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Developing a Tool to Assess Green Growth Potential at a National Level*

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Green growth is increasingly being integrated into national development plans as a means of simultaneously achieving economic growth and environmental goals. However, green growth approaches are disparate given the different stages of development, resource endowments, socioeconomic characteristics, and unique development challenges in countries. This study aims to build a country assessment tool called the Green Growth Potential Assessment (GGPA) to help policymakers formulate and adopt green growth strategies that are tailored to their country context. GGPA uses a set of country indicator data — presented in the form of country scorecards — to benchmark country performances, which serves as a starting point to identify the priority green growth issues, their causes, and possible remedies.

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1. INTRODUCTION

Developing countries are facing challenges that are much more complex than what the advanced economies had faced in the past. Despite the fact that many developing countries are fast catching up in the development trajectory, eradicating poverty and improving people's living standards remain an enormous challenge. Moreover, countries are grappling with rapid depletion of natural resources and worsening ecological risks, thereby compromising the overall sustainability of resources for the current and future generations. Climate change is a serious global challenge that might even offset the development gains achieved in the past; various studies unanimously indicate that developing countries are much more vulnerable to climate change risks and that the poorest of the poor are likely to suffer more.

Against this backdrop, the decision makers of developing countries are quickly recognizing how the conventional development paradigm of "grow first and clean up later" or simply put as "brown growth" is no longer a viable option. Continuing the business-as-usual ways will result in irreversible lock-ins with huge detrimental costs spanning generations. Understanding their need to meet international commitments on climate change whilst tackling their unique development challenges effectively, an increasing number of developing country governments are adopting "green growth" as their long-term vision, development paradigm, and key policy goal. Green growth planning offers the opportunity to advance sustainable development as it veers away from being trapped in inefficient production and consumption patterns, and strikes the synergy between economic competitiveness, environmental sustainability, and social inclusiveness.

The exhaustive coverage and perspectives offered by the green growth model, however, necessitates country-specific approaches to greening the economy based on its unique circumstances. Despite the lack of a one-size-fits-all formula, the benefits of green growth as an alternative development paradigm — whether in the form of economic diversification, increased productivity of natural resources, or better living conditions and

inclusiveness — are promising and can enable countries to achieve the goals and targets of the new Sustainable Development Goals (SDGs) and honor the global commitment of combatting climate change at an unprecedented scale.

1.1. Literature Review

Driven by the need to help decision makers in the setting their own green growth agenda, measurement frameworks have offered ways to diagnose country-specific conditions and priorities. These measurement frameworks commonly involve the use of indicator sets (which can be the basis for the construction of composite indices) to help identify and interpret the interactions between issues related to green growth. OECD's proposal (OECD, 2011) is most pragmatic in the sense that it identifies the sphere of production and consumption as the roots for conceptualizing green growth. Specifically, OECD's framework focuses on the interactions between inputs (including natural resources, labor and capital), process (multifactor productivity), and outputs (income and goods and services). UNEP's framework (UNEP, 2014) is tailored to the policymaking process in that different indicator sets are to be used for the steps of issue identification, policy formulation, policy assessment, and policy monitoring and evaluation. Although the work emphasizes the need for phased approach to the use of indicators, limited availability and quality of data relevant to green growth in developing countries is identified as a significant bottleneck to implementation.

Extending from the efforts on building measurement framework, numerous studies in literature have applied unique green growth indicator sets at varying levels — national, sub-national, and sectoral — as an attempt to provide a status quo. Kim *et al*. (2014) proposed a set of 12 indicators to evaluate green growth and support its integration into government policies at national level. A set of 78 indicators relevant to green growth were shortlisted by means of multi-criteria analysis and Delphi analysis conducted through expert consultation, and categorized into 5 areas encompassing efficiency of

production, efficiency of consumption, stock and quality of natural resources, quality of life, and responses by economic actors. Each indicator was normalized relative to the 10th percentile of all OECD countries, which resulted into country scorecards.

Lin and Lin (2016) constructed the Green Economy Performance (GEP) indicator and Green Productivity Growth Indicator (GPGI) at city level, to assess China's status in terms of integrating resource conservation and environmental protection into economic expansion. The study focused primarily on air pollutants in regards to the environment, as it was seen as the critical issue of concern for China's environmental degradation. A total of 6 input and output variables were used in construction of the indicators — capital input, labor input, energy consumption, GDP output, SO_2 emissions, and dust generation — which were either processed or derived by combining non-radial directional distance function and meta-frontier Malmquist productivity approach.

Valle and Climaco (2015) evaluated the greenness of the economic activities (as defined by the national classification of economic activities in Brazil) in the city of Rio de Janeiro. A total of 12 indicators were used to evaluate the economic, environmental, and social aspects of each economic activity, by introducing performance thresholds (e.g., below average, average, above average).

Buys *et al*. (2014) developed the Sustainability Scorecard, which assesses the viability and sustainability of the dairy industry in Australia across the triple bottom line of economy, environment, and social impacts. The dairy industry was conceptualized into sub-components (i.e., farm, factory, and market), each of which have complex interaction with one another represented through indicators reflecting the three pillars of sustainable development.

1.2. Objectives

Although several diagnostic indicator tools for green growth have been

developed to reflect the political desire to measure and compare the performances to inform setting of future agenda and their goals, their application in developing countries must be able to resolve critical issues including: (1) limitations in data availability, (2) simplifying data processing (or avoid building black-box models) to enable informed assessment, and (3) providing opportunities for systematically engaging stakeholders in drawing conclusions to build ownership.

This study aims to build a simple and systematic tool which can overcome these obstacles, and inform decision makers of developing countries of their priority green growth issues and their underlying causes that are in need of transformative solutions, along with recommendations for targeted green growth policy interventions. Despite the differences across countries, green growth issues share deep-seated economic, environmental, and social characteristics that are both dynamic and complex. The potential target outcomes illustrate how green growth can even balance conflicting objectives and how the overlapping goals reveal the potential synergies.

2. CONCEPTUAL APPROACH AND METHODOLOGY

The Green Growth Potential Assessment (GGPA) developed in this study provides a cross-cutting analysis of a country's baseline development landscape, specifically the most pressing challenges and opportunities to determine the appropriate entry points for intervention in the context of green growth. As an analytical tool for examining a country's green growth potential and its key enablers to recommend actions in key areas of highest green growth impact, GGPA goes beyond a stand-alone macro-level analysis; it tries to link green growth to domestic and international issues of a country and how green growth actions can add value and help achieve broader development goals. Thus, GGPA demonstrates how green growth benefits are very much related and can be strongly embedded to a range of development aspirations, both local and regional/global.

Specifically, GGPA aims to: (1) conceptualize the country's green growth model that best suits a country's circumstances; (2) identify a country's green growth challenges and potentials based on understanding of its current status, and prioritize areas with the highest needs for green growth interventions; and (3) draw recommendations on future actions and inform setting of green growth goals.

In essence, GGPA is designed as a systematic approach to inform decision makers of the priority green growth issues and their underlying causes that are in need of transformative solutions, along with recommendations for targeted green growth policy interventions.

2.1. Green Growth: Definitions and Key Characteristics

There are a variety of definitions of green growth (and green economy) provided by a number of international organizations[1] and national governments have also defined green growth in line with their own objectives and focus. To date, there is no universally agreed definition of green growth but a fixed definition may be less necessary considering the need for flexibility to adapt to each country's need. Notwithstanding these various definitions, several key common aspects are salient.

Firstly, green growth puts emphasis on environment-economy nexus. It entails coordinated strategic actions that simultaneously pursue environmental sustainability and economic development. Thus, generating synergy between the two dimensions is the core strategy in pursuing green growth. For instance, green growth attempts to turn the costs of environmental conservation and climate action into economic opportunities such as emergence of new innovative green industries.

Secondly, it is a viable means to achieve sustainable development.[2] While

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[1] See OECD (2011), UNEP (2011), UNESCAP (2013) and World Bank (2012).

[2] "The Future We Want", an adopted document of the UN conference on sustainable development (Rio+20) held in June 2012, recognizes green economy in the context of sustainable development and poverty eradication as "one of the important tools available for achieving sustainable development".

the environment-economic nexus lies at its heart, green growth does not neglect the social dimensions of sustainable development, such as job creation, social inclusion, and poverty reduction. The bottom line is to ensure an equitable distribution of benefits and costs arising in the transition toward green growth.

Finally, it takes a holistic and integrated approach. Environmental challenges, such as rapid depletion of natural resource, are not solely environmental issues but could also be economic and social. As such, multiple entry points for policy interventions are necessary. In addition, due to the cross-sectoral nature of many green growth issues, a single policy action could yield multiple effects across various dimensions of the economy, environment, and society.

2.2. Green Growth Potential

Green growth potential implies unmet needs and possibilities for improvement in the pursuit of green growth. Although different potentials exist across a wide range of areas that encompass the concept of green growth, high-impact potentials are often most prominent in areas where a country is underperforming; these are areas that leave significant room for corrective measures to be exploited vigorously in pursuing future development. Driven by an absence of a single tool, a diagnostic approach to identifying and assessing green growth potentials should evolve around tackling the following key questions: (1) what is a country's current green growth performance and how does it fare in comparison to its peers?; (2) if the country is underperforming in certain areas, what factors explain this? Is this largely due to predetermined conditions (whether biophysical, climatic and other structural constraints) and thus are largely inevitable or could it be more attributed to human-induced factors (such as lack of policies and insufficient investment)?; and (3) if it is the latter, what are the actions to be taken to address the barriers and reap the potential green growth benefits?

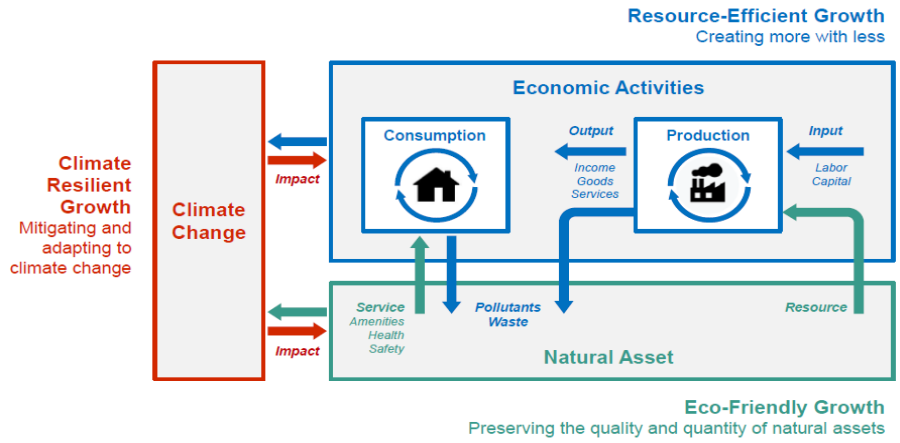
Once identified, green growth potentials must be further examined in the

context of policy formulation and planning, in a way to transform weaknesses into opportunities. The analytical case for green growth departs from harnessing ways to minimize the tradeoffs and maximizing the synergies between the opposing goals of economic growth and environmental sustainability. The process requires discarding conventional approaches and moving toward innovative strategies such as adequate pricing of environmental externalities (i.e., health impacts of air pollution), taking a long-term perspective to costs and benefits (i.e., building energy management systems), locating untapped green business opportunities (i.e., new technology adoption), and weighing the risks and challenges in business as usual growth path (i.e., increasing global competition for food).

2.3. Framework for Green Growth Diagnosis

The GGPA builds on the OECD's framework by incorporating "climate change" (see Figure 1) as an important dimension, as the phenomenon interacts with the sustainability of economic activities and natural assets in many complex ways. While the atmospheric absorption of GHG can be conceived as a part of the "sink function" of the natural asset, it is important

Figure 1 Graphic Presentation of the 3 Green Growth Pathways



Note: Based on the modified OECD framework.

to recognize that climate change has far reaching consequences — a holistic impact on the whole production-consumption system, as well as the sustainability of the natural resource stock. For example, climate change directly affects human welfare by altering service function (e.g., species extinction), resource function (e.g., access to water supply), capital (e.g., infrastructure destruction by extreme weather events), and multi-factor productivity (e.g., change in crop yields).

The modified framework provides the basis for conducting a green growth diagnosis for GGPA — most importantly in answering the questions 1 and 2 of the previous section. Notwithstanding the complexity and comprehensiveness of green growth as a development paradigm and the myriad of relevant issues in different country contexts, the framework can be the starting point to developing a common appreciation of the "three dimensions of green growth", which is the very first crucial step in understanding green growth potential. As illustrated in Figure 1, each dimension corresponds to a pathway that can be easily mapped out in the modified framework. Understanding how the concept of green growth seeks to harness the synergies and trade-offs in moving from resource-intensive to resource-efficient production and consumption; quantitative to qualitative growth; and climate-vulnerable to climate-resilient growth, GGPA proposes three major green growth pathways: Resource-Efficient Growth (REG); Eco-Friendly Growth (EFG); and Climate-Resilient Growth (CRG).

2.4. Green Growth Pathways

Through the formulation of three pathways, the concept of green growth can be disaggregated in a structured way, leading to a clear delineation of a set of themes or areas that best capture the essence of green growth. From a methodological standpoint, the pathways become the basis to logical and well-substantiated selection of indicators for measuring a country's green growth performance. This approach, however, does not intend to oversimplify the concept of green growth considering its complexity and

broad coverage. While the three green growth pathways are not all exhaustive, it is assured that these would at least cover most, if not all, issues relevant to green growth.

1) Resource-Efficient Growth (REG): Increasing the efficiency of production and consumption activities is one of the core values of green growth. This is especially the case for developing countries where the low levels of productivity in utilizing resources are often the reason for poor competitiveness. Some of the main issues of importance to green growth under this pathway include:

- Intensity of energy and material uptake, reflecting general efficiency of utilizing natural resources or recycling wastes;
- Water and land productivity, reflecting the efficiency of water and land use as a finite resource for economic activities;
- other productivity factors, which include the efficiency of utilizing non-natural resource inputs (e.g., labor, technology, capital)

2) Eco-Friendly Growth (EFG): The pathway focuses on ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. Green growth aims to ensure that economic growth exerts pressure (i.e., pollution and exhaustion of resources) within tolerable levels for the environment to maintain its long-term health; it is also founded on the idea that environmental sustainability does not necessarily oppose growth. Some of the main issues of importance to green growth under this pathway include:

- Rate of changes in renewable natural resource stock (i.e., fishery, land, forest, and water) available for utilization;
- Rate of changes in non-renewable natural resource stock (i.e., fossil fuel) available for utilization;
- Quality of environmental resources, such as biodiversity in flora and fauna, and overall health of the ecosystems.

3) Climate-Resilient Growth (CRG): The pathway focuses on the impacts and risks imposed by climate change on production and consumption functions of the economy (i.e., REG) and environmental sustainability (i.e., EFG). Green growth stresses the need to reap the co-benefits in climate change adaptation/mitigation and economic growth (i.e., prevented loss in agriculture and fisheries, growing low-carbon markets). Some of the main issues of importance to green growth under this pathway include:

- CO_2 emissions intensity of economic activities, which intensifies the greenhouse effect and impacts of climate change;
- Exposure, sensitivity, and adaptive capacity (i.e., vulnerability) of economic activities to the changing climate.

One important caveat to highlight is that GGPA does not recommend an absolute green growth pathway for a particular country; it does not propose that a country should select or prioritize one single pathway. In other words, the potential for green growth in each pathway varies by country depending on the unique combination of environmental, economic, and social attributes and development priorities.

For instance, the “low carbon green growth model” promoted by the Republic of Korea is rooted in the needs for reducing CO_2 emissions and improving resource efficiency through adoption of green technologies. Such process was designed in a way to foster new engines for economic growth, such as emergence of innovative industries engaged in green goods and services (i.e., energy storage systems, building energy management services). The Korean model would not be the case for most developing countries like Brazil, which largely equates green growth to sustainable forest management given its heavy reliance on forest resources. On the other hand, countries of the Middle East may consider the rapid depletion of fossil fuels such as oil and gas, on which their economies heavily depend, as a driver toward economic diversification, thereby framing green growth as the transition from hydrocarbon toward the non-hydrocarbon sectors. For small islands in the Pacific and other archipelagic countries, green growth can focus on

addressing climate vulnerability to prevent climate change from affecting the development gains achieved in the past.

GGPA recognizes that its three green growth pathways are not perfectly robust and comprehensive; with the evolution and growing complexities of development challenges, it may even to be possible to identify additional dimensions (or growth paths) to complement the gaps. The conceptual approach and methodology presented in this study is a starting point and will need to be further elaborated through learning and gaining of experience from in-country application.

3. METHODOLOGY DEVELOPMENT

GGPA starts with an assessment using selected indicators, followed by validation, sector analysis, and recommendations. As an analytical tool, GGPA is user-friendly, participatory, and country-driven. The whole GGPA process can be successfully implemented if there is adequate data from reliable sources and active participation from various stakeholders during the country-led consultation process.

The main output is the identification of a set of priority issues (based on indicators) with the highest greening potentials. Based on this, a set of issue-sector pairs is agreed among policy makers and key stakeholders. Then, suggested is the prioritized set of issues and sectors and the corresponding recommendations for pursuing green growth in these areas. Thus, the whole GGPA process should be able to determine the key sectors and issues as appropriate entry points and deep dive into what actions are need for the country to maximize the concomitant benefits and synergies.

This step specifically involves the following activities:

- Provide an overview of the national circumstances (e.g., drivers of change, constraints, and untapped opportunities) in relation to pursuing green growth in the context of sustainable development, by using 23 country dashboard indicators under five themes: geography

and climate, demography, economy, governance and finance, and social inclusiveness.

- Assess the current situation based on the three sets of diagnostic indicators representing the three green growth pathways: Resource-Efficient Growth (REG), Eco-Friendly Growth (EFG), and Climate-Resilient Growth (CRG). These capture the major synergies and trade-offs of green growth in the context of the production-consumption framework. Each pathway contains several indicators that encapsulate the core concepts of green growth. It is also assured that the selected indicators have sufficient and readily available data from online sources.
- Use spider diagrams to present the results in a visual format and conduct a comparative analysis of the country's situation vis-à-vis its peer countries. The spiders will be supported by an analytical discussion of the main findings. The analysis should be made in the context of country dashboard indicators (e.g., understanding energy intensity as a function of GDP growth, urbanization rate), understand how the issues may be interconnected (e.g., water productivity, water stress, climate change sensitivity), and contemplate the underlying causes of each priority issue (e.g., high energy intensity is a result of energy consumption by the transportation, building, and water sectors).

In this study, a set of priority issues for the Republic of Korea is to be identified and see if the results go along with general perceptions on the ROK's green growth status and highest greening potential. It is worth noting that the identification of green growth priorities and the corresponding recommendations on the way forward should be framed in the context of the country's national development plans, its targets in relation to the new Sustainable Development Goals (SDGs), and other international commitments to ensure alignment and harmonization of national objectives.

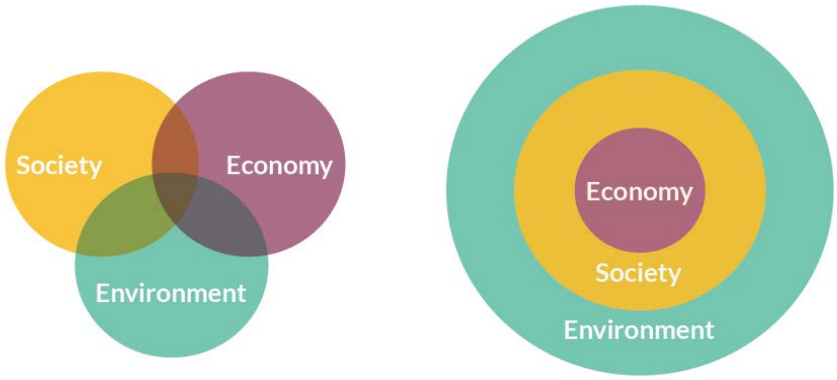
From a methodological standpoint, the use of indicators is critical.

Indicators are considered as an objective measure of performance because it is numerical. Its factual nature — assuming that the data comes from reliable sources — makes the use of indicators a very good starting point to track trends and benchmark performance. The numerical values help convey a shared understanding of the overall green growth landscape in the country. The preliminary results also send a clear signal and objective message to policy makers about where the country stands in terms of key development indicators.

3.1. STEP 1: Country Overview (Dashboard Indicators)

A good point of departure in understanding green growth is to examine the relationship of the economy, environment, and society in the context of the three pillars of sustainable development. The conventional development perspective treats these three dimensions as equal and partially overlapping (as shown in the left-hand side of Figure 2). In reality, however, the economy usually carries more weight in decision making, the effects of which create harmful environmental and social externalities (as shown in the right-hand side of Figure 2).

Figure 2 Reimaging the Relationship between Economy, Society, and Environment



Source: Cato (2009).

The green economics paradigm, on the other hand, views the environment as the lifeblood of the economy and social relationships (as illustrated in the right-hand side of Figure 2). It highlights the dependence of both the economy and society on the environment; specifically, economic activities operate within a network of social relationships, which in turn operate within fixed environmental boundaries. Thus, a well-functioning economy depends on the quality of social conditions, rules, and relationships of the society as well as the ability of the environment to provide ecosystem services to sustain human activities.

If the environment thus contains both the economy and society, policymakers should always consider how decisions could lead to environmental externalities with long- term repercussions on the economy and society. In defining environmental spill-overs, understanding the drivers of change is crucial to determine the natural or man-made factors that influence the development processes. Some of the most common drivers of environmental change include population growth, land use and land cover change, climate variability, and the like.

For GGPA, the starting point to gauge the country's drivers of change is by conducting a trend analysis that covers the economic, social, and environmental dimensions, and examining how these pillars interact with one another over a period of time. Particularly, understanding how anthropogenic drivers tend to affect the quality of the natural ecosystem — leading to a continuum of externalities — is key in gaining a comprehensive snapshot of the country's development progress in the past five to ten years. The analysis should reveal where the country stands in terms of achieving its development goals, delving into the correlations of its performance within the three pillars, such as how economic growth is achieved at the expense of environmental quality and social equity, or how GDP growth is slowed down to provide more breathing space for the environment, or how rapid economic growth — in parallel with environmental degradation — is inflicting a huge social divide, etc. The stark variations of indicator data across countries will yield country-specific observations that will set the stage for a more robust

Table 1 GGPA Dashboard Indicators

Theme	Sub-Theme	Indicator	Unit
Natural Drivers	Geography and Climate Change	Land Size	km^2
		Renewable Internal Freshwater Resource per Capita	m^3/person
		GEF Benefit Index for Biodiversity	0-100 (low - maximum potential)
		Average Precipitation in Depth	mm per year
	Demography	Total Population	million persons
		Urbanization	% of total population
		Urban Population Growth Rate	annual %
Human-induced Drivers	Economy	Total GDP	billion USD (current USD)
		Share of GDP by Agriculture	% of GDP
		Share of GDP by Manufacturing	% of GDP
		Share of GDP by Services and Other Sectors	% of GDP
		GDP Growth Rate	annual %
		GDP per Capita	current USD
		Unemployment Rate	% of total labor force
	Governance and Finance	Foreign Direct Investment, net inflow	% of GDP
		Ease of Doing Business Index	country ranking
		Corruption Perception Index (CPI)	country ranking
	Social Inclusiveness	Access to Improved Water Source	% of total population
		Access to Improved Sanitation Facilities	% of total population
		Access to Electricity (rural / urban)	% of population
		Human Development Index (HDI)	country ranking
		Population under Absolute Poverty Line (USD 1.25/day)	% of total population
		Gini Coefficient	0-100 (perfect equality - perfect inequality)

analysis in the succeeding steps of GGPA.

The drivers are represented in GGPA in the form of 23 “dashboard indicators” encompassing different areas and issues, which are either natural or human-induced. These indicators are further grouped into five overarching themes that capture the core drivers of change, namely geography and climate, demography, economy, governance and finance, and social

inclusiveness. The themes are expected to cover most, if not all, types of drivers of change in the country, and the information is envisaged to provide a robust characterization of the country's growth trajectory based on top-down background information. Aside from analyzing the country's major drivers of change, the dashboard indicators could also identify untapped opportunities that reveal consistently low or lagging values over time, but could be improved through human interventions. It could also reveal other defining characteristics, which may not be drivers of change, but could serve as useful contextual information for the succeeding analyses.

Note that the findings based on the 23 dashboard indicators should be complemented by a comprehensive literature review of the country's overall development landscape to enrich the discussion. This complementary background information is expected to validate and complement the initial results, thus providing an objective foundation for the preliminary findings. Note that the analysis will not only be validated by literature review but will also be strengthened by stakeholder consultation in the next stage.

3.2. STEP 2: Green Growth Diagnosis (Indicator Sets for the 3 Green Growth Pathways)

The preliminary analysis based on dashboard indicators and literature review will be followed by a diagnosis of the country's green growth performance through a set of indicators for the three pathways: REG (10 indicators), EFG (8 indicators), and CRG (7 indicators). The indicators are selected based on relevance to the concepts of the three pathways (e.g., energy intensity, as an indicator, is key to understanding energy efficiency), measurability, and data availability. As much as possible, the indicators should also be related to a number of sectors to generate a multi-sectoral approach in analyzing the results. Some indicators, however, may have to be sector-specific such as agricultural productivity (land) and coastal shell fishing pressure (fishery).

Note that these indicators are not to be considered as "perfect" sets as there

could still be noticeable gaps depending on the country context. Thus, there will be room for flexibility in making sure that the indicator sets reflect the specific conditions of the country. Thus, some indicators may be less relevant for the country while those that are not included in the current set may be more suitable and thus, could be added in the list as long as it is coherent with the pathway's concept and that the data is readily available. In case of data scarcity, identifying one or more proxy indicators in consultation with the country counterpart is recommended. The lessons throughout the exercise of modifying the indicators should be well documented especially during the pilot testing of the GGPA framework.

3.2.1. Measuring the country's potential for eco-efficient growth (10REG indicators)

The set of REG indicators measures how efficient the country's resource production is in view of its input vis-à-vis outputs. Thus, production factor efficiency is key to understanding resource-efficiency. As emphasized in the previous chapter, resource-efficiency focuses on adding greater value in the production of goods and services while minimizing inputs and mitigating environmental impacts.

The REG indicator set is composed of a total of ten indicators encompassing all the major production factors in an economy. As shown in Table 2, REG includes three major themes, namely energy efficiency, resource productivity, and other productivity factors. Energy efficiency, characterized by reducing energy consumption while providing the same level or quality of service, is measured in terms of energy intensity and distribution losses of electricity. Moreover, resource productivity, basically defined as the quantity of goods and services obtained from the expenditure of unit resource, is measured in terms of material intensity, solid waste generation capacity, waste recycling rate, fresh water productivity and agricultural productivity. In addition, REG also takes into account other factors of productivity such as labor productivity, Logistics Performance Index, and technological readiness.

Table 2 GGPA-REG Indicators

Theme	Sub-Theme	Indicator	Unit
Energy Efficiency	Energy Intensity	Energy Intensity Level of Primary Energy	MJ/unit GDP
	Energy Loss	Electric Power Transmission and Distribution Losses	% of output
Resource Productivity	Material Intensity	Material Intensity	kg of domestic consumption/unit GDP
	Waste Generation	Municipal Solid Waste Generation Intensity	kg of waste/unit GDP
	Waste Recycling	Recycling Rate of Solid Waste	% of waste generated
	Water Productivity	Water Productivity	GDP/m^3 of freshwater withdrawal
	Land-use Productivity (Agricultural)	Agricultural Land Productivity	USD/km^2
Other Factor Productivity	Labor Productivity	Labor Productivity	GDP/worker
	Logistics Performance	Logistics Performance Index	1-5, higher the better
	Technology	Technological Readiness	1-7, higher the better

3.2.2. Measuring the country's potential for eco-friendly growth (8 EFG indicators)

The set of indicators under the EFG reveals how the country is managing the quality and quantity of its natural resource base by looking into the patterns of current resource use and its sustainability. Thus, both the quality and quantity of natural resources play a key role in understanding the degree of environmental sustainability in the country, thereby highlighting two major themes: natural resource quantity (renewable or non-renewable) and environmental quality.

Natural resource quantity includes coastal shelf fishing pressure, changes in forest cover, water stress index, and natural resource depletion. On the other hand, aside from changes in the number of endangered species, environmental quality also touches upon the overall quality of water, soil, and air by looking into water quality index,[3] trends in soil health,[4] and

[3] Adopts the index used by the Environmental Performance Index, which uses three parameters measuring nutrient levels (dissolved oxygen, total nitrogen, and total

Table 3 GGPA-EFG Indicators

Theme	Sub-Theme	Indicator	Unit
Quantity of Natural Assets	Fishing Pressure	Coastal Shelf Fishing Pressure	ton/km^2
	Forest Cover Changes	Changes in Forest Cover	annual change (%)
	Water Consumption	Water Stress	0-5 (higher the greater competition among users)
	Natural Resource Depletion	Natural Resources Depletion	% of GNI
Quality of Natural Assets	Endangered Species	Changes in the Number of Endangered Species	annual change (%) 2013-2015
	Water Quality	Water Quality Index	0-100 (higher the better)
	Soil Quality	Trends in Soil Health (Index)	0-50 (higher the better)
	Air Quality	Population-Weighted Exposure to PM2.5	μg/m^3

average exposure to air pollution. Note that some are indexes and not indicators; but for the purpose of GGPA and for simplicity in terminology, these indices will also be considered as indicators.

3.2.3. Measuring the country's potential for climate-resilient growth (7 CRG indicators)

The CRG indicators present the country's conditions in the context of climate change as well as its commitment to mitigation and adaptation. Specifically, it diagnoses the country's performance in terms of reducing greenhouse gases (4 indicators) and to what extent the country is vulnerable to and capable of adapting to climate-related risks (3 indicators).

Specifically, mitigation indicators measure the country's GHG emission trend in the last five years, the degree of carbon intensity, renewable energy production, and carbon stock in living forest biomass. On the other hand, adaptation indicators[5] measure the extent the country is exposed to climate

phosphorus) and two parameters measuring water chemistry (pH and conductivity) to understand levels of water quality.

4) Measures the physical quality, related to loss of soil mass and structure; and the long-term chemical well-being of the soil in terms of nutrients and absence of toxicities built up (FAOSTAT).

5) Adopts the ND-GAIN Index which defines vulnerability as exposure and sensitivity to

Table 4 GGPA-CRG Indicators

Theme	Sub-Theme	Indicator	Unit
Climate Change Mitigation	CO_2 Emissions	CO_2 Emission Trends	annual growth rate (%)
	Carbon Intensity	Carbon Intensity	tCO_2/unit GDP
	Renewable Energy	Renewable Energy Production	% of total electricity output
	Carbon Stock Changes	Carbon Stock in Living Forest Biomass	annual change in million tonnes
Climate Change Adaptation	Exposure	Climate Change Exposure	0-1, lower the less exposed
	Sensitivity	Climate Change Sensitivity	0-1, lower the less sensitive
	Adaptive Capacity	Adaptive Capacity to Climate Change	0-1, lower the higher adaptive capacity

risks due to predefined conditions, the degree in which the country is likely to be negatively affected by climate hazards, and the amount of available resources for climate change adaptation. The difference between carbon stock (under CRG) and forest cover changes (under EFG) is worth noting as these indicators are selected to cover separate but interconnected levels of analysis through the lens of environmental sustainability and climate resilience. Changes in forest area (in percentage) enables good understanding of the country's deforestation trend in comparison with its peers, and how such trend could be strongly linked to the provision of ecosystems services (i.e., providing clean water and decent living conditions). On the other hand, carbon sink, as an indicator under CRG, has greater implications on carbon loss, analyzed in a global context considering how mitigation of greenhouse gases has become an international agenda.

3.3. STEP 3: Analysis of Preliminary Findings

This step involves using the numerical results in the previous step to

climate, population, infrastructure and resource stress, as well as the country's adaptive capacity to those stresses.

identify a set of key issues that are likely to have a high green growth potential. Based on the findings revealed by the three sets of green growth pathways (REG, EFG and CRG), a spider diagram is created as a visual presentation of the country's performance in all given indicators. As previously mentioned, the underlying assumption is that the potentials are most prominent in areas of underperformance; in other words, areas (i.e., issues or indicators) that leave much room for corrective measures are seen as great windows to be exploited in pursuing green growth going forward.

The preliminary findings prepared in step 1 should provide answers to the following questions, which are to be validated in consultation with country stakeholders in phase 2.

- What is the country's current performance in different areas of green growth, and how does this compare to its peer countries?
- What factors explain the underperforming areas? How much is attributable to the underlying conditions (i.e., lack of natural endowments and high population density) and human-induced factors?
- Most importantly, what are the underlying causes or sectors relevant to the key issues identified in the country?

3.3.1. Identification of underperforming areas

At the core of making use of a country's indicator data is presenting the information in a way that helps evaluating performance based on a common scale. Theoretically, the data would need to be presented in an absolute rating scale (i.e., high, medium, or low performance) or a notionally common scale (i.e., ranking figures and percentile scores) that enables relative evaluation of performances. Some of the challenges involved in this normalization exercise include:

- Setting of absolute rating scales can be controversial, given the characteristics of what the indicators are designed to measure. For example, how low is considered low enough in terms of a country's energy intensity?
- The common scale must enable logical comparison of apples to

oranges. For example, which is the country's area of weaker performance, energy intensity or water productivity?

- The common scale must allow a simple yet accurate depiction of country's performance. For example, use of "country rankings" is limited in that it needs to be accompanied by additional information (i.e., measures of central tendency, such as the mean and interquartile range) for accurate assessment of performance.

Notwithstanding some of the inherent limitations in normalization exercise, the GGPA framework suggests that the country indicator data are normalized into "percentile scores" following simple steps below:

- The 10th percentile and 90th percentile of values for each indicator are computed from data available for countries worldwide. This process establishes a threshold of data acceptance, considering possible abnormal deviations and uncertainties (in the accuracy) of the global country dataset.
- A country's percentile score for each indicators is calculated through two-point normalization exercise using the 10th percentile and 90th percentile of values. In other words, percentile scores are computed to reflect a country's standing relative to the highest (i.e., 10th percentile) and lowest (i.e., 90th percentile) global performance for each indicators.

The normalization exercise must consider how higher values can mean weaker performance for some indicators (i.e., energy intensity), and ensure consistency in representation of percentile scores; in other words, higher percentile scores represent better performances for all indicators.

As a means of conducting relative evaluation, the country scores are to be compared to the average scores of its peer country groups in the form of same spider diagram. Notwithstanding the different country contexts in which performance occurs, the GGPA framework proposes that the peer country group is to be based on the "income level" (equivalent to GNI per

capita). For example, Colombia's scorecard is to be compared primarily to that group of upper-middle economies, which is Colombia's income group. Extended filtering of peer countries in addition to the income level (i.e., countries of the same geographical area or similar population densities) may be carried out, but is to be done carefully, as it may run the risk of poor benchmark representativeness from data limitation. The comparison charts will be backed up by a critical analysis of the major trends behind indicators and their interconnections as well as the underlying causes of priority issues.

The comparative analysis could not just be limited to peer countries within the same income group. Note that some countries may want to be benchmarked with a specific group of countries (e.g., some middle-income countries aspire to be at par with the OECD members in terms of key development indicators). This additional comparison can contribute toward a better understanding of future gaps. Even in cases where the country's performance is relatively good vis-à-vis its peers, it could be found out that there are specific areas that need more attention at an accelerated pace to meet its green growth ambitions.

The relative evaluation approach taken by the GGPA framework is founded on how a wealth of empirical studies provide evidence that per capita income is positively related to environmental performance.[6] In addition, "income level" can serve a strong benchmark to many developing countries interested in pursuing green growth, as their development aspirations often place equal emphasis on economic growth and environmental sustainability (which, in a nutshell, is the essence of green growth). The assessment on the 25 diagnostic indicators employed by the GGPA framework largely support the following empirical findings:

- Country performances increase with the rise of income for 19 out of the 25 diagnostic indicators.[7] All of the diagnostic indicators under

[6] Of course, this does not necessarily mean that that "income level" is the only prominent variable; factors such as level of education (i.e., capacity to initiate environmental programs) and governance (i.e., effective administration and regulation) also have good correlations to certain areas of a country's environmental performance.

[7] This argument holds true with slight deviations for areas of "energy loss", "renewable energy", and "carbon sink".

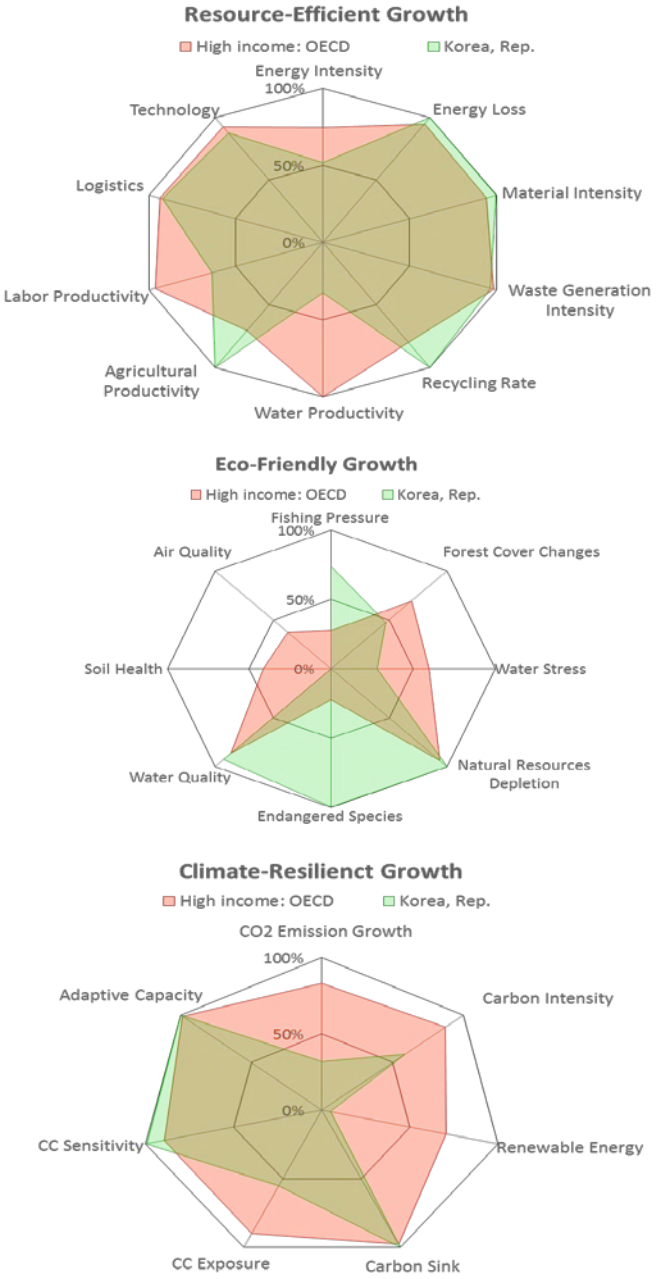
the REG pathway and most of the indicators under the CRG pathway (i.e., 6 out of 7 diagnostic indicators) follow this trend. This finding is in strong support of the economic theory which suggests that control of pollution, resource efficiency, and climate resilience improves along with economic growth.

- A total of 3 diagnostic indicators under the EFG pathway follow a trend that is completely opposite to that described above. Namely, these are “fishing pressure”, “changes in the number of endangered species” and “air quality”. Such trend is supported by the notion that despite the increased capacity for control and mitigation, environmental problems in wealthier countries magnify with increasing levels of consumption. In other words, decoupling of environmental degradation and economic growth still remains a significant challenge in these areas.
- A total of 3 diagnostic indicators show a weak correlation to country’s income levels. Namely, these are “water stress” and “soil health” of the EFG pathway, and “carbon intensity” of the CRG pathway. The lack of correlation for water stress and soil health may be explained by how these issues are largely predetermined by the given natural circumstances (i.e., low water availability and naturally poor soil conditions) which are difficult to be reversed through human actions. The trends for carbon intensity may be supported by the so-called environmental Kuznets curve theory, which asserts that environmental degradation tends to get worse as modern economic growth occurs until average income reaches a certain point over the course of development.

3.3.2. Case of the Republic of Korea

The preliminary identification of a country’s areas of underperformance needs to be carried out carefully, with due consideration given to the varying correlations between performances and income levels described above. The example for the Republic of Korea (ROK) given in Figure 3 demonstrates

Figure 3 Country Scorecards for the ROK and its Peer Countries



how powerful the spider diagrams are in visualizing multiple areas of a country's green growth performances. The ROK's performance (in green) is compared to the average performance of other high-income countries in the OECD (in red). Higher percentage values mean better quality and performance; the percentage values are relative and normalized representations based on indicator/index datasets released by well-acknowledged institutions.

The results show that while the ROK performs relatively well in terms of REG indicators, it lags behind its peer countries in terms of EFG and CRG performance. Based on the spider diagram, the ROK's green growth issues are found to primarily evolve around "high energy consumption" (i.e., energy intensity and carbon intensity), "poor water management" (i.e., water productivity and water stress), "deteriorating air quality" (i.e., air quality and CO_2 emissions growth), and "lack of climate change actions" (i.e., carbon intensity, renewable energy, water stress, and climate change exposure). The identified areas in this stage will serve as point of departure toward a more rigorous analysis in the next step, where the data is validated and deliberated among stakeholders and experts to come up with sound policy recommendations.

Even if the ROK shows a fair performance in the REG path, its energy intensity and labor and water productivity lag behind other high income OECD members, which means the ROK has a good potential to improve energy efficiency and labor and water productivity. In EFG path, the ROK shows poor performance in air quality, soil health, and water stress while it is doing well in fishing pressure, natural resource depletion, endangered species, and water quality. In CRG path, most of indicators show poor performance compared with those of peer countries except carbon sink. Particularly, the share of renewable energy is quite low compared with that of its peer countries.

The shape of the spider diagrams helps focus on multiple areas that contribute to a common outcome, while the area of its shape helps understand a country's performances in the three dimensions of green growth

(i.e., REG, EFG and CRG). Although the GGPA framework is in support of striking a balance between the three key dimensions of green growth, the three spider diagrams can have strong implications for the country's conceptualization of green growth. For example, a country with poor showing centered principally on REG indicators may need to ensure that their green growth concept and strategies would focus on improving the productivity and efficiency of economic activities.

Once the underperforming areas or priority green growth issues for a given country are selected, a study is carried out to interpret the reasons and underlying causes of poor performance. As an example, the issue of "high energy intensity" may be attributable to a large share of energy-intensive industry, low insulation efficiency of buildings, congestion of transport, or household energy-use behavior. Such sectoral approach is recommended to help organize the underlying cause from different issues. For example, "congestion of transport" may relate to issues in addition to "high energy intensity", such as poor logistics performance, poor air quality, and low adaptive capacity to climate change.

The discussion on country performances should also correlate to the dashboard indicators. For example, how do the country's recent structural changes in GDP (i.e., GDP share by sector) and GDP growth rate have affected its performance in terms of energy intensity? Or similarly, is low access to improved sanitation facilities a reason to the country's poor showing in terms of water quality? In addition, the discussion on country performance should also seek to interconnect the different areas. For instance, how do water productivity, agricultural productivity, water stress, and climate change sensitivity influence one another? Or similarly, how do material intensity, natural resource depletion, and adaptive capacity influence one another?

3.4. STEP 4: Validation, Sector Analysis, and Recommendation

Once the preliminary findings are summarized and a general analysis is

completed, the data should go through validation based on a series of stakeholder consultations. Validation is to identify and prioritize underlying causes or sectors. It should determine the following: (1) if policy makers and key stakeholders agree to the conclusion drawn from the dashboard and diagnostic indicators; and (2) identify and shortlist the issues and sectors that are accountable for the poor performance. After the issues and sectors are prioritized, the analysis deeps dive into understanding what actions are necessary for the country to maximize green growth gains.

3.4.1. Sector analysis

Building on the insights gleaned from the validation process, the next step is to prepare key recommendations, which are key intervention options for sectors with the highest green growth potential and may serve as a starting point for future green growth actions in the country. The recommendations on green growth policy options could fall within four dimensions, namely: (1) national policies and strategies; (2) institutions and governance; (3) finance, technology, and capacity; and (4) market and business.

3.4.2. Policies and strategies

This dimension covers policy instruments, to be implemented by national and sub- national entities, which could be regulatory (command-and-control approaches such as technology mandate and efficiency standards), voluntary (e.g., green lifestyle initiatives, eco-labeling), market-based instruments including financial incentives (e.g., cap-and-trade, feed-in-tariffs), and other government-led interventions (e.g., green public procurement). The recommendations under this dimension should fairly take into account the country’s current development plans and strategies to facilitate mainstreaming and integration instead of proposing stand-alone policies and strategies.

3.4.3. Institutions and governance

The institutional aspects of green growth include: legal enabling

environment (whether green growth is well articulated in the country's constitution and rule of law); political participation (if existing mechanisms ensure wide consultation, participation, and engagement of the stakeholders including the poor and socially marginalized groups); economic institutions (prevalence of robust markets and labor force); and research and innovation systems (breakthrough innovations driving a high value-added green economy, PPP mechanisms, etc.).

3.4.4. Finance, technology and human capital

This dimension refers to the capacity of a country to absorb and channel green investment, innovate and deploy technology, and optimize human knowledge and skills. Developing countries have multiple windows of opportunities for furthering green investments such as the government budget and expenditure, fiscal system and incentive mechanisms, investment mechanisms, and financial system capacity. Opportunities related to technology transfer mechanism, and diffusion of research knowledge and application to industries alongside capacity building could also be explored.

3.4.5. Market and business

This dimension refers to the ability of the private sector to invest and create new markets for environmental goods and services. Green economic transformation requires the engagement of both the public and private sector. Essentially, shifting investment and policy focus toward green industries (be it clean and renewable energies, green infrastructure and city development as well as more client resilient agriculture and promotions of ecotourism) are expected to generate green jobs and diversify a country's industries, thereby bringing about new business opportunities.

3.4.6. Preparation of key recommendations

This stage involves a more in-depth analysis of the highlighted issues in the previous step. The following areas should be considered to deepen the analysis:

- Alignment with national development and climate policies and strategies: this looks into the country's development and investment strategies in the prioritized sectors and issues; and if the identified issue-sector pair with high green growth potential are aligned with the country's sustainable development and green growth goals and pathways.
- Coherence: the critical concern to be addressed to ensure coherence is if the policies and strategies are optimized in a way to maximize the transition toward the green economy. It should also delve into the barriers contributing to sustaining brown economy and offsetting the country's green growth efforts (e.g., sustained subsidies on fossil fuel dwarfing the impacts of introducing feed-in-tariff).
- Political feasibility: while more in-depth analysis would need to be conducted eventually, it could provide a general approach where there is any political momentum built up in support for a particular sector or areas in line with green growth.
- Identification of low hanging fruits and strategic leverage points: in synthesizing the recommended actions in short and mid/long term, the analysis may look into actions that are deemed as low-hanging fruits and strategic leverage points to ensure success.

4. CONCLUDING REMARKS

Green growth approaches are disparate given the different stages of development, resource endowments, socioeconomic characteristics, and unique development challenges in countries. The distinct local conditions thus imply different priorities and strategies in relation to green growth and this has implications on the national economic planning process.

Against this backdrop, this study has developed a tool to assess "Green Growth Potential" at a national level as a diagnostic tool for examining a country's performance in key green growth areas, in an effort to help identify

and transform the areas of underperformance into opportunities for high-impact green growth interventions. GGPA thus aims to determine the appropriate entry points for green growth actions, ensuring that the process of issue identification and agenda setting is based on a systematic, objective, and participatory approach to country diagnosis. However, with data available, GGPA can apply to assess green growth potential of sub-national level.

GGPA is a user-friendly and country-driven methodology of identifying and prioritizing key issues and sectors through a combination of top-down and bottom-up approaches. It disaggregates green growth into three dimensions — Resource-Efficient Growth, Eco-Friendly Growth, and Climate-Resilient Growth — which serve as the basis for the logical and substantiated selection of 25 country indicators/indices that measure green growth performance.

The case of the Republic of Korea shows that while the ROK has performed relatively well in terms of REG indicators, it lags behind its peer countries in terms of EFG and CRG performance. Based on the spider diagrams, the ROK's green growth issues is found to primarily evolve around "high energy consumption" (i.e., energy intensity and carbon intensity), "poor water management" (i.e., water productivity and water stress), "deteriorating air quality" (i.e., air quality and CO_2 emissions growth), and "lack of climate change actions" (i.e., carbon intensity, renewable energy, water stress, and climate change exposure). The identified areas in this stage will serve as point of departure toward a more rigorous analysis through validation and sector analysis and recommendations.

The purpose of GGPA extends beyond its findings; it should catalyze tangible actions in the form of policy reforms grounded on the recommendations. With strong government buy-in, GGPA can initiate a process that will help translate the findings into concrete actions that address the country's most pressing green growth challenges. Considering its rich technical content, GGPA also serves as an effective lobbying tool to attract investments as it strengthens the business case for green bankable projects in

the country. It also enriches the current discourse on green growth in the country, shaping public dialogue on how green growth can help advance the sustainable development agenda.

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