04

Conceptual framework

4.1 Underlying concepts and goals

The conceptual framework for the Green Growth Index builds on GGGI's definition of green growth:

> *Green growth is a development approach that seeks to deliver economic growth that is both environmentally sustainable and socially inclusive. It seeks opportunities for economic growth that are low-carbon and climate resilient, prevent or remediate pollution, maintain healthy and productive ecosystems, and create green jobs, reduce poverty and enhance social inclusion.*
>
> (GGGI Refreshed Strategic Plan 2015-2020, (GGGI, 2017:p.12).

This definition emphasizes four closely interlinked concepts that support green growth and sustainable development: low carbon economy, ecosystem health, resilient society, and inclusive growth.

The concept of **low carbon economy**, which the United Kingdom's Department of Environment, Food and Rural Affairs (DEFRA) introduced through its energy white paper, "Our energy future - creating a low carbon economy," in 2003, emphasizes "higher resource productivity — producing more with fewer natural resources and less pollution" (DEFRA, 2003: p.6). It has become a widely used strategy for transitioning from a high-carbon to a low-carbon production structure, with a particular focus on energy efficiency as well as clean and renewable energy (Xin, Yuding, & Jianzhong, 2011; Yuan, Zhou, & Zhou, 2011; EFFECT, 2013). Low carbon as a pathway to growth has also been instrumental in the climate change negotiations, with low carbon emissions as a key measure for climate change mitigation (Goerild et al., 2016). Investment, innovation, and skilled labor requirements are important challenges in transitioning to sustainable low carbon economy (Foxon, 2010; ILO, 2011; Nelson, Hervé-Mignucci, Goggins, Szambelan, & Zuckerman, 2014; Goerild et al., 2016), and governments are increasingly promoting these through incentive programs and supportive policies (NRTEE, 2012), thus helping to transform challenges into opportunities.

The role of a low carbon economy in creating business, employment, and other new economic opportunities is now widely recognized (CCICED, 2009; Xin et al., 2011; Worrall, Roberts, & Whitley, 2018). In addition to an increase in climate change impacts, energy costs, and population growth – "growing understanding of limitations to ecosystem health to create increasingly favourable conditions … to invest in and develop markets for clean or green technologies" – contribute to global transition to low carbon economy (NRTEE, 2012). More recently, however, debates on the transition to low carbon economy have not only focused on how to conserve ecosystem health, but also on "how to address the adverse impacts on specific vulnerable industry sectors, groups of people and communities" (Gambhir, Gree, & Pearson, 2018). A "just transition" to low carbon economy is a new concept that aims to minimize unemployment risk, create decent employment (Popp et al 2018), and avoid other unintended outcomes that can result in excluding segments of society.

In the last decades, **ecosystem health** has become increasingly relevant due to degradation of natural resources, such as land, minerals, water, air, and forest, and their services to the people in the form of food, energy, raw materials, culture, and wellbeing, among other issues. Rapport (1995) emphasizes that ecosystem health is a normative concept, so that desired sustainable conditions are subject to societal perceptions. Because it is a useful concept for setting new goals and providing new integrative models for environmental management (Fu-Liu & Shu, 2000; Gaudet, Wong, Brady, & Kent, 2008), ecosystem health has become widely relevant for forming national and international management programs to protect and conserve forest, rangeland, coastal, marine, and freshwater ecosystems (Rapport et al., 1999). Thus, indicators for ecosystem health should, inter alia, be aligned with ecosystem protection and management goals (Lu et al., 2015), for instance, better environmental quality, reduced GHG emissions, and biodiversity conservation.

Ecosystem management involves applying knowledge and technology to achieve the desired conditions of ecosystems (Salwasser, 1995), including efficiency in using these natural resources to reduce environmental stress. An ecosystem is considered healthy when it is free from distress and degradation, resilient to stress (Costanza, 1992; Rapport, Costanza, & McMichael, 1998), and able to sustain services to people (Tett et al., 2013). Because of the interdependence between ecosystems and society, the resilience of society depends very much on ecosystem resilience: "Conditions necessary to sustain the capacity of an ecosystem are very much dependent on society, and yet in turn, society is dependent on these very ecosystems for their own health and development" (Hearnshaw, Cullen, & Hughey, 2005).

The concept of social or societal resilience, which underpins a **resilient society**, draws from the social-ecological perspective of resilience. It is "the capacity of social-ecological systems to absorb recurrent disturbances ... so as to retain essential structures, processes and feedbacks" (Adger, Hughes, Folke, Carpenter, & Rockström, 2005: p.1036). The definitions of social resilience generally refer to the capacities of society to "tolerate, cope with, and adjust to environmental and social threats of various kinds" (Keck & Sakdapolrak, 2013: p.8). While scientific debates on practical utility of resilience and its linkages to vulnerability continue (Birkmann, 2006; Bach et al., 2013; Miller et al., 2010), policymakers increasingly use the concept of social resilience to respond to climate change and manage disaster risk and as instruments to implement post-2015 international agendas, including the Sustainable Development Goals, the Sendai Framework for Disaster Risk Reduction, and the Paris Agreement under the United Nations Framework Convention on Climate Change (de Bruijn, Buurman, Mens, Dahm, & Klijn, 2017). In the context of climate change, social resilience has been considered the inverse of vulnerability (Birkmann, 2006; Sapountzaki, 2007; Gaillard, 2007); thus, vulnerable social-ecological

systems are those that have lost resilience (Folke, 2006). In this case, adaptation of "humans in nature" becomes a relevant consideration in social resilience (Keck & Sakdapolrak, 2013), where capacity for adaptation is facilitated through assets, resources, and environment (Windle, 2011).

Five forms of capital are considered to provide enabling conditions for building a resilient society: natural, including water, land, forests, and minerals; financial, including savings, income, and pensions;, human, including knowledge, skills, and health; social, including networks, trust, and mutual exchange; and physical, including shelter, water, sanitation, and energy (Sapountzaki, 2007; Sapountzaki, 2007; Jermalaviius & Parmak, 2012). Adger (2000:p.352) suggests that "social resilience is … observed by examining positive and negative aspects of social exclusion, marginalization," implying that enhancing social inclusion and reducing marginalization are key to building a resilient society.

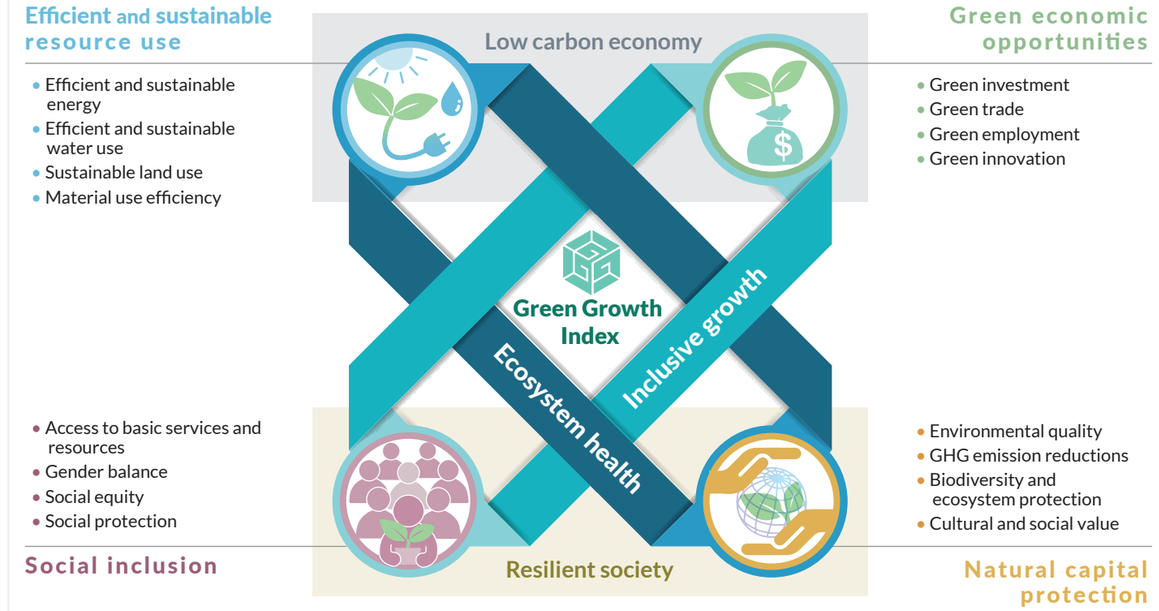
The concept of **inclusive growth** has evolved as a response to growing social inequalities and exclusions, particularly since the financial crisis in 2008 (Dutz, Kessides, O'Connell, & Willig, 2011; Haan, 2015). There is so far no universal definition for inclusive growth (Dutz et al., 2011; Ranieri & Ramos, 2013b, 2013a; Alexander, 2015; IMF, 2017; Lee, 2019), allowing room for different interpretations (Burch & McInroy, 2018). Although it has some overlaps with the concepts of human rights, inequality, redistribution, rural development, entitlements, and capabilities concepts (i.e., broad-based growth, shared growth, and pro-poor growth; Dutz et al., 2011; Gupta & Vegelin, 2016; IMF, 2017), inclusive growth suggests a more progressive pathway. Unlike other related concepts, inclusive growth does not focus on direct redistribution of income or benefits (Dinda, 2011; Haan, 2015), but on conditions that will enable the poor, vulnerable, disadvantaged, or excluded segments of society to participate in economic activities, contribute to growth process, and benefit from economic growth (Dinda, 2011; Haan, 2015; Lee, 2019).

Inclusive growth thus emphasizes equal access to economic opportunities within the society which are created through growth in investment, innovation, entrepreneurship, and employment (Dutz et al., 2011; Dinda, 2011; George, Mcgahan, & Prabhu, 2012). The concept emphasizes a growth strategy that builds on the economy and society (Walby, 2018), with the economy capable of creating new opportunities for the society and the society capable of taking part in sustaining economic growth. The latter suggests that "expanding human capabilities (e.g., through productive employment) are … regarded as instrumental in improving economic outcomes" (Alexander, 2015: p.5). This interpretation of inclusive growth emphasizes the need to invest in basic services (Dinda, 2011; Dinda 2011), invest in human capital to empower the poorest, and reduce social vulnerability by reducing exposure to risks and disasters (Gupta & Vegelin, 2016; Gupta and Vegelin 2016). Walby (2018) defines such public spending as social investment as opposed to welfare because social investment means that "inclusion and economic growth are co-produced, not trade-offs." This is a broader interpretation of inclusive growth, where "non-income measures of human capabilities and well-being are valued as human development outcomes, rather than solely as instruments to accelerate economic growth" (Alexander, 2015). Because "inclusive growth does not sufficiently consider or address environmental degradation," (Burch & McInroy, 2018: p.5) creation of economic opportunities should be guided by a "just transition" to low carbon economy, which could enhance social equality and sustainable development (Worrall et al., 2018; Worall et al. 2018).

4.2 Policy relevance of dimensions

The Green Growth Index comprise four dimensions: efficient and sustainable resource use, green economic opportunities, natural capital protection, and social inclusion (Figure 8). The indicators for **efficient and sustainable resource use** represent the use of major natural resources including energy, water, land, and material. The indicators for **green economic opportunities** include investment, trade, employment, and innovation. These two dimensions and their indicators are relevant to the concept of low carbon economy. The indicators for **natural capital protection** include environmental quality, GHG emission reductions, and biodiversity and ecosystem conservation. The indicators for **social inclusion** include access to basic services and resources, social equality, and social protection. These two dimensions and their indicators are relevant to the concept of resilient society.

Figure 8 Conceptual framework for the Green Growth Index



The concept of ecosystem health suggests that environmental management, in this case the efficient use of resources, could lead to desired goals or outcomes, such as protection of the natural resources. But resource efficiency and natural capital protection dimensions can be considered a connected system, that is they have inherent feedback mechanisms, because conservation and restoration of natural capital are also key drivers in transitioning to a low carbon or green economy (ten Brink, Mazza, Badura, Kettunen, & Withana, 2012). Similarly, the concept of inclusive growth emphasizes the co-production of social inclusion and economic growth, such as from innovative green opportunities (Walby, 2018). The economic, social, and environmental challenges that necessitate policy actions and decisions in the four green growth dimensions are discussed below.

4.2.1 Efficient and sustainable resource use

In recent years, there has been a significant increase in demand for resources, such as energy, water, land, and materials, due to an increase in population and living standards as well as in unsustainable production and consumption. Global population is growing at a rate of 1.07 percent per year (Worldometers, 2019) and projected to reach 9.8 billion in 2050 (UN DESA, 2017). Current trends in consumption will increase food requirements by 60 percent and water use by 40 percent by 2030 (UNEP, 2017; UNEP, 2018), and crop production by up to 55 percent by 2050 (UNEP, 2014a; UNEP, 2018). Natural resources, the very foundation of socio-economic development (EEA, 2015), are depleting at a fast rate and threatening global sustainability. Almost half of the nine planetary boundaries have been exceeded, which could lead to irreversible damage on Earth, including the climate system (UNEP, 2018). While meeting the basic needs of growing populations is necessary, the Earth's limit to generate resources and absorb waste should not be ignored (EEA, 2016). A change in production and consumption patterns is necessary to meet the increase in the demand and generate less wastes and pollution in the future. An economy-wide transformation is necessary if the carrying capacity of Earth and planetary boundaries are not to be exceeded.

The main objective of resource efficiency is to decouple economic growth from resource use. A study revealed that resource efficiency could reduce resource use by 17 percent by 2050 (Hatfield-Dodds et al., 2017). A four- to 10-fold increase in resource efficiency will be needed by 2050 (European Commission, 2011) to sustain economic growth. Evidence shows the existence of relative decoupling, where economic growth increases at a rate higher than resource use. However, absolute decoupling, where resource use declines in absolute terms, has not yet occurred. This is in part due to efficiency gains being often accompanied by a rebound effect, where such gains are invested in further activities entailing additional resource use (Shao & Rao, 2018; Bringezu, Schütz, Steger, & Baudisch, 2004). Addressing these issues is of the utmost significance, especially for public policy measures in many countries which are required to achieve absolute decoupling of resource use and ideally of environmental impact (UNEP, 2017b).

One of the core principles of green growth is the efficient use and management of natural resources and stocks (European Commission, 2019). UNEP calls for a resource-efficient economy (UNEP, 2011), while the World Bank states that green growth is one that is efficient in its use of natural resources (WB, 2012). According to OECD, green growth strategies should include well-designed and executed policies that maximize the efficient allocation of resources in such a way that is good for the environment and the economy and that provides incentives to use natural resources efficiently (OECD, 2011).

4.2.2 Natural Capital Protection

Natural capital is considered the most fundamental form of capital as it provides the basic conditions and provisions for human existence (EEA, 2015). It is composed of resources used in production processes (biotic or abiotic), but also englobes ecosystem services provided by nature (Milligan, Terama, Jimenez-Aybar, & Ekins, 2014). Ecosystems provide provisioning, regulating, and cultural and supporting services through the natural functioning and interaction of ecosystems which are beneficial to life and specifically to humans (Milligan et al., 2014; Costanza et al., 2017). The ecosystem services provided to humans were valued at approximately USD 125 trillion in 2011 (Costanza et al., 2014). Biodiversity is important for sustainable ecosystem services (Cleland, 2011) but its overall state is declining. As widely reported, "the world is already facing the mass extinction of species" (Earth Day Network, 2018).

Biodiversity loss is evident in every region of the world and is reducing nature's capacity to regenerate and contribute to people's well-being (Suzuki, 2018). Such a decline coupled with climate change will only accelerate and intensify the deterioration of natural assets, making the earth considerably less habitable for human beings and large numbers of other living organisms. An evident increase in global GHG emissions was notable in 2017 after two years of almost no growth. Carbon dioxide emissions rose by 1.2 percent in 2017 (Olivier & Peters, 2018). Air quality around the world is declining (CCAC, 2018) and overfishing is considered one of the biggest threats to the marine ecosystem, where "world's marine fisheries had 33.1 percent of stocks classified as overfished in 2015" (FAO, 2018: p.45).

Natural capital protection is considered especially relevant for green growth given the level of dependence societies have on natural capital for its goods and services. OECD (2011) states that green growth entails that natural assets continue to provide environmental services on which our well-being relies, while the UN ESCAP (2013) identifies green growth as needing to enhance the earth's natural capital. Natural capital exists independently but the benefits can only be derived from the interference of human beings (Committee, 2014). Historically, most countries around the world have exploited natural capital for the sole purpose of economic growth with limited considerations of environmental impacts. This has resulted in significant adverse impacts on biodiversity and in aggregated resource depletion. This directly jeopardizes the very objective of green growth, which is to recouple environmental protection with the economy (Vazquez-Brust, Smith, & Sarkis, 2014).

4.2.3 Green Economic Opportunities

Green growth strategies create new economic opportunities by accelerating investments and innovation that reinforce the foundations of sustainability (Bowen & Fankhauser, 2011). The objective of green growth is to identify cost-effective measures to reduce pressure on the environment, maximize the benefits of the cleaner sources of growth, and transform the conventional sectors into green sectors (OECD, 2011). These objectives, however, require large investments (Bowen & Fankhauser, 2011). More than USD 300 billion was invested globally in clean energy in 2018 (BloombergNEF, 2019), helping to generate jobs in the renewable energy sector. Currently, the total number of employees in renewables are 11 million (IRENA, 2019). Clean sources of energy were developed as well as new jobs were created improving the standard of living. OECD has identified the sectors that have the potential to create green jobs if adequate policies are to be implemented. These sectors include green agriculture, renewable energy, sustainable forestry, clean industry, public transport, recycling and waste management, and federal government activities (OECD, 2017a).

However, the shift of investments from conventional to the green sectors means a shift in the task profile and nature of the jobs (Lehr, Lutz, & Edler, 2012). Almost 1.5 billion people are expected to be affected by the transition to a greener economy (ILO, 2012). This could also mean loss of jobs in carbon-intensive industries (WB, 2012; OECD, 2017a). Therefore, it is essential to address the implications caused by the green transition to the labor market. Studies have shown that skill shortages are accounted for as one of the main barriers to the growth and development of the green industries (WB, 2012). Hence, effective measures should be embedded in environmental and labor policies to facilitate the efficient re-training of the workforces (Pestel, 2014).

Recognizing both the importance and limitations of sustainability, green growth focuses on multiple objectives, which are to enhance economic growth while simultaneously increasing social cohesion and environmental protection (Kasztelan, 2017). The green growth narrative turns the current environmental crisis that stems from the impacts of climate change into opportunities and serves as a practical measure to achieve sustainable development (OECD, 2011). Going beyond low-carbon growth and measures to tackle climate change, green growth strategies construct the cost-effective pathways to develop environmentally friendly technologies and cultivate a fair environment resulting in a resilient society (Kasztelan, 2017). Moreover, these strategies enhance opportunities for trade through green certified products and related services as well as through green international supply chains (UNEP, 2013). Green trade, in turn, creates opportunities for specialization, competition, economies of scale and innovation (WTO & UNEP 2018).

4.2.4 Social Inclusion

Inequality at present is persistent and self-evident. At least 900 million people are still living on less than USD 1.90 per day (WB, 2015). Just under one billion people are still living without access to electricity (SEforAll, 2017) and 2.8 billion people without access to clean cooking (IEA, 2017), while 2.1 billion people do not have access to safe drinking water (WHO, 2017). Lack of access to basic services and resources is directly related to the absence of income. Further, lack of income translates to people strongly depending on nature and ecosystem services to earn their livelihood. The level of degree to which an individual rely on the environment depends immensely on their economic circumstances and many other structural conditions and constraints. An economy that is very dependent on the environment also relies on social welfare for its growth (Bouma & Berkhout, 2015). The recent work of IMF suggested that economic growth would be unsustainable if inequality were disregarded. Economic growth generally tends to be higher in countries where equality is higher (Ostry, Berg, & Tsangarides, 2014).

Access to basic resources should be accompanied by social equity and social security if the social performance is to be measured adequately and inequality is to be reduced. A society can only be inclusive when every member of the society has not only equal access to resources, but also opportunities to participate fully in social processes irrespective of the individual abilities, ethnic and social background, gender, or age. For example, large-scale green investments can create jobs for disadvantaged groups and decrease inequality gaps particularly in the developing countries (Euro Cities, 2015). Employment opportunities for socially fragile groups can help to alleviate poverty, which in turn is considered an important hurdle for social inclusion (Eyraud et al., 2011). However, policies need to ensure that jobs created through green growth are decent jobs, which are productive, secure, offer social protection, and include social dialogue (UNEP, 2012). They also need to ensure that women have equal access to green job opportunities, particularly in energy and transportation sectors where women are traditionally not part of the workforce (Baruah, 2018).

4.3 Links to relevant sustainability issues

4.3.1 GGGI's priority areas

GGGI's engagement to support transformation of countries' economies cut across different economic sectors and development issues. However, to maximize the impact of its products and services, GGGI's intervention emphasizes change in four priority (or thematic) areas including sustainable energy, water and sanitation, sustainable landscapes, and green cities, which are defined as follows:

- **Sustainable Energy** refers to expanding access to affordable and sustainable energy services, improving sustainable energy generation mix and enhancing and integrating energy efficiency;
- **Water and Sanitation** aims to address issues impacting sustainable water resources management by encouraging reuse of water, increased access of water services (including sanitation) for all and water related innovation in industries, agriculture and households, and through policy reforms that support the strengthening of the water sector;
- **Sustainable Landscapes** centers on sustaining natural capital, reducing deforestation and ecosystem degradation, while pursuing green growth, sustainable trade and ensuring food and livelihood security. Priority areas include forests, agrarian landscapes, wetlands, coastal and marine ecosystems, including peatlands and mangroves; and
- **Green Cities** focuses on mainstreaming and localizing green growth into urban planning and management; supporting low-carbon, smart, and climate resilient cities; solid waste management particularly focusing on waste-to-resource approaches; and green mobility and non-motorized transport, linked to clean urban transportation, with a direct link to improving air quality.

Figure 9 presents the link of the green growth indicators to these priority areas. Two of the indicators, (1) the ratio of total primary energy supply to GDP and (2) the share of renewable energy to total final energy consumption are directly linked to **sustainable energy**. Other indicators such as the (1) ratio of CO_2 emissions to population excluding AFOLU and (2) ratio of non-CO_2 emissions to population excluding AFOLU have sectoral data that provides a measure in the performance on sustainable energy. For **water and sanitation**, there are three indicators that are very relevant such as (1) water use efficiency, (2) share of freshwater withdrawal to available freshwater resources, and (3) population with access to safely managed water and sanitation. Covering major types of ecosystems (i.e., terrestrial, freshwater, coastal, marine) and economic sectors (i.e., agriculture, forest and other land use), the **sustainable landscapes** are linked to 25 percent of the 36 green growth indicators. The indicator for freshwater withdrawal to available freshwater resources can be further disaggregated by sectors including agriculture, albeit data for most countries are presently not available. The three indicators, (1) air pollution, (2) mean annual population-weighted exposure (PM2.5), municipal solid waste (MSW) generation per capita, and (3) proportion of urban population living in slums are directly linked to **green cities**. The indicator on population with access to safely managed water and sanitation are available for urban and rural areas, which can be used to measure green growth performance for green cities.

Figure 9 Green growth indicators by thematic areas

Dimensions		Indicators	Cross-cutting	Sustainable energy	Water and sanitation	Sustainable landscapes	Green cities
Efficient and sustainable resource use	EE1	Ratio of total primary energy supply to GDP (MJ per $2011 PPP GDP)		■			
	EE2	Share of renewables to total final energy consumption (Percent)		■			
	EW1	Water use efficiency (USD per m^3)			■		
	EW2	Share of freshwater withdrawal to available freshwater resources (Percent)			■	▲	
	SL1	Average soil organic carbon content (Tons per hectare)				■	
	SL2	Share of organic agriculture to total agricultural land area (Percent)				■	
	ME1	Total domestic material consumption (DMC) per unit of GDP (DMC kg per GDP)	■				
	ME2	Total material footprint (MF) per capita (MF tons per capita)	■				
Natural capital protection	EQ1	PM2.5 air pollution, mean annual population-weighted exposure (Micrograms per m^3)					■
	EQ2	DALY rate as affected by unsafe water sources (DALY lost per 100,000 persons)	■				
	EQ3	Municipal solid waste (MSW) generation per capita (Tons per year per capita)					■
	GE1	Ratio of CO_2 emissions, excluding AFOLU to population (Metric tons per capita)	■	▲			
	GE2	Ratio of non-CO_2 emissions excluding AFOLU to population (Tons per capita)	■	▲			
	GE3	Ratio of non-CO_2 emissions in agriculture to population (Gigagrams per 1,000 persons)				■	
	BE1	Average proportion of Key Biodiversity Areas covered by protected areas (Percent)				■	
	BE2	Share of forest area to total land area (Percent)				■	
	BE3	Soil biodiversity, potential level of diversity living in soils (Index)				■	
	CV1	Red list index (Index)				■	
	CV2	Tourism and recreation in coastal and marine areas (Score)				■	
	CV3	Share of terrestrial and marine protected areas to total territorial areas (Percent)				■	
Green economic opportunities	GV1	Adjusted net savings, minus natural resources and pollution damages (Percent GNI)	■				
	GT1	Share of export of environmental goods (OECD and APEC class.) to total export (Percent)	■				
	GJ1	Share of green employment in total manufacturing employment (Percent)	■				
	GN1	Share of patent publications in environmental technology to total patents (Percent)	■				
Social inclusion	AB1	Population with access to safely managed water and sanitation (Percent)			■		
	AB2	Population with access to electricity and clean fuels/ technology (Percent)	■				
	AB3	Fixed Internet broadband and mobile cellular subscriptions (Number per 100 people)	■				
	GB1	Proportion of seats held by women in national parliaments (Percent)	■				
	GB2	Ratio of female to male with account in financial institution, age 15+ (Percent)	■				
	GB3	Getting paid, covering laws and regulations for equal gender pay (Score)	■				
	SE1	Inequality in income based on Atkinson (Index)	■				
	SE2	Ratio of urban to rural, access to safely managed water/ sanitation and electricity (Percent)	■				▲
	SE3	Share of youth not in education, employment or training, aged 15-24 years (Percent)	■				
	SP1	Proportion of population above statutory pensionable age receiving pension (Percent)	■				
	SP2	Healthcare access and quality index (Index)	■				
	SP3	Proportion of urban population living in slums (Percent)					■

■ Currently linked to the priority areas ▲ Indicators can be disaggregated for the specific priority areas

4.3.2 SDGs and other global sustainability targets

Sustainable Development Goals (SDGs) are an excellent framework for transition towards a green growth pathway for GGGI members and the planet (GGGI, 2017). Given that the Green Growth Index measures and tracks the green growth performance of countries worldwide, it is crucial to integrate SDG indicators in its framework. Currently, 232 indicators are covered in the 17 SDGs. SDG indicators are a reliable and comprehensive dataset which provide an excellent source for the construction of the Green Growth Index. Furthermore, as all UN member governments have agreed to reach specific targets in SDGs, it is necessary for the Green Growth Index to be aligned with the SDGs in order to make it relevant to national policy worldwide. It will enable countries to visualize easily their level of performance in achieving the SDGs, similar to the OECD's Measuring Distance to the SDG Targets (OECD, 2019b). The Green Growth Index, building upon a highly participatory global initiative engaging hundreds of experts in all parts of the world, uses the foundations of the SDGs to construct a new balanced and unbiased index on green growth. During the regional workshops (Chapter 3), experts indicated their preference to benchmark the Index against SDGs.

Figure 10 and Acosta (2019) presents the relationship of the green growth indicators that were used in the Index to the SDG indicators. The 21 green growth indicators are SDG indicators, and the remaining contributes not only to the SDGs but also other international agreements. For example, CO_2 emissions per capita, excluding AFOLU (GE1), non-CO_2 emissions per capita, excluding AFOLU (GE2), and non-CO_2 emissions in agriculture per capita (GE3) have a large impact on the Paris agreement's objective to keep global average temperature to well below 2 °C above pre-industrial levels. Average soil organic carbon content (SL1) and share of organic agriculture to agricultural land area (SL2) contributes to Aichi Strategic Goal B to reduce the direct pressures on biodiversity and promote sustainable use, while soil biodiversity, potential level of diversity (BE3) Aichi Strategic Goal C to improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity.

While the indicators for green economic opportunities have no direct link to the targets of the SDGs and other international agreements, they generally have contribution to sustainable development. For green investment, adjusted net savings minus natural resources depletion (GV1) was a relevant indicator in the United Nations Commission for Sustainable Development (UN DESA, 2007). For green trade, the share of environmental goods to total export (GT1) was used as an indicator by UNEP (PAGE, 2017a, 2017b). The share of green employment in manufacturing (GJ1) was a pertinent indicator for green jobs, which was used by Bowen & Kuralbayeva (2015) and the June 2017 OECD report for the G7 Environment Ministers (OECD, 2017a). Finally, for Green Innovation, the share of environmental technology to total patents (GN1) was considered by the OECD for cross-country comparisons of technology output (Dernis & Guellec, 2001).

GGGI's indicators for the Green Growth Index provide a comprehensive vision of sustainable development, taking into consideration the SDGs and other relevant international agreements' targets. It thus provides a useful metric for evaluating performance in achieving these targets as well as the objectives of green growth. So far, only the SDSN's SDG index (Sachs et al., 2019) and the OECD's Measuring Distance to the SDG Targets (OECD, 2019b) show the distance of countries' performance to SDG targets. The Green Growth Index emphasizes measuring performance in achieving not only SDG but also other sustainability targets. It is the first composite indicator for green growth to make explicit links to the SDGs and sustainable development. It gives a comprehensive vision of green growth and is intended to support policy directed towards achieving sustainable development targets.

Figure 10 Links of Green Growth Index to Sustainable Development Goals (SDGs)

A Sustainable Development Goals (SDG) indicators used in the Green Growth Index

Dimensions	Indicators		Sustainable Development Goals (SDGs)*		
			Goal	Target	Indicator
Efficient and sustainable resource use	EE1	Ratio of total primary energy supply to GDP	Affordable and clean energy	7.3	7.3.1
	EE2	Share of renewables to total final energy consumption	Affordable and clean energy	7.2	7.2.1
	EW1	Water use efficiency	Clean water and sanitation	6.4	6.4.1
	EW2	Share freshwater withdrawal to available freshwater	Clean water and sanitation	6.4	6.4.2
	ME1	Total domestic material consumption per GDP	Decent work and economic growth Responsible consumption and production	8.4 12.2	8.4.2 12.2.2
	ME2	Total material footprint per capita	Decent work and economic growth Responsible consumption and production	8.4 12.2	8.4.1 12.2.1
Natural capital protection	EQ1	PM2.5, mean annual population-weighted exposure	Sustainable cities and communities	11.6	11.6.2
	EQ2	DALY rate as affected by unsafe water sources	Good health and well-being	3.9	3.9.2
	BE1	Proportion of KBAs covered by protected areas	Life below water Life on land	14.5 15.1 15.4	14.5.1 15.1.2 15.4.1
	BE2	Share of forest area to total area	Life on land	15.1	15.1.1
	CV1	Red list index	Life on land	15.5	15.5.1
	CV3	Share of terrestrial and marine PA's to territorial areas	Life below water	14.5	14.5.1
Social inclusion	AB1	Access to safely managed water and sanitation	Clean water and sanitation	6.1 6.2	6.1.1 6.2.1
	AB2	Access to electricity and clean fuels/technology	Affordable and clean energy	7.1	7.1.1 7.1.2
	AB3	Internet broadband and mobile cellular subscriptions	Partnerships to achieve the goal Industry, innovation and infrastructure	17.6 9.c	17.6.2 9.c.1
	GB1	Seats held by women in national parliaments	Gender equality	5.5	5.5.1
	GB2	Ratio of female to male with financial account	Decent work and economic growth	8.10	8.10.2
	SE2	Ratio urban-rural, safe water/sanitation and electricity	Affordable and clean energy Clean water and sanitation	6.1 6.2 7.1	6.1.1 6.2.1 7.1.1
	SE3	Youth not in education, employment or training	Decent work and economic growth	8.6	8.6.1
	SP1	Proportion of population receiving pension	No poverty	1.3	1.3.1
	SP3	Proportion of urban population living in slums	Sustainable cities and communities	11.1	11.1.1

* Details on SDG targets and indicators are available on these links: https://unstats.un.org/sdgs/indicators/database/; https://unstats.un.org/sdgs/metadata/

Figure 10 Links of Green Growth Index to Sustainable Development Goals (SDGs) *(continued)*

B Link of green growth indicators to SDGs and other sustainability targets

Dimensions	Indicators		Link to SDGs and other targets			
			Sustainable Development Goals (SDGs)*		Other targets	
Efficient and sustainable resource use	SL1	Average soil organic carbon content	Life on land	15.3.1	Aichi	
	SL2	Share of organic agriculture to agricultural area	Zero hunger Responsible consumption and production	2 12	Aichi	
Natural capital Protection	EQ3	Municipal solid waste generation per capita	Sustainable cities and communities	11.6.1		
	GE1	CO_2 emissions per capita, excluding AFOLU	Climate action	13	Climate	
	GE2	Non-CO_2 emissions per capita, excluding AFOLU	Climate action	13	Climate	
	GE3	Non-CO_2 emissions in agriculture per capita	Climate action	13	Climate	
	BE3	Soil biodiversity, potential level of diversity	Life on land	15.3.1	Aichi	
	CV2	Tourism and recreation in coastal and marine areas	Responsible consumption and production	12.B		
	CV3	Share of terrestrial and marine PA's to territorial areas	Life on land	15.1	Aichi	
Green economic opportunities	GV1	Adjusted net savings	Responsible consumption and production	12		
	GT1	Share of environmental goods to total export	Responsible consumption and production	12		
	GJ1	Share of green employment in manufacturing	Industry, innovation and infrastructure	9		
	GN1	Share of environmental technology to total patents	Responsible consumption and production	12		
Social inclusion	GB2	Ratio of female to male with financial account	Gender equality	5.1		
	GB3	Laws and regulations for equal gender pay	Gender equality Reduced inequality	5.c 10.2		
	SE1	Inequality in income based on Atkinson	No poverty Reduced inequality	1.1.1 1.2.1 10.1.1		
	SP2	Healthcare access and quality index	Good health and well-being	3.8.1		

* Details on SDG targets and indicators are available on these links: https://unstats.un.org/sdgs/indicators/database/; https://unstats.un.org/sdgs/metadata/