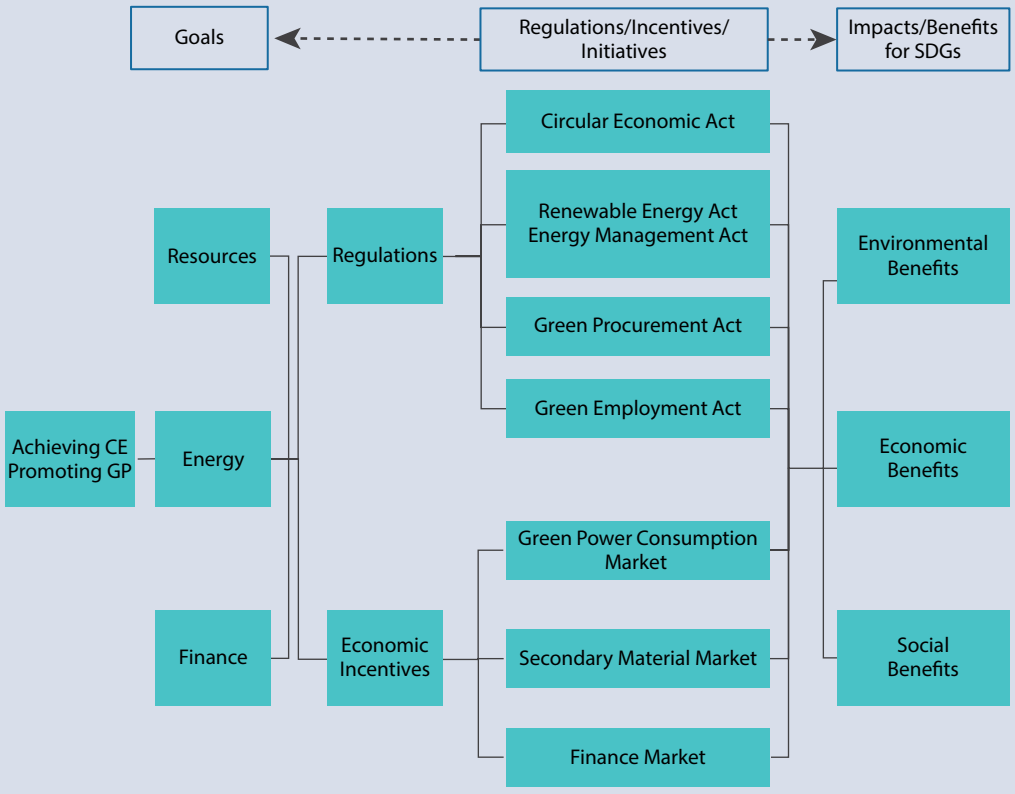
Between July and December 2021, this study was conducted by twelve National Experts from the APO members. It was coordinated by the chief expert and the APO Secretariat. The twelve countries include Bangladesh, Cambodia, the Republic of China (ROC), Fiji, India, Indonesia, Islamic Republic of Iran (IR Iran), Malaysia, Pakistan, the Philippines, Thailand, and Vietnam. The methodology for this research includes three components: (1) country data analysis, (2) questionnaire-based survey, and (3) synthetic quantitative analysis.

2.1 Country Data Analysis

All sustainability initiatives rely on promotions and regulations at the country level. Regulations and economic incentives are measures utilized by government authorities to create sustainability benefits (see Figure 1) and conserve resources. The evolution of national policies and initiatives on GP and CE among the APO members was reviewed in the APO publications on GP for SDGs [1] [2]. All national experts were commissioned to collect further literature, data, and information about regulations and incentives related to GP and CE in their countries.

FIGURE 1

ANALYSIS FRAMEWORK FOR THE PROMOTION OF GP AND CE.



Based on the analysis framework in Figure 1, the country data collected was intended but not limited to those listed in Table 1. In addition to explaining aspects of different policy goals of GP, CE, and SDGs, the report heavily relies on the analysis of all national experts to understand how the policies coordinate and interact with each other.

TABLE 1

COUNTRY DATA ABOUT GP, CE, AND SDGS COLLECTED DURING THE STUDY.

	Green Productivity	Circular Economy	SDGs
Policy history, framework, and initiatives	√	√	√
Authorized implementers and supporting agencies, NGOs, think tanks, academia, and associations	√	√	√
Regulations, incentives, and budgets	√	√	√
Industries of concern	√	√	
Technology intervention at a sectoral level to reduce inputs (in the industries of concern)	√	√	
The use of Industry 4.0 (digital technologies and automation) in the industries of concern	√	√	
Cases of best practices	√	√	√
Data and information websites	√	√	√
Economic impacts from policies on sectors* (agricultural, industrial, service)	√	√	
Environmental effects*	√	√	
Social benefits*	√	√	

* Estimation by national experts and derived from secondary data

2.2 Surveys of Enterprises and Organizations

A quick survey was conducted on private and public enterprises to examine the influence of GP, green production, and CE policies on business performance at the corporate level for the issues listed in Table 2. A complete questionnaire is enclosed in the Appendix 1.

TABLE 2

SURVEY QUESTIONNAIRE USED FOR COLLECTING DATA FROM THE CORPORATES DURING THE STUDY.

Survey Content	Examples

Basic information about corporate and organizations	• Country
	• Business scope
	  ◦ Domestic
	  ◦ Regional (such as ASEAN and Asia-Pacific)
	  ◦ Global
	• The sector and industry
	  ◦ Agriculture
	  ◦ Industry
	  ◦ Service
	• No. of total employees
	• Average annual revenue/budget
	• Average annual return rate

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Survey Content	Examples
Corporate Green Goal, if any	• Corporate or organizational goals ◦ GP ◦ CE ◦ SDG ◦ ESG ◦ GHG
Current and future green activities to be involved with, if any	• Clean production • Lean manufacturing • Green procurement • Design for the environment • Usage of secondary materials, recycled water, renewable energy • Energy saving, GHG reduction, carbon footprint
Implementation of management framework	• ISO 26000 • ISO 45001 • ISO 50001 • ISO 14000s (e.g., 14001, 14051) • ISO 323/59000 or other international standards for CE (e.g., BSI 8001, UL 3600) • National standards for sustainability (e.g., waste or wastewater management)
Current requirements and incentives received from governments or authorities for green transformation	• Regulations from the government or any green protocols to follow • Incentives and assistance offered by the government (e.g., tax reduction)
Impact of green activities, regulations, and incentives on the organization	• Profit or productivity change • Corporate image or reputation • Contribution towards sustainability
Future needs from government or authorities for green transformation	• Training of the workforce • Financial capitals • Technology transfer • Management skills • Networking

GHG, Greenhouse Gas; ISO, International Organization for Standardization.

2.3 Data Synthesis and Analysis

The national experts processed and analyzed the data according to the methods they were familiar with and drew conclusions on the complementarities of GP and CE for each APO member country. They also evaluated its implications on SDGs. The steps taken for executing this project are as follows.

2.3.1 Data Collection

The secondary and primary data collected through the survey questionnaire cover the following information.

- The mechanisms and overall status of promoting GP and CE among the APO members.
- Best practices of enterprises in GP and CE.

- The impacts of GP and CE activities at the corporate level, both in the public and private sectors.

- The need to develop GP, CE, and other green programs further.

2.3.2 Data Analysis

With the data collected, the national experts conducted the following analysis.

- Analysis and interpretation of the opportunities and challenges of promoting GP and CE among the APO members (e.g., SWOT analysis).

- Quantitatively identifying the environmental and economic benefits of GP and CE in the agriculture, industry, and service sectors and their implications on climate-change-related activities and the UN SDGs.

The Chief Expert further conducted a synthetic analysis with the data from all participating members to identify the following issues.

- The current status of GP and CE among the APO members.

- The influence of international green protocols adopted by the APO members on their productivity.

- The strategies and visions of GP and CE among the APO members to conclude what has been done and steps that need to be taken in the future.

INTRODUCTION TO GREEN PRODUCTIVITY AND CIRCULAR ECONOMY

The symbiosis of environmental protection and economic development has been emphasized in the national and international policies since the 1960s, especially in developing countries where policymakers often give higher priority to economic development than environmental protection. In the late 1980s, the principle of environmental-friendly economic development was expanded to "sustainable development" with the inclusion of social aspects. Therefore, various policy concepts on "green" were proposed with a slightly different focus. Notably, GP proposed in the 1990s and CE that has received more attention since 2010 are the two mainstream policy approaches adopted in many countries and regions.

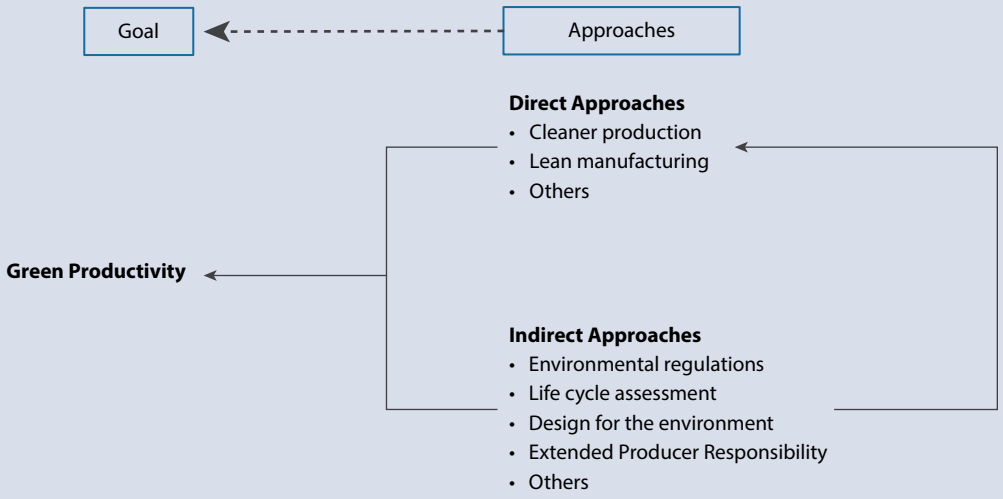
3.1 Green Productivity

The APO introduced the concept of GP in 1994, two years after the 1992 Earth Summit in Rio de Janeiro, Brazil. GP is the APO's response to the renewed global commitment to environmental preservation following the adoption of the Rio Declaration on Environment and Development by more than 178 governments. The GP concept was formulated to simultaneously enhance productivity and address environmental concerns for overall socio-economic development. It combines productivity and eco-friendly management tools, techniques, and technologies that reduce the impact of a firm or organization's activities, products, and services on the environment while enhancing profitability and competitive advantage. Overall, GP is positioned as a holistic strategy to ensure economic progress and competitiveness while tackling environmental issues and championing sustainability. More details on the GP initiatives of the APO can be found at https://www.apo-tokyo.org/wedo/gp2020/.

GP aims to establish efficient production and consumption systems without or with less degradation of environmental quality and exploitation of natural resources [3]. It focuses on manufacturing processes and other supporting mechanisms. For GP, the direct approaches or strategies include initiatives such as "cleaner production" and "lean manufacturing" to reduce the input of resources and the generation of pollution in the manufacturing process. In addition, there are supplementary or indirect approaches to support cleaner production like Extended Producer Responsibility (EPR), environmental regulations, life cycle assessment, design for the environment, etc. Together, these approaches and strategies will likely increase green production processes for a higher volume of environment-friendly products.

FIGURE 2

THE APPROACH STRUCTURE OF GREEN PRODUCTIVITY.



3.2 Circular Economy

The concept of CE can be traced back to the 1960s. Given the limitation on the availability of resources on the earth, some economists advocated CE as an economy producing no waste, no pollution, and hence no impact on the environment in all aspects of the economy, such as production, transportation, consumption, and final disposal. Unlike the Linear Economy, it is believed that CE will enable biological nutrients to re-enter the biosphere. This also means that in CE natural resources can be re-utilized and the production system can be designed to ensure that natural resources, including materials, water, and energy, are continuously circulated.

To increase resource utilization, CE is interpreted in various ways. For example, recycling waste is frequently referred to as CE and encouraged through regulations. For the post-consumption recyclables, the principle of EPR is often applied.

Another generally recognized format of CE is the symbiosis of industries or industrial ecology. The waste or byproducts generated from one company can be used as input for manufacturing in another company. This helps create a food chain-like circle to reduce total waste generation to a minimum. Also, in some cases, CE reflects the overall economic growth pattern that consumes less energy, materials, and water and produces less pollution at all production, consumption, and transportation stages.

More recently, the European Union released CE Package [4] and promulgated 'Closing the loop – An EU action plan for the Circular Economy' in December 2015 [5]. The main idea of this directive is to push Europe towards a more sustainable way of utilizing the resources on the earth with a focus on three aspects of the economy: production, consumption, and recycling. The main principles proposed in this directive include minimizing waste generation, expanding the life and value of products, and increasing the value-added from recycling practices.

In response to the EU's policies, the Ellen MacArthur Foundation (EMF) and McKinsey & Company jointly published a report 'Towards the Circular Economy: Economic and Business Rationale for an

Accelerated Transition' [6]. EMF also put forward six practices of ReSOLVE in the report, 'Growth Within: A Circular Economy Vision for a Competitive Europe.' [7] The six practices are:

1. **Regenerate:** Emphasizing the use of renewable energy and recycled materials.

2. **Share:** Providing products to users through sharing to maximize their use efficiency.

3. **Optimize:** Improving product performance and efficiency, reducing waste in the supply chain, and introducing contemporary technologies such as big data analysis, automation, and remote sensing.

4. **Loop:** Reinvesting the components that can be used in the production and encouraging the cooperation of product recycling responsibilities to create a larger cycle.

5. **Virtualize:** Providing electronic interaction methods, such as online shopping, e-books, and other e-commerce that reduce resource usage.

6. **Exchange:** Choosing better-performing and easily recyclable materials or technologies to make the product easier to reuse.

Table 3 illustrates five different formats or concepts, where each CE concept focuses on different stages or aspects of an economy. However, there are also different degrees of emphasis.

TABLE 3

CE CONCEPTS AND ACTIVITIES.

CE Concepts	Economic Activities Covered Under CE					
	Resource Exploitation	Design and Manufacturing	Transportation and Logistics	Consumption (of products and services)	Final Disposal	Commerce and Business
Recycling	Secondary focus	Main focus			Main focus	
Industrial Symbiosis		Main focus				
Economic Growth	Secondary focus	Main focus	Secondary focus	Secondary focus	Secondary focus	Secondary focus
EU CE Package		Main focus		Secondary focus	Main focus	Secondary focus
EMF & McKinsey	Secondary focus	Main focus		Secondary focus	Main focus	Main focus

Main focus Secondary focus

3.3 Complementarities between APO GP Strategies and CE Principles

GP, CE, and other initiatives have been proposed to achieve sustainability. These aim to reduce the negative impact of human activities on the environment. Some of these initiatives have further become agreements and protocols for specific goals to look for. For example, the UN Framework Convention on Climate Change (UNFCCC), operating for almost 30 years with the primary mission to reduce greenhouse gas emissions, is the most significant international negotiation for environmental purposes. More recently, the European Environmental Taxonomy that evaluates the sustainability of economic activities for financial institutions to make investment decisions has

been under discussion and will soon become a standard for sustainability evaluation [8]. Accordingly, sustainable activities can be said to have the following six characteristics. To qualify as a sustainable activity, the initiative should make a substantive contribution to at least one of these six environmental objectives.

1. Climate change mitigation
2. Climate change adaptation
3. Sustainable use and protection of water and marine resources
4. Transition to a CE
5. Pollution prevention and control
6. Protection and restoration of biodiversity and ecosystems

At the same time, the activities do not significantly harm the other relevant objectives but need to meet minimum safeguards. These six sustainability criteria outline the major categories of environmental issues in the current world that need to be solved by human actions.

GP and CE aim at national and eventually global sustainability but in different aspects, at different economic levels, and by different approaches. For GP, developing environmental-friendly products and green productivity are the primary goals. On the other hand, as indicated in Table 3, CE encourages environmental products and productions at the design and manufacturing stage, focusing on better resource utilization. In addition to the emphasis on increasing the physical efficiency of materials and resources, business models and financial schemes have been intensively discussed in recent years. They are expected to enable CE to take a big step forward. Therefore, CE focuses more on resource efficiency issues across all economic aspects. At the same time, GP is more focused on design and manufacturing, including all aspects of sustainability (Figure 3).

FIGURE 3

ASPECTS VS. ISSUES OF CONCERN IN SUSTAINABILITY COVERED BY GP AND CE.

Economic Aspects or Human Activities

Issues of Concern	Resource Exploitation	Design and Manufacturing	Transportation and Logistics	Consumption and Commerce	Final Disposal	Other Activities
Climate change mitigation (energy uses)		Green Productivity				
Climate change adaptation (infrastructure)						
Sustainable use and protection of water and marine (resources)						
Transition to a circular economy (resources)	Circular Economy					
Pollution prevention and control (environmental quality)						
Protection and restoration of biodiversity and ecosystems (ecosystems)						
Other sustainability issues						

With different concepts and approaches to sustainability available for the APO members, it is important to identify and clarify how both GP and CE complement each other when it comes to meeting the UN SDGs. It is also important to understand the impacts of these two approaches on the economy and which aspects or sectors should be addressed on a priority basis to achieve future goals.

STATUS OF GP AND CE AMONG THE APO MEMBERS

From July to October of 2021, an online questionnaire was distributed in 12 participating countries to outline the overall status of GP and CE policies, practices, and their impact on APO members. Based on the 1,145 responses to the online survey, the information is outlined as follows.

4.1 Basic Information of the Survey Respondents

4.1.1 Characteristics of the Respondents

Figures 4, 5, and 6 indicate the following:

- 14.9% of the respondents are from India, followed by Vietnam (10.8%) and Bangladesh (10.7%).
- 82.5% of the respondents are from the corporate sector, including the public and private sectors. Only 17.5% of respondents are from NGOs or NPOs.
- In terms of operational areas, most of the respondents (64.6%) function at the domestic level while the remaining 35.4% are regional and global players.
- Over 62.5% of respondents are mature corporates with more than ten years of operational experience, while the remaining 37.5% are from younger companies.
- 47.9% of the respondents belong to the industry sector, while 40.8% come from the service sector and 11.2% from the agriculture sector.
- Of the respondents, 54.4% have more than 100 Full-time Employees (FTEs) while 45.5% are small companies.

4.1.2 Organizational Green Goals and Activities of the Respondents

Figures 7, 8, 9, 10, and 11 indicate the following:

- More than half of the respondents (51%) are catching up with SDGs, followed by those aiming to implement ESG (46.6%). There is a significant difference in the percentage of those who realize their organizations are pursuing GP (42.7%) and those with CE (26.2%).
- Energy-saving and carbon footprint reduction activities are the most preferred practices. These are related to climate change initiatives and operating costs. This is followed by green consumption and procurement (36.5%) and cleaner production (32.7%), those that are more associated with the principles of GP. The activities related to CE, such as using secondary materials (32.6%), increasing product recyclability (25.3%), take-back recycling (31.6%), optimizing product life span (17.7%), and applying new business models (17.8%), are less accepted than the group of GP activities.

FIGURE 4

COUNTRIES AND CLASSIFICATION.

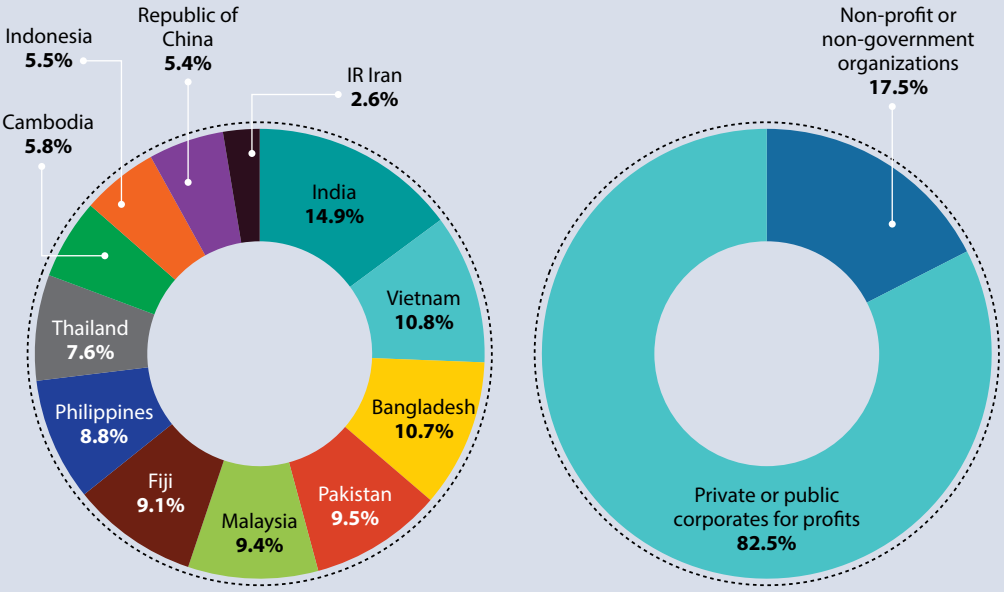
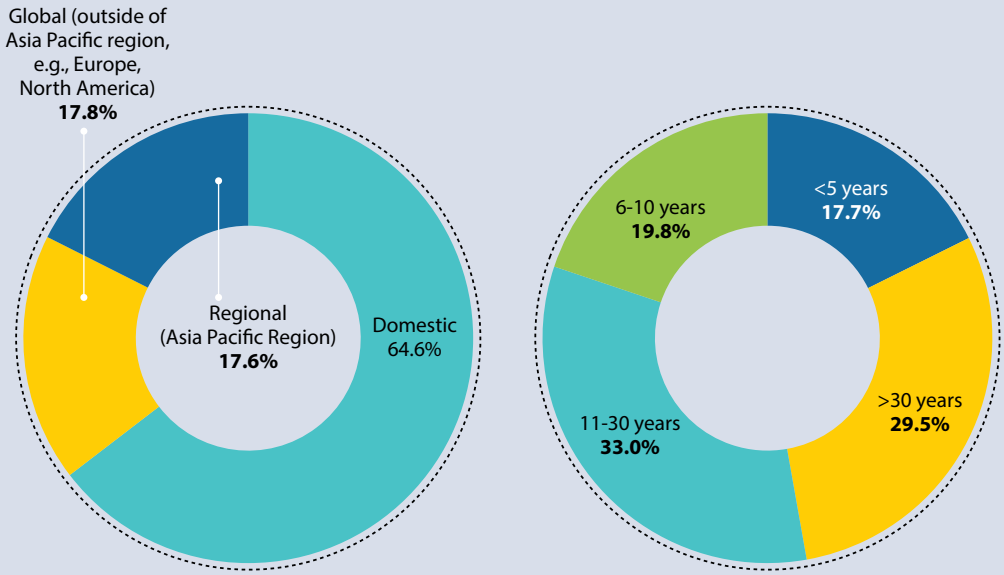


FIGURE 5

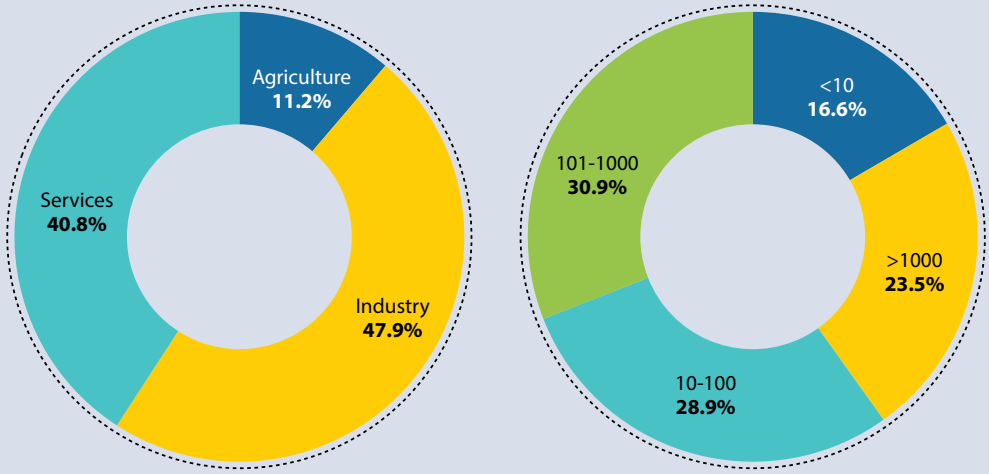
GEOGRAPHIC AREA AND YEARS OF ESTABLISHMENT.



- The survey reveals that over 42.2% of respondents are engaged in national standards for sustainability while 38.8% of respondents follow global environmental standards. Only a small percentage of the respondents follow the international energy management scheme of ISO 50001 (8.2%). An even smaller percentage of respondents understand CE standards of ISO 323/5900 (5.8%).

FIGURE 6

SECTORS AND NUMBERS OF EMPLOYEE.



- More respondents are aligned to the requirements or regulations of environmental management (58.5%), followed by energy regulations (38.7%), material and water recycling (31%), and green procurement (24.5%).

- In terms of the incentives offered by the governments for motivating organizations to adopt sustainability initiatives, 39.1% of respondents indicated that they have received training and consultation, while 33.8% benefited from tax deductions and 22% received subsidies for adopting clean technology.

FIGURE 7

GREEN GOALS.

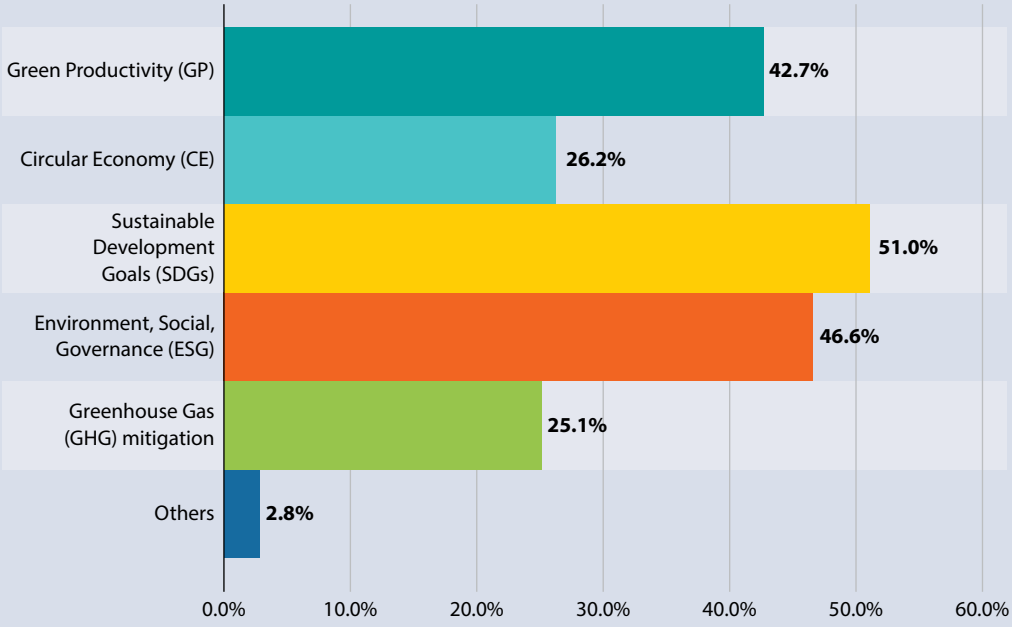


FIGURE 8

GREEN ACTIVITIES.

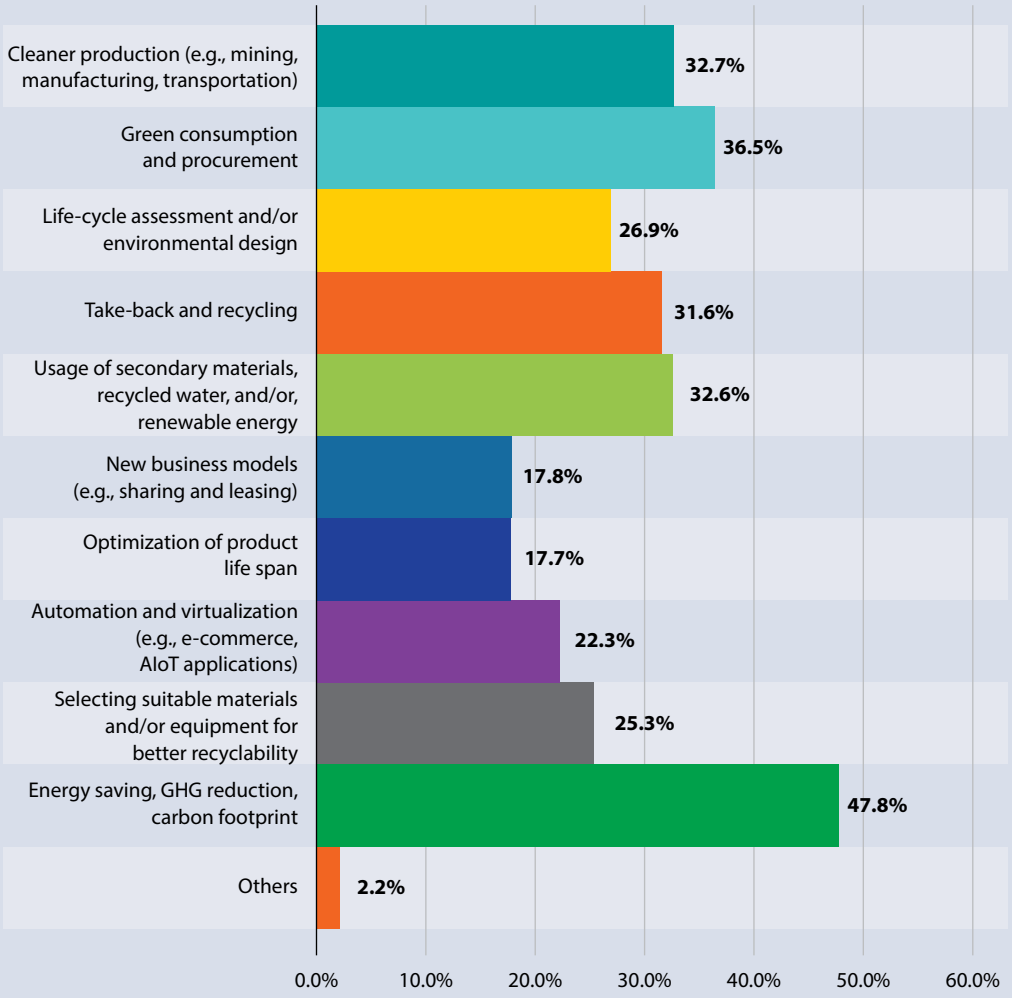


FIGURE 9

MANAGEMENT FRAMEWORK.

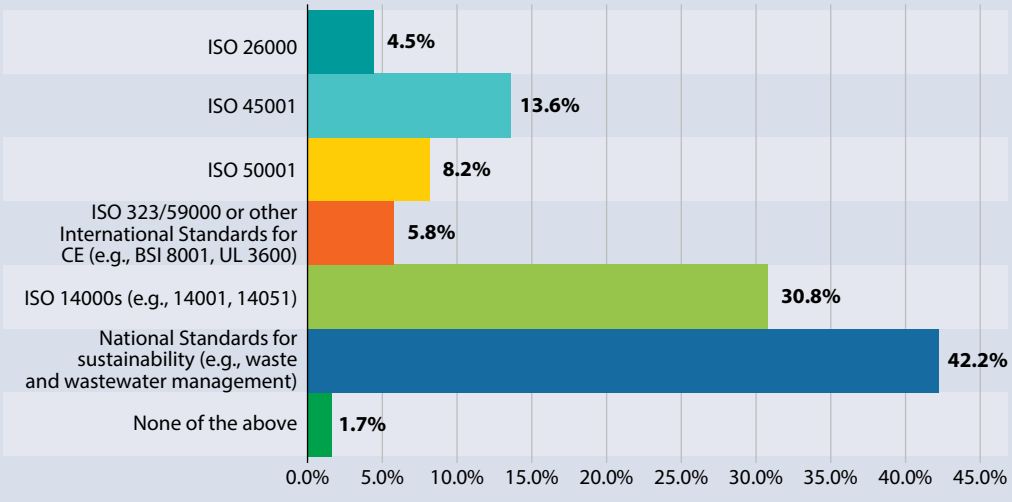


FIGURE 10

REQUIREMENTS AND REGULATIONS.

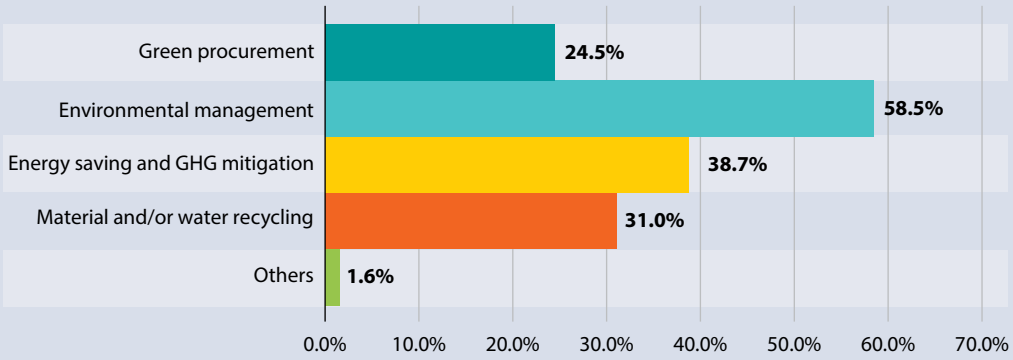
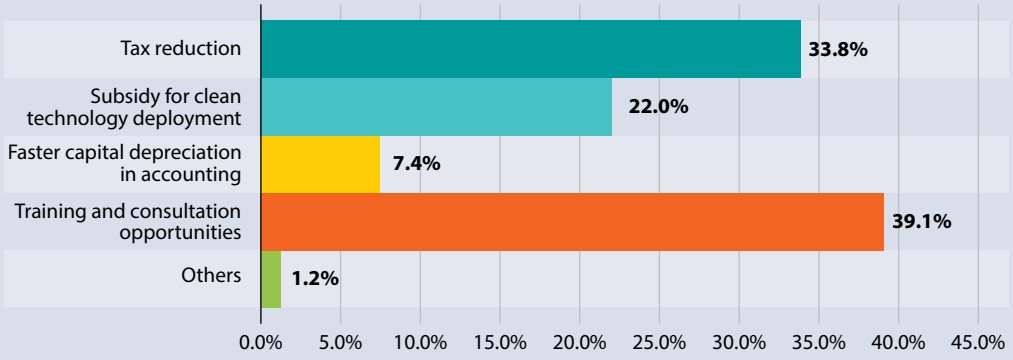


FIGURE 11

GOVERNMENT INCENTIVES.



4.1.3 Impacts of Green Activities and the Future Needs

Figures 12, 13, and 14 indicate the following:

- More than 70% of respondents indicated that they had a positive impact of the green initiatives, while only 3.3% of the respondents said they were negatively influenced.
- Over 46.2% of respondents pointed out that green initiatives have contributed towards sustainability, while 43.7% of respondents believe that it has helped improve the corporate reputation.
- Training of workforce (68.7%) and technology transfer (58.7%) are two areas where the corporate sector is looking for assistance, followed by financial capital (52%) and management skills (51.9%).

4.2 Cross-tabulation Analysis

Base variables

Based on the basic information collected from 1,145 responses to the questionnaires, an in-depth cross-analysis was conducted to understand the difference between corporates with different attributes under the following categories.

Location: While the complementarities between GP and CE are considered, the factors of regional differences in culture, political situation, economic development, and other aspects were taken into account. For this purpose, all twelve countries have been divided into two groups: (1) East Asia and Fiji (Cambodia, Fiji, Indonesia, Malaysia, the Philippines, the ROC, Thailand, and Vietnam), and (2) South Asia and IR Iran (Bangladesh, India, IR Iran, and Pakistan).

Sector: Since the needs and activities are different in all three major economic sectors, the project uses agriculture, industry, and services as three major bases for comparison.

Years of operation: The history and the year of operation are also considered a variable to understand the needs of the green transformation process of an organization. Therefore, the criterion has been taken into account to outline the status based on the number of years a corporate has been in operation.

FIGURE 12

GENERAL IMPACT.

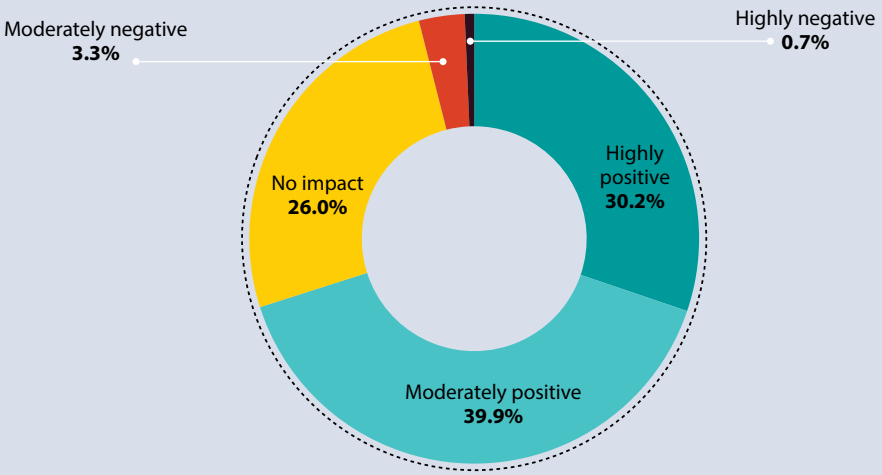


FIGURE 13

ASPECTS OF IMPACT.

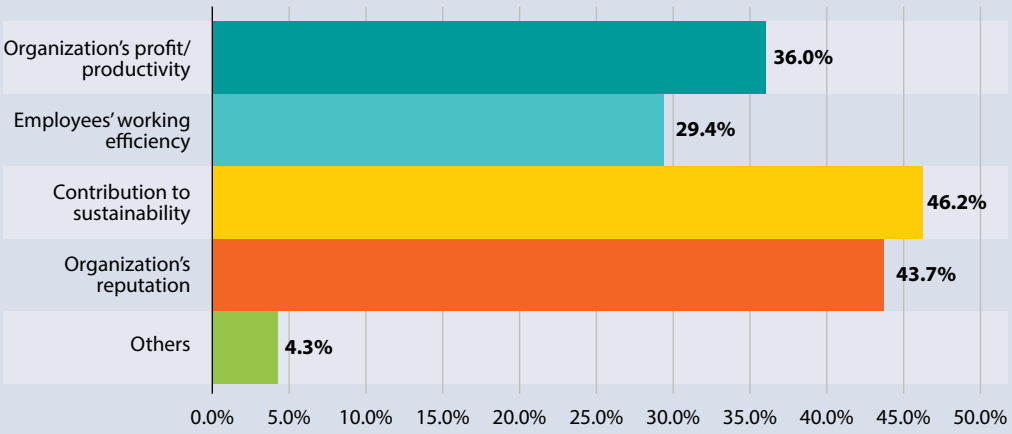
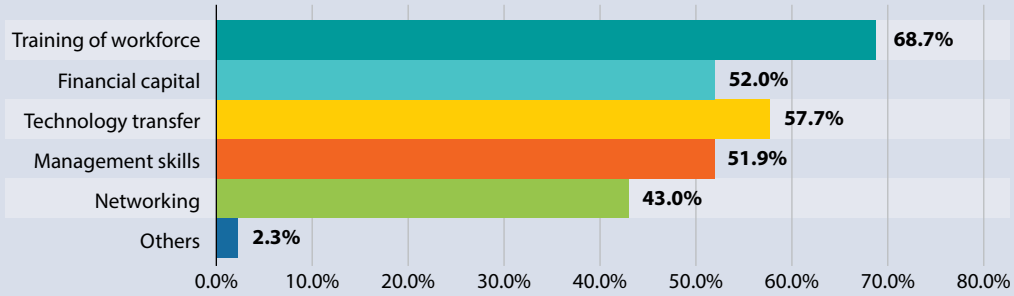


FIGURE 14

FUTURE ASSISTANCE NEEDED FROM THE GOVERNMENT.



Compare variables

Components of green activities, management frameworks implemented, requirements and regulations from governments, incentives from governments, and future assistance needed have also been compared as part of the compare variables. However, to simplify the comparison and in response to the mission of this project, the items in each category have been regrouped.

The green activities undertaken by the respondents are divided into four groups as four comparable variables:

1. **CE-related activities** about resource efficiency. This includes:
    - Take-back and recycling
    - Usage of secondary materials, recycled water, and/or renewable energy
    - New business models (e.g., sharing and leasing)
    - Optimization of product life spans
    - Selecting suitable materials and/or equipment for better recyclability
2. **GP-related activities** about pollution control. This includes:
    - Cleaner production (e.g., mining, manufacturing, transportation)
    - Green consumption and procurement
    - Life-cycle assessment and/or environmental design
3. **Climate change activities** related to energy efficiency and carbon reduction. This includes:
    - Energy-saving, GHG reduction, carbon footprint
4. **Others** related to sustainability. This includes:
    - Automation and virtualization [e.g., e-commerce and Artificial Intelligence of Things (AIoT) applications]

The items in the category of Management Frameworks Implemented are divided into four groups:

1. **CE-related management** about resource efficiency. This includes:
    - ISO 323/59000 or other International Standards for CE (e.g., BSI 8001, UL 3600)
2. **GP-related management** about pollution control. This includes:
    - ISO 14000s (e.g., 14001, 14051)
    - National Standards for sustainability (e.g., waste and wastewater management)
3. **Climate change-related management,** including energy efficiency and carbon reduction:
    - ISO 50001
4. **Others** about sustainability, including:
    - ISO 26000
    - ISO 45001

The items in the category of Requirements and Regulations from Governments are also divided into four groups:

1. **CE-related regulations** about resource efficiency. This includes:
    - Material and/or water recycling
2. **GP-related regulations** about pollution control. This includes:
    - Green procurement
    - Environmental management
3. **Climate change regulations** related to energy efficiency and carbon reduction. This includes:
    - Energy-saving and GHG mitigation
4. **Other** related regulations about sustainability. This includes:
    - Automation and virtualization (e.g., e-commerce, AIoT applications)

The items in the category of Incentives from Governments are divided into two groups as follows:

1. **Financial assistance,** including:
    - Tax reduction

- Subsidy for clean technology deployment
- Faster capital depreciation in accounting

2. **Training assistance,** including:

- Training and consultation opportunities

4.2.1 Cross-tabulation Analysis between Geographic Locations

Corporates in both groups, East Asia and Fiji (Group A) and South Asia and IR Iran (Group B), indicate that their governments have brought in more regulations in GP than CE (Figure 15). In terms of the number of green activities, a high percentage of corporates indicate that they practice both GP and CE activities indicating that CE may not be just a concept but is being practiced by the corporates in various formats (Figure 16). It can also be inferred that more countries have understood the importance of environmental protection while pursuing national development, and therefore set up more regulations. However, until recently, CE was not clearly identified and there was not much discussion and debate about it. In practice, however, CE has been in place and practiced. In addition, the same reasoning applies to the management frameworks implemented by the corporate sector. As shown in Figure 17 more corporates across both groups of countries have adopted GP-related management schemes than CE and climate change-related frameworks. This indicates that the APO countries need guidance and management tools for CE.

Furthermore, two groups of corporates also show the difference: more organizations in Group A have been working on CE-related activities than GP as compared to those in Group B countries. This implies that countries in Group A may be more aggressive in promoting resource conservation and utilization than those in Group B.

Another conclusion from Figure 15 and Figure 16 is about climate change issues. As compared to CE, countries in both groups have well-placed regulations to deal with issues related to climate change due to the continuous effort by the UNFCCC. However, the number of corporates working on activities related to climate change such as energy saving and GHG emission reduction is low. This indicates that any task related to easing climate change is more difficult and needs more assistance than either GP and CE.

In terms of the incentives that the corporates have received from their governments, almost 50% of the respondents in Group A countries indicated that they have received both financial assistance and training opportunities. Respondents in Groups B countries on the other hand indicated lesser training opportunities as compared to financial assistance (Figure 18) from their governments.

4.2.2 Cross-tabulation Analysis between Sectors

Taking three major economic sectors as base variables, it can be concluded (similar to the results indicated in Figure 16) that irrespective of the sector, a significant portion of corporates have been engaged more in GP- and CE-related activities than in climate change activities. The agriculture sector does not engage in CE activities as much as in GP activities, even though it considers climate change issues more seriously. On the other hand, more companies in the industry and service sectors have been working on CE than on GP, indicating that there is a mandatory and stricter compliance requirement to meet the CE than GP in the two sectors, globally (Figure 19).

FIGURE 15

GOVERNMENT REQUIREMENTS AND REGULATIONS IN DIFFERENT GEOGRAPHIC LOCATIONS.

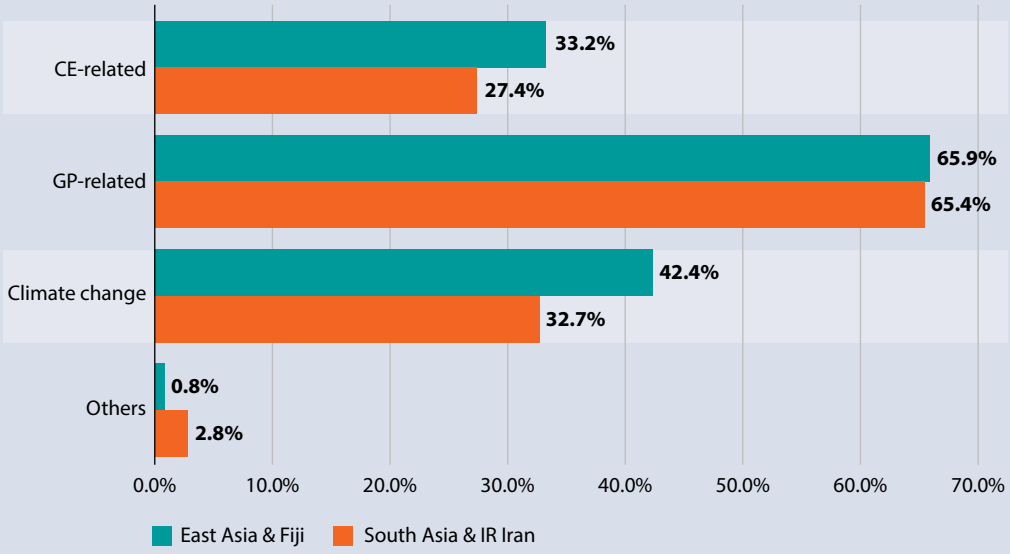
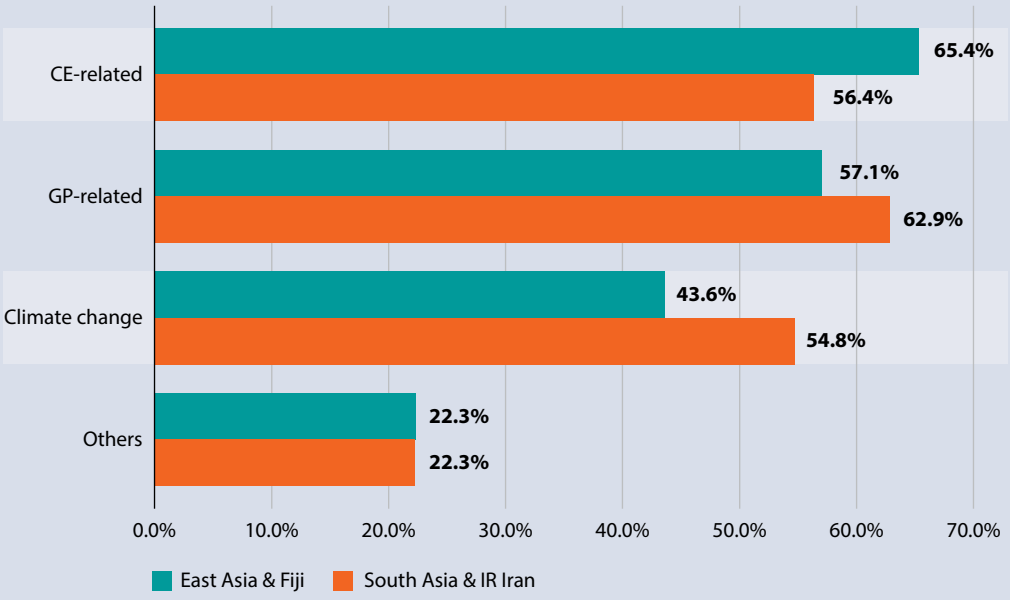


FIGURE 16

GREEN ACTIVITIES IN DIFFERENT GEOGRAPHIC LOCATIONS.



As indicated in Figure 20, both agriculture and service sectors receive about equal opportunities between financial and training assistance. Almost half of the industry sector received financial assistance, higher than the percentage of companies that received training assistance in the same sector. However, looking at financial assistance as a target for analysis, we find that a higher percentage of respondents in the industry sector (49.9%) have received financial assistance from governments as compared to those in agriculture (38.7%) and service sectors (40.5%). This implies that more financial resource has been invested in the industry sector for green transformation.

FIGURE 17

MANAGEMENT FRAMEWORKS IMPLEMENTED IN DIFFERENT GEOGRAPHIC LOCATIONS.

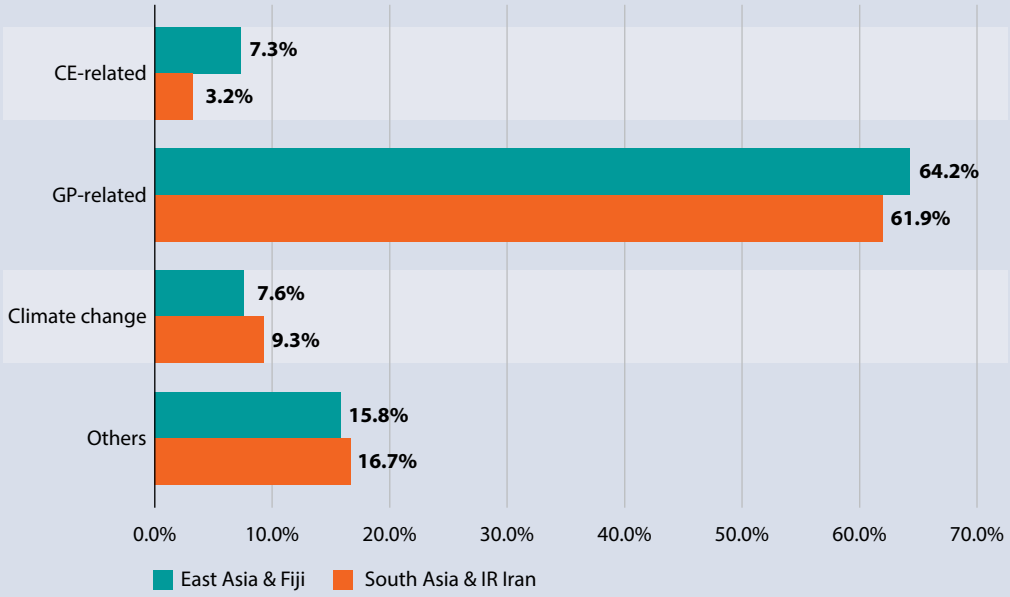
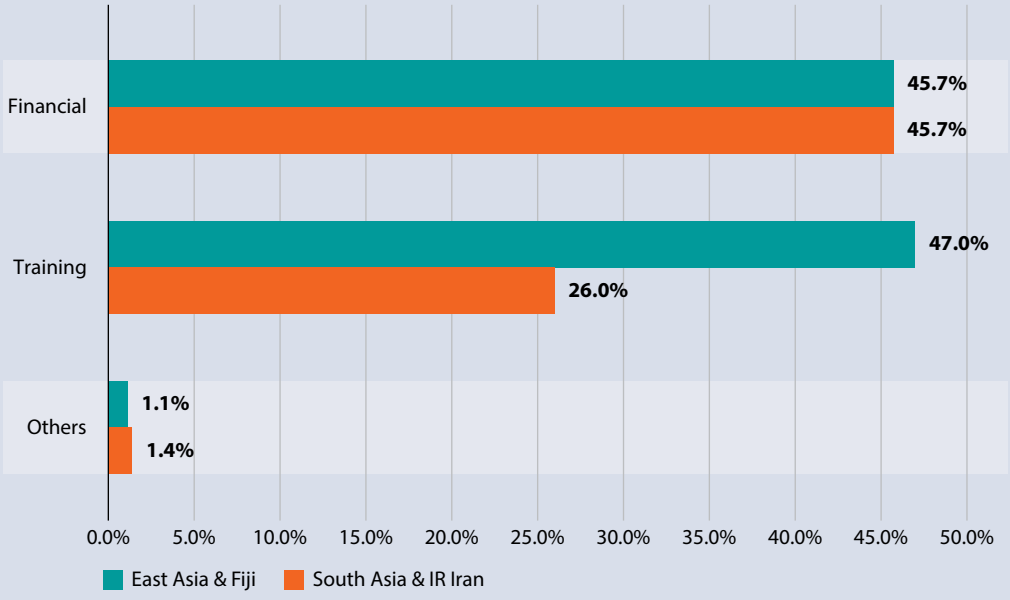


FIGURE 18

COMPARISON OF GOVERNMENT INCENTIVES IN DIFFERENT GEOGRAPHIC LOCATIONS.



Across all three sectors, the priority order for future assistance is training, technology transfer, financial capital, management skills, and networking opportunities. The agriculture sector probably needs more assistance in 'training of the workforce' and 'financial capital' than the other two sectors. 'Technology transfer' is less expected for the service sector than the agriculture and industry sectors, while all sectors need opportunities for networking (Figure 21).

FIGURE 19

COMPARISON OF GREEN ACTIVITIES BETWEEN THE SECTORS.

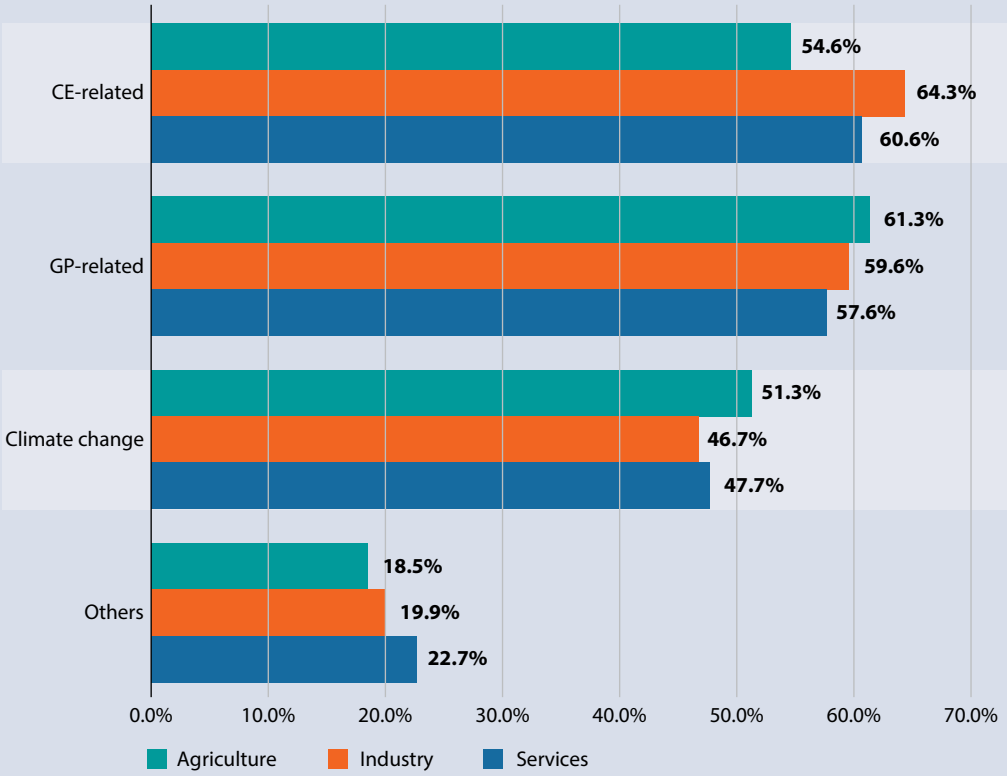


FIGURE 20

INCENTIVES AND ASSISTANCE RECEIVED BY DIFFERENT SECTORS.

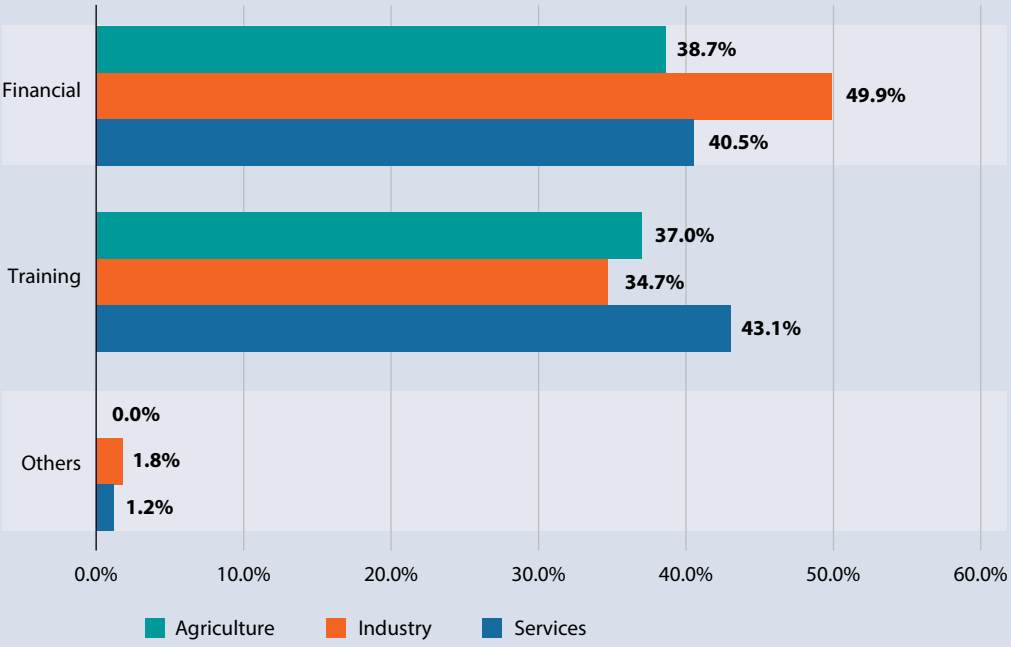
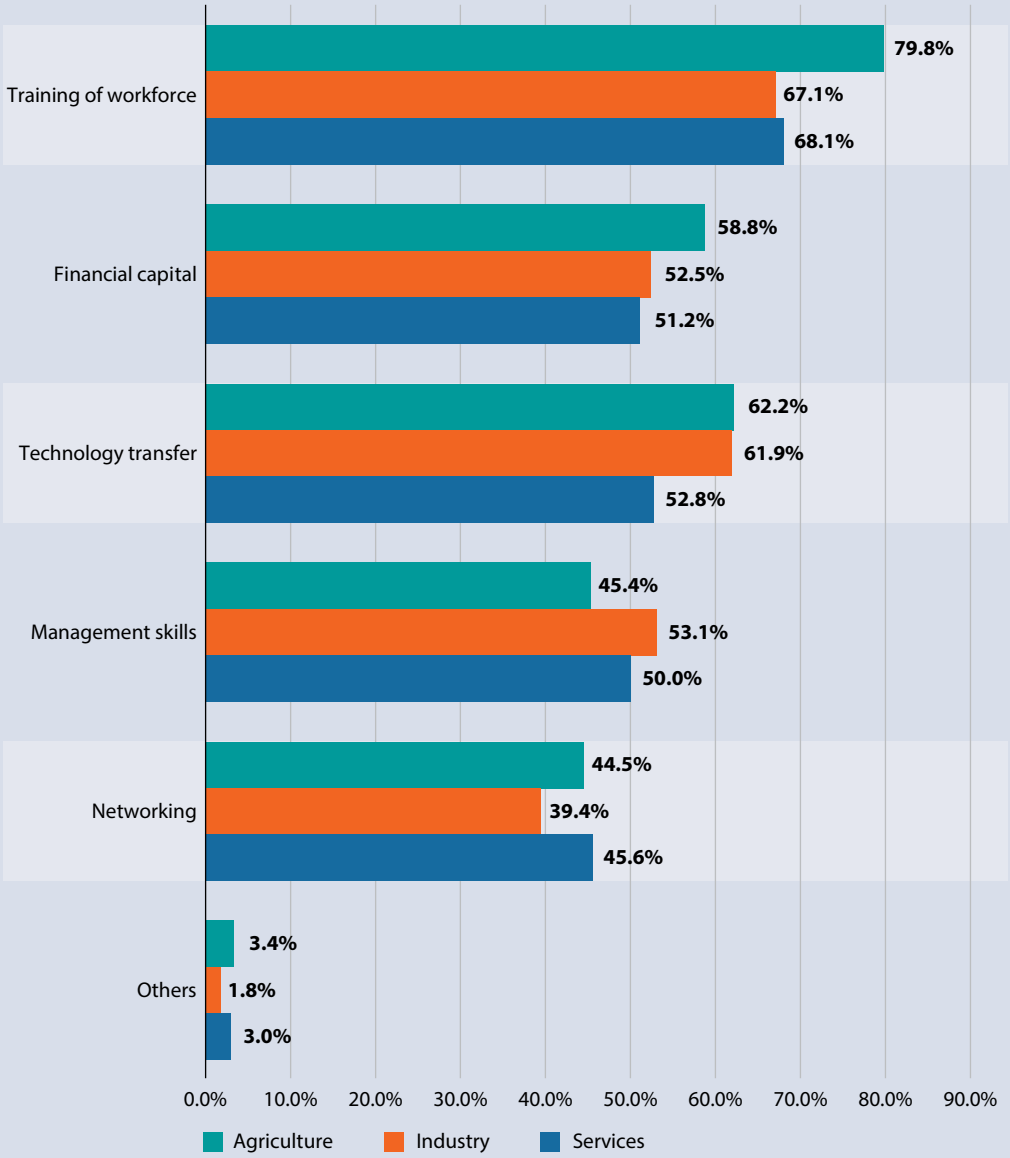


FIGURE 21

FUTURE ASSISTANCE NEEDED BETWEEN SECTORS.



4.2.3 Cross-tabulation Analysis between Corporates of Different Sizes

The size of a company also matters and is an important factor that defines the level of engagement by corporates in green transformation initiatives. This study also shows a general trend: irrespective of the domain, larger corporates are more active in green transformation, including CE, GP, and climate change (Figure 22). At the same time, larger corporates tend to receive more financial incentives and technical assistance from the governments (Figure 23). It can be concluded that larger corporates have more resources and opportunities to transform themselves to meet sustainability goals.

As shown in Figure 23, SMEs with 10-100 FTEs have received much less assistance related to finance and workforce, lower than that received by micro-sized enterprises with less than 10 FTEs. In addition, Figure 22 also indicates that the 10-100 FTEs group also has lesser engagement in climate change-related activities as compared to those in the less than 10 FTEs group.

FIGURE 22

GREEN ACTIVITIES UNDERTAKEN BY CORPORATES (BY SIZE).

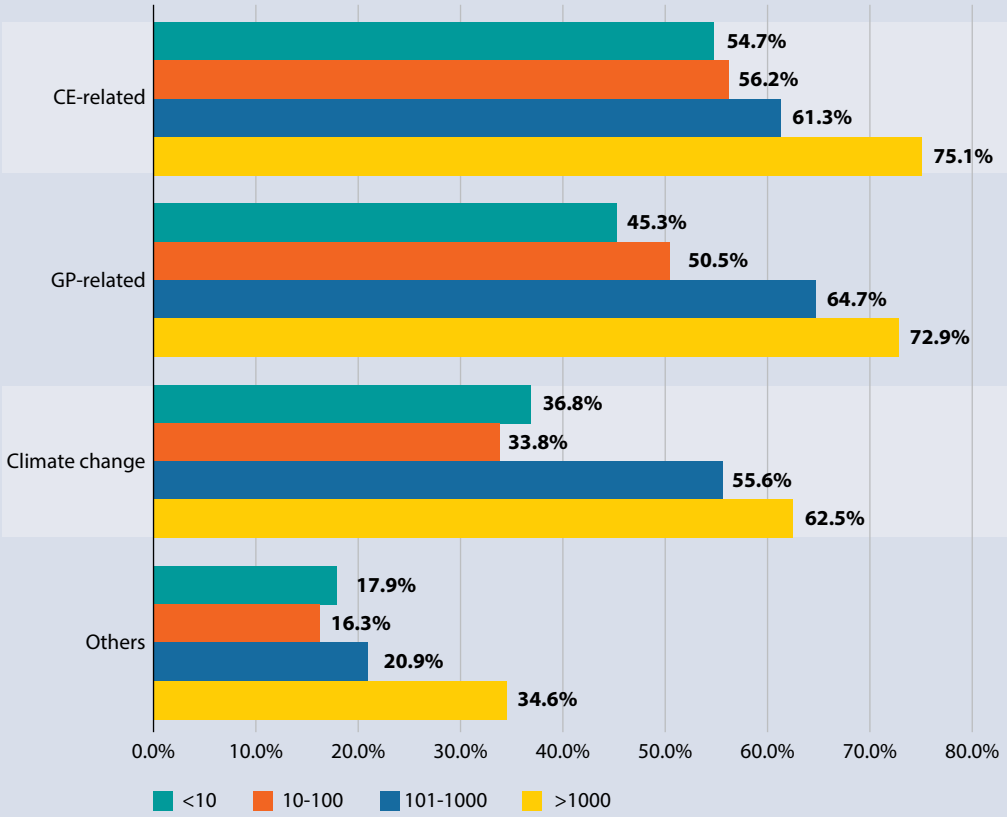
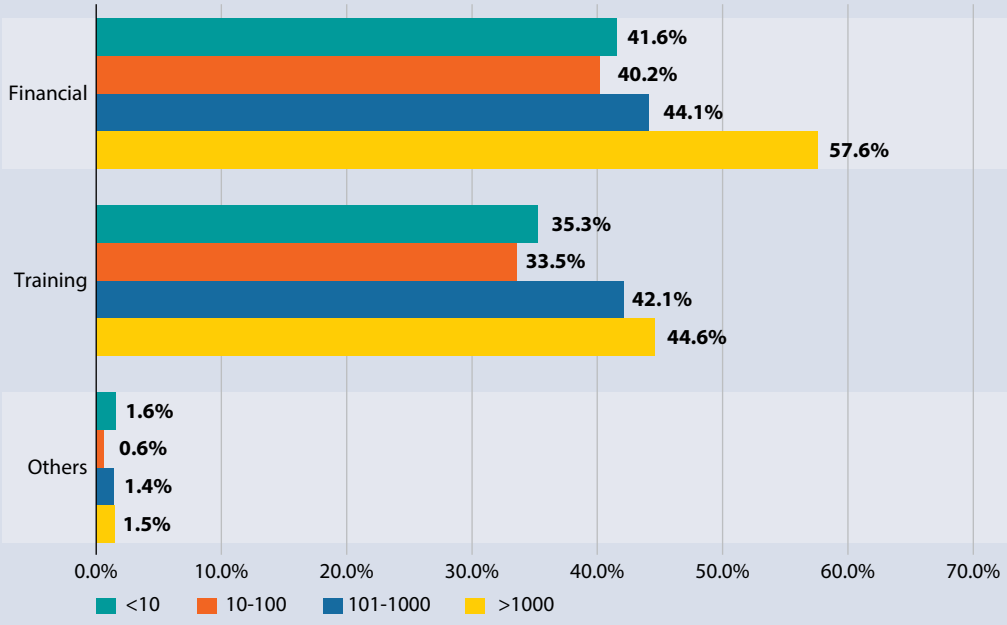


FIGURE 23

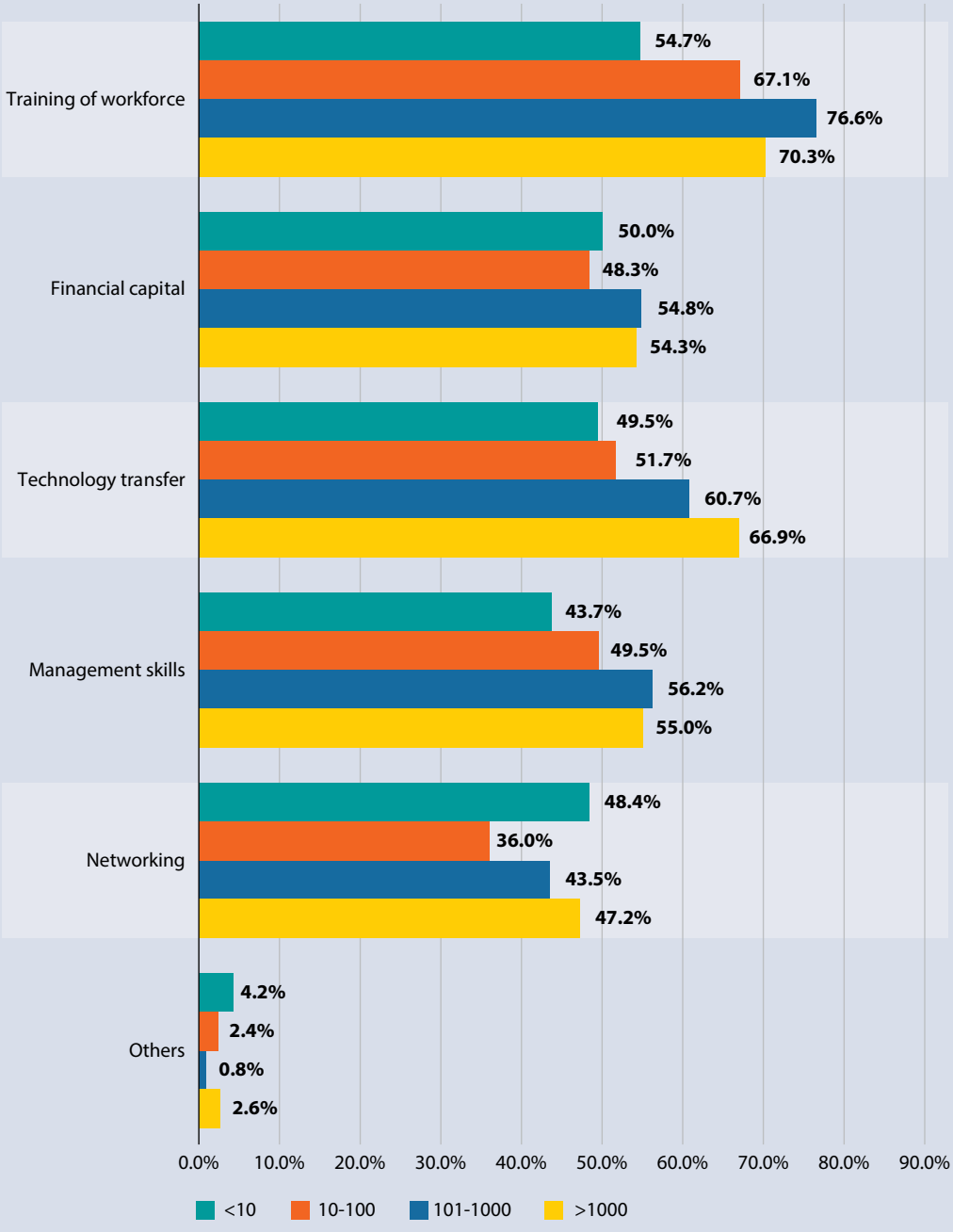
INCENTIVES RECEIVED BY CORPORATES (BY SIZE).



In terms of the assistance needed from governments, corporates with a higher number of FTEs were found to be more aggressive in seeking support for training of the workforce, technology transfer, and management skills. However, the group with the largest number of employees (more than 1,000 FTEs) indicated lesser need from governments as compared to the second-largest corporate group (100-1,000 FTEs). Figure 24 indicates that as the companies scale up their operation, they need more assistance from governments to manage their growth and drive green initiatives. However, the need for official assistance in large and mature companies is much lesser than the smaller corporates, and it can be in other formats as well.

FIGURE 24

FUTURE ASSISTANCE NEEDED BY CORPORATES (BY SIZE).



4.3 Summary

The analysis of the survey and 1,145 responses to the online questionnaire from 12 APO members during the period July to October 2021 provides an understanding of the GP, CE, and other green initiatives taken up by the APO countries. These initiatives can be summarized as follows.

Recognition of the green concept

In terms of the adoption of green initiatives, more corporates in the APO members have SDGs and ESG as part of their corporate goals and visions. Also, as compared with CE, a more recent campaign around the world, GP is more recognized due to promotion by the APO for almost 30 years.

Practices and actions

At the program level, energy-saving and carbon footprint reduction activities under UNFCCC climate change initiatives are more practiced than other green activities. However, more corporates have started to adopt environmental management tools to ensure compliance with government regulations. This is also because they have access to more environmental management schemes as part of the global efforts to upgrade organizations' GP initiatives.

Impacts and expectations

The majority of organizations surveyed indicate positive impact from green transformation initiatives, especially in terms of their contribution towards sustainability and improvement of corporate image. The organizations indicate two major areas where they need government support: training the workforce, and technology transfer.

Comparisons between geographic locations

The study indicates that more corporates in the East Asia region were engaged in CE-related activities than GP as compared to those in the South Asia region. This is due to the difference in the degree of promotion to drive efficiency of resource usage in the industry sector. In addition, corporates in East Asia received both financial assistance and training while those in South Asia had fewer training opportunities than financial assistance.

Comparisons between sectors

The industry and service sectors are more responsive to the requirements and initiatives of GP and CE than the agriculture sector. Also, the government offers more financial assistance such as tax deductions for green engagement to the industry sector as compared to the agriculture and service sectors. Overall, the agriculture sector needs more assistance in 'training of workforce' and 'financial capitals' than the other two sectors.

Comparisons between organizations of different size

The size of the corporate defines its ability to drive green transformation and the opportunity to receive assistance from the government. Therefore, larger organizations have a higher level of engagement in green activities but need less assistance. SMEs, on the other hand, need higher-level of assistance, more than start-ups and micro-size corporates.

IMPLEMENTATION OF GP AND CE AMONG THE APO MEMBERS

Depending on the unique characteristics of policy formation and promotion in each member country, the introduction of CE and implementation of GP are at different stages and in different formats. Reviews by the national experts, background statistics, and status of the implementation of the GP and CE from existing literature and quantitative data such as annual budget, number of participating enterprises, and annual production values, have been used for further analysis. The study aims to identify the contribution of GP and CE towards meeting the SDGs in each MC. In addition, the study further aims to suggest the role of the actors like government, academia, private sectors, NGOs, etc. in driving CE- and GP-related development for the future, and in promoting GP and CE policies.

5.1 Bangladesh

5.1.1 Initiatives and Policies

The Government of Bangladesh (GOB) has taken several initiatives and developed plans and policies to implement the strategy. The main elements are shown in Table 4. These policies support GP and CE-related activities. But there is no dedicated policy for GP and CE.

TABLE 4

BANGLADESH: INITIATIVES AND POLICIES FOR IMPLEMENTING GP AND CE.

Name of the Policy	Policy Year
Draft National Environmental Policy	2018
Solid Waste Management Rules	2010
National 3R Strategy for Waste Management	2010
Draft Solid Waste Management Rules	2018
Draft E-Waste Management Rules	2018
Draft SRO on Plastic Waste Management	2019
Renewable Energy Policy	2008
National Sustainable Development Strategy	2008
Bangladesh Industrial Policy	2016
Compulsory Use of Jute Package Act	2010, 2013

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Name of the Policy	Policy Year
City Corporation Act (2009)	
Bangladesh Environment Conservation Act (with amendments)	1995
Bangladesh Environment Conservation Rules (with amendments)	1997
Bangladesh Biological Diversity Act	2017
Ecologically Critical Areas Management Rules	2016

The Government of Bangladesh has emphasized green development to reduce the negative impacts of climate change and promote pollution-free development in the country. The country's government established the Bangladesh Climate Change Resilience Fund (BCCRF) in May 2010. BCCRF is a multi-donor trust fund created to collect and disburse climate adaptation funding and the GOB has signed a Memorandum of Understanding (MoU) with the World Bank and other development partners to take it forward. Besides, the government also established Bangladesh Climate Change Trust Fund (BCCTF) based on the allocation from the national budget and under the legal mandate by the Parliament in 2010.

TABLE 5

ENVIRONMENT MANAGEMENT FUNDS IN BANGLADESH.

Fund Name	Established	Purpose	Funded by	Authorities	Amount
Bangladesh Climate Change Trust Fund (BCCTF)	2009	To build a climate-resilient Bangladesh capable of dealing with the impact of climate change	Government revenue	Government of Bangladesh	USD450 million
Bangladesh Climate Change Resilience Fund (BCCRF)	2010	To support the implementation of Bangladesh's Climate Change Strategy and Action Plan for 2009-2018	Development partners and the World Bank	Government of Bangladesh	USD170 million
Green Climate Fund (GCF)	2010	To assist developing countries in responding to the manifold challenges of climate change	UN Framework Convention on Climate Change	Economic Relations Division, Ministry of Finance	USD3.3 billion

Source: Bangladesh Climate Change Trust http://www.bcct.gov.bd/site/page/e6fb75e8-f5e5-4bed-8adc-e6183e69353a/-, Bangladesh Climate Change Resilience Fund https://cleancooking.org/binary-data/RESOURCE/file/000/000/106-1.pdf, Climate Financing for Sustainable Development, Finance Division, Ministry of Finance, Government of Bangladesh ..\Budget Book English Version 01_06_2021.pdf

The allocation to the BCCTF was highest at the early stage of the fund development during the fiscal year 2011-12. However, it has gradually decreased because separate policies were adopted by various ministries and regulatory agencies, and separate budget allocation following the government initiatives.

Bangladesh Bank (BB), the central bank of the country has instructed all banks and financial institutions in the country to take forward green banking and green credit through policy guidelines. The BB has formed a Climate Risk Fund to promote green initiatives for the banks and financial

institutions. The banks and financial institutions allocate at least 10% of their CSR budget to the climate fund. In 2016, banks and financial institutions allocated BDT376,078.12 million (USD4,700.98 million) to the Climate Risk Fund and disbursed BDT503.2 billion (USD6,290 million) as green finance. The BB also encourages banks and financial institutions to fund green projects to ensure sustainable development in the country. Moreover, BB has fixed a 5% mandatory credit quota for green finance out of the total loan disbursement of banks and financial institutions in 2016 [9].

The apex bank formulated several policy guidelines for promoting green banking in the country. It undertook several initiatives to formulate necessary policies for improving in-house environmental performance and promote green banking by 2011. The Bangladesh Bank motivated banks and financial institutions to disclose their environment-related activities and performances on websites and annual reports by the year 2012. In 2013, it also mandated the banks to publish annual sustainability reports as per the international standard. Commercial banks in the country also practice several green initiatives following instructions from BB. These include green governance, paperless banking, installation of solar energy in branches, promotion of green credit, green financing, and filing of reports on green banking activities.

Several initiatives like environmental taxes and ecological compensation mechanisms have also been taken by the GOB for green development in the country. The GOB has contributed 7% of public expenditure for green growth activities in the country [10]. It also proposed a 1% 'green tax' as Environmental Protection Surcharge in the budget for fiscal 2014-2015 for factories causing dangerous-level pollution. This green tax has motivated the garment factories to set up waste treatment facilities and the brick factories to adopt environment-friendly production processes.

TABLE 6

ENVIRONMENTAL TAXES IN BANGLADESH.

Item	Taxation System	Target	Initiatives
Fossil fuel use	Nominal value-added tax (VAT) on fuel products based on the taxation of imported oil. There is no additional excise tax on fuel oil in the form of a carbon tax to discourage its use.	Importers of Fossil fuels have to pay VAT.	The effective tax rate for selling price on fossil fuel: petrol (12.9%), diesel (10.2%), kerosene (10.2%), and fuel oil (15.7%)
Industrial air pollution	Other than transport and the brick manufacturing sector, the rest of the industrial sector is left free to pollute the air including electricity generation, especially those units that run on furnace oil, diesel and coal. There is no pollution charge for industrial emissions either directly or on output or through polluting inputs.	Transport sector and the brick manufacturing.	• Ban on two-stroke engine-based three wheeler was imposed in Dhaka city and vehicle age restrictions were also imposed to reduce carbon emission. • Initiatives to reduce air pollution with a focus on the transport sector and brick manufacturing. • Enactment of the Brick Manufacture and Brick Kiln Installation Act in 2013.

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Item	Taxation System	Target	Initiatives
Industrial water pollution	Penalty, conducting mobile court, sealed and gas and electricity lines.	All types of industries.	• The government banned the use, production, and marketing of polyethylene shopping bags in 2002 and has made it mandatory for industries to set up Effluent Treatment Plants (ETPs) to treat their waste before discharging it to water bodies. • Inter-sectoral coordination among the related ministries and allocation of resources towards implementation.

Source: Environmental Fiscal Reforms in Bangladesh, Ahmed Sadiq, 2018

5.1.2 Implementation of GP and CE in the Private Sector

The Government of Bangladesh has brought in legislation and regulations to encourage organizations to adopt GP and develop CE. However, there has been less involvement of the public in the adoption of CE principles and practices. It was noted that government legislation and regulations have not been able to arouse much public participation. Thus, the notion of GP and CE remains insufficiently understood by the masses. The general public still has a conservative mind set of single-use and disposal as the major way to treat waste. They are not yet familiar with the concept of recycling and reuse, which is a hindrance to driving CE in Bangladesh.

5.1.3 Recommended Strategies

The general recommendations are:

Capacity building

- Enact appropriate rules and guidelines to promote the adoption of GP and CE.
- Make available appropriate and affordable technological options to reduce, reuse, and recycle waste.
- Create enabling environment to increase private sector participation in treatment and recycling activities and projects.
- Organize capacity-building programs for city corporations, municipalities, secondary towns (pourashavas), as well as industries on different approaches of GP and CE.
- Promote R&D to support investment in environment and energy industries for resource efficiency and sustainable waste management.

Raising public awareness through information, education, and demonstration projects

- Need to ensure that GP and CE concepts find space in the media.
- Make available regular information on source separation and promote waste reduction at source.
- Reports on best practices and success stories on waste minimization and recycling.
- Reports on financial and environmental benefits of GP and CE.

Creating partnership

- Ensure that all stakeholders are involved from the development stage of the strategy to the implementation, monitoring, and evaluation stages.

- Create multi-sectoral engagement including, local government, health, agriculture, education, finance, commerce, industry, information, and energy sectors. All sectors must work hand in hand for the promotion of GP and CE. This includes building partnerships with NGOs and civil societies.

5.2 Cambodia

5.2.1 Initiatives and Policies

The concept of CE is inextricably tied to the aims outlined in the SDGs, Cambodian Sustainable Development Goals, as well as other major governmental policies and initiatives, including the Cambodian National Development Plan. A key component of Cambodia's economic development and social growth is the participation of micro, small, and medium-sized enterprises (MSMEs). For transition to the CE to be a success, MSMEs must actively participate in the process. The Government of Cambodia's Industrial Development Policy 2015-2025 aims to develop and modernize the country's MSMEs, for example, by assisting them in expanding and strengthening their manufacturing bases, as well as by facilitating technology transfer and industrial linkages between MSMEs and other key players in the country.

The Cambodian National Sustainable Consumption and Production Roadmap intends to establish a long-term path for the country's industrial development. The Cambodian labor law, for example, which guarantees the rights of employees in all industries, is in effect, while the energy industry operations are governed by the electricity law. In addition to developing and implementing energy policies, plans, and programs, the Ministry of Mines and Energy is responsible for developing and implementing technical specifications.

The Electricity Authority of Cambodia (EAC) is an autonomous institution that promulgates legislation, gives licenses to energy companies, and conducts cost studies of electricity. In addition, the EAC oversees, directs, and organizes the operations of electricity sector operators and consumers to ensure that they comply with the rules, guidelines, and technical standards established by the Ministry of the Environment.

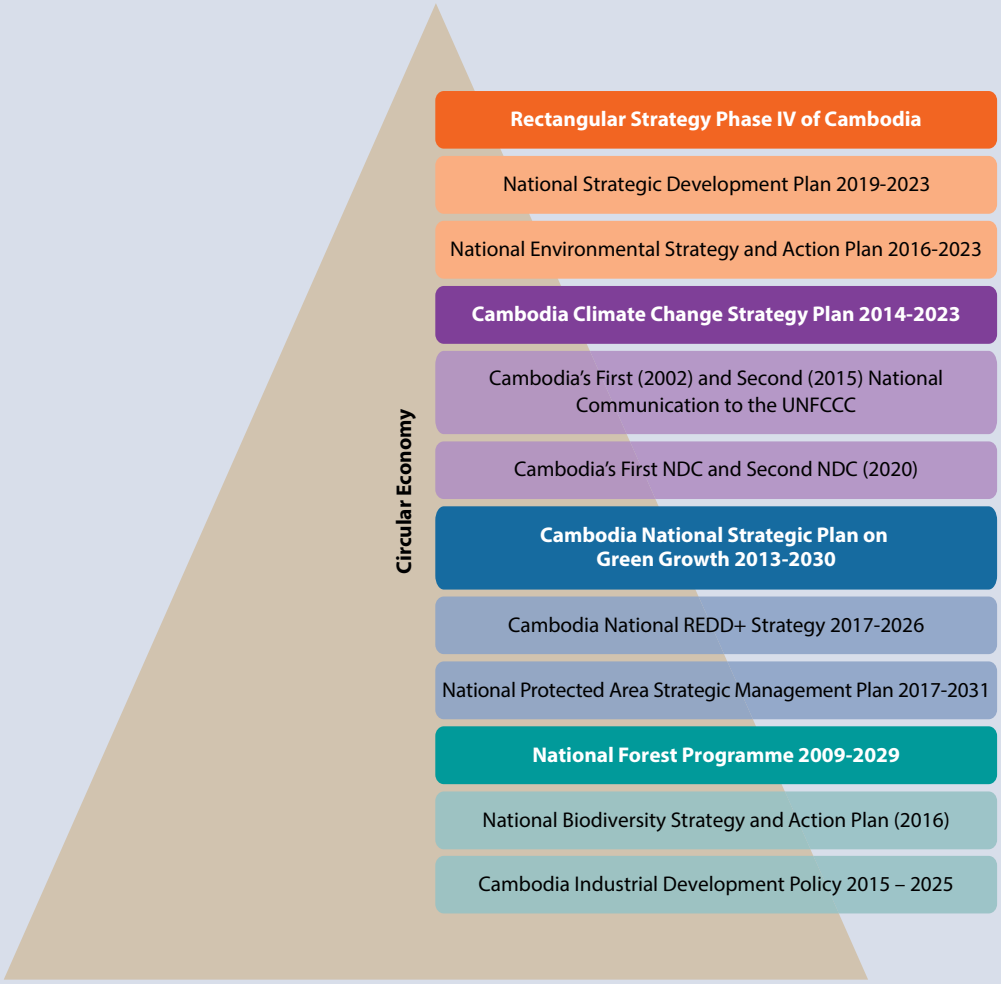
Environmental protection and management of the natural resource in Cambodia are governed by the Law on Environmental Protection and Natural Resource Management, which established the Ministry of Environment (MoE) as the primary organization in charge of developing policies, issuing regulations, and coordinating efforts for waste disposal and pollution control. Under Sub-Decree 113 (2015) of the Municipal and District Authorities Act, municipal and district authorities are responsible for designing and implementing solid waste management programs. Other key waste management legislations include Sub-Decree No. 36 on Solid Waste Management (1999), Sub-Decree 72 on the Environmental Impact Assessment Process (2001), and Sub-Decree 36 on Solid Waste Management (2001).

Even though Sub-Decree 72 is not expressly connected to waste management, it assures that waste management projects avoid any environmental hazards associated with building the facilities. In addition, the Phnom Penh Waste Management Strategy and Action Plan, which was formed in 2009

defines the methods for rubbish management (2018-2035). Cambodia's Industrial Development Policy (2015-2025) and the National Strategic Plan on Green Growth both explain how to achieve these objectives (2013-2030). The related regulations and initiatives are shown in Figure 25. The Ministry of Industry, Science, Technology, and Innovation (MISTI) is in charge of industrial strategy and technological advancements in the country.

FIGURE 25

HIERARCHY OF REGULATIONS AND INITIATIVES TO SUPPORT THE CIRCULAR ECONOMY IN CAMBODIA.



5.2.2 Implementation of GP and CE in the Private Sector

The implementation of GP and CE in the private sectors can be concluded by SWOT analysis as below.

Strengths and opportunities

- Most industries in Cambodia include goals related to resource use like efficiency, energy, and water management to meet their GP and CE obligations. Among all the sectors, the agriculture sector has a better potential of adopting GP and CE as most of its initiatives comprise GP and CE goals.

- The goals of Rectangular Strategy Phase IV of Cambodia have been addressed to achieve sustainable development and poverty reduction in the country.

- Governmental requirements and policies for industries include environmental management, energy saving, GHG mitigation, and material and/or water recycling.

- Incentives from the government on green activities include training and consultation, tax reduction, and subsidy for clean technology and deployment.

- GP and CE are aligned with the priorities set out under the Cambodian SDGs and key national policies and strategies [11].

Weaknesses and threats

- Most industries in Cambodia have only domestic business or operation and follow low management standards for GP and CE. Therefore, not many industries pursue and implement international standards like ISO14000s and ISO 50001.

- Industry and service sectors focus only on GP goals and not on CE. Most industries lack technology, management skills and network, training of the workforce, and financial capital.

- There are limited economic incentives and economic benefits. While several supporting policies and regulations exist, there are implementation challenges due to a lack of clarity and understanding of roles and responsibilities, and a low level of awareness about GP and CE.

- Economic growth and population lead to increases in the use of energy and materials, and the amount of waste generated.

- Limited alignment of infrastructure and modern technologies with GP and CE prevents organizations from efficiently using environmental resources.

- Insufficient information and data inhibit investment and promulgate suppositional waste management practices while unexpected crises such as COVID-19 pandemics can be a constant threat.

5.2.3 Recommended Strategies

The following policy recommendations can help the government and private sector in Cambodia achieve their GP and CE goals.

For the government

- Create awareness about GP and CE frameworks among the industry sector, MSMEs, and other stakeholders through MISTI.

- Promote product labeling and value-added products for environmental-friendly production for agriculture and service sectors through MISTI and MoE.

- MISTI and the Ministry of Economic and Finance should collaborate to encourage start-ups along with GP and CE concepts by promoting tax incentive mechanisms. The

same mechanisms should apply to the three sectors that have been applying GP and CE.

- Banks supporting SMEs should provide financial support for the three sectors that comply with GP and CE in coordination with MISTI.

For the private sector

- The associations of entrepreneurs should play a crucial role in disseminating and sharing best practices in GP and CE.

- Organizations need to mobilize waste management resources and product supply chain to cut cost through the implementation of GP and CE.

5.3 Republic of China

5.3.1 Initiatives and Policies

Previous policies, strategies, and initiatives such as EPR, Environmental Science and Technology Parks, Sustainable Materials Management, and Economy-wide Material Flow Accounts provide an essential base for GP and CE in the ROC.

In 2018, the Ministry of Economic Affairs (MOEA) in the ROC initiated the CE promotion plan. It is a cross-departmental plan collaborated by the Environmental Protection Administration (EPA), Council of Agriculture, Construction and Planning Agency, Ministry of Interior, and other governmental departments. The plan incorporates four strategies as shown in Figure 26.

1. Circular technology and material innovation research park

2. New circulation demonstration park

3. Green consumption and transaction

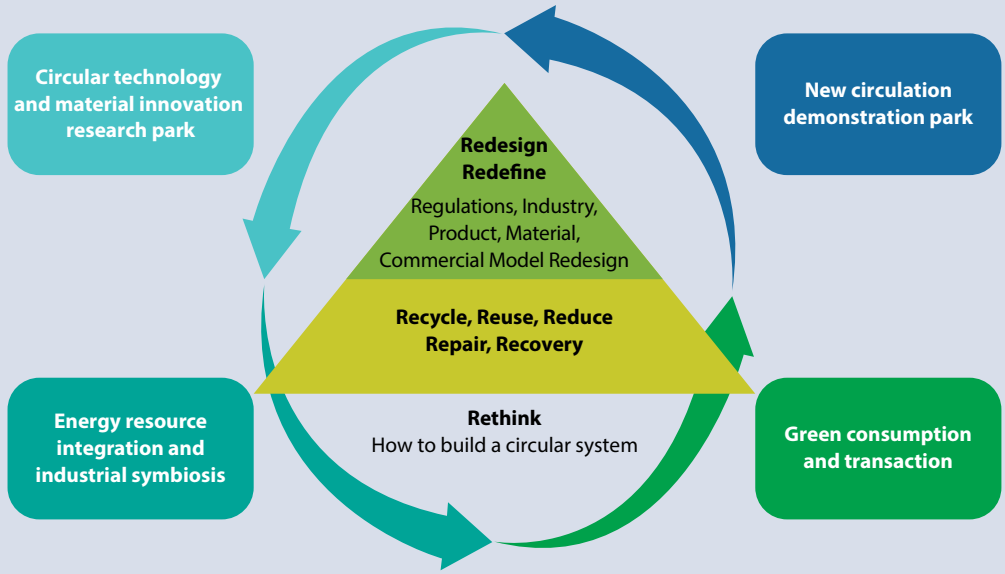
4. Energy resource integration and industrial symbiosis

The plan lays emphasis on innovations to trigger new business models for CE. The circular solar module, Carbon Capture and Storage of Taichung power plant, and biogas power generation are among the demonstration cases. Besides the need for innovative business models, low confidence in secondary material usage is another barrier for CE. The circular material verification and matchmaking platform integrated with AI visual recognition and blockchain are promoted in the plan as a third-party management mechanism to assure transparent and appropriate usage of secondary materials.

While MOEA initiated the plan to drive CE in the country, EPA also released the recycling promotion plan to ensure the recovery of resources from 2018 to 2020 [12]. The strategies in the plan included production, consumption, waste management, and secondary material market to create a comprehensive circular management structure as shown in Figure 27. While MOEA tried to promote industrial transformation, EPA focused on the integral part of resource and waste management to avoid any possible environmental issues [13].

FIGURE 26

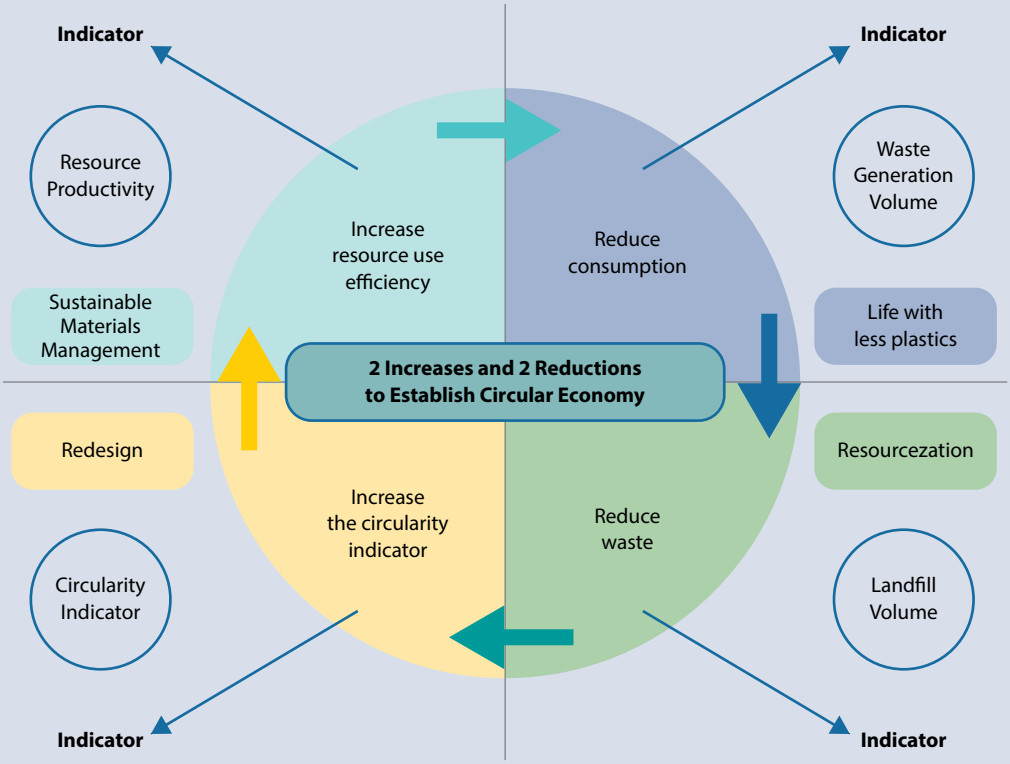
STRATEGIES AND PLANS FOR PROMOTING CIRCULAR ECONOMY IN THE ROC.



Source: Circular Economy Promotion office website; https://cepo.org.tw/.

FIGURE 27

THE RECYCLING PROMOTION PLAN FOR RESOURCE RECOVERY (2018-2020).



Source: Environmental Protection Administration, Executive Yuan, ROC (Taiwan).

5.3.2 Implementation of GP and CE in the Private Sector

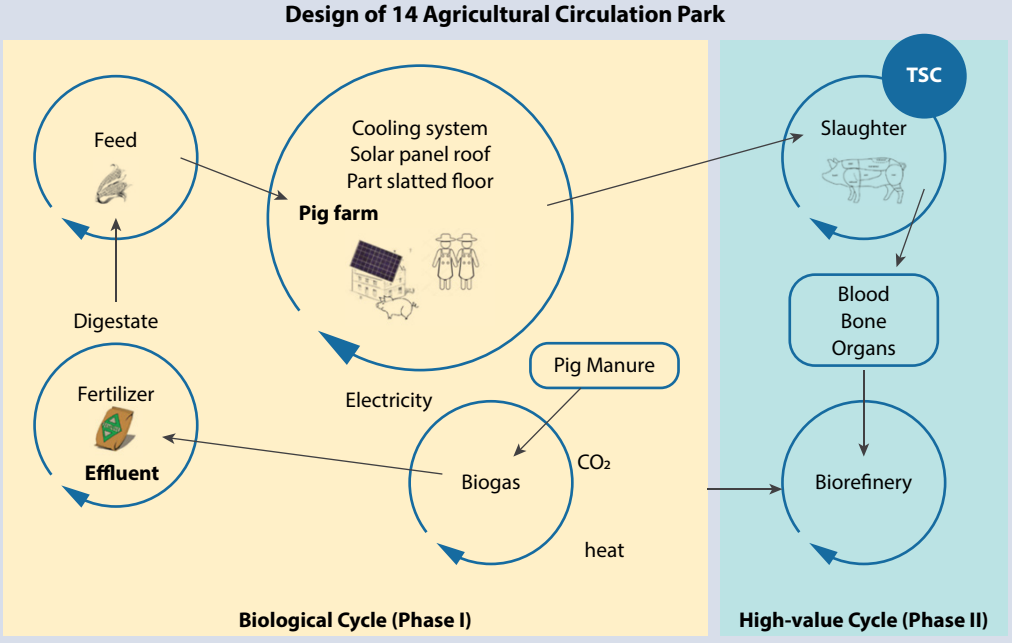
Other than the government departments, NPOs played an important role as a think-tank and for networking. Industrial Technology Research Institute (ITRI) runs the CE promotion office for MOEA to implement the plan, hold relevant cross-department meetings or public-private sector conferences, and provide suggestions for new issues during the promotion. Circular Taiwan Network (CTN) focuses on networking with international organizations and bodies like the EU member countries, the UN, and other countries. CTN also conducts brainstorming workshops to generate new ideas and promote new collaborations and recently started promoting the concept of Circular Collaboration for Climate Crisis. Chung-Hua Institution for Economic Research initiated the CE award in 2019 to provide a stage for industries to showcase their contribution towards the circular economy.

State-owned or previously state-owned companies such as Taiwan Sugar, Taipower, and China Steel have been focusing on implementing CE. These companies provide consultation to the government. The agricultural park of Taiwan Sugar built a new standard and business model for pig farming shown in Figure 28. The new pig farming is integrated with the biological phase, which includes solar power, a cooling and biogas system, and a high-value cycle that emphasizes comprehensive usage of blood, bone, and organs of pigs.

The efforts for renewable energy and waste such as fly ash made Taipower another demonstration of CE implementation. With the adoption of new technology for producing steel using hydrogen, China Steel is now on its way to transformation but continues to face the existing challenge of slag recycling. However, with secondary material becoming more acceptable to construction applications than before, the situation is improving.

FIGURE 28

THE RECYCLING PROMOTION PLAN FOR RESOURCE RECOVERY (2018-2020).

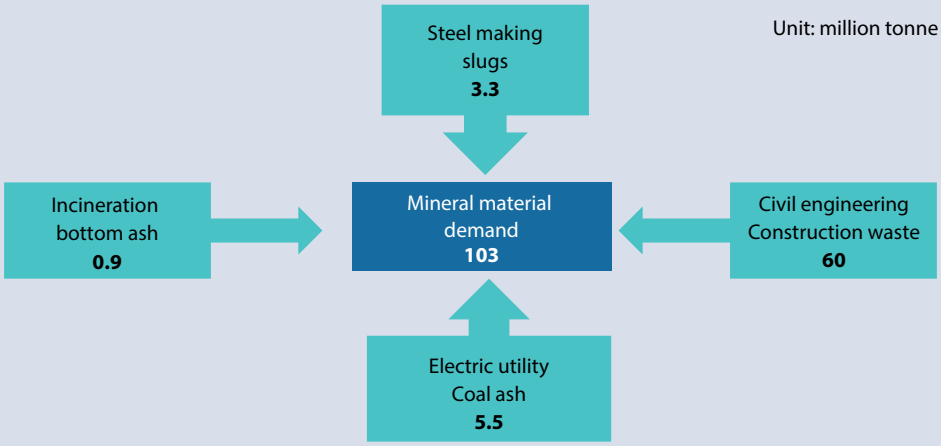


Source: Presentation for Circular Economy in Taiwan Sugar Corporation by Dr. Jan Chang.

The most representative example is the innovative pigpen of Taiwan Sugar that is driving a new farming trend. Figure 29 illustrates the relationship between the relevant industries and the demand for mineral materials. The industries of civil engineering, steel making, electric utility, and waste treatment compete for the mineral material (non-metal material) demand with virgin material. EPA promotes the inorganic recycling material to enter the market, such as road engineering, back filler, cement mill, port work, etc. The priority setting and quality of the recycling material are essential. For example, back filler with low-quality requirement attracts all kinds of secondary materials. Under limited demand, the government needs to control the quantity and let high-quality material enter road engineering or cement mill usage.

FIGURE 29

ANALYSIS OF INORGANIC RECYCLING IN ROC.



Inorganic recycling material promotion by EPA

ROC has also been concerned about reducing food waste which stood at 579 kilotons in 2016 and 530 kilotons in 2020. EPA promotes the recycling of food waste as feed for pig farming and fertilizer by composting. In the long-term, the EPA plans to set up three biomass energy plants that can produce more renewable energy.

Plastic waste has been another concern and the total consumption of plastic in ROC stood at 2.7 million tonnes or 117 kg per capita in 2016. It caused serious oceanic pollution concerns. Plastic bottles and straws were the top issues that needed to be tackled on priority. The EPA took legal action to restrict the use of plastic straws that affected over 8,000 stores. This will be discussed in the section later.

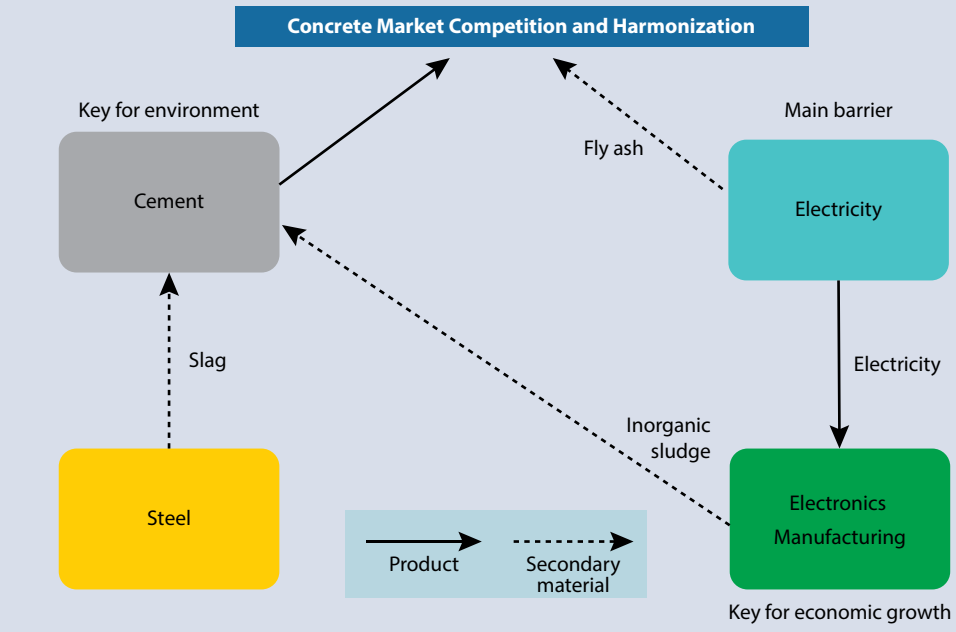
A specific situation for inorganic secondary materials is described here to illustrate the challenges faced by ROC, as simplified in Figure 30. ROC has a prosperous electronics manufacturing industry that consumes a very high amount of electricity during production. Since coal is used for electricity generation, high demand for electricity leads to the generation of a large quantity of fly ash. Technically, fly ash is a good substitute for cement and hence a competition to the cement industry. Unfortunately, the cement industry plays an essential role in dealing with inorganic waste, including the slag from the steel industry and inorganic waste from the electronics manufacturing industry.

A competition between cement and fly ash for a share of the concrete market may also hamper the recycling efforts of the steel industry, and worse, for the electronics manufacturing industry. Because of the limited space in ROC, the government needs to harmonize the usage of virgin and secondary materials, or the recycling issues may slow the performance of the electronics manufacturing sector and impact the economic growth.

The issue can get further complicated if other relevant industries are taken into account. Therefore, the government tries to affect all industries to avoid any possible barriers and generate a comprehensive solution, even if it is difficult. In the next section, we will first discuss inorganic recycling and the relevant industries, due to its importance. The other important issues of food and plastic waste will also be discussed.

FIGURE 30

MATERIAL MANAGEMENT COMPLEX IN ROC.



5.3.3 Recommended Strategies

The strategies recommended here are based on resource management and material flow management. According to the statistics of four types of materials, we can find the current material usage and relevant industrial supply chain.

For GP and CE, aiming to achieve zero waste and zero carbon for sustainable consumption and production, the following steps are suggested taking into account the mechanical and biological cycles of CE.

- Reduce materials from fossil fuel to the minimum level.
- Use innovative biomass materials to replace those from fossil fuels.
- Maximize the use of renewable energy from solar, wind, biomass, etc.

- Use new industrial symbiosis technologies to recycle essential metals for the utilizations in renewable energy and essential industries in ROC.

- Focus on long-term civil engineering planning without the use of virgin sands, gravels, and other mineral resources.

- Improve the ability to quickly recycle waste from infrastructure and building damages caused by natural disasters such as flooding, earthquake, typhoon, fire, or other reasons as a consequence of climate change.

As shown in Figure 31, the following three-pronged strategy can be adopted to help ROC meet its zero-waste and zero-carbon goal.

- **Full management:** Flow of materials, information, and funds should be traced, recorded, and managed. This makes digital transformation very important and hence, digital product tracking should be developed in the long term. Other factors that affect material or waste generation include climate risk, natural disasters, building ageing, increase in demand for renewable energy, and new innovative technologies.

- **Full recycling:** Bulk material and circulation of critical material are equally essential for industries and the environment. Thus, innovative recycling and refining technology are necessary and urgently needed. Bio- and bio-degradable materials can enter into a material recycling loop or energy recovery. For this, the landfill should be transformed into a material bank that can provide a buffer for appropriate circulation timing.

- **Full recovery:** The circular or secondary material should be applied to the original use, not downgrade use. Considering the inevitable loss of materials, all product designs should be planned for use of less material in production.

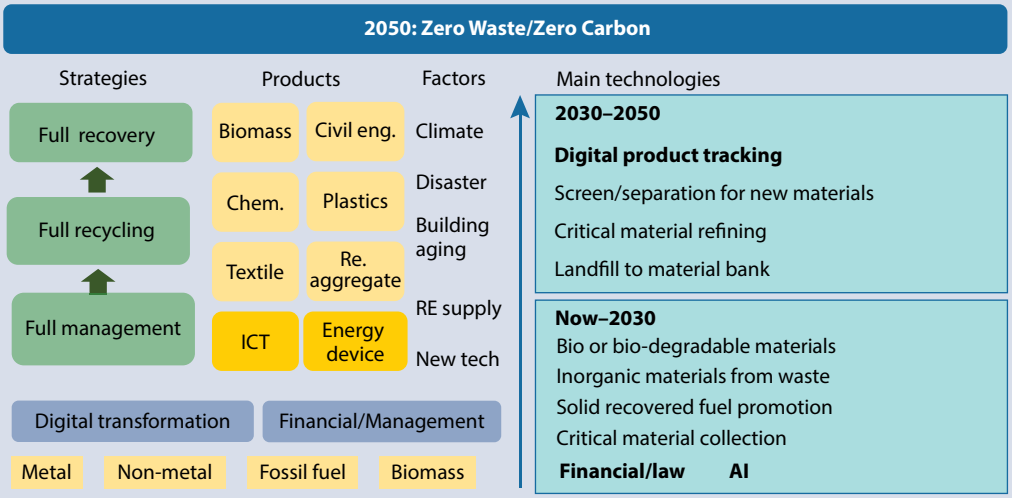
The relevant technologies are divided into two categories according to the level of difficulties in development. The framework is also open to the use of new technologies, provided it meets the principles mentioned above. The financial tools and legal system are essential to generate the driving force for industries and consumers. However, their speed is usually slower than those of technology innovations.

The recommended strategies are based on MOEA and EPA plans as described in Section 5.3.1. Innovation is needed for triggering new business models that can integrate the concept of GP and CE. Full management can be implemented with the verification of circular material and a matchmaking platform to define the zero-waste base. For the target products, full recycling means strengthening the market side for secondary material used so that companies can find qualified and trusted sources for the required secondary materials. In the full recovery stage, all materials need to be used for industrial production as raw material or fuel.

For use of renewable energy in the future, ROC must consider upgrading relevant equipment with existing materials instead of those using virgin materials. This will also help connect CE and carbon reduction. The strategy can also be viewed as complementary to the plans of MOEA and EPA focusing on the material, product, and relevant technologies.

FIGURE 31

STRATEGIES SUGGESTED FOR ROC.



5.4 Fiji

5.4.1 Initiatives and Policies

Fiji has developed several legislations and implemented many policies at the district and national levels. Most of its work has been carried out towards strengthening the CE, where the economic output is improved through resilience to environmental impacts.

The Department of Environment, governed by the Ministry of Waterways and Environment, is the most effective governing body to enforce environmental regulations and legislation. The ministry has developed a five-year strategic plan that incorporates sustainable development goals [14]. In addition, the Government of Fiji has developed policies that reflect environmental and sustainability concerns. The following are some of the legislations:

1. In 2020, the Climate Change Bill was passed as a law
2. In 2014, Fiji developed the Green Growth Framework
3. In 2019, Fiji conducted the Fiji Green Jobs Assessment
4. Geneva Convention Act, 2007
5. Environment Management Act, 2005
6. Environment and Climate Adaption Levy Act, 2015
7. Environment Management (EIA Process) Regulations, 2007
8. Environment Management (Waste Disposal and Recycling) Regulation
9. Forest Act, 1992
10. Climate Relocation of Communities Trust Fund Act, 2019
11. Climate Action Trust Fund Act, 2017

5.4.2 Implementation of GP and CE in the Private Sector

The primary research data reveals that industries in Fiji face difficulties in fully adopting and implementing GP and CE practices. Many discrepancies have been noticed while assessing the level of commitment of organizations toward these concepts. To fill the gaps and take full advantage of GP and CE, organizations need to come out of their comfort zone and put in additional efforts.

5.4.3 Recommended Strategies

GP and CE are growing concepts in Fiji. The government has developed strategies, policies, and legislation to support its commitments to the SDGs and environmental protection. The private sector, on the other hand, focuses more on productivity. Thus, they use GP concepts more than CE.

For private corporates and public organizations

- Commitment and fund: Organizations need to be more committed and allocate funds to employ more employees to handle green projects.

- Workforce upskilling and reskilling: When green frameworks, objectives, and procedures are introduced, workers need to understand the rationale behind them so that the implementation is smooth and without confusion.

- Setting up green goals of the organizations: As part of the framework, the organizations may design a green policy to help define its green objectives and goals. This will set the roadmap for the organization and provide guidance on how to achieve the green vision.

- Setting up strategic green plans: This could either be incorporated into the business strategy or it could be an independent plan focusing on current and future green projects and initiatives. An organization with a vision can convey its motive and the purpose to its people. Identifying green plans will also enable the government to achieve its environmental objectives.

- Adoption of management framework: While most organizations follow the National Standards for Environment Management and Regulatory Compliance, they also need to introduce management frameworks. The International Organization for Standardization has developed several standards and guidelines for sustainability, environmental management, and productivity that organizations can adopt and implement. The benefits of adopting management frameworks range from an increase in customer satisfaction to a growing market range. However, the ultimate objective is to set a benchmark for other organizations to learn and improve their green practices.

5.5 India

5.5.1 Initiatives and Policies

India already has central policies in place to encourage and assist state governments implement environmental safety measures that are mandatory for industrial units. The National Green Tribunal (NGT) is also playing a pivotal role in ensuring that industrialization does not overheat the economy or put the poor and vulnerable at disproportionate risk. The NGT, on numerous occasions, has directed the Ministry of Environment, Forest and Climate Change (MoEFCC) to issue stricter

norms for effluent and sewage treatment plants, and has assisted the Ministry of New and Renewable Energy (MNRE) in making its proposals more effective.

In its 2015 Paris Climate Agreement commitments, India had pledged to reduce its intensity of GDP emissions by 33-35% of 2005 levels by 2030. At the 2009 Copenhagen climate summit, it had promised to lower emissions by 20-25% by 2020. According to the MoEFCC Minister, as of December 2020, India had reduced its GDP emissions intensity by 21%. Further, the national water conservation campaign Jal Shakti Abhiyan seeks to deliver clean drinking water to every household, in combination with the Swachh Bharat Abhiyan (Clean India Mission) and the Namami Gange (Clean Ganga) programs. Finally, a complete policy framework to support electric mobility and metro transportation is being implemented in major cities.

Major initiatives by the Government of India include the following:

1. Launch of Swachh Bharat Abhiyaan for city-level waste management
2. Notification of six waste management rules from a regulatory perspective for waste management
3. Establishment of Skill Council of Green Jobs for promoting green jobs in India

Over the years, the Government of India has done substantial work towards policy interventions and formulation such as [15] the notification of National Ambient Air Quality Standards, formulation of environmental regulations and statutes, setting up of a monitoring network for assessment of ambient air quality, the introduction of cleaner and alternate gaseous fuel like CNG and LPG, and ethanol blend, etc., as well as promotion of cleaner production processes.

India is a vast country with 28 states and eight union territories and various initiatives have been taken at the state level as well for different sectors as listed below [16].

Policy instruments for setting up wastewater management systems

TABLE 7

STATE-WISE INITIATIVES FOR SETTING UP WASTEWATER MANAGEMENT SYSTEMS IN INDIA.

State	Sector Focus	Year of Policy Launch and Operative Period	Project	Policy Description	Maximum Amount Allocated
Haryana	MSME	2020 onwards	ETP	Tech upgradation support + Subsidy - 50%	INR25 lakh per project (USD33,314)
	MSME	2020 onwards	ZLD	Subsidy - 25%	Not specified
	MSME	2020 onwards	ZLD	Subsidy - 50% on each: 1. Technology acquisition 2. Patent 3. Testing equipment	Tech - INR25 lakh (USD33,314) Patent: INR25 lakh (USD33,314) Testing: INR10 lakh (USD13,325.60)
	MSME	2020 onwards	ZLD	Interest subsidy - 5% (CLSS)g	INR10 lakh per year (USD13,325.60)

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State	Sector Focus	Year of Policy Launch and Operative Period	Project	Policy Description	Maximum Amount Allocated
Madhya Pradesh	MSME	2014 onwards (amended in Dec2018)	ETP	Subsidy - 50%	INR2.5 lakh per project (USD3,331.40)
	Industrial areas/ parks	2014-2019	ETP, STP, ZLD, etc.	PPP	Not specified
Odisha	MSME	2015	ZLD	Subsidy - 20%	INR20 lakh per project (USD26,651.20)
Gujarat	Industrial area	2020-25	CETP	Subsidy - 40%	INR50 crore (USD6,662,800) + total support limit of 75% of total fixed capital investment
	Industrial area	2015-2020	CETP	Financial assistance	Not specified
Andhra Pradesh	Industrial area	2015-2020	ETP, STP, ZLD, etc.	Subsidy - 25%	INR50 lakh per project (USD66,628.00)
Maharashtra	Industrial area	2018-2023	ETP, STP, ZLD, etc.	Financial assistance	Total allocation of INR1,000 crore from the Critical Industrial Infrastructure Fund
Karnataka	Industrial area	2020-2025	STP	Subsidy - 50%	INR1 crore per project (USD133,256.00)
	Industrial area	2020-2025	CETP	Subsidy - 50%	INR5 crore per project (USD666,280.00)
	Large enterprises	2020-2025	ETP	Subsidy - 50%	INR2.5 crore per project (USD333,140.00)
	MSME	2020-2025	ETP	Subsidy - 50%	INR50 lakh per project (USD66,628.00)
	MSME	2020-2025	ZLD	Subsidy - 50%	INR7.5 lakh per project (USD9,994.20)
Jharkhand	Industrial area	2016	CETP	Financial assistance	Not specified
Uttar Pradesh	Industrial area	2017-2022		Financial assistance	Not specified
Telangana	Industrial area	2014	CETP	PPP	Not specified

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State	Sector Focus	Year of Policy Launch and Operative Period	Project	Policy Description	Maximum Amount Allocated
Rajasthan	Industrial area	2019-2024	CETP + ETP and ZLD networks	Financial assistance	Not specified
	Industrial area	2019-2024	Reuse and Recycling of Industrial Waste Plant	Subsidy - 50% (to suppliers of the plant)	INR50 lakh one-time assistance (USD66,628.00)
	Industrial area	2019-2024	ZLD	Subsidy - 50% on investment	INR5 lakh one-time assistance (USD6,662.80)
		2019-2024	ZLD	Capital subsidy - 20% (suppliers for the plant)	INR50 lakh (on investment of INR25 crore in the Biotechnology Sector) (USD66,628.00)

ZLD, Zero Liquid Discharge; STP, Sewage Treatment Plant; CETP, Common Effluent Treatment Plant; PPP, Public-Private Partnership.

Policy instruments for supporting water and energy conservation

TABLE 8

STATE-WISE INITIATIVES FOR SUPPORTING WATER AND ENERGY CONSERVATION IN INDIA.

State	Sector Focus	Year of Policy Launch and Operative Period	Project	Policy Description	Maximum Amount Allocated
Gujarat	Industrial units	2014–2019	Energy/ water conservation	Financial assistance on the cost of the audit	Not specified
Rajasthan	Industrial area	2019–2024	Water conservation	Reimbursement of 50% of the cost of water audit	INR2 lakh (USD2,665.12)
	Industrial area	2019–2024	Water conservation	Subsidy – 50% (to the supplier of the plant)	INR50 lakh one-time assistance (USD66,628.00)
	Industrial area	2019–2024	Rainwater harvesting	Capital Subsidy –50%	INR 50 crore on total fixed capital investment (USD6,662,800)
Odisha	MSME	2015	Energy conservation	Financial assistance on the cost of the audit	INR1 lakh for micro enterprises (USD1,332.56) INR2 lakh for small enterprises (USD2,665.12) INR 3 lakh for medium enterprises (USD3,997.68)

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State	Sector Focus	Year of Policy Launch and Operative Period	Project	Policy Description	Maximum Amount Allocated
Karnataka	MSME	2014–2019	Rainwater harvesting	Capital Subsidy –50%	INR1 lakh (USD1,332.56)
	MSME	2014–2019	Energy conservation	Subsidy – 10% of capital costs	INR5 lakh (USD6,662.80) if energy use is reduced by 10% or more
	MSME	2020–2025	Rainwater harvesting	Capital Subsidy –50%	INR2 lakh (USD2,665.12)
	MSME	2020–2025	Water conservation	Reimbursement of 75% of the cost of water audit	INR10 lakh per audit (USD13,325.60)
Maharashtra	Large enterprises/ MSME	2013–2018	Water conservation	Capital Subsidy –50%	INR5 lakh each unit (USD6,662.80)
	Large enterprises	2013–2018	Energy/ water conservation	Reimbursement of 75% of the cost of audit	INR1 lakh on water audit (USD1,332.56)
	MSME	2013–2018	Energy/water conservation	Reimbursement of 50% of the cost of audit	INR1 lakh on water audit (USD1,332.56)

Several state government initiatives have helped to ensure economic development while taking the environmental factors into due consideration. Environmental challenges ranging from waste management, water scarcity and reuse, and solar energy have been solved through specific state-level schemes. Although not all state-level industrial policy schemes have a green focus, several states have taken steps to ensure GP.

As per the analysis, some of the large Indian states such as Maharashtra, Rajasthan, and Karnataka have initiated projects for reviving traditional water bodies and providing community drinking water systems. For example, Rajasthan launched Mukhyamantri Jal Swavalamban Abhiyan in 2016 to make villages self-sufficient in water, whereas Haryana is aiming to make rainwater harvesting mandatory. It is also promoting crop diversification to move towards less water-intensive crops.

On the waste management and generation front, states such as Rajasthan have set up centers that facilitate the creation of a low-cost, end-to-end, rural solid waste management model, as a consolidated effort of the local communities. Similarly, Maharashtra aims to create zero-waste wards through participative governance. A ward is an administrative unit of the city region in India.

In terms of liquid waste, southern states like Telangana have witnessed a surge in the number of liquid waste treatment plants, indicating that regulations backed by strict monitoring can be an effective measure. Another state in eastern India, Jharkhand, has achieved landmark success in becoming the country's first Zero Liquid Discharge city with the help of Tata Steel's Bara Treatment Plant.

Towards electricity and energy generation, the western Indian state of Gujarat has implemented a scheme for farmers, where 60% of the initial investment is done by the state government. Under the initiative, farmers can generate electricity for captive consumption and sell surplus power to the grid. Similarly, the state of Maharashtra is working towards setting up a fund to promote green fuel.

The initiatives mentioned above highlight some of the projects that have been implemented or are being implemented by the states across India to strengthen CE. These efforts have been possible due to the coordinated efforts of the Central and the state governments to ensure energy efficiency, conservation, and support for setting up better infrastructure for non-conventional energy generation and transmission.

5.5.2 Mechanism for Promoting GP and CE

Technology development ecosystem and circular economy

The Department of Science and Technology (DST) in India has been supporting basic research on circularity for quite some time, primarily channelizing resources to the Council of Scientific and Industrial Research, which is also among the largest government-supported R&D organizations in the world. For supporting the development and commercialization of local and indigenous technologies as well as faster adaptation of imported technologies, the Government of India established the Technology Development Board under DST. It also has a Seed Support Scheme that promotes technology start-ups through Technology Business Incubators and Science and Technology Parks. These enterprises can explore partnerships with various R&D institutions in India through collaboration and take up technologies for commercialization [17]. For instance, DST and the Ministry of Railways, in a joint R&D initiative, aim to develop new solutions for fuel efficiency, alternate fuels, and emission control for railways. In the year 2000, DST set up the National Innovation Foundation (NIF) for strengthening grassroots innovations in technologies and outstanding traditional knowledge. NIF has a database of over 225,000 technological ideas and traditional practices from across 585 districts. One of the unique features of the foundation is the setting up of the Augmented Fabrication Laboratory with support from the Massachusetts Institute of Technology.

Finance for promoting circular economy [18]

Proactive investments in the climate-aligned sectors provide banks access to low-cost capital mobilized by Development Finance Institutions and supranational funds, including GCF. Despite these promising opportunities, financing CE business models come with a set of unique risks and challenges, given the changing nature of cash and material flows.

Some of the risks from a financial institution perspective include uncertainty about consumer behavior regarding the acceptance of the circular products, posing payment-related risks. The absence of a proven past performance track record of the new product and technology might inhibit investors from undertaking robust risk analysis. There are also concerns about the residual value of products in secondhand markets, which may impact the financial viability of such CE models. ING Bank, in its report 'Rethinking Circular Finance in a Circular Economy', concludes that multiple forms of capital are needed to finance a CE.

5.5.3 Implementation of GP and CE in the Private Sector

The CE practice requires a systems approach that considers the broader economic, social, and environmental systems in which commercial supply chains operate.

The three prominent sectors having enormous CE opportunities in India are discussed below.

Cities and construction

As India invests in long-term infrastructure to improve citizens' quality of life, for example through the Smart Cities Mission, it could incorporate CE principles to design the infrastructure needed for water, sanitation, and waste management services at scale. This will create an effective urban nutrient and material cycle. More systemic planning of city spaces, integrated with circular mobility solutions, can contribute to higher air quality, lower congestion, and reduced urban sprawl. Flexible use of the building and urban space, enabled by digital applications, can increase the utilization rate, getting more value from the same asset.

Higher efficiency and lower overall building and infrastructure costs could also help meet the housing needs of the urban poor, without compromising on safety and quality. CE principles can contribute to construction activity in ways that create economic value and decouple development from the use of virgin, non-renewable resources. Renewable and recycled materials and modular construction methods can minimize waste and reduce construction costs. Buildings can be designed to be adaptable to changing needs and contribute to a regenerative urban ecosystem during their use phase, including energy generation, connection to nutrient cycling systems, etc.

Food and agriculture

India is the second-largest producer of agricultural products in the world, accounting for nearly 7.68% of total global agricultural output, according to the country's Ministry of Statics and Programme Implementation. Agriculture plays a vital role in India's economy and accounted for about 17% of its GDP in 2016-17. It is estimated that over 58% of the rural household in India depends on agriculture as their principal means of livelihood [19].

There is an urgent need for an agricultural system framework that can retain natural capital, boost economic and ecological resilience, and deliver a stable supply of fresh, healthy, and diverse food to India's growing population besides closing the gap in nutrient loops. Leveraging the current small-farm structure, India could create large-scale networks of farmers, interconnected and symbiotic in their practices and committed to regenerative approaches. Combining local knowledge and traditional methods, like working with a large variety of species and modern technologies including precision farming, digitally-enabled asset, and knowledge-sharing systems could increase yield while significantly decreasing requirements for resources such as water, synthetic fertilizers, and pesticides.

Reducing food waste across the supply chain could make the Indian food system even more effective. This would require optimizing production and digitizing food supply chains to match supply and demand more easily. Urban and peri-urban farming can bring food production closer to consumption, reducing food waste and transportation requirements. Composting and aerobically digesting food waste with no other valuable use and post-consumption nutrients, those contained in human excreta, allow restoration of nutrients to the soil and production of energy.

Mobility and vehicle manufacturing

CE principles can contribute to the mobility system that meets the growing need of the Indian population, especially in cities, while limiting negative externalities, such as GHG emissions, congestion, and pollution. Taking reparability, remanufacturing, and recycling into account in vehicle design and creating the appropriate reverse cycle infrastructure can reduce the need for virgin, non-renewable resources, and energy.

Building vehicles that rely on zero-emission propulsion technology could reduce negative externalities like GHG emissions, pollution, and dependence on imported fossil fuels. As car ownership is currently low, adoption of newer technology could be rapid as the ownership expands. A multimodal, door-to-door, on-demand mobility system embracing vehicle-sharing trends and leveraging digital innovation could provide efficient and effective transportation with high vehicle usage and occupancy rates. Mass transit as the backbone combined with other forms of transport, including vehicle-as-a-service, for convenient last-mile connectivity can create convenient door-to-door journeys. Technological innovation can help plan these journeys and make traveling safer and faster.

5.5.4 Recommended Strategies

To improve material resource efficiency and promote CE, it is necessary to handle all the drivers, including regulatory instruments, market-based incentives and disincentives, public procurement, capacity building of stakeholders, awareness-raising and information sharing, and to involve all stakeholders, such as businesses, consumers, communities, scientists and academics. A mix of instruments can address multiple resource domains and contain interacting instruments targeting multiple actors, levels of governance and sectors, and life-cycle stages of resource use.

Recommended policy instruments may include the following:

For governments

- Address regulatory gaps.
- Design innovative market-based instruments.
- Adapt green public procurement policy.
- Support recycling and recovery structures.
- Strengthen product responsibility through EPR and shared responsibility.
- Strengthen research and knowledge base.

For the private sector

- Create resource-efficient business models.
- Create awareness and develop the capacity of stakeholders.
- Prepare an action plan and monitor progress.

Further, the following actions by the governments are required to lead the way for the transition to CE [20].

- Set direction and show commitment.
- Create enabling regulatory frameworks and remove policy barriers.
- Create platforms for multi-stakeholder collaboration.

- Represent the interests of groups like the informal sector, and facilitate collaborative initiatives among businesses, the public sector, and other stakeholders.
- Support circular models through public procurement and infrastructure.
- Embed CE principles in education.
- Conduct research and pilot projects to create a knowledge base and establish proof points.

5.6 Indonesia

5.6.1 Initiatives and Policies

Adoption of the green industry in Indonesia is regulated by Law No. 3 of 2014 on Industrial Affairs. The law stipulates that the Government of Indonesia will work towards policy formulation, institutional capacity strengthening, standardization, and provision of facilities to enable green industry. Further, strategic planning regarding CE in Indonesia is implied in the National Medium-Term Development Plan (RPJMN) for 2020-2024. Implementation of the 2020-2024 RPJMN includes the Company Performance Rating Assessment Program (PROPER) and policies such as carbon tax, with the government emphasizing efficient use of raw materials, low carbon emissions, and reduction in the use of plastic.

The Government of Indonesia also promulgated Presidential Regulation Number 18 of 2020 related to RPJMN for 2020-2024, which directs policies to increase economic value add. Besides, the government has also brought in Presidential Regulation Number 59 of 2017 for the Implementation of the Achievement of Sustainable Development Goals. It allocated IDR15.2 trillion (approximately USD1.05 billion) in 2018 for environment protection, including forest management, waste management, and CO_2 emission control. In 2019, the state budget for the environment was increased by 16.4% to IDR17.7 trillion (approximately USD1.2 billion), while the Budget Tagging for Climate Change in the fiscal year 2020 was IDR 2.7 billion (USD187 million). In 2020, this declined 0.45% to accommodate budget allocation for COVID-19 [21].

The government is making efforts to realize the sustainable environmental goals through institutions and programs like PROPER, initiated by the Ministry of Environment and Forestry (MoEF). In addition to PROPER, the government has other special programs and institutions like the Green Industry Center (PIH), the National Energy Council, B3 Biofuels, and Refused Derived Fuel. The PIH is tasked with overseeing the adoption of green industry standards by the companies in Indonesia. Companies that pass the standards get the green industry certificate. The Minister of Industry has appointed several organizations as Green Industry Certification Bodies through the regulation (Permenperin) No. 41/M-IND/PER/12/2017 of18 December 2017.

The Ministry of Industry (MOI) also supports industrial actors to realize a sustainable circular economy. Based on the data obtained from the interviews and secondary data provided, the ministry has launched several programs as listed below.

1. Several activities for creating CE have been carried out by the Green Industry Center between 2014 and 2021. The details of the activities are listed in Table 9.

TABLE 9

PROGRAMS OF THE MINISTRY OF INDUSTRY TO SUPPORT THE CIRCULAR ECONOMY IN INDONESIA.

Implementation Year	Program/Activity
2012	E-Waste Potential Mapping Study
2014	Industrial Pollution Control (identification of potential types of commodities for circular economy development)
2015	Formulation of the e-waste guidelines for the industrial sector (Updated in 2019)
2015	Formulation of the packaging waste management guidelines for the industrial sector
2017	Formulation of the plastic waste recycling guidelines for the industrial sector (Updated 2020)
2017	Study on Refused Derived Fuel (RDF) standards and criteria
2019	Formulation of the electronic waste management schemes in the industrial sector
2020	Formulation of a roadmap for the implementation of circular economy in the electronics industry
2021	Construction of mini depots in six locations 1. Cirebon 2. Bandung 3. Malang District 4. Malang City 5. Depok 6. Banyuwangi
2021	Study on the application of circular economy policy in the industrial sector

Source: Ministry of Industry (Indonesia) 2021 and secondary data.

2. The MOI in Indonesia is committed to providing technical guidance to companies and assistance, including creating awareness of applicable regulations, good waste management procedures as recycled raw materials, and waste management as a result of waste recycling activities. In practice, more than 100 companies and local government work units have been involved in providing technical guidance [22].

3. Based on data collected by the MOI, the number of people working in the recycling industry is more than five million, and the number may increase when data from other recycling industries are taken into account.

4. The implementation of CE, which is part of the effort to implement a green industry, has environmental and socio-economic impacts as listed in Table 10.

TABLE 10

IMPACTS OF IMPLEMENTING CIRCULAR ECONOMY IN INDONESIA.

Category	Impact
Environmental impacts	• Efficient utilization of natural resources with the use of raw materials from recycled products. • Reduction in the generation of waste and leftover from the production process and used products. • Reduction in CO_2 emission caused by exploration of raw material and waste pile.

(Continued on next page)

(Continued from the previous page)

Category	Impact
Socio-economic impacts	• Opportunities for employment in the formal and informal sectors. • Business opportunities for local governments. • Higher value of used products. • Increase in consumer and community awareness on responsible consumption and disposal of waste.

Source: Ministry of Industry (Indonesia) 2021 and secondary data.

5.6.2 Mechanism for Promoting GP and CE

The PROPER program

PROPER encourages compliance in environmental management by providing incentives for corporate reputation. A mandatory instrument, PROPER enables monitoring of environmental management compliance by institutions and persons in charge of business and managing green initiatives. PROPER helped 2,038 companies achieve 88% environment management compliance in 2020, an increase of 3% from 2019. This included 972 companies from the agro-industry sector, 584 from manufacturing infrastructure services, and as many as 482 from the oil and gas energy mining sector. In addition, the companies carried out 806 innovations. It also led to a reduction in carbon emissions by 131 million tonnes [23]. A good rating for implementing environmental sustainability regulations also adds to the reputation of the companies.

Figure 32 indicates that 32 companies have received gold PROPER for implementing comprehensive environmental management and sustainable corporate social responsibility programs. The PROPER award is categorized by colour where blue PROPER indicates that the company has undertaken environmental sustainability measures, including waste management, land management, water management, air pollution control, and environmental impact analysis. Green PROPER means that the company has taken environmental management steps more than what is stipulated, including additional steps towards biodiversity and energy efficiency. Red PROPER means that the company has carried out some environmental management, while black PROPER indicates that the company has not made any environmental management effort.

According to data from the MoEF, as many as 1,707 companies have also received blue and gold certification in PROPER. This has helped reduce GHG by approximately 93.83 million tonnes and pollutants by 50.59 million tonnes.

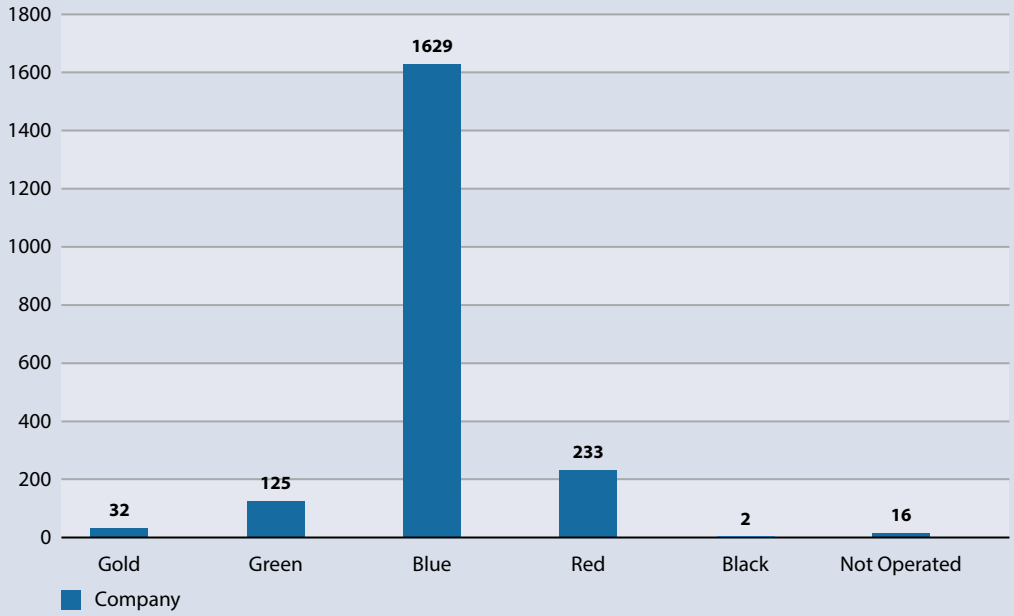
Special Allocation Fund (DAK) for the environment

Indonesia implemented the Policy for distribution of Special Allocation Fund (DAK) in fiscal year (TA) 2001 with the enactment of Law (UU) Number 25 of 1999 on Fiscal Balance between the Central and Regional Governments. This marked the beginning of fiscal decentralization in Indonesia. In 2004, Law Number 25 of 1999 was revised and replaced by Law Number 33 of 2004 on Financial Balance between the Government and Regional Governments. Law Number 33 of 2004 defines DAK as a fund sourced from APBN (state budget) revenues allocated to specific regions to finance special activities that are regional and as per the national priorities. In other words, DAK is defined as a fund allocated to local governments (Pemda) to help finance certain activities that have been decentralized to Pemda and are in line with the national priorities.

After the enactment of the regulation, DAK for the environment sector was launched by the government. The planning of DAK for the environment was initiated in 2005, and the first implementation was

FIGURE 32

NO. OF COMPANIES RECEIVING THE PROPER RATING.



Source: https://proper.menlhk.go.id/proper/berita/detail/329

done in 2006. The allocation of DAK for the environment is one of the instruments designed to expedite rolling out projects to improve the quality of the environment in the country.

5.6.3 Recommended Strategies

It can be concluded that Indonesia produces a high volume of waste and carbon. The Government of Indonesia initiated steps towards ensuring environmental sustainability after the publication of the environmental impact analysis, and recently on the green industry. Responding to the need, the country's government took strategic measures to reduce waste and carbon. The government will develop five phases and sector focus to reduce waste and carbon generation. Controlling carbon emissions and waste can provide significant economic growth, and the government is currently preparing plans for implementation in 2025-2030.

Based on the survey results, organizations in Indonesia currently have sufficient awareness of maintaining environmental sustainability. This is evidenced by the implementation of environmental projects, although it is still simple in scope. In the future, Indonesia can implement the concepts of CE better if the government takes strategic steps to encourage organizations to transform environmental management models into more sustainable ones.

The following policies are recommended:

1. Reform industry and energy sector regulations to make them environment friendly while considering state revenues and expenditures.

2. Stimulate green industry by applying the life principle of go green at the community level to drive conventional industries to transform into green industries.

3. Collect excise duties on products that produce greenhouse gas emissions. Also, improve public facilities, environment, and provision of incentives that help the wider community.

5.7 Islamic Republic of Iran

5.7.1 Initiatives and Policies

Iran's Ministry of Petroleum established the Iranian Fuel Conservation Company (IFCO) in 2000. The core mission of IFCO includes demand management and policy development for fuel consumption. It also has the mandate of developing regulations and technical standards for energy consumption in different sectors like transportation, construction and building, and the industry. IFCO is targeting a 50% reduction in the country's energy intensity by 2031 [24].

The Parliament of IR Iran ratified the Energy Consumption Schema Reform Law in 75 Articles in February 2011 focusing on the following pivots [25] and [26].

- Supporting entities to develop modern technologies of energy conservation
- Supporting energy services companies
- Developing appropriate policies for the final consumers
- Implementing energy management systems
- Developing and deploying energy consumption standards
- Educating energy consumers aiming to improve energy intensity

It is expected that IR Iran can achieve more success with its policies for saving energy by expanding the privatization process in the future.

The Waste Management Law of IR Iran is the first and most important national legislation on waste management. The country's Parliament ratified this law in 23 Articles in May 2004. The Law defines the legal framework and the obligations of both the executive entities and the waste producers. Article 4 of the Law deals with recycling and requires government institutions to facilitate waste reduction activities, produce recyclable products, and use recycled materials in new products. In addition, Article 17 emphasizes providing maximum legislative facilities for the construction and implementation of recycling plants, environmental regulations, and standards.

The Department of Environment of IR Iran developed the National Strategic Plan on Climate Change in 2017. The plan focuses on five areas, including a reduction in CO_2 emissions, water resource management, agriculture and food security, biological resources, and health for mitigation and adaptation to climate change. The plan also analyzed the opportunities, threats, strengths, and weaknesses of each sector approaching climate change [27]. In addition, the Green Management Program Regulation deals with energy, water, and other resources such as paper consumption, using equipment and facilities efficiently, and waste reduction in governmental and public institutions and organizations [28]. Among all environmental concerns, the water crisis is the most significant environmental challenge in IR Iran. The country faces water stress, both in municipal and rural regions, due to the overconsumption of water across economic sectors. However, there are a number of national regulations that address this issue in the country.

The Government of IR Iran also provides incentives, including motivating regulations to support Iranian firms improve their performance on the environmental front. The regulation stipulates that local firms spend one-thousandth of the total sale of their products on pollution control. The companies can compensate for the environmental damage by installing eco-friendly equipment and developing green areas, etc. The government treats these costs as a tax exemption [29].

Under a separate law, organizations can spend one-thousandth of their total sale of goods and services to improve the environment. The government calculates those costs as tax exemption. While there are regulations to finance environmental projects firms seldom use them due to bureaucratic hurdles.

5.7.2 Implementation of GP and CE in the Private Sector

Some regulations require firms to establish sustainability departments to address environmental issues. Remark 19 of the 2nd Five Year Development Plan of Iran (ratified in September 1996) requires all industries and institutions with over 10 MW power or 5000 cubic meters of oil equivalent annual consumption to establish an energy management department [30]. Remark 1 of the Article 16 Iran Clean Air Act requires all the SMEs with over 50 employees to establish Health, Safety, and Environment department and to employ at least one environmental specialist [31].

Energy saving is the top priority of firms exploring GP and CE. Energy intensity in IR Iran is four times more than the global average, reflecting the weak structure of energy consumption and the high potential for energy conservation in the country.

Low energy prices because of huge fossil energy subsidies are an important reason for conducting productivity programs with difficulty in the country. These subsidies impact the organization's willingness to improve energy efficiency and productivity processes, and even products. It is argued that by investing this money into productive sectors, rather than distributing it via direct and indirect subsidies, the country will be able to tackle its critical economic problems.

The government pays subsidies to empower consumers against rising prices and to preserve the cost of living. However, in the long term, energy subsidies have many diverse economic and political consequences [32].

- Increases consumption and wastage of energy
- Weakens incentive for innovation and use of efficient technologies
- Degrades environment by lowering air quality, especially in urban areas
- Puts a heavy burden on the government budget
- Increases cross-border smuggling of oil products to neighboring countries

The Parliament of IR Iran ratified the Subsidy Reform Law in January 2010 and the government initiated the subsidy reform plan with strong political support [33]. The plan has been influenced by the unique economic circumstances of the country. The foreign exchange market was faced with instability after the imposition of sanctions in January 2012. Hassanzadeh concluded that the subsidies reform plan in Iran was hit by large-scale international sanctions [34]. Iran's INDC document reports that international sanctions prevented the nation from hitting its 30% energy intensity sanction targets, set out in its 5th Five-Year Development Plan (2010-2015) [35].

5.7.3 Recommended Strategies

Despite the number of regulations focusing on driving GP and CE in IR Iran, there is a lot of scope for improving the environmental performance of the local firms. The stability of economic indicators also play an important role in implementing sustainable initiatives. Providing possible foreign direct investment in environmental and sustainable plans can improve environmental quality and provide better economic benefits.

There is also a need for inter-sectoral cooperation to enhance productivity criteria in SMEs. Cooperation between the Department of Environment, Ministry of Energy, and National Productivity Organization can accelerate GP and CE plans in the economic sectors. These plans are applicable mainly for the areas suffering from critical problems such as the water crisis. However, increasing public awareness can play a key role in making any sustainable development plan successful.

5.8 Malaysia

5.8.1 Initiatives and Policies

The recent policies in Malaysia focus on reducing dependency on petroleum products and mainstreaming environmental considerations while ensuring reliable, affordable energy and safeguarding energy security. The promotion of renewable energy remains a priority for Malaysia, as evidenced by the enforcement of the Renewable Energy Act 2011 and implementation of the Feed-in Tariff scheme [36]. There is a plan by the government to make energy supply sustainable by resource diversification, continuous investment in new infrastructure, and deployment of state-of-the-art technology to harness renewable energy and energy-storage technologies. The initiatives for improving efficiency in electricity generation and consumption, however, need to be enhanced.

Agriculture

For the agriculture sector, oil palm is the most economically important crop followed by rubber. In 2020, Malaysia accounted for 25.8% and 34.3% of the world's palm oil production and export, respectively. Including other oils and fats produced in the country, Malaysia accounted for 9.1% and 19.7% of the world's total oil and fat production and export in the same year.

The refining of crude palm oil commenced in the early 70s in response to the government's call for increased industrialization. The emergence of refineries marked the introduction of a wide range of processed palm oil products. The country has also introduced sustainable practices in the sector, including utilization and optimization of idle agriculture land and product certification. Oil palm is planted on 4.2 million hectares, less than 13% of the total land area of Malaysia while rubber is planted on approximately 1.07 million hectares. The government is not planning to open new land for the cultivation of oil palm and rubber due to sustainability issues but focusing on the enhancement of productivity. Other significant agricultural activities are paddy farming and livestock for economic reasons and to ensure food security [37].

For the transport sector, greater emphasis has been placed on developing an efficient and integrated public transport system to enhance economic growth and quality of life over the past decade. The Land Public Transport Commission was established in 2010 to provide a holistic solution to the land public transport system for the cities. A National Land Public Transport Master Plan was also formulated to drive the regulatory and industry reform for the sector.

Several initiatives are being considered to utilize green technology across the land, aviation, and maritime transport sectors to improve energy efficiency and reduce carbon emissions. Plans are also underway to improve connectivity and infrastructure to make travel more efficient and also to embark on new transportation technologies such as Energy Efficient Vehicles and Electric Vehicles (EVs). The government is also looking at new initiatives to encourage the use of EVs as well as methods to incentivize purchases.

Solid waste management

The Solid Waste and Public Cleansing Management Act 2007 (Act 672) applicable only in Peninsular Malaysia and the Federal Territories of Putrajaya and Labuan enables the Department of Solid Waste Management and Solid Waste and Public Cleansing Corporation to manage the solid waste in the six states and two federal territories that implement the Act. For the remaining seven states solid waste management is under the jurisdiction of the respective city, municipal, and district councils based on the local government ordinance. Several initiatives have been taken to improve waste management in Malaysia and to make it more sustainable.

According to a study in 2012, about 45% of domestic, institutional, commercial, and nonmanufacturing-related industrial waste in Malaysia can be recycled. Besides, almost 60% of construction waste could be recycled and reused. Therefore, an effort has been made to recover maximum recyclable materials such as paper, plastic, metal, glass, and fabric. Major steps have been taken towards the implementation of separation at source regulation for domestic, industrial, commercial, institutional, and construction waste. The regulation to separate the recyclable from residue waste (to be disposed of at disposal facilities such as sanitary landfills) for domestic waste was introduced in 2015 [38], while the regulation for industrial, commercial, institutional [39], and construction [40] waste was introduced in 2019. Malaysia is also planning to reduce the amount of food waste disposed of at the landfill by at least 75% of the total amount generated in 2026 [41].

The country is aspiring to establish a CE system besides strengthening the activities of 3R (Reduce, Reuse and Recycling). A waste-to-energy (WTE) facility is also being constructed with a capacity to treat about 600 tonnes of waste per day. It will have a capacity to generate between 20 to 25 megawatts (MW) of electricity that could light about 25,000 houses [42]. In 2021, a tender for the construction of two WTE facilities was floated. Each facility will have the capacity of handling 800 tonnes of waste per day. There are also plans to build several WTEs and Anaerobic Digesters throughout the country.

The country's environmental goals are defined in its Roadmap towards Zero Single-Use Plastics 2018-2030 which aims to achieve "zero single-use plastics for a cleaner and healthier environment in Malaysia by 2030." The initiative focuses on a concerted effort by several agencies and takes a phased, evidence-based, holistic approach by involving all stakeholders in jointly addressing single-use plastics pollution in the country. Some of the initiatives under this roadmap are communication, education and public awareness plans, technical guidelines, regional cooperation (marine debris), pollution charge on single-use plastic bags by states (fixed premises), federal pollution levy on plastic manufacturers and a Circular Economy Roadmap for plastics, including bottles [43].

CO_2 equivalent emission and green initiatives

Till 2020, the country has received about USD470 million in green financing under Green Technology Financial Scheme 2.0, involving 112 certified green projects and USD235 million in

investments across 243 green projects under the Green Investment Allowance Tax (GITA). Similarly, Green Technology and Climate Change Corporation (MGTC) collaborated with government and industry stakeholders to reduce 0.839 million tCO_2eq in greenhouse gas emissions by implementing low carbon initiatives. About 2,300 new green products and services were launched in the local green economy marketplace by SMEs with the help of GreenTech.

Green Income Tax Exemption for MyHIJAU Mark service providers and GITA for companies acquiring green technology assets are listed under the MyHIJAU directory. As of FY2020, MGTC has approved a total number of 243 applications with a potential value amounting to RM965.6 million, which is expected to reduce GHG emissions by 575,564 tCO_2eq and create a total of 471 green jobs [44].

The vision, supported by the Government Green Procurement effort that started in 2016 with the participation of five ministries, is now practiced by all government departments. The green procurement initiative relies on MGTC's MyHIJAU Mark registration and the maintenance of a growing list of products that are green certified. These range from paint, fertilizers, and solar panels, to home appliances, and ICT products, and include over 7,498 items. The MOF references these items for purchase by the ministries. As of 2019, the government spending on green products was 21%, which it is targeting to increase to 24% [45].

There are four strategic directions in the Green Technology Master Plan 2017-2030. The first strategic direction is to widen the adoption of green procurement by the government. Secondly, it aims to make green technology mainstream through targeted programs that encourage informed purchasing decisions based on heightened environmental consciousness. A smart partnership involving the government, manufacturers, and retailers is an innovative way to achieve this. The third aspect looks at nurturing research, development, and commercialization, which will move Malaysia from adopting and adaptation of non-domestic technologies to creating its original intellectual property. Finally, the fourth strategic direction is to strengthen human capital development that is capable of pursuing innovation and excellence in each industry.

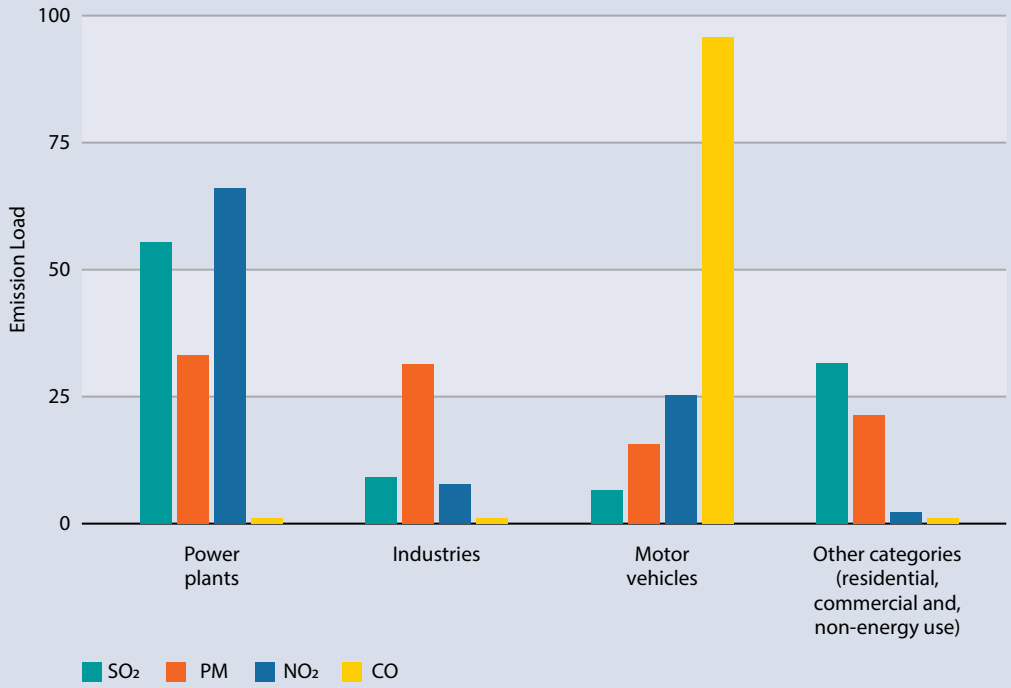
Environmental pollution and the industry

Complying with environmental regulations is a prerequisite for sustainable living and development. Therefore, it is important to ensure whatever activity conducted must be in line with the environmental requirement in ensuring no harm to the environment, society, and economic growth capability and potential. The Department of Environment, equipped with the Environmental Quality Act, 1974 (Act 127), regulates all activities related to the discharge of wastes into the environment, overseeing pollution control to enhance environmental quality. From the DOE's yearly report, the environmental quality of several important parameters such as ambient air quality, emission load for air, and pollution load for surface water could be retrieved.

The main sources of emission load of SO_2, PM, NO_2, and CO were also stated in the report as shown in Figure 33. The power plants contributed the highest emission load of SO_2, PM, and NO_2 at 55%, 33%, and 66% respectively. However, motor vehicles remained the highest contributor of CO at 95.6% [46]. Stern measures such as stopping the construction of new coal-based power plants and reducing dependency on them are needed to address issues related to power plants. For transportation, there is a need to encourage the usage of train and public transport, and embrace EVs.

FIGURE 33

AIR POLLUTION: CONTRIBUTIONS BY INDUSTRIES IN MALAYSIA.



Adaptation to the Sustainable Development Goals

The launch of Malaysia's new development blueprint of Shared Prosperity Vision 2030 (SPV 2030), which aims to develop a fair and equitable distribution of economic development at all levels by 2030, reflects Malaysia's commitment to implementing the SDG agenda. The country has committed to achieving SDGs by 2030 and the Zero Net Carbon goal by 2050. With the launch of SPV 2030 and the commitment of the government, organizations have an opportunity to get support and guidance from the related government agencies.

Key economic growth activities (KEGA) are one of the strategic thrusts of SPV 2030. It also emphasizes conversion to Renewable Energy (RE) and aims to increase the contribution from RE to 31% of total electricity source by 2025, up from the current 20%, and further to 40% by 2035 [47]. Among the technologies that will be adopted for that purpose are mini-hydro, solar, algae, biomass, biogas, and municipal solid waste. Green Economy is another important initiative introduced by KEGA and being practiced by more informed societies that emphasize low-carbon activities and effective energy, secure maritime, plastic substitute products, smart and sustainable cities, sustainable coastal development, environmental preservation, and rehabilitation, climate-adapted technology, and organic farming. Green Economy also refers to creating a CE that can operate without emitting waste and smart and high-value farming deploying advanced and modern services.

The Twelfth Malaysia Plan, 2021-2025, injects fundamental reforms in realizing the spirit of Keluarga Malaysia (Malaysia Family) that will truly transform the development trajectory to achieve a prosperous, inclusive, and sustainable Malaysia. Some of the strategic initiatives specific to sustainability are embracing a CE, advancing green growth, and developing sustainable cities. The initiative to promote green growth focuses on three priorities: implementing low-carbon,

clean, and resilient development; managing natural resources efficiently to safeguard natural capital; strengthening the enabling environment for effective governance and ensuring sustainable energy for all. To address the issue of climate change, under this plan, Malaysia targets to achieve a 45% reduction of GHG emission intensity to GDP by 2030.

5.8.2 Implementation of GP and CE in the Private Sector

Several initiatives have been introduced to make the industry environment friendly, with measures promoting energy efficiency and the adoption of 'greener' manufacturing processes that reduce water and raw material consumption while minimizing air pollution, solid waste, and wastewater generation. Recommendations include scaling up to adopt CE, where the industrial system would be more restorative or regenerative and improves resource performance and material savings.

In line with the UN SDGs and recommendations of the Task Force on Climate-related Financial Disclosures, Bursa Malaysia Securities Berhad introduced the Sustainability Reporting Guide. Compliance with the Sustainability Report as required by Bursa Malaysia will enable companies to adopt a holistic approach to business management while considering the economic, environmental, and social risks and opportunities alongside financial implications. This will also help embed the culture of green initiatives and sustainability in organizations. This could be achieved by highlighting how sustainability can facilitate, support, and drive corporate and societal value while improving awareness of the risks and opportunities connected to sustainability considerations.

The organization also needs to support the Government of Malaysia to reduce the emission of carbon footprint, which is a significant effort to curtail the increase in average earth temperature. Although energy is a major contributor to CO_2 emission, the contribution from manufacturing processes and waste is still significant. Organizations are encouraged to intensify energy-saving initiatives and adopt renewable energy. GP and CE could play a major role in improving the production processes and consumption of the product to reduce the contribution of CO_2 from the industry and waste sectors. Research and innovation are required to support these initiatives coupled with the subsidies from the government for tax examination and finance.

5.8.3 Recommended Strategies

To ensure the successful implementation of green initiatives, Malaysia can initiate several measures as explained.

- Provide comprehensive guidance on green initiatives to include all elements such as GP, CE, SDGs, ESG, and GHG. If possible, avoid overlapping activities to ensure clear demarcation for easy monitoring and assessment. There is no need to change the name or denomination of the initiatives or activities for ease of acceptance by various groups and societies.

- Setup a surveillance mechanism and system of reporting to properly monitor the overall implementation of green initiatives at the organization level, based on criteria and guidelines.

- Provide a platform for companies to share their initiatives and achievement that would encourage innovation and dissemination of good practices. For example, the case study by Kloth Malaysia to create circularity of fabric in the country could be replicated to address issues of plastic packaging, food waste and other types of waste.

- Involve government and authorities to support, promote, facilitate, and regulate the green initiatives, especially capital incentives, training, technology transfer, networking, and management skills development. Special attention should also be given to SMEs because they are large in numbers, diversified and generally lack awareness.

5.9 Pakistan

5.9.1 Initiatives and Policies

In response to the changing industry dynamics and increased burden of carbon legislation, the world has primarily pinned its hopes for a turnaround on two landmark pillars of strategic and ambitious international collaboration: the UN SDGs and the Paris Agreement. Pakistan is also bound to the goals mentioned above and aims to contribute to achieving the global SDGs and developing a sustainable infrastructure for economies without hurting economic growth.

According to German Watch, Pakistan has been ranked among the top ten countries globally affected most by climate change in the past 20 years due to its geographical location. According to the Global Climate Risk Index annual report for 2020, Pakistan has lost 0.53% per unit GDP, suffered economic losses worth USD3792.52 million, and witnessed 152 extreme weather events from 1999 to 2018. Similarly, ADB analysis shows that the socioeconomic costs of environmental degradation are considerable with climate adaptation needs ranging between USD7-14 billion per year. The government is cognizant of the situation and is taking measures at policy, management, and operational levels to mitigate the adverse effects of climate change in the country.

The following initiatives have been taken by the concerned ministries:

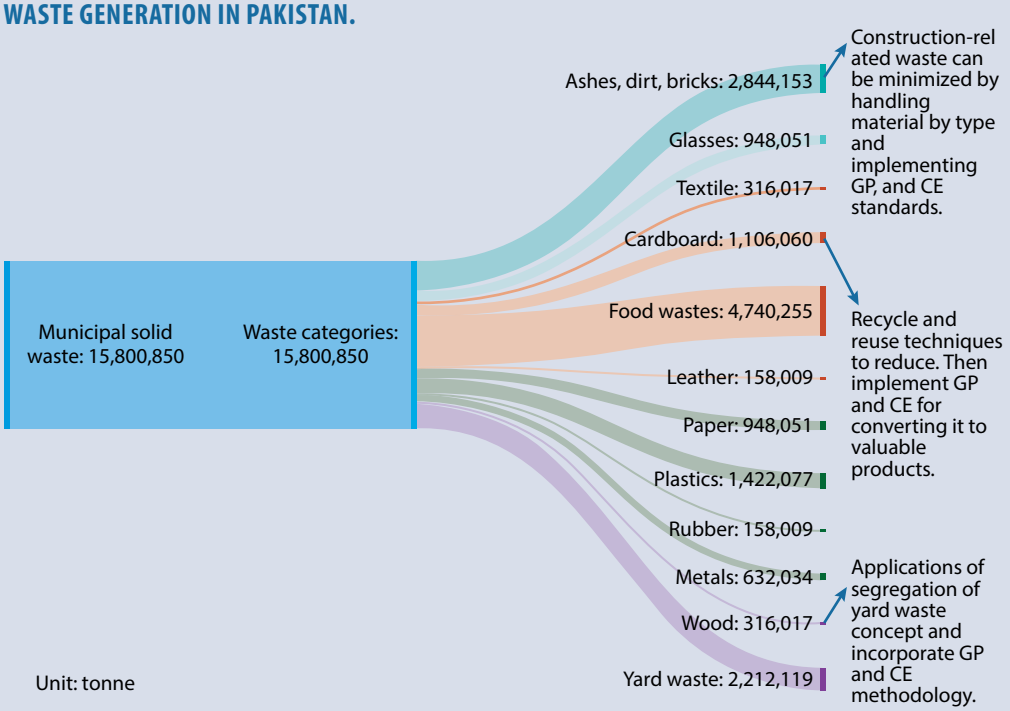
- Ecosystem Restoration Initiative
- Nationally Determined Contribution
- Attaining Land Degradation Neutrality
- Ten Billion Tree Tsunami Program
- Capacity building on water quality
- Certification/Accreditation under Certification Incentive Program
- WASH cell

Nowadays, waste has become a vital part of the Pakistani economy; an outcome of the economic activity, it can be used as an input for other economic activities through material or energy recovery. Pakistan generates over 3.3 million tonnes of plastic waste and nearly 15 million tonnes of solid waste annually. This is expected to increase sharply to 66 million tonnes per year by 2050. This shows a significant potential to implement the reuse and recycle strategy to be more productive.

Waste generation in Pakistan can be classified under various heads, as explained in Figure 34. It also depicts the composition of waste and the volume of different types of waste generated in the country. The composition of major waste includes food waste, which is followed by ash, brick and

FIGURE 34

WASTE GENERATION IN PAKISTAN.



dirt, yard waste, wood waste [48], etc. Figure 34 shows that waste generation in the country is versatile and represents the overall waste generation from industrial, agricultural, commercial, and residential activities [49].

5.9.2 Implementation of GP and CE in the Private Sector

Textile sector

The textile industry comprises nearly 46% of the manufacturing sector in Pakistan, employing over 40% of the population, directly or indirectly, in the country. Globally, Pakistan is the fourth largest cotton producer. It also ranks third in terms of world yarn production and hosiery manufacturing. The cotton industry contributes more than 8% of the country's GDP, which shows its importance and size.

The textile sector in Pakistan follows a linear economic approach for production, distribution and utilization of apparel. Since the industry primarily uses virgin feeds, including millions of tonnes of non-renewable resources, the resources can be used for a limited period only. The key lies in preserving resources and highlighting capital by controlling limited stocks, along with balancing renewable source flows through CE [50]. In an efficient circular system, the products enter the economy at their highest value and then re-enter after using waste to produce bio-textiles [51].

Construction sector

Construction activity during FY20 jumped by 8.1% due to an increase in government support and an uptick in investment by the private sector. The construction sector absorbs 7.6% of the country's total labor force and provides stimulus to over 42 ancillary sectors, including aluminum, brick, cables, cement, fixtures, glass, kitchen and bathroom fittings, marble, paint, steel, tiles, transportation, warehousing, and wood.

Pakistan can design CE for the construction sector around five main pillars: plan and design, effective procurement, effective construction, effective operation, and end-of-life management. The plan and design phase must focus on reducing carbon footprint [52] by using simulation tools. In the procurement phase, renewable construction material should be procured, which is recycled to enhance circularity in the process. In the construction phase, pre-usable formwork or prefabricated structures should be reused to minimize material waste. In the operation phase, buildings should be monitored periodically to ensure maintenance and repair for the extension of life. BIM software can be used to analyze building performances. Also, an end-of-life assessment should be done to estimate and plan the life span of the buildings by implementing productivity concepts like 5S, TQM, 7QC, and other problem-solving tools.

Gaps in implementation of GP and CE

Based on the data analysis following gaps can be identified. These can serve as a baseline for future GP and CE integrated approaches.

- Lack of understanding of the basic concepts of GP and CE in different sectors.
- Lack of business-led collaboration and disruptive innovation through specified supply chain or global network.
- Gap in understanding the role of institutions, both academics and government, for integrated GP and CE to thrive in the country.
- Lack of project-based approach for integrated GP and CE.
- Lack of a systematic, unitized, and centralized framework that can help scale key materials for the adoption of integrated GP and CE concepts into the economy.

5.9.3 Recommended Strategies

Pakistan is a developing country with huge potential for industrial expansion and emerging cheap skilled labor. Experts believe that a CE cannot thrive under the existing traditional policies. Necessary legislations have to be made to change the behavior of enterprises to prevent them from pursuing quick gains through short-term acts. Thus, it is essential to develop a legal framework to focus on GP tools and techniques for CE.

In Pakistan, the textile, construction, and energy sectors should be studied. These sectors are the most significant contributors to the national GDP with enormous utilization of natural and synthetic resources. Thus, training, DEMO companies, and comparison of CE best practices on policy, technology, and bottlenecks worldwide and within Pakistan should be organized and developed for small and medium enterprises. This will help in developing a sustainable economic activity within Pakistan that will increase resource security, lower imports, and increase exports.

5.10 Philippines

5.10.1 Initiatives and Policies

For a while now, several economy-related policies and frameworks are already in place in the Philippines. This includes the Ecological Solid Waste Management Act of 2000, which lays out a systematic, comprehensive, and ecological solid waste management program protecting the public health system

and the environment. While the law was enacted in 2001, there has been very little change in solid waste management due to a lack of awareness and mismanagement in basic societal sectors.

Republic Act No. 10771 or the Green Jobs Act was ratified and enacted in April 2016 to leverage the structural changes needed "towards a sustainable, low-carbon, climate-resilient economy" through the creation of jobs and potentially new industries that are eco-friendly. Almost six million jobs can be created by adopting recycling, reusing, remanufacturing, renting, and improving the durability of goods. Industry sectors that can benefit from CE initiatives include materials reprocessing, automotive repair, remanufacturing, construction and recycling, agriculture, forestry, food processing, and waste management.

The resolution Safeguards in PPP: Mainstreaming Environmental, Displacement, Social, and Gender Concerns was signed in December 2018. It aims to "prevent negative impact on people and the environment in implementing" PPP projects. However, there were specific policies targeting other areas aimed at creating CE and driving GP.

The Green Public Procurement (GPP) refers to a procurement process for businesses offering goods and services with lower environmental impact within their life cycle. The Government of the Philippines adopted this as a voluntary process for organizations in compliance with the UN-SDGs (Government Procurement Board – Technical Support Office, 2017) [53]. This was first introduced in 2004 through Presidential Executive Order 301, Establishing a Green Procurement Program for All Departments, Bureaus, Offices, and Agencies of the Executive Branch of Government. The GPP is seen to contribute to the economic goals of the country.

On the other hand, Kalikasan Green Productivity, Green Purchasing towards Green Philippines is a biennial advocacy event that brings together different stakeholders, organizations, and industries, and creates a platform to gather sustainability and green initiatives commitment. It was recognized by Malacañang through Malacañang Memorandum Circular 68, s.2019 as a valuable platform for information dissemination, identification and presentation of best practices, and sharing of knowledge and experience on strategies towards achieving a green economy.

The National Ecolabelling Programme by the Green Choice Philippines or NELP-GLP is a third-party ecolabeling initiative guided by the principles of ISO 14020 and ISO 14024. These are international standards that focus on environmental management. NELP-GLP is primarily a consumer's guide for selecting environmentally-sound products. It also helps manufacturers adopt processes and supply products that are environment-friendly and stipulate its environmental compliance as a "market-based instrument" to complement the government's environmental policy. This compliance is marked by the Green Choice Seal, awarded to manufacturers and producers that meet the PCEPSDI's criteria. SDG 14, which focuses on environmental management, is being investigated in the country and other nations in Asia and the Pacific.

The Green My Enterprise (Green ME) program was developed by the National Wages Productivity Commission of the Department of Labor and Employment to help improve the productivity and performance of workers through the application of GP technologies. This training and consultancy program strengthens the existing productivity policies and practices implemented for and by the MSMEs. The Green ME program aims to increase awareness and understanding of GP in MSMEs. It also aims to increase the adoption of GP practices for a cleaner and safer workplace, healthier and productive workforce, competitive GP practices, and create more green jobs.

Lastly, the ADB assisted the NEDA in formulating the Philippine Action Plan for Sustainable Consumption and Production (PAP4SCP). This was made for Filipinos to produce and consume green goods and services to accelerate the shift towards sustainable and climate-smart practices and lifestyles. The primary aims of the PAP4SCP are centered on consumer awareness, marketing products with ecolabel seals, improved and streamlined certification on eco-labeled products, and crafting a call for action towards waste reduction.

5.10.2 Implementation of GP and CE in the Private Sector

In recognition of the importance of GP and CE, the three largest economic sectors in the country, agriculture, industry, and service sectors, made significant contributions to the Philippines' efforts towards creating a sustainable economy.

Agriculture sector

Various policies and programs toward GP and CE have been implemented since the 1960s in the agriculture sector. In terms of GP and CE programs, the Philippines was recognized as one of the outstanding countries with innovative projects on sustainable agriculture [54]. Some of the notable initiatives relevant to CE include (1) empoldering technique, (2) WWF Philippines and Pilmico Foods Corporation aquaponics project, (3) Philippine Rural Development project, (4) Sustainable Agroforest Land Technology (SALT3), and (5) Farmer-Scientist Training Program (FSTP).

The empoldering technique, a method of reclaiming low-lying land from bodies of water by building up dikes and constructing drainage canals, has provided fishery, crop, and aquaculture with better access to fresh water for improved production. It has also employed CE principles since the method creates a new upland microenvironment, which serves as a seedbed allowing the combination of fish with rice crop [53]. Overall, it displays the potential of circular agriculture with increased nutrient regulation and plant density, despite low nutrient and labor input.

The WWF Philippines and the Pilmico Foods Corporation recently introduced aquaponics to their foodshed design for poor communities. Water from the aquaponics system is used to water the crops grown in the foodshed, while the excess produce is used to feed livestock. The system has a low power demand, which is addressed by solar panels installed on the roof [55]. Such a project improves yield production and food availability, increases employment opportunities, and enhances food security for the region [53]. Similarly, SALT3 employs innovative methods of growing crops in between nitrogen-fixing trees and shrubs for shelter, crop rotation, and multi-storey cropping which address soil depletion and erosion, and preserve soil regenerative properties, while maximizing farm space (Tacio, 2019) [56]. These GP and CE farming methods and technologies also support the efforts of the Philippine Rural Development Project and the Global Environment Facility in promoting sustainable farming practices among farmers and fishers for the conservation and protection of marine and coastal resources [53].

The Agriculture and Fisheries Modernization Act of 1997, the Fisheries Code of 1998, the Republic Act 10601 or the Agriculture and Fisheries Mechanization Law, and the Republic Act 10068 or the Organic Agriculture Law are among other legislations that foster circular and green production. In general, these policies aim to empower farmers and fishers through the provision of training and certification for their farm products and proper planning and strategic agriculture and fishery development while alleviating environmental and human health degradation [57], [58], and [59].

Industry sector

The second-largest economic sector, the industry sector, also made remarkable efforts toward GP and CE. Its focus on green infrastructure fosters competitiveness, productivity, and employment opportunities, bringing environmental and economic benefits. Environment-wise, green infrastructure improves the reach, reliability, and efficiency of the national electricity grid without creating air pollution. Economically, green infrastructure broadens the economic base, creates new markets, and provides inclusion and connectivity across the Philippines.

In the manufacturing sector, the country launched the Promotion of Green Economic Development program implemented by GIZ that "elaborates a strategic approach on how GED can be comprehensively addressed within the overall industry road map process and become integrated into selected sectoral road maps" [60]. Another outstanding GP and CE initiative is technospheric and waste mining implemented in the mining sector, wherein gold mine tailings are reprocessed using new technologies to recover residual gold. Other important initiatives include moving the semiconductor value chain in the electronics industry and implementing the new EV under the Comprehensive Automotive Resurgence Strategy or CARS Program. The program has efficiently generated PHP9.1 billion of capital expense investments in producing 147,000 vehicles and 100,000 jobs. This has helped the Philippines save USD700 million in foreign exchange and is predicted to save the economy another USD1 billion in foreign exchange by 2024 [61].

However, there is a gap in the current GP and CE initiatives of the industry due to the demand for new base and precious metals to move toward a low-carbon economy. Since the country has limited reserves, opportunities for circular innovation will also be limited to those who already have the technical capacity. The country's industry sector needs to employ new approaches like big data, IoT, and material recycling to enhance demand forecasting and production planning for better quality and higher profit margins.

Nonetheless, implementation of innovation-centered and science and technology-based industrial policy, employment of the Inclusive Innovation Industrial Strategy, and execution of the House Bill 7609 (otherwise known as the Act to promote CE and a whole-of-nation transition towards a sustainable future), aid the industry sector in its GP and CE endeavors [60].

Service sector

GP and CE endeavors include remarkable accomplishments of the service sector: (1) ecotourism development, (2) creation of the Global Green Freight Action Plan, (3) European Chamber of Commerce of the Philippines' (ECCP) Circular Economy award program for the fashion business companies, (4) legalization of ride-sharing and carpooling services, (5) medical waste treatment initiatives, and (6) workshops and training conducted by several universities.

In terms of tourism and recreation, there are various ecotourism projects in the country some of which are LGU-led [62]. Regarding transportation, the Philippines agreed to sign the Global Green Freight Action Plan in 2013, which "intends to assist governments and businesses to promote trade in a cost-efficient way, thereby improving people's quality of life while preserving the environment. It is an important strategic pillar for developing a sustainable transport system and for improving logistics performance of countries and their economies" [63]. There are also notable CE transportation initiatives in various cities promoting battery-powered "green jeepneys" and "green buildings" and implementing battery-run tricycles [61]. Currently, the most relevant trend is the ride-sharing and carpooling apps launched by e-commerce company Rocket Internet, which allows car owners to post their available spare seats to commuters who are taking the same route at the same time [64].

In the commerce sector, ECCP in partnership with the Philippines actively advocates sustainability-related activities, including GP and CE, to put the country at a competitive advantage for local and foreign investments. One of its activities is the distribution of ECCP Europa Awards to recognize the exceptional performance of companies in promoting sustainability, GP and CE according to global standards and the Philippine Development Plan [65].

On the health sector front, the Philippines conducted GP and CE practices in terms of medical waste management which includes: (1) material recovery and recycling, banning of polystyrene foam packaging, composting, and encapsulation of autoclaved sharps waste of the hospital waste management team at Maria Reyna-Xavier University Hospital in Cagayan de Oro City; (2) safe practices to prevent radiation exposure in General Santos Doctors Hospital led by the radiology technology team; (3) use of safer alternatives for surface cleaning and cleaning of non-critical items by the housekeeping staff, autoclaving of waste, and maximizing natural lighting at St. Paul Hospital-Tuguegarao City; (4) installation of the first Philippine hospital biodigester designed by a biomedical waste worker to convert food and garden waste into methane gas for the kitchen and laundry, solar panels for water heating, green walls for cooling, and vermicomposting at Perpetual Succor Hospital in Cebu City; (5) wastewater treatment and reuse of treated water for gardening led by the engineers of Philippine Heart Center and Our Lady of Peace Hospital in Paranaque City; and (6) mercury-free dental services from the San Lazaro Hospital dentists [66].

In the education sector, several researches and workshops have been conducted for a more comprehensive application of GP and CE initiatives. The Graduate Study and Research in Agriculture (SEARCA), for instance, conducts workshops and training courses on CE in agriculture for executives and trainers (SEAMO-SEARCA, 2021). Another remarkable initiative is the Eco-Products International Fair and Conference organized by the Development Academy of the Philippines focusing on integrated waste management for GP. In terms of research, however, only a few studies promoting CE adoption, like the works of Balanay and Halog (2018) [67], Hilario (2019) [68], and Cabugon (2017) [69] were conducted in the country.

According to the PSA 2021 report, the service sector in the country posted a positive growth of 9.6% [70]. In fact, among the ASEAN countries, the Philippines is more inclined towards a better service economy for its comprehensive digital strategy. This paves the way for the Philippines to build networks and linkages with multinational institutions and prioritize investments in more efficient technology over upgrading old technologies and equipment. However, reports indicate that the CO_2 emissions in the country have increased. Thus, there is a further need for quality innovation and technology absorption for the service industry in the Philippines to prosper.

5.10.3 Recommended Strategies

CE strategies to strengthen GP implementation in the Philippines' largest economic sectors

GP promotes the utilization of strategies, techniques, and technology in reducing resource input and pollution generation in the manufacturing processes and supporting mechanisms. In line with the goals of GP, the circular economy advocates for increased resource utilization and value-added recycling practices to achieve zero waste for greater revenue generation. At present, several CE initiatives and policies have been employed in the major industries in the country. While there are significant improvements in the GP and CE implementation in the agriculture, industry, and service sector, there are still issues and gaps that need to be addressed. Table 11 shows the recommended strategies to address the issues and gaps encountered in each sector of the country.

To increase productivity of the three sectors, the following GP strategies must be employed: (1) Total Productive Maintenance, (2) Total Quality Management, and (3) process modification. For environmental protection, there are several existing GP strategies, including ISO 14001/EMS, 3Rs, good housekeeping/5S, design change, and waste management. These strategies, if implemented properly, will help alleviate the adverse effects of environmental degradation and improve the efficiency of global production-and-consumption systems, leading to economic growth.

Supplementary to GP strategies, among the most popular CE strategies recommended for the Philippines include: (1) enhancing data and digitalization, (2) promoting circular product design, (3) strengthening business enterprises, (4) establishing a good market for waste and recycled raw materials, and (5) maximizing value from buildings and biomass.

In addressing the current agricultural issues such as small farm size, land tenure, reduced farm labor, expensive equipment for small farmers, and inadequate technology transfer mechanisms, this study recommends strengthening small agricultural business enterprises. In addressing the demand for a new base and precious metals in the building and manufacturing industry, promoting circular product design and maximizing value from buildings and biomass are recommended. To conserve the limited reserves and resources, the country's industry sector needs to employ new approaches (i.e., big data, IoT, material recycling) to enhance demand forecasting and production planning for better quality and higher profit margins. This study also recommends developing new product designs, where the materials, chemicals, and components can retain high value for a longer duration such that repair and high-quality recycling are made possible.

Enhancing data and promoting digitalization is also crucial in improving the performance of the service industry, especially in effectively implementing ride-sharing and carpooling services that address the country's transportation problems. Overall, data and digitalization would help in improving political will and management capacity issues in the agriculture sector, demands and opportunities for circular innovation issues in the industry sector, and quality considerations, innovations, and technology absorption issues in the service sector, since enhanced data provide industries with valuable, accessible information regarding material consumption, quality, and quantity, which are crucial in developing new solutions and services.

TABLE 11

RECOMMENDED CE STRATEGIES FOR GP ENRICHMENT IN THE THREE LARGEST SECTORS OF THE PHILIPPINES.

Sector	Issues and Gaps	GP Strategies	CE Strategies
Agriculture	Management capacity	• Total Productive Maintenance • Total Quality Management • Process modification • ISO 14001/EMS • 3Rs • Good Housekeeping/5S • Waste management • Design change	• Enhancing data and digitalization • Promoting circular product design • Strengthening business enterprises • Establishing a good market for waste and recycled raw materials • Regulating energy consumption and waste generation of building constructions
Industry	Demand for new base and precious metals; opportunities for circular innovation will be snapped up by first-movers due to finite reserves		
Service	Quality considerations, innovations, and technology absorption issues		

Key actors in implementing recommended CE strategies for enhanced GP

As shown in Table 12, the Philippines can achieve the above-mentioned CE strategies through the collaboration of the public sector, business sector, and the education sector, with all key actors performing supplementary roles. This is specifically important for enhancing data and digitalization and for promoting CE in product design. Towards this, the public sector must design policies, regulations, and action plans that would encourage the research sector to study the importance of digital growth in helping the business sector adopt CE principles in their product design processes.

It is recommended that similar roles be performed by the key actors in introducing new consumption patterns for the CE. The government should also mandate the education sector to offer curricula on CE at the primary, secondary, and vocational levels. The public sector also plays a crucial role in strengthening business enterprises by creating regulations that would support enterprises in their CE business model development, production method, and technology. The policies must be reviewed such that the design does not limit or impede the CE processes of the business sector, especially the manufacturing and building sector.

For establishing a proper functioning market, there is a need for setting up a more aligned and uniform household waste collection practice, recycling system, and waste regulation administration. A collaboration between government, business, and the academic sector is crucial in acquiring funds for the CE research programs that would inform SMEs on how to develop, implement, and upscale circular business.

Finally, it is recommended that the manufacturing industry increase value of their construction materials, reduce maintenance costs, and minimize environmental and human health risks. In doing so, the building industry needs information from research on construction waste reduction. Most importantly, the government should set a requirement for the energy cost and waste generation of construction materials. These guidelines would assist the business sector in their CE endeavors.

TABLE 12

THE ROLES OF KEY ACTORS IN THE IMPLEMENTATION OF RECOMMENDED CE STRATEGIES FOR GP.

CE Strategies	Roles of Key Actors		
	Public Sector	Business Sector	Research and Academic Sector
Enhancing data and digitalization	• Develop action plans and strategies for digital growth.	• Incorporate the action plans in their business operations; use available data as a basis for product design decisions.	• Create research programs on data and digitalization for CE transition.
Introducing new consumption patterns	• Create policies requiring education institutions to incorporate circular economy in primary, secondary, and vocational schools.	• Design products and components with a longer life span.	• Offer curricula matching the needs of the target group for transitioning to the circular economy.
Promoting circular product design	• Incorporate circular economy in product policy.	• Employ circular product design, production processes, and business models.	• Create research programs on CE which provide technical and financial assistance to SMEs on how to develop, implement, and upscale circular business.

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CE Strategies	Roles of Key Actors		
	Public Sector	Business Sector	Research and Academic Sector
Strengthening business enterprises	• Create regulations that support enterprises to develop and use their own CE model, production method, and technology.	• Collaborate with other sectors to acquire funds for circular economy implementation.	• Create research programs on CE which provide technical and financial assistance to SMEs on how to develop, implement, and upscale circular business.
Establishing a good market for waste and recycled raw materials	• Create policies that would harmonize waste collection procedures.		
Maximizing value from buildings and biomass	• Design building regulations that ensure increased extent and value of reuse and recycling of construction materials, and reduction of total energy consumption. • Set requirements for construction materials' "embedded energy" – i.e., the sum of all energy used. • Increase production and waste management.	• Increase value of construction materials, reduce maintenance costs and environmental and human health risks.	• Conduct research on how to reduce construction waste.

5.11 Thailand

5.11.1 Initiatives and Policies

In 2018, Thailand generated over 27 million tonnes of municipal solid waste, most of which was neither recycled, nor disposed of appropriately. Only 25% of the plastic waste was recycled. The problems of municipal solid waste and plastic waste are one of the major problems in Thailand that needs to be resolved urgently.

Potential businesses and companies with CE concepts can increase their business value from waste management and drive their business toward green growth. Therefore, the country cannot drive and achieve Thailand 4.0 with just innovation and technology utilization and implementation. It needs significant progress and operation toward green growth, especially through the BCG model. Thailand also plans to implement the CE concept within the Eastern Economic Corridor, a special investment zone.

Many Thai companies have taken the first step to integrate the CE concepts in their operation. For example, Magnolia Quality Development Corporation, a Thai real estate developer, has committed to innovation for sustainability throughout their value chain. They increase construction efficiency and apply recycled plastic waste in their property development projects. PTT Global Chemical Public Company Limited has established collaboration with a Japanese company for biodegradable products and compostable bio-based PBS plastic from agriculture products. Lastly, True Corporation, a leading telecommunication company in Thailand, has launched a Mobile Phone Recycling Program to promote e-waste recycling. The company distributes devices composed of e-waste to its partners.

The Ministry of Interior has motivated the industries in Thailand to adopt GP by focusing on three key areas: (1) improvement of manufacturing processes, (2) waste management, reuse, and recycling, and (3) promotion and encouragement of CE growth. The Government of Thailand has also launched and implemented the Roadmap on Plastic Waste Management (2018 – 2030) to deal with the plastic waste issues, setting a goal that all plastic must be recycled by 2027. To support these policies and activities, the Thailand Board of Investment has launched incentive schemes for Thai companies and businesses to support private investment and operation in line with the CE concept, including the use of secondary raw materials, waste recycling operations or systems, and improvement in production processes to make it environmental-friendly.

With greater concern for the environment and raising awareness of social responsibility and SDGs achievement, Thai companies and businesses are forced to change their business operations and models. Driven by the disruptions, they are transitioning from the linear model of 'take-make-dispose' to the circular paradigm of 'make-use-return' by applying advanced technology and innovation to 'close the loop' with support from the government (e.g., incentive schemes for investment attraction).

TABLE 13

GP AND CE INITIATIVES AND PROGRAMS IN THAILAND.

Initiatives and Programs	Main Functions and Purposes	Parties Engaged
BCG Economy Model (Bio-Circular-Green)	• Capitalize domestic biodiversity throughout the supply chain by strengthening the capacity of local communities. • Create high value added for production through the use of biological resources, science, technology and innovation (STI). • Emphasize resource efficiency and waste management. • Utilize natural resources more efficiently with least adverse impacts on the environment. • Waste utilization to avoid resource shortage. Use appropriate resources and reduce greenhouse gases emission. • Enhance the quality of living and reduce environmental risks.	**Authority** Government **Parties engaged** 1. Ministry of Natural Resource and Environment (MNRE) 2. Ministry of Industry (MOI) 3. Ministry of Interior 4. Some public and private sector companies with interest in Circular Economy
The Roadmap on Plastic Waste Management (2018 – 2030)	• Reduce and replace some single-use plastic by using environmentally-friendly products. • Recycle target plastic waste by applying the circular economy principle. • Encourage the use of secondary raw materials. • Improve production processes to make them environment-friendly. • Encourage 3Rs concept: Reduce for the usage reduction or use as necessary, Reuse for repeated use, Recycle for invention of new products.	**Authority** Government **Parties engaged** 1. Pollution Control Department (PCD) of the Ministry of Natural Resource and Environment (MNRE) 2. Ministry of Interior 3. Some public and private sectors

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Initiatives and Programs	Main Functions and Purposes	Parties Engaged
Green industries	• Develop urban areas based on the potential of resources and physical structure to increase productivity and reduce the impact on the environment. • Develop occupational health and safety standards and promote social responsibility to balance economic growth with the environment. • Improve production processing, environmental management, and social responsibility. • Maximize resource utilization.	**Authority** Government **Parties engaged** 1. Department of Industrial Works (DIW), Ministry of Industry (MOI) 2. Some factories and enterprises

5.11.2 Implementation of GP and CE in the Private Sector

The following sectors and industries are classified based on GP and CE coverage.

Industry sector: Automotive, electronic, petrochemical and chemical, cement, food and beverages, textile, and garment industries.

Agriculture sector: Industries of rice, bagasse, oil palm, rubber, and fishery.

Service sector: Tourism, education, medication, financial, and transportation industries.

Thailand's economic growth depends on export activities, especially yields and commodities from the agriculture sectors and automotive-electronic sectors. Here is a summary of Thailand's important sectors and industries for export activities.

In terms of economic benefits, GP and CE introduce ways and means to optimize available resources most efficiently, which can help businesses reduce costs and increase income. They can also broaden opportunities to expand and invest in new business areas, such as logistic and distribution services, high-quality waste recycling, biofuel production, sharing platform and technology-related businesses. It could accelerate enactment of new laws and regulations, including those related to taxation. Adopting the CE approach can also result in cheaper production, multi-functioned products and services, and easier distribution and reuse. Importantly, they generate job vacancies and increase employment rates to drive the economy. GP and CE are also crucial to increasing the GDP and driving economic growth. However, there are economic barriers to implementing GP and CE. Currently, the price of raw materials is unpredictable and the quality of secondary resources is not competitive. While upfront investment is required sometimes, the demand for products and services is small, and professionals with relevant techniques or ICT knowledge are not available. Therefore, it is difficult to develop and operate a CE business model, and most investors still operate in the linear model.

GP and CE reduce the negative impact of land use expansion, soil quality degradation, water, and air pollution, toxic substance contamination, climate change impact, and GHG emissions. It encourages the reuse of raw materials, increases agricultural productivity, and decreases negative externalities resulting from the linear production model. All new business models need to be

considered and attached to clean environment and innovation plan and regulation, otherwise, they are not ready to challenge and implement GP and CE concepts presently.

5.11.3 Recommended Strategies

1. Green growth and sustainable development should be promoted to ensure the balance between environmental growth and social-economic growth, or the balance of quality of life and quality of natural resources and the environment, through bioeconomy. It led us to quality-of-life enhancement, social fairness improvement, environmental risk, and environmental scarcity reduction, through various measures such as environmental-friendly consumption and production, greenfield and forest area expansion, wildlife resources, and biodiversity preservation, and ensured individual awareness of social responsibilities and the national interests.

2. Sustainable climate-friendly based society growth should be promoted. It should focus on GHG emission reduction and low-carbon society promotion, disaster management improvement and individual ability to cope with natural disasters and climate change, and investment promotion in environmentally-responsible infrastructure projects.

3. Public and private investment in climate-friendly infrastructure development should be supported by the government and included in the national agenda, and plans in all aspects, including engineering and infrastructure development, promotion of low-carbon products and services, national competitiveness enhancement, investment incentive measures, and business preparation plans to deal with climate change issues, and climate-related laws and legislation.

4. The national environment standards should be promoted to meet the international environmental standard, to reduce pollution and toxic residual/substances in soil, water, air and forests, wildlife, and biodiversity in the areas affected by any human project implementation. Innovation and technology to reduce waste and pollution, and 3R–Reduce-Reuse-Recycle to save natural resources and the environment, are implemented.

5. Eco-friendly water-, energy- and agricultural security should be promoted through an integrated water management system, increasing the productivity of water usage, water-related disaster prevention and management, and renewable and alternative energy production and management, further leading to the higher productivity and security of food production bases.

6. Water productivity and its system and management should be enhanced to promote water usage and reuse efficiency to meet international standards. It includes water security in household-, commercial- and service needs in the cities, urban water system and management, water map system, clean water distribution system, and wastewater system and management (collecting and draining) in communities. It also includes water integrated system for reservoirs, critical areas and crisis situations, and water control system for modern agro-industrial estates, rainwater, and irrigation, especially in agricultural areas, economic zones, and tourist sites. All are based on criteria and priority to promote value-added in water production and services.

7. Eco-friendly energy security and energy usage should be promoted to increase renewable and alternative energy production and develop electricity management on both the demand

and supply sides for higher efficiency and flexibility of renewable and alternative energy consumption. It is also essential for supporting more efficient energy use in the industry sector, promoting connectivity between the agro-industrial, business, and household sectors, supporting research and development, and upgrading energy storage and smart grid technology to enable a higher proportion of power from renewable and alternative energy, along with decentralized centers of power generation while supporting marketing tools and economic measures to increase energy management efficiency that is friendly to the environment.

8. Efficiency through energy intensity reduction should be enhanced, and energy conservation and efficient use of energy should be supported to reduce the national cost of energy through financial and non-financial tools and legal measures. This includes encouraging energy-saving building design, promoting financial incentives, enforcement of building and design regulations, and promoting campaigns and knowledge sharing to educate the public about energy-saving. Other measures include, promoting the use of energy-saving equipment and machinery, displaying green labels on energy-saving vehicle and equipment, and supporting environmentally-friendly logistics and transportation.

5.12 Vietnam

5.12.1 Initiatives and Policies

Vietnam is strongly committed to the implementation of SDGs through the issuance of Vietnam's Sustainable Development Strategy in 2004, for 2011-2020, and most recently, the National Action Plan to implement the 2030 Agenda for Sustainable Development. Vietnam has nationalized the global 2030 Agenda into a National Action Plan for implementing 17 SDGs and 115 specific goals in line with conditions and priorities for development of the country. On 25 September 2020, the government also issued Resolution No. 136/NQ-CP on sustainable development.

Although Vietnam does not have a national program framework on CE, the content has been reflected in many national development strategies and policies in the past (Table 14).

TABLE 14

SUMMARY OF NATIONAL DEVELOPMENT STRATEGIES AND POLICIES ON CE IN VIETNAM.

Strategies and Policies	Official Number	Issued by
Law on Environmental Protection	No. 55/2014/QH13	13th National Assembly
Law on Investment	No. 59/2005/QH11	11th National Assembly
Decree on urgent solutions in the field of natural resources and environment	No. 27/NQ-CP	Government
Five-year socio-economic development plan from 2016 – 2020	No. 142/2016/QH13	13th National Assembly
Vietnam Industrial Development Strategy to 2025 and a Vision to 2035	No. 879/QD-TTg	Prime Minister
Strategy on cleaner industrial production to 2020	No. 1419/QĐ-TTg	Prime Minister
Strategy for using clean technologies by 2020	No. 1216/QĐ-TTg	Prime Minister

Law on Environmental Protection

On 23 June 2014, the 13th National Assembly passed the Law on Environmental Protection No. 55/2014/QH13, consisting of 20 chapters and 170 articles. The Law on Environmental Protection 2014 which came into effect on 1 January 2015 inherits the basic contents of the Law on Environmental Protection 2005. However, it overcame the limitations of unenforceable provisions to legislate new guidelines and policies on environmental protection. Promoting the consumption of environmentally-friendly products is mentioned in eight out of 170 Articles. These include Article 5, Article 6, Article 41, Article 42, Article 43, Article 44, Article 45, and Article 151. Of these, Articles 43, 44, and 151 are directly related and are the basis for promoting sustainable consumption activities in Vietnam.

Law on Investment

The 2005 Law on Investment No. 59/2005/QH11 has articles related to investment to promote environmental sustainability and changing the perception of consumption in enterprises as defined in Articles 3 and 27. Article 30 stipulates the areas where investment is prohibited, like projects that harm people's health, destroy natural resources and the environment, hazardous waste treatment projects brought from outside Vietnam, manufacturing of toxic chemicals, or use of toxic agents prohibited by international treaties.

Resolution No. 27/NQ-CP

To strengthen and improve the efficiency of state management of natural resources and the environment, the government issued Resolution No. 27/NQ-CP on 12 June 2009 focusing on several urgent solutions for managing natural resources and the environment. Specific responsibilities were assigned to each relevant line ministry to deal with critical natural resource and environmental issues. The focus was on timely and thorough handling of polluting establishments and environmental contamination. It was also meant to develop the environmental industry, provide guidance in the implementation of cleaner production, apply clean and environmentally-friendly technologies to industry and trade establishments, change the industrial production model towards sustainability, and determine a green industry.

Socio-economic development strategy

The Socio-Economic Development Strategy 2011-2020 mandated that by 2020 the newly established businesses must apply clean technology or adopt pollution reduction and waste treatment equipment. Today, over 80% of production and business establishments meet environmental standards. Urban centers of grade 4 or higher and all clusters, industrial parks, and export processing zones have centralized wastewater treatment systems; 95% of ordinary solid waste; 85% of hazardous waste, and 100% of medical waste are treated as per the standard. The five-year Socio-Economic Development Plan 2016-2020 had also set out four environmental targets, including treating 85% of hazardous material and 95-100% of medical waste by 2020.

Industrial development strategy

The Vietnam Industrial Development Strategy to 2025, Vision to 2035, and the Master Plan for Vietnam's Industrial Development to 2020, Vision to 2030 set out priorities for structural changes in development across industries. The target for 2025 is to develop an economical and efficient energy-using industry, new material industry, and environmental industry. The annual increase in greenhouse gas emissions in the industry will be 4-4.5%, while the energy elasticity of GDP will gradually decrease to 1 in 2020 and 0.6-0.8 by 2035.

Cleaner production strategy

The cleaner production strategy in the industry set out to achieve the following objectives between 2016 and 2020: to make 90% of production facilities aware of the benefits of cleaner production, 50% of production facilities to apply cleaner production methods, 8-13% of establishments save raw materials, and 90% of the offices under the Department of Industry and Trade have qualified staffs to guide cleaner production. Several key contents and priority areas focus on small and medium-sized industrial production enterprises, including raising awareness and capacity to apply cleaner production in industry, technical support for the application of cleaner production in industrial production facilities, and perfecting financial mechanisms and policies to promote the application of cleaner production in the industry.

Strategies for using clean technology

Strategy on using clean technology to 2020, with a vision to 2030, promotes the use of clean and environmental-friendly technologies, increasing efficiency in the use of energy, resources, and low emissions in production to promote green growth, mitigate climate change and improve community life. It was mandated that by 2020, 100% of new investment projects in the above industries must meet technical standards and regulations of clean technology. Over 60-70% of production facilities operating in the above industries have completed the formulation and implementation of a roadmap for technological innovation towards the use of clean technology.

Environmental industry development program

The project on developing the environmental industry to 2015, with a vision to 2025 with the goal to develop the environmental industry into an economic sector that makes an essential contribution to the structure of Vietnam's industrial development, can provide environmental technologies, equipment, services, and products to meet the requirements of environmental protection to treat and control pollution, overcome degradation, limit the increase in pollution and improve the quality of the environment, and sustainable use of resources.

The Prime Minister set up a National Steering Committee on Green Growth at the central level headed by Deputy Prime Minister. The Minister of Planning and Investment is the Deputy Head of the committee, while representatives of the Ministries of Finance, Industry and Trade, Agriculture and Rural Development, Transport, Construction, Natural Resources and Environment, and other relevant agencies have been appointed as trustees.

The Ministry of Planning and Investment is the focal point on green growth, helping the Prime Minister unify the implementation of the National Strategy on green growth. It coordinates with ministries, branches, and localities to formulate and submit promulgation mechanisms and policies to promote green growth.

5.12.2 Implementation of GP and CE in the Private Sector

Vietnam can fully apply two approaches to implementing CE. The systemic economy-wide approach has the advantage of several eco-industrial parks where businesses can come together to exchange raw materials and output that can serve as input for others. From the experience of these eco-industrial parks, the government can consider and develop the model with appropriate strategies and preferential policies.

Vietnam has many successful examples of businesses and sectors using such products, materials, substances, and approaches. These include the initiative to recycle beer bottle caps into iron

materials used in the construction by Tiger beer (belonging to Heineken Vietnam) or VAC models and variants (emission recovery from landfill), recovery of biogas from livestock farms, and model of waste recycling craft villages.

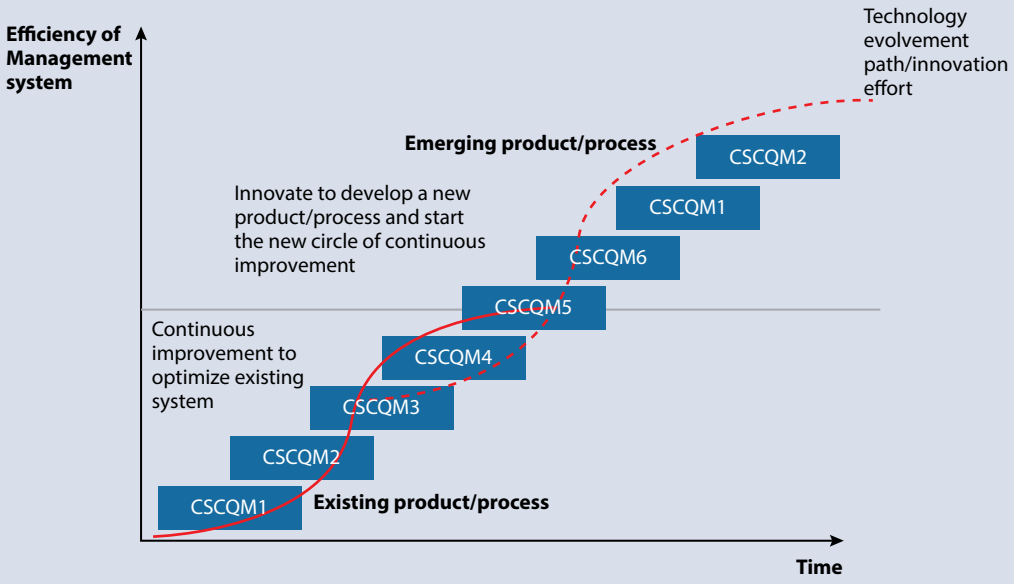
For a short-term solution, Vietnam should use a material-specific approach, focusing on reducing plastic waste, especially those from single-use products, impacting the whole economy. In terms of a long-term solution, in addition to continuing to expand the approach by types of materials, Vietnam can consider carefully designed and built models of circular industrial parks and circular cities.

For a long time, Quality Management Tools (QMTs) have been applied to improve firms' performance. The purpose of quality management practices is to minimize waste and resources through improvements while improving customer satisfaction and financial results. QMTs contribute significantly towards increasing productivity, reducing cost, improving delivery reliability, and reducing absenteeism among the employees. The benefit of QMTs in developing countries is extensively documented in the literature.

The integration of QM philosophy in SCM facilitates inner-link within firms and improves interconnection across the supply chain networks. The Circular Supply Chain Quality Management (CSCQM) model, as depicted in Figure 35, indicates five stages of SMEs' pathway to CSCQM.

FIGURE 35

CSCQM INTEGRATED MODEL.



Source: National expert's illustration based on STAMEQ training document.

In the first stage, enterprises focus on enhancing operations mainly based on labor factors and human resource force. This stage is called CSCQM1. It can be said that CSCQM1 is the period of productivity promotion based on labor driven base. The productivity improvement tools like Kaizen, 5S, QCC, and TWI are simple and suit the employee mindset. CSCQM1 helps build a culture of improvement in the enterprises. At the same time, these tools also help facilitate

communication across the supply chain. It is found that trained employees can better understand customer problems and communicate.

In the second stage of continuous improvement, enterprises focus on optimizing the utilization of capital equipment and machines. Productivity improvement tools such as QC, TPM, SPC, and IE, are applied to improve the reliability of equipment and thus investment efficiency of production lines and equipment. Reduction in waste and production cost translates into lower overall cost, which further improves the financial performance. For example, TPM optimizes the inventory by reducing stocks and tasks that do not add value to the final product. CSCQM2, thus, helps build a culture of optimizing resources in enterprises.

In the third stage, businesses aim to effectively manage labor and capital and focus on boosting productivity and minimizing cost by strengthening internal and external linkages. This stage is called CSCQM3 for promoting productivity based on the overall management foundation. Productivity improvement tools such as ISO, KPI, Lean, Six Sigma, and supply chain management are applied to allow managers or directors to track production progress through a control panel system. At this stage, SMEs focus on optimizing production and aim to enhance the link between the market, distribution network, production process, and procurement activities. CSCQM3 helps build a comprehensive management culture in the enterprises.

In the fourth stage, enterprises continue to enhance productivity through a systematic approach to capture, structure, manage, and disseminate knowledge across the organization. The CSCQM4 stage helps enhance work, reuse best practices, and reduce costs. It can be said that CSCQM4 is the stage of promoting productivity based on the knowledge management foundation. Productivity improvement tools such as Knowledge Management tools are applied to improve enterprise productivity. This helps build a culture of knowledge in the enterprises.

In the fifth stage, enterprises digitize activities to boost productivity by applying information technology solutions in production and business. This stage is called CSCQM5, and it is relevant to Industry 4.0. At this stage, SMEs integrate digital technologies into the entire product value chain, from design and R&D to manufacturing and services. The collected data and information are shared and communicated on an open innovation platform, which can help capture and analyze end-user needs in real-time, optimize resource management and use, and improve supply. Chain flexibility promotes production, service technology, and even business model innovation, so that producers in the industrial ecosystem can better finance. As SMEs, at this stage, can improve and standardize processes by addressing the root cause of the problem by eliminating waste, reducing variation, and effectively managing the knowledge flow in the company thanks to the application of previous SCQM tools, they are now ready to move toward digitalization with the integration of digital technologies to quality management and later to innovation management. CSCQM5 helps build a digital culture in enterprises.

Digital transformation is not the end of the journey. Enterprises continue to increase productivity by building and forming a system of innovation and developing a culture of innovation. This stage is called CSCQM6. This is the combined power of all resources (knowledge, digital, capital, innovative ideas, disruptive technologies, business models, etc.) to promote exponential productivity growth. It can be said that CSCQM6 is the stage of productivity promotion based on the innovative management platform. Productivity improvement tools such as ISO 56000:2020, ISO 56002:2019, ISO 56003:2019, and ISO 56004:2019 systems are applied to boost business productivity. Productivity 6.0 helps build a culture of innovation in enterprises.

5.12.3 Recommended Strategies

Institutionalizing and implementing CE in all activities

International experience shows that the institutionalization of CE, especially the development of the CE Law, is the solution chosen by many countries, typically the People's Republic of China, Germany, Japan, and the Netherlands. The law will help in the systematic and synchronized implementation of CE.

The government's vital role is to create an environment for the adoption of CE. It is an environment with a clear legal system, an appropriate roadmap, incentives (administrative mechanisms and procedures, finance, access to resources), and transparent sanctions. Since then, CE models have been encouraged and effectively implemented across all economic and social activities. In addition, the constructive role is also shown through green public spending.

Building a CE roadmap

Vietnam first needs to focus on managing plastic waste and disposable plastic products. In the long term, Vietnam can adopt the circular industrial park and circular city models to shape, design, and build carefully, from pilot to replication.

In addition, the roadmap also requires continuous implementation of other elements of the CE, such as encouraging renewable energy, promoting the use of environmental-friendly products, and perfecting and developing models. The CE model already exists in Vietnam.

In particular, the CE roadmaps worldwide identify enterprises as the central driving force for implementing CE. For the country, the Vietnam Chamber of Commerce and Industry (VCCI) represents the business community and is also considered a pioneer in CE. Therefore, the government should closely coordinate with the VCCI to implement the CE roadmap.

Promoting recycling markets

Along with limiting difficult-to-recycle waste such as plastic waste, the second approach also includes promoting the formation and development of recycling markets, such as the paper recycling market. Accordingly, the use of the 'market-based approach' to facilitate the formation and development of these markets should be taken into account. For Vietnam, some policy solutions in this group may include EPR, forming and developing a secondary raw material market.

Applying economic tools

There are several economic tools like taxes, fees, discharge permits, transfer of emissions, etc. However, there is a need to carefully decide where to apply which tools. One point worth noting is that the craft villages, households, and small-scale production models in Vietnam have not been closely monitored and managed. For example, plastic bag manufacturers often only pay flat tax because their output and revenue are not fully reported. This is a huge difficulty, affecting the feasibility of applying economic tools, such as a tax on non-biodegradable plastic bags.

Preparing for a shift in demand

The shift from a linear economy to CE is likely to bring changes in demand for resources. For example, to reduce greenhouse gas emissions, it is necessary to reduce the use of energy from fossil fuels and increase the use of renewable energy. Thus, there will come a point where the economy will reduce demand for coal and increase the demand for rare earth (used to make wind turbines). These issues need to be foreseen.

Building a database system on CE

The CE data is a collection of information on good circular practices and initiatives to review and replicate and includes essential data to help gauge the circularity of the economy such as solid waste recycling rate, waste reuse rate, and resource recycling efficiency. These are important data for the management, regulation, and implementation of the CE.

Industry 4.0 development associated with the CE

Many new circular initiatives can emerge from the development of technology. For example, software installed on the phone allows users to earn points when collecting recyclables. They can then use these points to make purchases at many supermarkets and shops instead of cash. This encourages people to participate in collection and recycling and helps to raise people's awareness.

It is important to note the impact of technological development on the CE. For example, the increasing popularity of smartphones and the shortening of the phone's life cycle due to technological upgrades lead to the wastage of billion batteries. This is hazardous waste that is difficult to recycle. Therefore, policymakers need to anticipate these impacts to be proactive in development decisions and strategies.

EXAMPLES OF GP AND CE PRACTICES

6.1 Material Flow Cost Accounting (MFCA) Implementation at Kushum Kali, Bangladesh

Defining the scope and material flow model

The team started by defining the scope of analysis by considering the four connected quality checks (QCs) at cutting, assembly, sewing, and lasting process as shown in Figure 36.

FIGURE 36

MFCA SCOPE OF ANALYSIS AT KUSHUM ASSEMBLY AND LASTING PROCESS.

Source: Kushum Kali Footwear, APO Demonstration Project on MFCA, 2019.

Defining input, output, material balance, and MFCA cost

Much waste was found at the cutting process stage, constituting the highest percentage of material losses. There were multiple reasons for these wastes, including the quality of the knife, variation in the cutting pattern, and quality of the machine. The assembly process had lots of wasted glue due to poor management of the tool used. Similarly, a significant amount of waste was generated during the trimming process.

The material balances were calculated for each QC, especially each cutting material. The results showed that the material losses could be up to 14%. The calculation of the MFCA cost and report was done for each QC and the overall MFCA calculation was made for the whole boundary.

The team members were asked to look at the production flow efficiency. The same technique was also applied to the Kushum Kali process to increase the overall system efficiency and throughput. The analysis found that the system cost (SC) can be drastically reduced with the productivity

improvement technique of Lean. The overall analysis helped create a plan to improve the system flow and reduce materials. This productivity improvement and MFCA concept led to 10 Lux savings annually.

Improvement in cutting material process and reduction in variation

At Kushum, the improvement of cutting losses was planned and implemented by using optimization of the pattern before cutting, jig and fixture improvement, and self-maintenance to help reduce the variation of cutting gap between each piece.

BEFORE

High volume of wastage due to lack of pattern optimization.

AFTER

Less wastage after pattern optimization.

Bad quality of knives due to lack of maintenance.

Better quality of knives with the implementation of 5s and self-maintenance.

High loss due to lack of mechanism for glue control.

Minimum loss after adoption of proper glue control mechanism.

Source: Kushum Kali Footwear, APO Demonstration Project on MFCA, 2019.

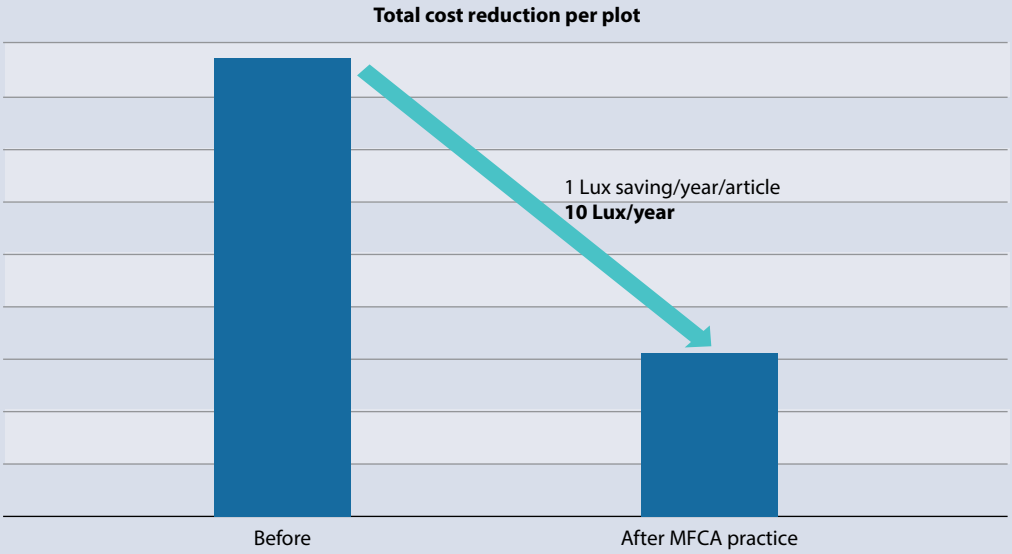
- The system flow was improved by balancing and reducing the cycle time, which led to a reduction in SC and EC costs. Reduction in manpower and improvement in the quality system led to a significant reduction in SC.

- New forms of production and quality control were devised and implemented. This brought a significant reduction in the waste generated due to rework. It also helped increase the throughput.

After implementing the MFCA, the company reduced the consumption of leather used for the upper part and sock by 7,000 sq. ft. It also reduced up to 4,900 yards of synthetic used, while the consumption of glue went down by at least 0.3 kg. The impact was an annual reduction in total material consumption cost by BDT30,000. This helped save around BDT10 lakh for a single article.

FIGURE 37

IMPROVEMENT RESULTS AT KUSHUM PROCESS.



Source: Kushum Kali Footwear, APO Demonstration Project on MFCA, 2019.

6.2 M's Pig Farm, Cambodia

The pig farm, M's Pig, was selected for the case study. Currently, the farm is equipped with the lagoon biodigester that can run the generator to produce electricity for the farm.

Approximately 6,000-7,000 tonnes of feed can be produced every month to feed around 4,000 heads of growing pigs. Generally, 4000-5000 m3 feed is produced per farm, per day. Waste management, bio-security, bad smell minimization, and a healthy environment, especially for staff and workers, are the benefits of operating the lagoon biodigester, particularly for producing biogas to run the electricity generator.

This farm has been on Green Goal and activities with green consumption and procurement, take-back and recycling, automation and virtualization, energy saving, and reduction in GHG and carbon footprint by applying national standards for sustainability (e.g., waste and wastewater management). The farm has a moderately positive impact from the green activity and approximately 1-2% on the organization's profit or productivity. It led to energy saving for humidity control and ventilation system in the farms and air-conditioner usage. In return, about 200,000 kWh was saved per month. Nevertheless, it requires training of the workforce, technology transfer, management skills, and financial capital for maintaining a sustainable supply chain.

FIGURE 38

A LAGOON BIODIGESTER THAT GENERATES ELECTRICITY FOR THE M'S PIG FARM.

Source: M's Pig Farm.

FIGURE 39

A GENERATOR THAT RUNS WITH BIOGAS FROM THE LAGOON BIODIGESTER.

Source: M's Pig Farm.

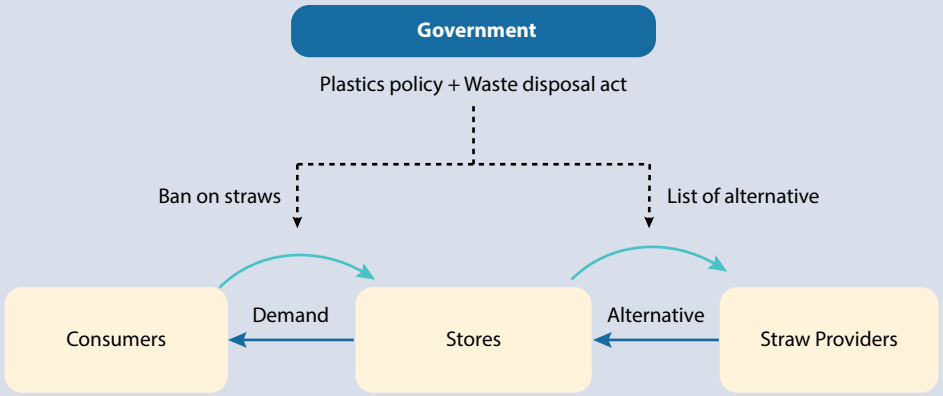
6.3 Ban on Plastic Straws, Republic of China

The ban on plastic straws is an effective measure for the service sector. Accompanied by new substitute ideas, such as bio-based straws or new cup design, it can help create new business models and companies. For example, Starbucks and Mos Burger changed their cup design to enable customers to drink directly without straws. Paper or other straws described in the measure are now common for customers.

This case demonstrates how government can leverage the existing law to realize the CE instead of proposing a new one, as illustrated in Figure. It formed a top-down driving force of the government. Once the habit of customers was forced to change, the stores modified their business model accordingly, and the providers adopted the alternatives to meet the demand of stores and customers. When exploiting the existing framework, we can reduce time and barriers to negotiate with stakeholders or people of with vested interests.

FIGURE 40

THE RELATIONSHIP FOR THE BAN ON STRAWS.



6.4 Future Farms Limited (FFL), Fiji

Future Farms Limited trading as Rooster Poultry

Rooster Poultry initiated a GP project with the assistance of the APO. The initiative aimed to use chicken litter as a value-added commercial product. Before initiating this project, Rooster Poultry developed one of the largest solar power systems in the country, a 500-KW system that can generate 25% of the power requirement at the site. The system has generated roughly 1,537 mWh of green energy since its launch. This has resulted in an estimated savings of 466,000 liters of diesel for Energy Fiji Limited (EFL) required to generate energy. Not burning diesel means that CO_2 emissions have been reduced by 1,094 tonnes, equivalent to planting 28,050 trees. Expansion of the solar power system at FFL aligns with the government's commitment to meet 90% of all Fiji's energy needs through renewable energy and the plans to reduce its carbon gas emissions before 2030, as outlined by Prime Minister Josaia Voreqe Bainimarama at the recent National Climate Change Summit.

EFL carries out Environmental Impact Assessment for any new development done. This is a legislative requirement by the Environment Management Act 2005. It also ensures that the Waste Management Act is abided by during production, thus the need to convert chicken litter into value-added products. EFL produces 70 tonnes of chicken litter per shed, which is converted into organic fertilizer as a product and is sold under the product name Compost Magic.

6.5 ACC Cement, India

ACC has a robust approach to promoting the use of alternative fuels and raw materials by co- processing hazardous and non-hazardous wastes in cement kilns. This allows the company an opportunity to offer unique and sustainable waste management solutions to industries, municipalities, and other bodies to effectively dispose of industrial wastes, municipal solid wastes, and biomass.

Safe management of waste through co-processing, as done in a highly professional setting utilizing the avant-garde technology available in ACC plants, ensures complete destruction of waste. The waste is managed safely without any change in the cement kiln exhaust gas composition or leaving any residues. ACC has been offering this solution under the Geocycle brand since 2014 though it started providing waste management services in 2005. In 2020-21, ACC consumed 5.33 MT of fly ash and 2.82 MT of slag, 0.4 MT of synthetic gypsum, including phosphor-gypsum, and 0.57 MT of alternative fuels and raw materials in cement manufacturing. Additionally, 0.16 MT of waste-derived resources comprising fly ash and slag was also consumed in concrete production [71].

6.6 Great Giant Pineapple (GGP) Co. PT, Indonesia

The company is engaged in the integrated agriculture sector with a wide reach and partnerships involving local farmers. GGP applies values in CE in its business model as follows.

TABLE 15

GGP BUSINESS MODEL.

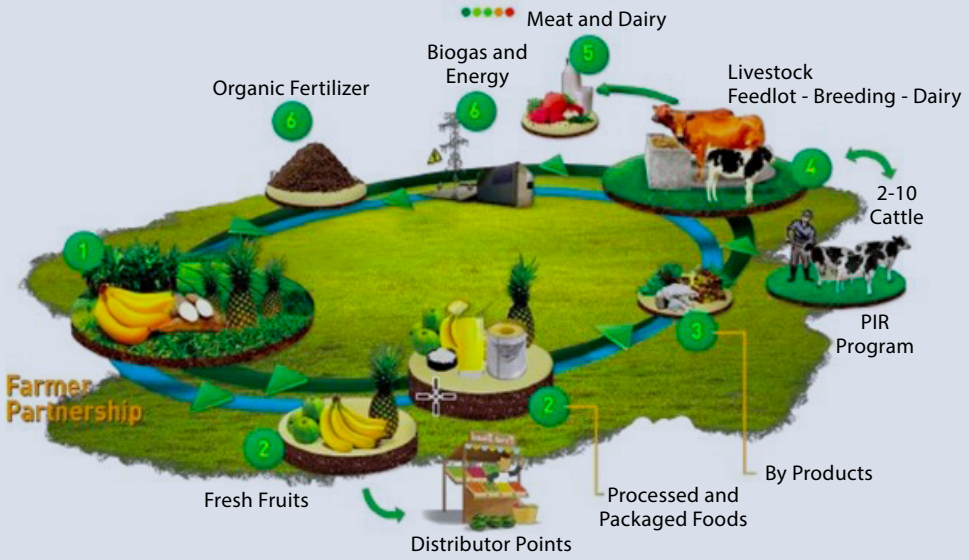
GGP Business Model	Description
Ensuring environmental sustainability	• Carbon footprint • Water sustainability • Energy efficiency conservation • Waste management system • Sustainable agriculture
Improving the socioeconomic condition of the community	• Community empowerment and development • Employee engagement • Health Promotion and education • Creating stock value
Ensuring business continuity and making GGP innovative to remain competitive and relevant, and supporting the company to achieve its growth strategy	• Improving business performance by generating operational efficiency and cost savings through a more sustainable business model (becoming a low-cost producer, increasing productivity, increasing volume and market expansion, etc.) • Promoting risk management and compliance to avoid and protect the company from current and future threats (food safety traceability, etc.) • Enhanced company brand value and reputation • Responsive to market changes and future trends and becoming a more innovative company and remaining competitive and business relevance

Source: PT Great Giant Pineapple secondary data; processed in 2021.

As described in table 15, GGP carries out the 4R business principles, namely Reduce, Reuse, Recycling, and upcycling (utilizing recycled products as raw materials for other products). GGP carries out an environmentally friendly production efficiency process from the beginning to managing company waste to be reused. The following illustrates the steps for implementing the CE in GGP.

FIGURE 41

APPLICATION OF CE IN THE UPSTREAM AND DOWNSTREAM PRODUCTION PROCESSES AT GGP.



Source: PT Great Giant Pineapple.

As explained in figure 41, GGP works with local farmers to carry out the upstream agricultural production process. This is aimed at building a better socio-economic condition for the community so that it feels the positive impact of the company. GGP also utilizes unsold harvested waste as animal feed. The livestock will later produce products in the form of meat and milk. In addition, GGP uses cow dung as an ingredient to make organic fertilizer for pineapple trees. This process creates a virtuous cycle of the CE.

GGP implements sustainable farming by changing agriculture practices that increase soil's biological, physical, and chemical quality by using bio-fertilizer and organic fertilizer applications. It also helps reduce contamination by hazardous substances, reserve water, and prevent biodiversity losses. Biological or organic pest control and integrated pest management are also part of the initiative. GGP implements soil and water conservation, which is carried out by returning biomass to the earth, rotating plants using legumes, planting bamboo along rivers to prevent erosion and sedimentation (soil and water conservation), and creating a water reservoir. GGP also makes liquid organic bio-fertilizer to improve soil biodiversity and uses compost for organic fertilizer.

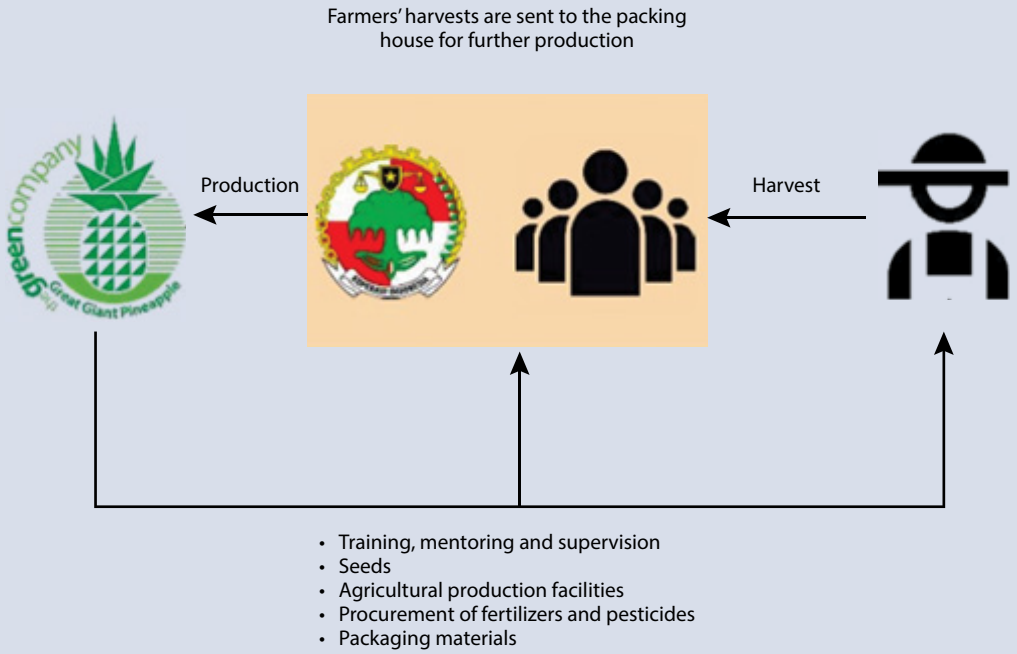
GGP reuses organic waste to make liquid organic biofertilizer and compost pellets. Both preparations are used as planting material. Compost application can accelerate plant growth (earlier forcing time by two months), and both 50-tonne per hectare and 100-tonne per hectare doses can increase the fruit weight. Application of over 50-tonne per hectare of compost on pineapple trees

has been carried out at eight locations. After nine months of planting with compost, tree and pineapple growth increased by an average of 6.5%. The compost also helped increase the biodiversity of microorganisms in the soil [72].

GGP implements Creating Share Value (CSV) as a partnership between GGP and agricultural cooperatives. An agricultural cooperative consists of several farmer groups (gapoktan), which includes farmer groups (poktan) in the smallest agricultural area in each village. The following is a partnership scheme between GGP and local farmers.

FIGURE 42

GGP CSV SCHEMATIC.



Source: PT Great Giant Pineapple.

As explained in figure 42, GGP collaborates with members of the farmer groups and agricultural cooperatives. GGP contributes by conducting training, mentoring, and supervision. It also assists in agricultural production facilities (saprodi) and farming tools and machinery (alsintan). This helps increase farmers' knowledge of production processes, technology, and income. The feedback given by farmers is in the form of good harvests per the standards desired by GGP. The company then buys at the agreed prices. After that, GGP carries out the packaging and production process as per the CE cycle. This initiative cuts through the traditional supply chain, thereby increasing the exchange value for farmers.

The partnership with the CSV scheme is formed by establishing a monitoring flow for production and material use. Transactions will be recorded on the eGrower application and the SAP-GGP system in the implementation context. Farmers will record on the e-Grower application to find out the use of agricultural materials and products from farmer partnerships in each partnership area. This application also helps farmers to plan the planting process, tidy up agricultural data, forecast production to be more accurate, and have real-time data, good connection, and communication.

6.7 Recycling and Reusing of Wastewater through the Buyback Economic Model, IR Iran

The Iranian National Water and Wastewater Engineering Company (NWWEC) is a subsidiary of the Ministry of Energy, including 34 water and wastewater subdivision companies. The main task of NWWEC is producing and distributing safe drinking water and collecting and treating urban and rural wastewater.

Many industries in IR Iran have benefitted by applying buyback for water and wastewater treatment. The NWWEC has also played a major role in protecting the city environment by implementing sewage management facilities without the general government budget assistance. The establishment time of the project can be used as an appropriate index for evaluating the effectiveness of these projects.

Overall, 40 contracts worth over IRR172,320 billion (about EUR1,750 million) have been awarded to the private sector and region's industries in the buyback contracts framework. Over 312 MCM of effluents have been allocated to the industries. Consequently, the treated effluent helps local and regional industries meet their critical water demand.

Environmental impacts of the project

This plan has positive environmental impacts with two different approaches. Firstly, the implementation of wastewater plans has reduced the pollution of aquifers. This has helped preserve the quality of groundwater. Secondly, the contracts have helped the local industries meet their water demands without being dependent on surface and groundwater resources. Given that IR Iran is located in an arid and semi-arid region using effluents as an appropriate resource to supply the industrial water needs can considerably help reduce the volume of water demand. The treated wastewater can meet the industrial and agricultural water demands reassuringly.

Costs and benefits of the project

The local government has assigned the sewerage treatment projects to the private sector based on the buyback model since 2011. So far, 40 contracts worth EUR1,750 million have been awarded using this model. In this regard, there are 35 contracts worth approximately EUR1,490 million for concluding various industries and in exchange to complete sewage facilities in 30 cities and 312 MCM per year of effluent to these industries.

Two contracts have been put into operation in Ardakan (Yazd province) and Lenjan (Isfahan province. Set up with an investment of more than IRR2,800 billion, the sewage treatment projects now supply around 11.5 MCM effluent per year to Chadormaloo Industrial and Mining Company and Mobarakeh steel company.

Qualitative information and intangible effects

- Improving public health and protecting the environment: Collection, transmission, and wastewater treatment will prevent negative secondary impacts on soil, water, and air. It will also help preserve the flora and fauna and the ecological quality of the habitats and the landscape.

- Protecting the groundwater basin: Reducing demand for extracting groundwater resources will ultimately lead to the conservation of groundwater table and prevent land subsidence.

- Meeting the industrial water demand: Reusing treated effluents can help meet the water demand of the local and regional steel and petrochemical industries.

- Improving the quality of surface and groundwater for drinking: Implementation of these projects will significantly reduce the use of surface and groundwater by the industries.
- Reducing dependency on the public budget and completing the projects on time.
- Enhancing the quality of project implementation by ensuring financial accessibility.
- Reducing the implementation cost through on-time scheduling and saving the project budget from the inflation rate.
- Creating direct and indirect job opportunities.

Demonstration of the impacts

As mentioned previously, the initiatives led to the supply of 312 MCM effluent annually to the industries enabling them to prevent the discharge of 375 MCM wastewater and protecting the surface and groundwater from getting polluted. Before defining this model, the local and regional industries met their water demands from the surface or groundwater resources, which led to the drastic drop in the number of water resources. The use of effluent through participation in the wastewater plan reduces the dependence of industries on groundwater resources and helps preserve the basin.

The industries involved in the buyback contracts are mostly located in arid and semi-arid areas and some of them have proposed supply of water from the Oman Sea and the Persian Gulf, as an alternate solution, if their need for water cannot be met locally. There are different methods for seawater desalination and its supply to target points.

Performance-based approach and explanation of the CE business model

The buyback project prepares a financial framework applicable to all the stakeholders. Local and regional industries are the principal applicants of the final system output, i.e., treated water. They treat urban effluent as the investor and purchase the water as a client.

Besides, the household sector can quickly access an appropriate effluent treatment system with the government benefitting from the involvement of the private sector in solving a public problem through an efficient financial model. In this approach, the government plays the role of a facilitator and supports the concept. In the pilot regions of Yazd and Isfahan provinces, there is a good potential of reusing and recycling water and using effluent as a resource for the water supply system.

6.8 Kloth Malaysia Sdn. Bhd. (KMSB), Malaysia

KMSB is a Malaysian tax-exempted social enterprise that inspires to be a catalyst for the textile and clothing CE to drive environmental, economic, and social impact. The company was awarded the Social Enterprise Accreditation status by the Ministry of Entrepreneur Development and Cooperatives for its positive impact on the environment.

By 2030, KMSB aspires to become Southeast Asia's preferred and trusted solution provider in managing and innovating textile waste and keeping them away from landfills. KMSB aims to address the issue of textile waste by establishing and developing value chains and movements where multi-stakeholders join hands to divert waste from landfills. In turn, the waste is recycled into new products and resources with higher material value and purpose.

Driven by passion and filled with determination, KMSB strives to improve the livelihoods of women from the impoverished, struggling, and vulnerable communities with economic empowerment through job opportunities.

Since its formation, KMSB has continued to uphold its Kloth 5R philosophy of "Rethink, Reduce, Reuse, Repurpose and Recycle" towards combating climate change arising from textile and clothing pollution.

KMSB owns the following brands, copyrights, and trademarks:

Kloth Cares

Tagline: Catalyzing circularity

Kloth Cares is an environmental, economic, and social impact brand committed to catalyzing the textile and clothing CE. It has addressed the textile waste issue by setting up and developing a value chain and movement that enables stakeholders to join hand and divert waste from the landfills. In turn, waste is recycled into new products and resources with higher material value and purpose.

Kloth Cares Fabric Recycling Movement (KCFRM)

Tagline: Keep fabric out of landfills

KCFRM addresses the issue of textile waste by establishing and developing value chains where stakeholders join hands to divert textile waste from the landfills. The waste is recycled into new products and resources with higher material value and purpose.

KCFRM initiatives include raising awareness, providing recycling facilities such as fabric bins, managing waste collection, data gathering and recycling unwanted items. The movement upholds Kloth 5R philosophy of "Rethink, Reduce, Reuse, Repurpose and Recycle" towards combating climate change arising from textile and clothing pollution.

Woman Up by Kloth Cares (Woman Up)

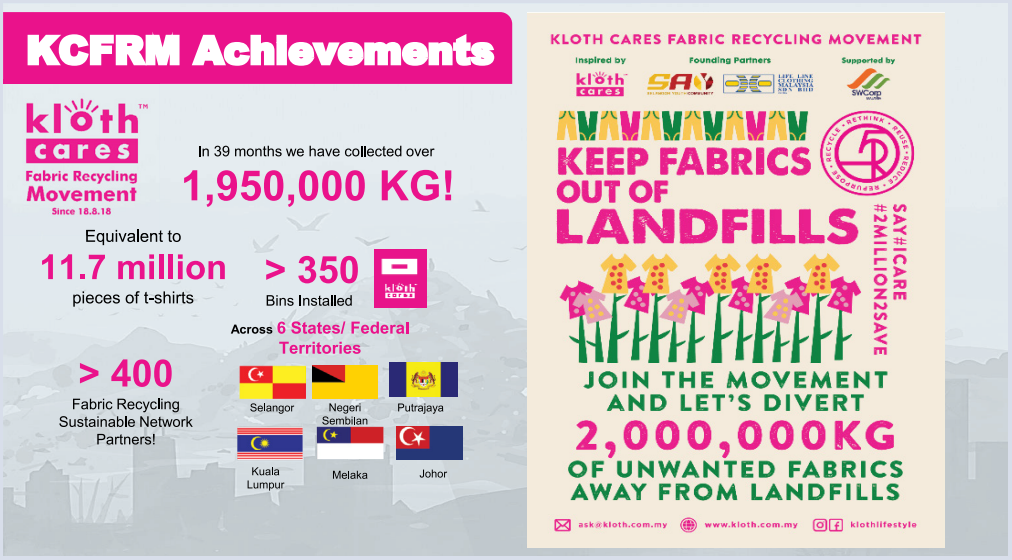
Tagline: Rising with #SHEconomy

It is an economic, social, and environmental movement brand inspired by Kloth Cares committed to improving the livelihoods of women, especially from the impoverished, struggling, and vulnerable communities, by providing job opportunities to them. The brand aims to include women in the formal or informal sectors, including those with physical and health challenges. Woman Up is also passionate about raising the living standards, mental wellbeing, and mojo amongst the youths and senior citizens.

Since it was established, Kloth has been able to collect 1.6 million kg of fabric and expand its services to five states in Malaysia as shown in Figure 43. During the period, Kloth managed to create a network of more than 400 partners. The process involved is shown in Figure 44.

FIGURE 43

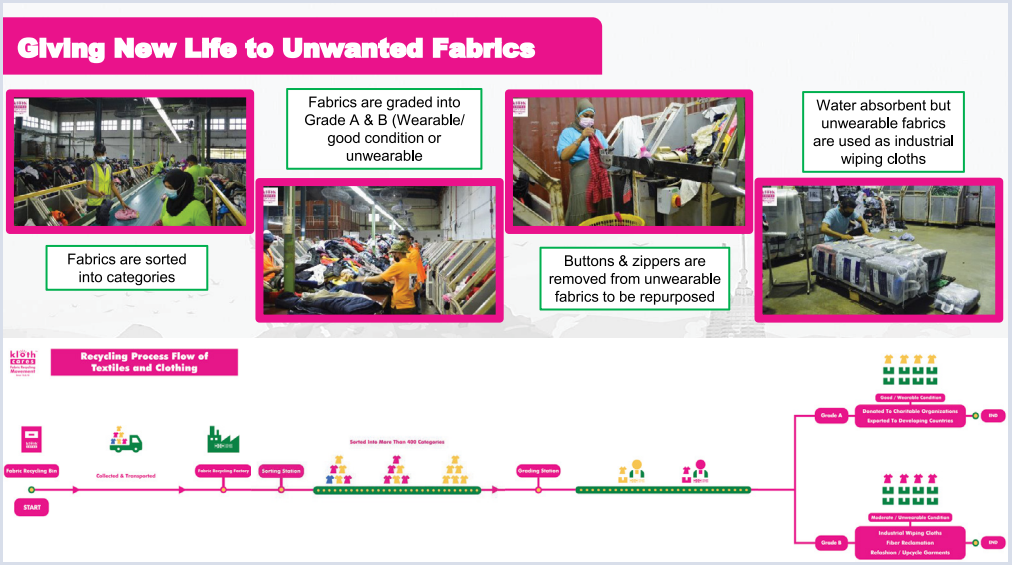
KLOTH IMPACT AND ACHIEVEMENTS.



Source: Kloth Malaysia Sdn. Bhd.

FIGURE 44

THE FABRIC RECYCLING PROCESS.



Source: Kloth Malaysia Sdn. Bhd.

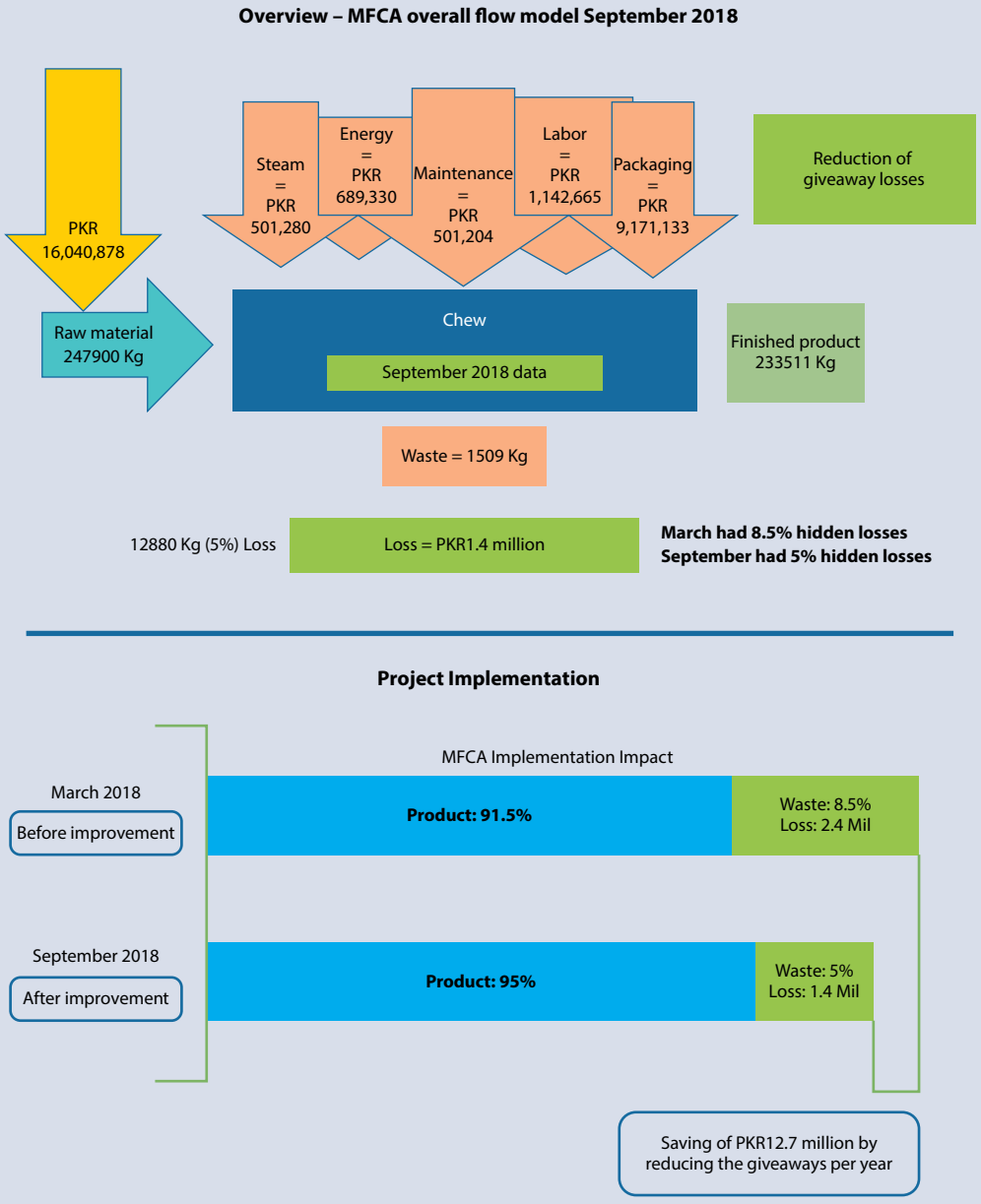
6.9 MFCA, Pakistan

Material Flow Cost Accounting (MFCA) is a management tool that assists organizations in better understanding the potential environmental and financial consequences of their material and energy practices. It also helps to improve them via changes in those practices. It does so by assessing the physical material flows in a company or a supply chain and assigning adequate associated costs to these flows. Thus, MFCA is a powerful tool for the adoption of GP, which allows the integration of different process streams and analyzes the potential savings through material and cost flow analysis.

An MFCA case study was done for an organization in Pakistan in line with the GP objectives. The process flow of the food industry included several unit operations, namely raw material handling, cookers, hopers, conveyors, extruders, cooling sections, and packaging. MFCA's overall approach was implemented for analyzing the cost associated with the process stream. At the first stage of MFCA implementation, in March 2018, the total amount of losses was found to be around 1.24 million or 8.5% of the input. Implementation of waste minimization techniques and tools by incorporating GP and MFCA helped reduce the loss to about 5%. As indicated in Figure 45, the company also saw its product percentage increase from 91.5% to 95% during the period. Thus, the overall savings came out to be nearly PKR12.7 million.

FIGURE 45

IMPACT OF THE MFCA PROJECT.



Source: APO Demonstration Project on MFCA, 2018.

This study validates the claim that industries have hidden losses or losses that becomes routine and is invisible in the production supply chain. This adds negative value to the process and increases resource utilization. Thus, it is necessary to have external audits and training on tools and techniques that can help the local workforce.

6.10 HighCrest Corporation, Philippines

The disposal and management of chicken manure have been a long-time challenge for poultry farms. The improper disposal of chicken manure causes water and soil contamination, potential community health problems, and pest infestations, leading to the spread of diseases.

The ADB (2020) study featured a waste-to-energy technology adopted by HighCrest Corporation, a commercial poultry farm located in Batangas, Philippines. HighCrest Corporation has 32 buildings that house 40,000 birds each. The farm operates at least seven cycles per year, producing 7,000 metric tonnes of chicken manure annually. To mitigate the adverse effects of excessive manure output, HighCrest Corporation established a tank system biogas plant to process and convert the manure into biogas as a source of heat and power or electricity.

TABLE 16

SUMMARY OF COSTS.

Particulars	Costs
Investment/Capital cost	PHP176,800,00 (USD3,563,970)
Maintenance and operating cost	PHP14,797,257.73 (USD298,286)
TOTAL	PHP191,597,258 (USD3,862,256)

Source: HighCrest Corporation.

Benefits

In addition to economic benefits through supplementary revenue, the tank system biogas plant's waste-to-energy technology generates various environmental, social, and health benefits as well.

Environmental benefits

Biogas is a renewable energy source for heat and electricity since inputs are in the form of organic wastes, such as manure or food waste. It helps reduce methane emissions from chicken manure by breaking it down to organic matter and converting it into carbon dioxide. It is nearly 34 times less potent as a greenhouse gas, thus contributing less to global warming [73]. Moreover, utilizing chicken manure as input in the biogas process properly disposes and manages manure. It also prevents water and soil pollution and other negative environmental impacts. Inevitably, waste reduction is an additional advantage. In the case of HighCrest Corporation, the company was able to reuse 7,000 metric tonnes of manure for energy production.

Social and health benefits

The installation of a biogas system at the poultry farm in HighCrest Corporation significantly reduced the bad odor from untreated manure, which affected nearby farms and households. In addition, it reduced the infestation of rodents and flies around digested manure and cut down on the possibility of transmission of diseases in the community.

Economic benefits

This technology can generate revenues amounting to a total of PHP39,466,400 per year, by generating electricity revenue and producing soil fertilizer (Table 17). The project has a payback period of 7.2 years and an estimated high internal rate of return (IRR) of 11.2%. This signifies that investment in biogas is profitable and desirable in the long run.

TABLE 17

SUMMARY OF BENEFITS.

Particulars	Revenues (in PHP)
Electricity revenue	PHP36,266,400 (USD731,065)
Revenue from fertilizer production	PHP3,200,000 (USD64,506)
TOTAL	PHP39,466,400 (USD795,571)

Source: HighCrest Corporation.

6.11 Siam Cement Group (SCG), Thailand

Established in 1913 following the Royal Decree of His Majesty King Rama IV, the Siam Cement Group is responsible for domestic cement production to support the building and infrastructure constructions in Thailand. The company helped Thailand reduce the import of cement. SCG is committed to aligning its business with sustainable development goals and good corporate governance principles. It also aims to become one of the regional business leaders with the ability to provide innovative products, services, and solutions, respond to the diverse needs of consumers, as well as operate business as per the CE concepts and contribute towards sustainable growth of the global society.

SCG's sustainable goals consist of the following:

1. Become a role model organization in good corporate governance, sustainable growth, and CE.
2. Achieve net-zero carbon emission by 2050.
3. Minimize natural resource usage and environmental impacts.
4. Enhance health and well-being and create an injury-and-illness free organization.

Presently, SCG is recognized as one of ASEAN's leading groups of companies, with the three core businesses, cement building materials, chemical, and packaging business. Each of the core businesses has successes in driving sustainable development programs.

Cement building materials business

SCG has successfully designed environment-friendly products and services as per its Green Choice Standard. In 2020, there were more than 50 registered items that were sold generating revenues of over THB44,000 million, an increase of 58%.

A new type of Hydraulic cement was developed, branded 'SCG Hybrid'. It was used to replace Portland cement type 1, due to its ease of molding, quick-drying, less work-time consumption, and GHG emissions reduction. In 2020, two million tonnes of Hydraulic cement were sold, thereby reducing GHG emission by 100,000 tonnes of carbon dioxide.

The company successfully transformed waste into alternative raw materials for energy production (waste-to-value), e.g., agricultural waste into biomass fuel pellets used as alternative energy in cement kilns. It helped reduce farmland burning and generated income for the farmers.

As part of an MoU, Siam City Cement Public Company Limited and the Siam Cement (Kaeng Khoi) Company Limited, developed a limestone quarry focusing on sustainable development. The MoU was witnessed by the Ministry of Natural Resource and Environment and MOI of Thailand, in accordance with the Mining Act. B.E. 2560. It aims to produce cement from limestone as per the CE concept.

The two companies also collaborated with the Circular Economy in Construction Industry, the network of Thai construction businesses aligning with CE, to implement CE concepts. The initiative is aimed to drive sustainable development in the country's construction sector and provide a better quality of life for Thai society.

To expand the green areas, 101,270 trees were planted inside and around the SCG factory, including 44,800 mangroves and 30,000 seagrasses. This has helped absorb over 14,132 tonnes of carbon dioxide during the last 10 years.

Chemical business

In 2020, SCG's chemical business initiated almost 400 innovation ideas, created more than 100 products, and launched 15 products in the market. Its EBITDA is expected to exceed THB400 million per year.

The company also developed a floating solar solution, which is more convenient to install and compatible with different solar panel designs. The floating solar solution business grew 260% with a capacity of 25.8 megawatts in 2020.

It promoted information management development to increase waste banks to foster and support communities' engagement in waste separation, through the application 'KoomKah'. The application has more than 8,000 users and deals with over 1,500 tonnes of recycled waste.

SCG has collaborated with other companies and institutes to showcase roads made of asphalt and plastic waste. The 7.7-kilometer road is constructed using 23 tonnes of recycled plastic waste. The model project has been executed as part of the MoU between SCG, the Department of Highways, the Department of Rural Roads, DOW Group Thailand, and Chiang Mai University. The research project used asphalt and plastic waste for road construction. The project aligns with the Government of Thailand's BCG model, covering three dimensions of Bio Economy, CE, and Green Economy.

The company also collaborated with AIT to create Zyclonic to improve sanitation with innovative water solutions. It can turn wastewater into clean water and germ-free effluents, which can be recycled or released into the environment without any harm. SCG consequently gained recognition and received an award on the World Toilet Day 2020.

Its operation and factory located at Rayong Industrial Land have also been certified Eco World Class with the highest score given by the Industrial Estate Authority of Thailand. SCG is the first industrial estate to get this certification for two consecutive years.

Packaging business

To achieve sustainable development and implement the CE concept in its packaging business, SCG aims to reduce the consumption of natural resources and increase the recycling of waste materials. To achieve this, the company has established 68 recycling centers across Thailand, Vietnam, and the Philippines.

The company successfully developed the first fully-recyclable bag from rice in Thailand. The rice bag is a multi-layer film bag made from a single layer of polyethylene (R-1) which is 18% less thick. The company also reduced the use of plastic pellets and energy in its production while maintaining the quality and standard. This is expected to help reduce the use of plastic by more than 300 tonnes and the emission of GHG by more than 600 tonnes of carbon dioxide per year.

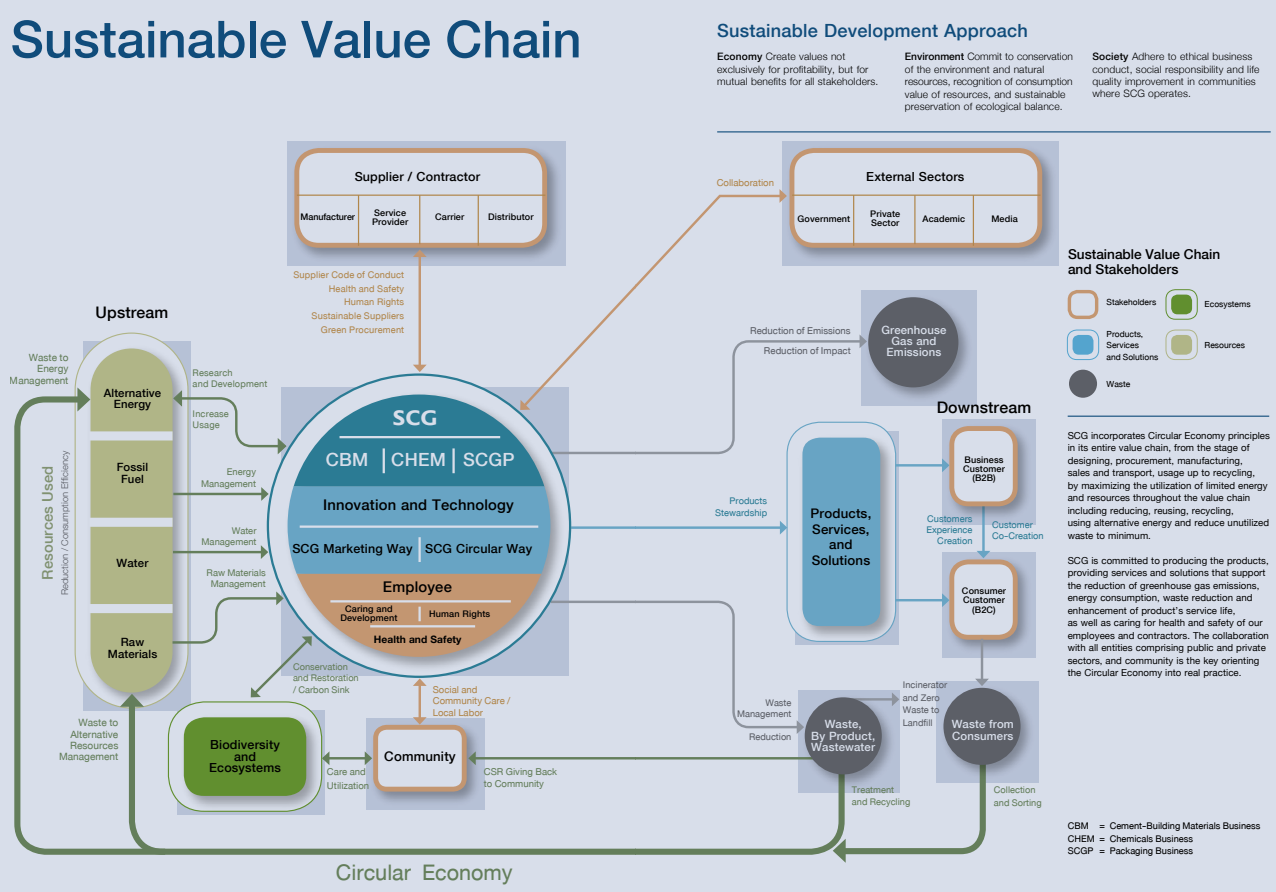
DezpaX, one of the SCG startups, became a complete solution packaging for food and beverage delivery operators. It provides a variety of packaging and packaging services at fair price rates. It has also collaborated with Siam Makro Public Company Limited to offer products and services across all provinces in Thailand.

The company has collaborated with the Thai Chamber of Commerce to buy sugarcane leaves to produce renewable energy. This is expected to reduce air pollution caused by the burning of farm waste and GHG emissions caused by coal usage. Besides, it provides additional income to the farmers. The project aims to reduce GHG emissions by 3,000 tonnes of carbon dioxide per year.

Eucalyptus woods shipped to their factory are required to be FSCTM (License Code FSCTM-C135609) certified and managed according to the five regulations: (1) not illegally harvested from the forest, (2) not harvested in violation of traditional and civil rights, (3) no forests where high conservation values are threatened by management activities, (4) no natural forests that were converted to non-forest uses, and (5) no forests with genetically modified trees.

FIGURE 46

SCG SUSTAINABLE SUPPLY CHAIN MAP.



Source: Siam Cement Group.

6.12 Heineken Vietnam, Vietnam

Heineken Vietnam is a member of Heineken Group, one of the world's leading beer manufacturers. To create a positive impact on people, planet, and the economy, Heineken Vietnam continues to attach sustainable development to all production and business activities. In 2017, VCCI ranked Heineken as the 'Most Sustainable Enterprise (manufacturing sector)' in the country.

Heineken Vietnam plays a pioneering role in promoting and applying the CE model in its operations. The clear goal of this model is to continue to find new ways to restructure, reuse, and recycle materials to extend the life of the material and maximize its value. Once applied, the model can benefit many stakeholders in the supply chain. The philosophy is carried out in many areas of Heineken's activities. The most notable is the way to generate energy to brew beer. In 2017, Heineken Vietnam converted about 54,000 tonnes of rice husks, an agricultural waste, into biomass fuel to generate heat energy. This initiative has enabled four of its six breweries to meet their thermal energy needs to brew 100% beer with carbon-free renewable energy while generating significant income for farmers and suppliers.

Heineken also continues to find ways to utilize waste from factories and 99.01% of its waste is recycled and almost no waste is disposed of by landfill. Similarly, treated wastewater is recovered to be used for various purposes such as watering plants. Heineken even captures gas from wastewater treatment systems, using it as biogas to generate heat.

Currently, over 5-6 factories of Heineken Vietnam brew beer with 100% renewable energy. In 2019, Heineken Vietnam supported the creation of 212,000 jobs (directly and indirectly) and contributed 0.95% of Vietnam's total GDP. Almost all its packaging materials are supplied domestically, creating an economic value of over VND5.7 trillion per year.

THE WAY FORWARD

- There is a higher level of awareness about the concept of GP than CE. Activities related to GP are practiced more, especially in the industry sector for greener products and production processes. On the other hand, the concept of CE has not been realized by most corporates and the general public. However, it has been adopted in practices such as applying secondary materials in production.

- As the manufacturing hub of the world, Asia sees more value in the principles of GP. It is beneficial for the industry sector across all APO members. CE for the manufacturing sector is also another format of GP in practice. A few approaches of CE have been applied in the APO members. However, CE is more specific in its approach towards sustainability and covers all aspects of the economy, including green production at the manufacturing stage. In addition, economic activities such as green commerce using innovative business models like leasing, sharing, product life extension, etc. are all crucial to achieving CE.

- Specific guidelines, technology training tools, and financial assistance for organizations and the general public to create an ideal CE ecosystem are lacking. Therefore, aside from the manufacturing aspect that has been covered by GP in the past decades, a lot of focus is needed on the following issues.

    - Facilitating and creating infrastructure for 'Reduce-Reuse-Recycle' programs as the fundamental platform for CE.

    - Inducing green financial mechanisms from governments and private institutions to drive CE and setting up creative business models.

    - Recognizing and promoting best CE practices in manufacturing, transportation, logistics, and services such as tourism, medication, recreation, education and public affairs, and creating more opportunities for dialogue across industries.

    - Establishing sound and complete regulations, standards, databases, and management schemes of CE to encourage the setting up of the circulation loop of materials, energy, and water, locally and worldwide.

- Despite recent campaigns like CE that are aimed at driving sustainability, GP continues to hold the position of strength and bottoms-up approach for most of the APO members pursuing the green economy policies. Based on the APO's achievements in promoting GP since 1994, the current status of GP, and the survey of 12 APO members, we can conclude that more effort is needed to address GP practices in the future.

    - Upgrade capacity through effective workforce training and technology transfer for enterprises.

- Align GP activities with Net-Zero GHG emission goal by 2050 or 2060 as set up by more than 130 countries, including energy inventory, energy saving, renewable energy adoption, and the roadmap for net-zero targets.

- Utilize the power of advanced digital technology, such as AIoT and simulation modeling tools to drive GP at the firm and industry levels.

- Promote the use of green accounting management tools by corporates to quantitatively present the sustainability costs and benefits in their operations.

- Establish GP database and quantitative indicator systems at the national level and across the APO members to track the performance, set the future agenda, and for easy access to resources and assistance in the APO region.

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APPENDIX 1
SURVEY QUESTIONNAIRE

Survey Questionnaire for Corporates and Organizations

I. Basic information of the organization

- Location of your organization/ company

☐ Bangladesh ☐ Cambodia ☐ Republic of China

☐ Fiji ☐ India ☐ Indonesia

☐ IR Iran ☐ Malaysia ☐ Pakistan

☐ Philippines ☐ Thailand ☐ Vietnam

- Classification of your organization

☐ Private or public corporates for profits

☐ Non-profit or non-government organizations

☐ Others, please specify:

- Geographic area of business or operation of your organization

☐ Domestic

☐ Regional (Asia Pacific Region)

☐ Global (outside of Asia Pacific region, e.g., Europe, North America)

- Years of establishment

☐ <5 years ☐ 6-10 years ☐ 11-30 years ☐ >30 years

- Sector your organization belongs to

☐ Agriculture ☐ Industry ☐ Service

- Number of total employees (FTE)

☐ <10 ☐ 10-100 ☐ 101-1000 ☐ >1000

- Number of employees (FTE) working on green, environmental or sustainable activities

  ☐ <10 ☐ 10-100 ☐ 101-1000 ☐ >1000

- Average annual turnover for the past 5 years (or budget, if you are a non-profitable organization)

  USD/year

- Average annual financial return rate if you are a "for profits" corporate

  %

- Average annual budget used for green, environmental or sustainable activities for the past 5 years

  USD/year

II. Organizational "Green Goals" and activities

- The "Green Goals" of your organization

  ☐ Green Productivity (GP)
  Please specify topics or approaches if possible:

  ☐ Circular Economy (CE)

  Please specify topics or approaches if possible:

  ☐ Sustainable Development Goals (SDGs)

  Please specify topics or approaches if possible:

  ☐ Environment, Social, Governance (ESG)

  Please specify topics or approaches if possible:

  ☐ Greenhouse Gas (GHG) mitigation

  Please specify topics or approaches if possible:

  ☐ Others, please specify:

  ☐ None of above

- Current and Future Green Activities

  ☐ Cleaner production (e.g., mining, manufacturing, transportation)

☐ Green consumption and procurement

☐ Life-cycle assessment and/or environmental design

☐ Take-back and recycling

☐ Usage of secondary materials, recycled water, and/or, renewable energy

☐ New business models (e.g., sharing and leasing)

☐ Optimization of product life spans

☐ Automation and virtualization (e.g., e-commerce, AIoT applications)

☐ Selecting suitable materials and/or equipment for better recyclability

☐ Energy saving, GHG reduction, carbon footprint

☐ Others, please specify:

☐ None of above

- Management framework Implemented in your organization

☐ ISO 26000

☐ ISO 45001

☐ ISO 50001

☐ ISO 14000s (e.g., 14001, 14051)

☐ ISO 323/59000 or other International Standards for CE (e.g., BSI 8001, UL 3600)

☐ National Standards for sustainability (e.g., waste and wastewater management)

☐ None of above

III. Current requirements or incentives received from governments or authorities for green transformation

- Requirements or regulations from the government or any green protocols to follow

☐ Green procurement

☐ Environmental management

☐ Energy saving and GHG mitigation

☐ Material and/or water recycling

☐ Others, please specify:

☐ None of above

- Incentives from the government

☐ Tax reduction

☐ Subsidy for clean technology deployment

☐ Faster capital depreciation in accounting

☐ Training and consultation opportunities

☐ Others, please specify:

☐ None of above

IV. Impacts on the corporate operation or capacity building from green activities, regulations and/or incentives

- General impact on your organization

☐ Highly positive

☐ Moderately positive

☐ No impact

☐ Moderately negative

☐ Highly negative

☐ Others, please specify:

- The aspects of the impacts on

☐ Organization profit/productivity, approximately by %

☐ Employees' working efficiency approximately by %

☐ Sustainability contribution, please specify

☐ Organization reputation

☐ Others, please specify:

- Future assistance needed from government or authorities for green transformation

  ☐ Training of workforce

  ☐ Financial capitals

  ☐ Technology transfer

  ☐ Management skills

  ☐ Networking

  ☐ Others, please specify

  ☐ None of above

APPENDIX 2

INFORMATION SOURCES ON GP AND CE

Country	Description	Sources
Bangladesh	Eighth Five-year Plan	GED, Bangladesh Planning Commission https://oldweb.lged.gov.bd/UploadedDocument/UnitPublication/1/1166/8FYP.pdf
	MFCA Manual, Demonstration Project, Improving Productivity through Material Flow Cost Accounting (MFCA) in Leather Sector, Bangladesh.	APO project code: 17-IN-04-GE-DMP-C-2868
	BGMEA Sustainability Report 2020	BGMEA, Bangladesh http://download.bgmea.com.bd/BGMEA%20Sustainability%20Report%202020.pdf
	Bangladesh Knitwear Manufacturers and Exporters Association	http://www.bkmea.com/
	National 3R Policy for Waste Management	Department of Environment, Ministry of Environment and Forest, Government of Bangladesh
	UNIDO Green Industry Policies for Supporting Green Industry (2011)	https://www.greengrowthknowledge.org/research/unido-green-industry-%E2%80%93-policies-supporting-green-industry
	Waste Concern National Workshop on Sustainable Management of Plastic to Leverage Circular Economy and Achieve SDG in Bangladesh	http://wasteconcern.org/national-workshop-on-sustainable-management-of-plastic-to-leveragecircular-economy-and-achieve-sdg-in-bangladesh/
	Bangladesh Climate Change Trust (BCCT)	http://www.bcct.gov.bd/site/page/e6fb75e8-f5e5-4bed-8adc-e6183e69353a/-
	Bangladesh Climate Change Resilience Fund	https://cleancooking.org/binary-data/RESOURCE/file/000/000/106-1.pdf
	Climate Financing for Sustainable Development	Finance Division, Ministry of Finance Government of the People's Republic of Bangladesh
	Circular Economy: A Potential Pathway to a Sustainable Bangladesh	The Daily Star, Feb 16, 2021
Cambodia	Cambodia Economy Overview	https://www.adb.org/news/cambodia-economy-recover-2021-accelerate-2022-adb
	M's Pig	http://www.mongreththy.com/MsPIG-en.html#
ROC	Industrial Technology Research Institute, ITRI	https://www.itri.org.tw/english/index.aspx
	Chung-Hua Institute for Economic Research	https://www.cier.edu.tw/
	Circular Taiwan Network	https://circular-taiwan.org/en/
	Circular Economy Promotion Office	https://cepo.org.tw/
	Database for Material Flow Management in ROC, RCAS	https://smmdb.epa.gov.tw/smm/webpage/enter.aspx
	The Recycling Promotion Plan by EPA	https://smmdb.epa.gov.tw/circulation/index

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Country	Description	Sources
Thailand	BCG Economy Model Office of National Higher Education Science Research and Innovation Policy Council	https://www.nxpo.or.th/th/en/bcg-in-action/
	Circular Economy Thailand Board of Investment	Circular Economy Shaping a Sustainable Future https://www.boi.go.th/upload/content/TIR5_2019_5e2e95134a76b.pdf
	Green Industry Ministry of Industry (MOI)	The Achievement in Implementation of the Government Policy and Industrial Strategy Fiscal Year 2019 http://old.industry.go.th/oig/index.php/2016-04-24-14-09-07/2018-07-03-07-44-25/2562-2/1283-the-achievement-in-implementation-of-the-government-policy-and-industrial-strategy-fiscal-year-2019-pdf?format=html
	Plastic Waste Management in Thailand World Wide Fund (WWF Thailand)	Scaling up Circular Strategies to Achieve Zero Plastic Waste in Thailand https://wwfint.awsassets.panda.org/downloads/zero_plastic_waste_in_thailand_en.pdf
	Circular Economy for Sustainable Resource Management Siwaporn Tangwanichagapong, Mohanakrishnan Logan, and Chettiyappan. Visvanathan	Circular Economy for Sustainable Resource Management: The Case of Packaging Waste Sector in Thailand https://www.researchgate.net/publication/336988756_Circular_Economy_for_Sustainable_Resource_Management_The_Case_of_Packaging_Waste_Sector_in_Thailand
	Case Study for Circular Economy The Siam Cement Public Company Limited	Sustainability Report 2020 Building Resilience for Sustainability Leadership https://www.scg.com/pdf/en/SD2020.pdf

LIST OF ABBREVIATIONS

3R	Reduce, Reuse and Recycling
ADB	Asian Development Bank
AIoT	Artificial Intelligence of Things
AIT	Asian Institute of Technology
APO	Asian Productivity Organization
BB	Bangladesh Bank
BCCRF	Bangladesh Climate Change Resilience Fund
BCCTF	Bangladesh Climate Change Trust Fund
CE	Circular Economy
CSCQM	Circular Supply Chain Quality Management
CSR	Corporate Social Responsibility
CSV	Creating Share Value
CTN	Circular Taiwan Network
DAK	Special Allocation Fund
DST	Department of Science and Technology
EAC	Electricity Authority of Cambodia
ECCP	European Chamber of Commerce of the Philippines
EFL	Energy Fiji Limited
EMF	Ellen MacArthur Foundation
EPA	Environmental Protection Administration
EPR	Extended Producer Responsibility
ESG	Environmental, Social, and Corporate Governance
ETP	Effluent Treatment Plant
EV	Electric Vehicles
FFL	Future Farms Limited
FTE	Full-time Employees
GCF	Green Climate Fund
GGP	Great Giant Pineapple
GHG	Greenhouse Gas
GITA	Green Investment Allowance Tax
GOB	Government of Bangladesh
GP	Green Productivity
GPP	Green Public Procurement
Green ME	Green My Enterprise
IFCO	Iranian Fuel Conservation Company
IoT	Internet of Things
ISO	International Organization for Standardization
ITRI	Industrial Technology Research Institute

KCFRM	Kloth Cares Fabric Recycling Movement
KEGA	Key Economic Growth Activities
KMSB	Kloth Malaysia Sdn. Bhd.
MC	Member Country
MFCA	Material Flow Cost Accounting
MGTC	Green Technology and Climate Change Corporation
MISTI	Ministry of Industry, Science, Technology, and Innovation
MNRE	Ministry of New and Renewable Energy
MNRE	Ministry of Natural Resource and Environment
MoE	Ministry of Environment
MOEA	Ministry of Economic Affairs
MoEF	Ministry of Environment and Forestry
MoEFCC	Ministry of Environment, Forest and Climate Change
MOI	Ministry of Industry
MoU	Memorandum of Understanding
MSME	Micro, Small, and Medium-sized Enterprises
NGT	National Green Tribunal
NIF	National Innovation Foundation
NWWEC	National Water and Wastewater Engineering Company (Iran)
PAP4SCP	Philippine Action Plan for Sustainable Consumption and Production
PIH	Green Industry Center
PPP	Public-Private Partnership
PROPER	Company Performance Rating Assessment Program
QC	Quality Check
QMT	Quality Management Tool
RE	Renewable Energy
ROC	Republic of China
RPJMN	National Medium-term Development Plan
SALT3	Sustainable Agroforest Land Technology
SC	System Cost
SCG	Siam Cement Group
SDGs	UN Sustainable Development Goals
SEARCA	Graduate Study and Research in Agriculture
SPV 2030	Shared Prosperity Vision 2030
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value-added Tax
VCCI	Vietnam Chamber of Commerce and Industry
WTE	Waste-to-Energy
WWF	World Wide Fund for Nature
ZLD	Zero Liquid Discharge

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