THE SHARED ENVIRONMENTAL INFORMATION SYSTEM AND GREEN GROWTH

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Background Paper

Mapping of UNECE environmental and OECD green growth indicators and their dataflows

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Summary

The UNECE environmental indicators (EIs) and the OECD green growth indicators (GGIs) were set up to provide solid knowledge bases for developing sustainable policies. This paper aims at identifying matches and differences between those distinct indicator sets by comparing their dataflows, metadata as well as the units of measurement. It was prepared to serve as a practical guide to show how the dataflows under the process of establishing the Shared Environmental Information System (SEIS), and underpinning the EIs, can be used to produce certain GGIs.

It is found that 11 of the 24 GGIs can be paired with EIs as they include dataflows, which are also part of the EIs. The majority of GGIs can be calculated based on dataflows from EIs, especially in the thematic areas of *the environmental and resource productivity of the economy*, *the natural asset base*, and *the environmental dimension of quality of life*. Taking the perspective of the UNECE list of EIs, indicators from the areas of *air pollution and ozone depletion, climate change, water, biodiversity, land and soil, agriculture, energy* and *waste* are relevant for the production of GGIs.

The paper also identifies areas, in which EIs differ from GGIs. Particularly, GGIs in the area of *economic opportunities and policy responses* focus on economic measures that go beyond the dataflows of the EIs. Moreover, for certain policy areas the indicators used by OECD and UNECE are different. In other cases, however, further joint efforts of OECD, UNECE, and partners with the member countries in aligning definitions and measurement methods would allow to produce more efficiently the two distinct indicator sets.

1 This background paper was prepared by Mr. Robin Rieprich and Ms. Christin Thurow, consultants to the OECD and UNECE Secretariats. The document will be revised in light of the discussion at the workshop.

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1. INTRODUCTION

1.1 Towards the Shared Environmental Information System

The Shared Environmental Information System (SEIS) aims to enhance the availability of integrated, relevant, high quality, timely and easily accessible environmental information, which provides the means for assessing the environmental status and the foundation for meaningful and informed environmental governance. With support of modern technologies such as the internet, the system would link all the existing data and information flows relevant at the country and international levels in support of the regular environmental assessment process.

Through the implementation of SEIS and corresponding benefits, such as efficiency gain and cost savings, effective and meaningful governance, simplification, innovation and an informed public, development in every country of the pan-European region could be positively affected.

Across the pan-European region the process of establishing such national systems is led by the United Nations Economic Commission for Europe (UNECE) and the European Environmental Agency (EEA). The UNECE Working Group on Environmental Monitoring and Assessment (WGEMA) was mandated to review the progress in establishing SEIS and - at its 16th session (Istanbul, 16-17 April 2015) - will be expected to agree on priority dataflows for implementation in 2015 in order to be ready for use for possible pan-European assessment cycle in 2016.

The ongoing work on dataflows for the establishment of national SEIS is implemented in close cooperation with other partners, such as the EEA and the Austrian Environment Agency implementing respectively the ENPI-SEIS-East project, and FLERMONECA, both funded by the European Union. Under the UNECE Joint Task Force on Environmental Indicators these partners join forces to support countries of Eastern Europe, the Caucasus and Central Asia in producing dataflows of 14 environmental indicators (EI) from a set of 41 EIs on thematic areas, such as air pollution, ozone depletion, climate change, water and biodiversity. Recent assessments of the countries' performance in this regard have shown that the countries produce and share the majority of these dataflows as well as additional information on the EIs[2].

The OECD also facilitates the exchange of experience and good practice on developing and applying green growth measurement framework in the countries of Eastern Europe, the Caucasus and Central Asia under the OECD/EAP Task Force. This includes activities carried out as part of the Eastern Partnership (EaP) GREEN project funded by the European Union in Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova and Ukraine (EaP countries). The project aims to build consensus on good practices and raise awareness about the value of GGIs, adapt GGIs in three EaP countries and identify 6-7 headline GGIs for the regional use.

1.2 Green economy, green growth and green growth indicators

In order to be prepared for upcoming challenges the world has to face, such as changing demands and opportunities for a growing global population or environmental pressure, which can undermine the ability to deliver those opportunities, the implementation of a green growth concept can promote economic growth and development on more sustainable grounds.

[2] http://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.33/2014/mtg2/ECE.CEP-CES.GE.1.2014.8_E.pdf

To this end, it is important for governments to pursue green policies aiming for green growth and simultaneously for greening the economy.

Policies that promote green growth need to be founded on a good understanding of the determinants of green growth and of related trade-offs or synergies. They need to be supported with appropriate information about the results obtained and the progress still to be made. This requires instruments and tools, which can be described as indicators that can raise awareness, measure progress and show potential opportunities and risks. These green growth indicators (GGI) send clear messages to support decision makers, as well as the public at large.

The OECD measurement framework organizes the indicators along four areas that capture the main features of green growth:

- Environmental and resource productivity, to capture the need for efficient use of natural capital and to capture aspects of production, which are rarely quantified in economic models and accounting frameworks.

- Economic and environmental assets, because sustained growth requires the asset base to be maintained and because a declining asset base presents risks to future growth. Particular attention is given to natural assets.

- Environmental quality of life, to capture how environmental conditions and amenities interact with people's lives.

- Economic opportunities and policy responses, to help discern the effectiveness of policy in delivering green growth.

To improve the indicators, countries, the OECD and other international organisations work together to develop the statistical basis and put in place environmental accounts in accordance with the System of Environmental and Economic Accounts (SEEA)[3].

[3] The SEEA is a system for organizing statistical data for the derivation of coherent indicators and descriptive statistics to monitor the interactions between the economy and the environment and the state of the environment to better inform decision-making. It contains the internationally agreed standard concepts, definitions, classifications, accounting rules and tables for producing internationally comparable statistics.

2. A MAPPING OF DATAFLOWS

Both the UNECE environmental indicators (EIs) and the OECD green growth indicators (GGIs) aim at providing solid knowledge bases for developing sustainable policies. With this aim in common, the GGIs go beyond environmental aspect, and examine the relations between economic development, environmental protection and social equity.

This paper aims at identifying matches and differences between EIs and GGIs. It was prepared to serve as a practical guide to show how the dataflows under the SEIS process, as required for the EIs, can be used to produce certain GGIs. To this effect, a mapping of dataflows underpinning the EIs and GGIs including their metadata was carried out.

The following sections show pairs of matching EIs and GGIs, through comparing dataflows, metadata as well as the units of measurement. For each thematic area a table provides an overview on the matching pairs. Each section is concluded with a short summary of the compatibility of matching indicators. Adopting the thematic areas of the EI, the mapping is structured along the areas of air pollution, ozone depletion, climate change, water, biodiversity, land and soil, agriculture, energy and waste.

2.1 Air pollution and ozone depletion (A)

Increased concentrations of pollutants in the low layer of the atmosphere can have various adverse impacts on human health, vegetation and materials. To this end EI *Ambient air quality in urban areas (A2)* and GGI *Environmentally induced health problems & related costs (14)* provide a measure to understand if negative impacts exist and if so, how severe they are.

Both indicators require data on particulate matter (PM_{10}) and ground-level ozone (O_3) expressed as annual average concentrations. EI A2 measures concentrations for the capital city and other major cities and the number of days with exceeded daily limit value. Dataflows are collected from an air quality-monitoring network incorporating fixed manual or automated monitoring stations, which may be complemented by mobile stations. GGI 14 measures the average annual exposure level of an average urban resident to outdoor particulates (PM_{10} levels in residential areas of cities with more than 100,000 residents). It further measures a weighted annual sum of maximum daily 8-hour mean ozone concentrations above the threshold ($\mu g/m^3$ per day) and is calculated for all days in a year. For data collection of O_3 a ground-based measurement is applied, whereas satellite-based-measurements for PM_{10} are used.[4] As there are clear differences between both GGI and EI in terms of data collection, raw data are not compatible for PM_{10}. At the same time, data evaluation may lead to similar conclusions.

When it comes to units of measurement, micrograms per cubic metres and the numbers of days with exceeded daily limit values are used for EI A2. GGI 14 is expressed as percentage of population and micrograms per cubic metres as well as micrograms per cubic metres per day. Regarding units of measurement both indicators are compatible.

[4] Ground-based-measurement would be more precise and would deliver more accurate values, if it was avertable.

EI A2 as well as GGI 14 focus on annual average concentrations and daily values of PM_{10} and O_3, but partly use different methods for obtaining dataflows, which prevents full matching. Furthermore EI A2 strongly focuses on concentrations of PM_{10} and O_3 in agglomerations and exceeding daily limit values to get an overview of the general exposure of the country's urban population, whereas the GGI 14 focuses on aspects with regard to population weighted concentrations.

In conclusion, GGI 14 on environmentally induced health problems can be partly produced by the dataflows of EI A2. As for both indicators the unit microgram per cubic metre is used, values are compatible in terms of the location and method of monitoring.

Table 1. Mapping of UNECE and OECD dataflows in the field of air pollution and ozone depletion

	Name of indicator	Dataflows from indicator	Unit of measurement of indicator
UNECE environmental indicator	Ambient Air quality in urban areas (A2)	▪ Annual average concentration of particulate matter (PM_{10}); ▪ PM_{10} - Number of days with exceeded daily limit value; ▪ Annual average concentration of ground-level ozone (O_3); ▪ O_3 - Number of days with exceeded daily limit value	▪ $\mu g/m^3$; ▪ number of days; ▪ $\mu g/m^3$; ▪ number of days
OECD green growth indicator	Environmentally induced health problems & related costs (14)	▪ Urban-population weighted PM_{10} levels in residential areas of cities (<100 000); ▪ Population weighted concentration of ozone to which the urban population is potentially exposed	▪ percentage of population; $\mu g/m^3$; ▪ $\mu g/m^3$ per day

2.2 Climate change (B)

Increasing GHG concentrations can affect the earth's climate, and have potential consequences for ecosystems, human settlements, agriculture and other socio-economic activities. For that reason both EI *Greenhouse gas (GHG) emissions (B3)* and GGI *Production-based CO_2 productivity (1.1)* provide a measure to understand in how far a country is on the right track to keep the GHG emissions at an acceptable level. Both indicators are constructed following the requirements of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) and cover the following six substances, in particular: carbon dioxide (CO_2); methane (CH_4); nitrous monoxide (N_2O); partly halogenated hydrofluorocarbons (HFCs); perfluorocarbons (PFC); sulphur hexafluoride (SF_6).

Both EI B3 and GGI 1.1 require information on CO_2 from the combustion of fossil fuels and biomass as a major contributor to GHG emissions. While EI B3 aggregates the air emissions in CO_2 equivalents, the dataflow of GGI 1.1 is on production-based CO_2 productivity, i.e. GDP[5] generated per unit of CO_2 emitted in production. Obtained dataflows and following data evaluation could bring compatible findings in the field of GHG emissions.

[5] A number of UNECE and OECD indicators are calculated in relation to a country's gross domestic product (GDP). For comparative purposes both organizations suggest to use numbers for GDP based on chained constant US dollars (international dollars) and constant purchasing power parities (PPP). However, 2011 was defined as a base year for the EIs, while OECD works with the base year 2005. When dataflows produced as part of the EIs are used for the calculation of GGIs, different values for a country's GDP may have to be included. The applied base year should always be provided as part of the metadata.

Regarding the units of measurement for CO_2, dataflows of EI B3 are presented in megatons per year. Furthermore EI B3 contains data on CO_2 emissions in tons per GDP, which should not be confused with the OECD approach of production-based CO_2 productivity by calculating GDP per emitted unit of CO_2 in thousand tons per year.

The distinction between different sectors producing GHG emission is applied for EI B3, but not for GGI 1.1. There one can find CO_2 emissions from fossil fuel combustions, emitted within the national territory, excluding bunkers, sinks and indirect effects.

In conclusion, the measured substances as well as the units of measurement are compatible. Therefore GGI 1.1 can be produced with dataflows of EI B3. As for EI B3 selected sectors are distinguished, which are not defined for GGI 1.1, both indicators are not fully compatible.

Table 2. Mapping of UNECE and OECD dataflows in the field of climate change

	Name of indicator	Dataflows from indicator	Unit of measurement of indicator
UNECE environmental indicator	Greenhouse gas emissions (GHG) (B3)	▪ Aggregated GHG emissions by sectors (energy, industrial processes, solvent and other product use, agriculture, land use and forestry, waste) in CO_2 equivalents	▪ mt/year
OECD green growth indicator	Production-based CO_2 productivity (1.1)	▪ GDP generated per unit of CO_2 emitted in production	▪ GDP/production-based CO_2

2.3 Water (C)

Freshwater resources

Freshwater resources are of major environmental and economic importance. Pressures on freshwater resources are exerted by overexploitation and by environmental degradation. Since water quality is closely linked to water quantity, the relation of freshwater abstraction to the renewal of stocks is a central issue in sustainable freshwater resource management and an important indicator on the state of the natural asset base. To this end, two EIs, *Renewable freshwater resources (C1)* and *Freshwater abstraction (C2)*, correspond to the GGI *Freshwater resources (7)*, providing a measure to understand the state of freshwater resources.

In terms of dataflows, both EI C1 and GGI 7 require data on available renewable freshwater resources. The EI in particular refers to the methodology of data collection applied in the UNSD/UNEP Questionnaires on Environment Statistics[6]. Data are usually collected at selected hydrological stations and calculated on the basis of long-term measurements of levels, flow rates and inflows/outflows carried out on rivers and lakes as well as groundwater horizons and countrywide precipitation. OECD, on the other hand, produces its own figures on freshwater resources[7], also based

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[6] *See* http://unstats.un.org/unsd/environment/questionnaire.htm

[7] *See* http://stats.oecd.org/

on data provided by its member countries on water received from precipitation net of evapotranspiration, and from inflowing rivers from neighbouring countries. OECD points out that definitions and measurement methods employed by member countries may vary considerably among them. Therefore, further efforts to align the national methodological approaches are necessary. OECD, UNSD, and other organizations already work together closely to harmonize their questionnaires for the collection of data on water indicators[8].

Both the EI C2 and the GGI 7 require dataflows on abstraction rates of freshwater. However, OECD categorizes water uses as abstraction for irrigation, abstraction for other uses (including cooling, industrial processes), and abstraction for public supply, while UNECE classifies according to the International Standard Industrial Classification (ISIC): abstraction by water supply industry, households, agriculture, forestry and fishing, manufacturing, electric industry, and other economic activities).

The available freshwater resources and freshwater abstraction are to be provided in million cubic metres for the EI, from which the unit of measurement used for the GGI, cubic metres per capita, can easily be calculated.

Moreover, the "Water Exploitation Index (WEI)" included in the EI C2 is equal to the "Water stress index" contained in GGI 7. It is calculated as the share of freshwater abstracted in the available renewable freshwater resources and expressed as a percentage.

In conclusion, GGI 7 could be produced with dataflows of the EIs C1 and C2, when categorizations of water uses are aligned between OECD and UNECE.

Water productivity

The availability of water for meeting basic human needs is a prerequisite for life, health and economic development. Both UNECE and OECD have designed indicators to monitor the efficient use of limited water resources by economic sectors. Dataflows from EI *Total freshwater use (C3)* can be used for the production of GGI *Water productivity (4)*. For EI C3 dataflows on total freshwater use (by ISIC sectors: households, agriculture, forestry and fishing, manufacturing, electric industry, other economic activities) are to be provided. At the same time, the GGI includes the value added per unit of water consumed by sector (also classified according to ISIC). While the general structure of the required data on water use is fully compatible, as for freshwater resources, measurement methods employed by countries may vary.

For the GGI 4, the freshwater use by sector is calculated in relation to outputs of the economic sectors. Those outputs may be defined differently for different sectors: for the energy sector, for example, they could be defined as the amount of energy generated per unit of water used; for agriculture it could be the crop output per unit of water used. Also for these relational values, dataflows from the EIs (in particular the area of energy) may be relevant.

Water use by sectors is to be provided as million cubic metres for the EI, from which the dataflow for the GGI, expressed as unit of GDP per cubic metre, unit of energy per cubic metre, etc. can be calculated. Furthermore, EI C3 also contains data on freshwater use per GDP which should not be confused with the OECD approach of water productivity (calculated as GDP per freshwater use).

[8] *See* http://www.unwater.org/KWIP/doc/UN-Water_KWIP_-_Harmonization.pdf

In conclusion, dataflows from EI C3 can contribute to producing GGI 4. However, countries have to invest further efforts to align measurement methods of water use. At the same time, beyond the dataflows included in EI C3, additional data on the output of economic sectors are necessary for the production of the GGI 4.

Population with sustainable access to safe drinking water

Public health cannot advance without access to an adequate supply of clean drinking water. Therefore, both the UNECE and OECD indicators contain a measure of the extent to which the population of a country has access to sources of clean drinking water, being an indicator of human well-being through the availability of environmental services.

Synergies are found for the production of EI *Drinking water quality (C9)* and GGI *Population with sustainable access to safe drinking water (16.2)*. For the EI C9, the population connected to the water supply industry, and the population using untreated surface water and groundwater is measured. The respective data should be estimated based on numbers from the water supply industry and from national public authorities. At the same time, OECD defines its GGI 16.2 according to the Millennium Development Goals (MDGs). In the MDGs "access to safe drinking water" is defined as the proportion of people using improved drinking water sources: household connection; public standpipe; borehole; protected dug well; protected spring; rainwater. Therefore, the categorization of drinking water sources is more detailed in the GGI 16.2 than in the EI C9. For both indicators, the same units of measurement are to be used: the population connected to different sources of drinking water is expressed in millions of people or as a percentage of the total population.

In conclusion, dataflows from EI C9 are only partially suitable to produce the GGI 16.2, as the EI only includes a smaller number of drinking water sources. To reach full compliance, further work on the alignment between the EI and the GGI would be necessary.

Population connected to sewage treatment

Wastewater treatment is a basic prerequisite for minimizing pressure on both surface and groundwaters in terms of water pollution. As both groundwaters and surface waters are abstracted for the production of drinking water, or even for direct use (self-supply), the reduction of water pollution represents one of the basic preconditions for human health and well-being. To this end, the UNECE and OECD sets alike include an indicator on wastewater treatment.

While using different terminology, both the EI *Population connected to wastewater treatment (C14)* and the GGI *Population connected to sewage treatment (16.1)* show the degree of a country's population connected to facilities for the physical and/or chemical reduction of biochemical oxygen demand (BOD) and suspended solids in wastewaters. Both dataflows are to be categorized in primary, secondary, and tertiary treatment. The data on the share of the population not connected to a sewerage network, which are required by the GGI, can be easily calculated based on UNECE dataflows by abstracting the population connected to a wastewater collecting system from the total population of a given country.

The same units of measurement are used for the EI and GGI: total numbers of the population connected are to be provided in millions, shares of the population connected in the total population are expressed as a percentage.

Unlike in the EI, the population connected to a wastewater collecting system without subsequent treatment is not included in the GGI.

In conclusion, GGI 16.1 can be fully produced with dataflows from the EI C14.

Table 3. Mapping of UNECE and OECD dataflows in the field of water

	Name of indicator	Dataflows from Indicator	Unit of measurement of Indicator
UNECE environmental indicator	Renewable freshwater resources (C1)	▪ Renewable freshwater resources (Internal flow + Inflow of surface and groundwaters)	▪ million m^3
OECD green growth indicator	Freshwater resources (7)	▪ Available renewable natural resources (groundwater, surface water)	▪ m^3; ▪ m^3/capita
UNECE environmental indicator	Freshwater abstraction (C2)	▪ Fresh surface water abstracted ▪ Fresh groundwater abstracted ▪ Total freshwater abstraction (by water supply industry, households, agriculture forestry and fishing, manufacturing, electric industry, other economic activities).	▪ million m^3
OECD green growth indicator	Freshwater resources (7)	▪ Abstraction rates (national, territorial) of available renewable natural resources (by major use)	▪ m^3; ▪ m^3/capita
UNECE environmental indicator	Freshwater abstraction (C2)	▪ Water Exploitation Index (WEI)	▪ percentage (Freshwater abstracted / Renewable freshwater resources)
OECD green growth indicator	Freshwater resources (7)	▪ Water stress	▪ percentage (Freshwater abstracted / renewable freshwater resources)
UNECE environmental indicator	Total water use (C3)	▪ Total freshwater use (by households, agriculture, forestry and fishing, manufacturing, electric industry, other economic activities)	▪ million m^3
OECD green growth indicator	Water productivity (4)	▪ Value added per unit of water consumed, by sector (classified according to ISIC)	▪ unit of GDP / m^3 ▪ other sectoral units, e.g. for energy sector: toe generated per m^3
UNECE environmental indicator	Drinking water quality (C9)	▪ Population connected to water supply industry ▪ Population using untreated surface water ▪ Population using untreated groundwater	▪ million; ▪ percentage of total population
OECD green growth indicator	Population with sustainable access to safe drinking water (16.2)	▪ Population with sustainable access to safe drinking water	▪ million; ▪ percentage of total population
UNECE environmental indicator	Population connected to wastewater treatment (C14)	▪ Population connected to a wastewater collecting system; ▪ Population connected to wastewater treatment facilities (by categories: primary, secondary, tertiary treatment)	▪ million; ▪ percentage of total population
OECD green growth indicator	Population connected to sewage treatment (16.1)	▪ Population connected to sewage treatment (by categories: primary, secondary, tertiary treatment); ▪ population not connected to a sewerage network	▪ million; ▪ percentage of total population

2.4 Biodiversity (D)

Forest resources

Forests are among the most diverse and widespread ecosystems on earth and have many functions. They provide timber and other products; deliver recreation benefits and ecosystem services, including regulation of soil and water regimes; are reservoirs for biodiversity; and act as carbon dioxide sinks. Overexploitation, fragmentation, environmental degradation and conversion into other types of land use threaten this important part of the natural asset base.

To this end, the EI *Forests and other wooded land (D3)* and the GGI *Forest resources (8)* contain dataflows on forest area and the area of wooded land to understand whether forests and wooded land are used in a sustainable way. Both indicators refer to the FAO/UNECE Global Forest Resource Assessments (FRA) for data collection, which are carried out every five years (currently FRA 2015 is finalized). Therefore these dataflows are fully compatible.

In terms of the unit of measurement of forest areas both UNECE and OECD use square kilometres and measure the percentage of forest areas in the total land area. Also, the forest area per capita which is part of the GGI and expressed as square kilometres per capita, can easily be calculated based on the units of the EI.

The distinction between natural and planted forest and designated forest areas in the EI is not applied in the GGI. The GGI also contains data on volume of forests and stock changes over time, which are not part of the EI, but are contained in the FRA.

In conclusion, GGI 8 can partly be produced with dataflows from the EI D3, with additional data on the volume of forests and stock changes needed.

Wildlife resources

It is widely recognized that biodiversity has an intrinsic value and that the maintenance of this natural asset base is essential for human life and sustainable development. Many species are currently decreasing in population size and are at risk of extinction. To this end, the UNECE set contains two indicators, *Threatened and protected species (D4)* and *Trends in the number and distribution of selected species (D5)*. Both indicators contain dataflows that can be used to produce the GGI *Wildlife resources (13)*.

Both EI D4 and GGI 13 require dataflows on threatened species. However, the 2014 OECD report on GGIs focuses on threatened mammals, birds, fish and vascular plants only, while the EIs also include data on reptiles, amphibians, invertebrates, mosses, lichens, fungi and algae on top of the categories suggested by OECD.

The dataflows necessary for the production of both indicators are based on the IUCN lists of threatened species. Therefore, those dataflows are fully compatible. As units of measurement the percentage of species threatened of species assessed or known is used for both indicators. The data on protected species included in EI D4 are not required for GGI 13.

Complementary to the dataflows on threatened species, data on the abundance of selected species are contained in both EI *Trends in the number and distribution of selected species (D5)* and GGI *Wildlife resources (13)*. For the EI two species each from the categories “Keystone species”, “Flagship species”, “Endemic species” and “Other characteristic species” should be selected as proxies and data on the number of individuals should be provided. OECD uses a similar approach by selecting certain species under its indicator 13. The 2014 OECD report on GGIs uses bird populations (farmland or forest birds populations or breeding bird populations) as a proxy to measure the state of wildlife in a country. As those may be selected as characteristic species for a country for the EI, both indicators are compatible. The number of individuals of the respective species is used as units of measurement for the UNECE and OECD indicators. OECD also calculates an index by setting the number of individuals in a base year (1980) equal to 100.

In conclusion, GGI 13 can be fully produced with dataflows from the EIs D4 and D5, when the species selected as proxies are aligned.

Table 4. Mapping of UNECE and OECD dataflows in the field of biodiversity

	Name of indicator	Dataflows from Indicator	Unit of measurement of Indicator
UNECE environmental indicator	Forests and other wooded land (D3)	▪ Total forest area; ▪ Total area of other wooded land	▪ 1000 km^2; ▪ Percentage of total land area
OECD green growth indicator	Forest resources (8)	▪ Area of forests and wooded land	▪ km^2 per capita; ▪ percentage of total land area
UNECE environmental indicator	Threatened and protected species (D4)	▪ Number and percentage of species threatened (mammals, birds, fishes, reptiles, amphibians, invertebrates, vascular plants, mosses, lichens, fungi, algae)	▪ Number of species threatened; ▪ percentage of species threatened
OECD green growth indicator	Wildlife resources (13)	▪ Species threat status: mammals, birds, fish, vascular plants in percentage of species assessed or known	▪ Percentage of species threatened
UNECE environmental indicator	Trends in the number and distribution of selected species (D5)	▪ Number of selected species — Keystone species, Flagship species Endemic species, Other species — characteristic species for country	▪ Thousands of individuals
OECD green growth indicator	Wildlife resources (13)	▪ Trends in farmland or forest bird populations or in breeding bird populations; ▪ Trends in species abundance	▪ Number of individuals; ▪ Population index

2.5 Land and Soil (E)

Land uptake and land change

Land uptake by transport infrastructure, urban and industrial development and other purposes has a high impact on the environment. Moreover this leads to changes in land use and cover as well as to conversions of land from natural to artificial state. This highly increasing development is monitored by an EI on *Land uptake (E1)* and finds importance under a GGI on *Land resources: land cover conversions and cover changes from natural state to artificial state (11).*

In terms of EI E1, dataflows on total land uptake broken down by sectors, as well as dataflows on total land uptake broken down by country area, are collected. Furthermore EI (E1) requires data for the following sectors: mining and quarrying areas, constructions, manufacturing areas, technical infrastructure, transport and storage infrastructure, commercial, financial and public services, residential areas including recreational facilities and other uses (landfills, waste dumps, tailing pits and refuse heaps). For calculating the share of total land uptake in the country area, land uptake is divided by the total area of the country. GGI 11 also monitors changes in land use and land cover. It focuses on sectors such as agriculture and food production, forestry and biomass, urbanization and infrastructure development, production of biofuel and non-food crops, other renewable energy production, mining and quarrying, water and flood management, protection of biodiversity and cultural landscapes.

Data on EI E1 are given in thousands of square kilometres. Additionally, the share of total land uptake in the country area is calculated as percentage. For GGI 11 changes in land use are calculated in hectares and square kilometres. Furthermore natural areas lost for urban development are provided as percentage. Therefore EI E1 is compatible with GGI 11 pertaining to units of measurement.

In conclusion, GGI 11 on land resources can be produced with dataflows from EI E1 on land uptake, if the sectors are paired.

Soil erosion

Soil erosion is a natural phenomenon, which can be caused by natural soil and landscape characteristics as well as meteorological parameters. However, it tends to be greatly accelerated by human activity. Especially agricultural procedures can have negative effects on the quality of soil. Through inappropriate agricultural management, natural forces such as wind and water can cause topsoil losses. An EI on *Area affected by soil erosion (E2)* and a GGI on *Soil resources: degree of top soil losses on agricultural land and on other land (12)* were introduced to measure this phenomenon.

For EI E2 dataflows on total area affected by wind and water erosion and the degree of wind and water erosion are calculated. The data are collected for agricultural land, which is defined as the sum of areas under arable land, permanent crops and permanent meadows/pastures. Five categories for the degree of erosion are distinguished: no affect (tolerable), light affect, moderate affect, strong affect and extreme affect. GGI 12 focuses on the degree of top soil losses on agricultural land and especially on agricultural area affected by erosion of wind, water and total erosion. For GGI 12 the agricultural land is defined as (1) arable and permanent crop land and (2) permanent meadows and pasture, and (3) other land, which includes forest, other wooded land, dry open land with special vegetation cover and open land without or with insignificant vegetation cover. What is defined as other land under GGI 13 is not covered by IE E2.

In terms of unit of measurements, the total area affected by erosion (wind and water separately) of EI E2 is measured in square kilometres, while the degree of erosion is shown as a percentage. GGI 12 is measured in hectares and square kilometres to reflect area affected by erosion. In addition, soil losses through erosion are shown in tons per hectare per year. The units of measurement are thus compatible for both indicators.

In conclusion, dataflows of GGI 12 on soil resources can be produced with dataflows of EI E2 on area affected by soil erosion.

Table 5. Mapping of UNECE and OECD dataflows in the field of land and soil

	Name of indicator	Dataflows from indicator	Unit of measurement of indicator
UNECE environmental indicator	Land uptake (E1)	▪ Total land uptake (broken down by sectors); ▪ Total land uptake (broken down by country area)	▪ 1000 km^2
OECD green growth indicator	Land resources: land cover conversions and cover changes from natural state to artificial state (11)	▪ Changes in land use and cover, conversions of land from its natural state to an artificial state and changes in the share of built-up areas.	▪ hectare; km^2
UNECE environmental indicator	Area affected by soil erosion (E2)	▪ Total area affected by wind and water erosion; ▪ Area by degree of wind and water erosion (extreme, strong, moderate, light, no effect)	▪ km^2; ▪ percentage
OECD green growth indicator	Soil resources: degree of top soil losses on agricultural land, on other land (12)	▪ Agricultural land area affected by erosion; ▪ Amount of soil lost through erosion	▪ km^2; hectare; ▪ t/hectare in a year

2.6 Agriculture (F)

Use of mineral fertilizers

The use of mineral and organic fertilizers in agriculture to increase the efficiency of cropping increases environmental hazards and has negative effects on other environmental components, interfering with the natural balance of soil microflora. Therefore EI *Fertilizer consumption (F2)* was introduced to monitor the extent of using fertilizers on agricultural areas. This thematic area is also considered through the GGIs *Nutrient flows and balances (3.4*) and *Land resources (11)*

The EI F2 measures agricultural area under crop treated with mineral fertilizers. It further measures the use of mineral fertilizers or, if such is not available, their consumption expressed as production minus export plus import. Furthermore, the EI F2 distinguishes between three basic nutrient components for mineral fertilizers: Nitrogen (N), phosphate (P_2O_5) and potash (K_2O). The GGI 3.4 focuses on agricultural nutrient balances, which are calculated as the difference between the total quantity of nutrient inputs entering an agricultural system, and the quantity of nutrient outputs leaving the system. This calculation is seen as a proxy to reveal the status of environmental pressures, such as declining soil fertility in the case of a nutrient deficit, or for a nutrient surplus the risk of polluting soil, water and air. Therefore, while both indicators focus on the spread of nutrients over the considered agricultural area, the EI F2 addresses only the nutrients entering the agricultural system. The indicators are not compatible.

In conclusion, GGI 3.4 cannot be produced with dataflows of EI F2 on fertilizer consumption.

Use of organic fertilizers

The EI F2 measures the use of organic fertilizers and agricultural area under crop treated with organic fertilizers. GGI 11 also measures the share of agricultural land under certified organic farming.

Concerning the unit of measurement, the agricultural land under organic farming is measured in million hectares while its share in total agricultural land under crop is measured as percentage. GGI 11 shows the area under certified organic farming as a percentage of all farming area.

In conclusion, GGI 11 on land resources can be produced by dataflows of EI F2 on fertilizer consumption.

Table 6. Mapping of UNECE and OECD dataflows in the field of agriculture

	Name of indicator	Data flows from Indicator	Unit of measurement of Indicator
UNECE environmental indicator	Fertilizer consumption (F2)	▪ Agricultural area; ▪ Area treated with mineral fertilizers; ▪ Area treated with organic fertilizers; ▪ Total area under crop; ▪ Share of area treated with fertilizers in total area	▪ million hectares; ▪ million hectares; ▪ million hectares; ▪ million hectares ▪ percentage
OECD green growth Indicator	Nutrient flows and balances (3.4)	▪ Nitrogen and phosphorus surplus intensities; ▪ Agricultural nutrient intensity related to changes in agricultural output	▪ nutrient balance expressed in terms of kilograms of nutrient surplus (deficit) per hectare of agricultural land per annum; ▪ changes in the gross N and P balance per hectare of agricultural land versus changes in agricultural production;
	Land resources (11)	▪ The share of agricultural land under certified organic farming	▪ percentage

2.7 Energy (G)

Energy is a key factor in industrial development and the provision of essential services. However, current energy production and consumption practices can have considerable negative impacts on the environment. Long term objectives include continuous increases in energy efficiency that are higher than increases in energy consumption, as well as switching to consumption of renewable energy sources that have less negative environmental impact.

To this end, the sets of EIs and the GGIs contain indicators monitoring energy efficiency and productivity. The EIs on energy are constructed of dataflows which are also necessary to calculate the GGIs on *Energy intensity by sector, Energy productivity, and Share of renewable energy sources in Total primary energy supply (TPES)*. In the following paragraphs, each of these areas will be discussed separately.

Both the dataflows required by the EIs on energy and by the sub-indicator under the GGI *Energy productivity (2)* are based on energy balances provided by the International Energy Agency (IEA)[9] and are therefore generally compatible. However, based on this data, slightly differing statistical operations are to be performed.

Energy intensity by sector

The EI *Final energy consumption (G1)* contains a dataflow on final energy consumption by category, with accordance to the ISIC classification: industry, transport, households, commercial and public services, agriculture, forestry and fishery, non-specified and non-energy use. This complies with the dataflow on the consumption of energy by sectors, likewise following ISIC, which is required for GGI *Energy intensity by sector (2.2)*[10].

OECD defines the sectoral energy intensity as the amount of energy consumed per activity or output for sub-sectors and end uses. The choice of the denominator often depends on data availability, and in particular the energy intensity in the residential sector, service sector, industrial sector, and the transport sector are calculated. The output or activity may be defined differently for different sectors: for the passenger transport sector, for example, they could be defined as the total passenger transport energy consumption per passenger-kilometre (pkm); for the industry sectors it could be total industry energy consumption per unit of value-added. Also for these relational values, dataflows from the EIs (in particular the *Passenger transport demand (H1)* and *Freight transport demand (H2)*) may be relevant.

The energy consumption by sector is to be provided as 1,000 tons of oil equivalent (ktoe) for the EI, from which the dataflow for the GGI, expressed as toe per unit of GDP, toe per passenger-kilometre etc. can be calculated.

In conclusion, dataflows from EI G1 can contribute to producing GGI 2.2. However, additional data on the output of economic sectors are necessary for the production of the indicator.

Energy productivity

Dataflows on *Total primary energy supply* (TPES) as required for EI G2 can be used to produce GGI *Energy productivity (2.1)*, which is calculated as GDP per TPES. This is the inverse of "Energy intensity" i.e. the energy supplied (or consumed) per unit of economic value generated (also see footnote 9). As both UNECE and OECD dataflows are based on IEA energy balances, TPES is consistently calculated as production plus imports minus exports minus international marine and aviation bunkers plus or minus stock changes.

The EI G2 suggests to express data as thousand tons of oil equivalent (ktoe). From this, the unit of measurement of the GGI 2.1 (unit of GDP per ton of oil equivalent (toe)) can be easily calculated. The TPES by fuel type, which is included in EI G2, is not required for the production of GGI 2.1.

In conclusion, GGI 2.1 can be fully produced with dataflows from the EI G2, when the data are related to a country's GDP.

[9] http://www.iea.org/statistics/topics/energybalances/

[10] At the macro level, energy intensity can also be expressed as total final energy consumption per GDP, TPES per capita, or TPES per GDP (also in EI G3. However, as in the context of green growth "energy productivity" is preferred over "energy intensity" as an indicator on energy efficiency on the macro level, these possibilities are not further discussed here.

Share of renewable energy sources in TPES

Dataflows from EI *Renewable energy supply (G4)* can be used for the production of GGI *Share of renewable energy sources in TPES (2.3)*. Both indicators require the production of dataflows on the share of renewable sources of energy supply in TPES: hydropower, biomass, biofuels and waste, wind power, solar power and geothermal energy.

Units of measurement for those indicators are fully compatible, both being expressed as percentage of the respective renewables in TPES.

Moreover, beyond the share of renewables in TPES, the GGI 2.3 distinguishes the share of renewables in electricity generation. This dataflow goes beyond the data included in the EI, as the total energy supply is not broken down into electricity generation and the generation of other fuels.

In conclusion, the GGI dataflow on the share of renewables in TPES fully complies with EI G2, while the share of renewables in electricity generation is not part of any EI.

Table 7. Mapping of UNECE and OECD dataflows in the field of energy

	Name of indicator	Dataflows from Indicator	Unit of measurement of Indicator
UNECE environmental indicator	Final energy consumption (G1)	▪ Final energy consumption by category (industry, transport, households, commercial and public services, agriculture, forestry and fishery, non-specified, non-energy use)	▪ ktoe
OECD green growth indicator	Energy intensity by sector (2.2)	▪ Energy intensity (final consumption or by sectors: manufacturing, transport, households, services)	▪ toe / unit of GDP ▪ other sectoral units, e.g. for transport sector: toe / pkm
UNECE environmental indicator	Total primary energy supply (G2)	▪ Total primary energy supply (production, export, import, international marine and aviation bunkers, stock changes)	▪ ktoe
OECD green growth indicator	Energy productivity (2.1)	▪ GDP per total primary energy supply	▪ unit of GDP / toe
UNECE environmental indicator	Renewable energy supply (G4)	▪ Energy from hydropower, biomass, wind power, solar power, geothermal energy	▪ ktoe; ▪ percentage of the respective renewables in TPES
OECD green growth indicator	Share of renewable energy sources in TPES (2.3)	▪ The share of renewables in TPES and in electricity generation (hydro, geothermal, wind, biomass, waste and solar energy)	▪ percentage of the respective renewables in TPES

2.9 Waste (I)

Sound and efficient use of natural resources is an important part of sustainable development. Waste represents a considerable loss of resources in the form of materials and energy. The treatment and disposal of the generated waste may cause environmental pollution and expose humans to harmful substances and infectious organisms. Waste generation is closely linked to the level of economic activity in a country and reflects society's production and consumption patterns. A reduction in the volume of waste generated per unit of GDP is an indication of the economy's move towards less material intensive production patterns.

To this end, both the UNECE and the OECD sets contain an indicator on waste. Two EIs, *Waste generation (I1)* and *Waste reuse and recycling (I3)*, contain dataflows which can be used for the production of GGI *Waste generation intensity and recovery ratios (3.3)*.

Both EI I1 and GGI 3.3 contain a dataflow on municipal waste generation, which is used as a proxy for "Total waste generation" with regard to the complexity of the calculation of total waste generation. Furthermore, both indicators contain dataflows on waste generation by source. The disaggregation of waste by sector for both indicators follows the major divisions of International Standard Industrial Classification (ISIC), which makes those dataflows generally compatible.

However, while the EI in particular refers to the methodology of data collection applied in the UNSD/UNEP Questionnaires on Environment Statistics, OECD also collects data on municipal waste through the OECD/Eurostat questionnaire on the state of the environment[11]. OECD points out that definitions and measurement methods employed by member countries may vary considerably among countries. Therefore, further efforts to align the national methodological approaches are necessary. OECD, Eurostat, UNSD, and other organizations already work together closely to harmonize their questionnaires for the collection of data on waste indicators.

For EI I1 thousand tons are used as a unit of measurement for the total amounts of waste and kilogram per unit of GDP and kilogram per capita for the respective sub-indicators. Those are easy to recalculate into the units of measurement used by OECD: thousand tonnes, tonnes per unit of GDP and tonnes per capita.

Dataflows on the percentage of reused and recycled waste in total managed waste (and/or in total municipal waste managed) contained in EI *Waste reuse and recycling (I3)* is compatible with the approach of GGI 3.3 for calculating waste recovery rates. The EI I3 includes a dataflow on the share of total waste reused and recycled in total waste managed (expressed as a percentage). The GGI measures waste recovery rates, which are defined as the amount of waste (or material) collected for recovery operations as a percent of the amount of waste generated (or collected)". As for waste generation, different definitions and measurement methods for recycled and recovered waste may be employed by the countries. Furthermore, the dataflows differ, as UNECE relates the data on recycled waste to the waste managed, while OECD works with the waste generated.

Data on the "amount of recycled materials (secondary raw materials) used in production as a percent of the total apparent consumption of the same materials", suggested as a dataflow for GGI 3.3, is not part of the EIs.

In conclusion, dataflows from EIs I1 and I3 can contribute to producing GGI 3.3.

However, countries have to invest further work to align measurement methods of waste generation and recycling. At the same time, beyond the dataflows included in the EIs, data on recycled materials used in production are necessary for the production of the GGI.

[11] http://stats.oecd.org/

Table 8. Mapping of UNECE and OECD dataflows in the field of waste

	Name of indicator	Dataflows from Indicator	Unit of measurement of Indicator
UNECE environmental indicator	Waste generation (I1)	▪ Total waste generation (may be expressed as generation of municipal waste); ▪ Waste generation by source (agriculture forestry and fishery; mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; construction; other economic activities; households)	▪ 1000 t / year ▪ kg / unit of GDP; ▪ kg / capita
OECD green growth indicator	Waste generation intensity and recovery ratios (3.3)	▪ Total waste generation (may be expressed as generation of municipal waste) ▪ Waste generation by sector	▪ 1000 t ▪ t / unit of GDP; ▪ t / capita
UNECE environmental indicator	Waste reuse and recycling (I3)	▪ Total waste reused and recycled	▪ 1000 t/ year; ▪ percentage of total waste managed
OECD green growth indicator	Waste generation intensity and recovery ratios (3.3)	▪ Waste recovery ratios	▪ Waste (or material) collected for recovery operations as a percentage of the amount of waste generated; ▪ Amount of recycled materials (secondary raw materials) used in production as a percentage of the total apparent consumption of the same materials.

3. OECD GREEN GROWTH INDICATORS BEYOND THE DATAFLOWS OF UNECE ENVIRONMENTAL INDICATORS

A number of OECD green Growth indicators (GGIs) can be produced with dataflows from UNECE environmental indicators (EIs), as was shown in the previous chapter. However, there are GGIs measuring issues that go beyond the dataflows that are part of the EIs. An overview on this is provided in table 9. Only the GGIs that have no corresponding dataflows with any EIs are discussed in this chapter, as the indicators that can partly be produced with dataflows from EIs are dealt with in chapter 2. The following discussion is structured along four main areas of the OECD approach on green growth: the environmental and resource productivity of the economy, the natural asset base, the environmental quality of life, and economic opportunities and policy responses.

In terms of the *environmental and resource productivity of the economy* the majority of the GGIs can at least partly be constructed with dataflows from EIs. Two fields are not directly included in the EIs: *demand-based and production-based material productivity* as well as *multifactor productivity*.

With regard to *demand-based material productivity* and *production-based material productivity* (GGIs 3.1 and 3.2), OECD maintains a "pilot database on material flows" based on ongoing international work on material flow accounting and analysis (MFA). Estimations of material resources are aggregated using mass-based weights and are classified as biotic materials (biomass for food and feed, wood), construction minerals, and other abiotic materials (industrial minerals and metals). Such dataflows are not included in the EIs, even though some estimations of material flows in countries of South-Eastern and Eastern Europe, Caucasus and Central Asia exist[12].

Also *Multifactor productivity* (GGI 5) has no corresponding EI. It is computed as the difference between the rate of change of output and the rate of change of total inputs (calculated as volume indices of combined labour and capital inputs for the total economy); shares of compensation of labour input and of capital inputs in total costs for the total economy are measured at current prices. The measure only recognises labour and capital inputs and not primary inputs of natural capital that also feed into production.

A second main theme of the GGIs, the *natural asset base*, is also related to a number of EIs. However, there are three GGI with no directly corresponding EI.

The *Index of natural resources* (GGI 6) is an economic tool, which is currently developed to monitor the evolution of a country's natural asset base and to help assess whether the use of its natural resource stocks is sustainable. In the UNECE list no such indicator exists so far. However, data on the stocks and flows of natural resources (e.g. water, wood) that are contained in the EIs may be used to calculate the index.

Moreover, dataflows on *Fish resources* (GGI 9) are not included in the EIs. To monitor the state of the marine environment, the UNECE set contains indicators on *Nutrients in coastal seawaters* (C12) and *Concentrations of pollutants in coastal seawater and sediments (except nutrients) (C13).*

[12] See, for example, http://www.cse.csiro.au/forms/form-mf-start.aspx

The set of GGIs also contains an indicator on *Mineral resources (10).* The indicator calculates the available stocks or reserves for selected minerals on the global level. No corresponding EI exists.

Under the *headline of the environmental dimension of quality of life*, OECD lists three GGIs, of which one, *Exposure to natural or industrial risks and related economics losses (15)*, has no corresponding EI. The GGI is listed under the subtheme of Environmental health and risks. While in the guidelines to the EI the relevance to health issues of a number of indicators is specified, no direct references to natural or industrial risks are given.

The area *economic opportunities* and *policy responses*, which includes indicators on technology and innovation, environmental goods and services, international financial flows, and prices and transfers builds on economic dataflows such as Research and Development (R&D) expenditures, flows of official development assistance (ODA) and environmentally related tax revenue. With its focus on assessing the state of the environment, those measures are not included into the set of EIs and for none of the eight GGI in this area a corresponding EI exists.

Table 9. Overview on OECD green growth indicators and corresponding UNECE environmental indicators

(OECD green growth indicators with no corresponding UNECE environmental indicators are marked in gray)

	OECD green growth indicators	Corresponding UNECE environmental indicators
	The environmental and resource productivity of the economy	
Carbon and energy productivity	**1. CO_2 productivity**	
	1.1 Production-based CO_2 productivity GDP per unit of energy-related CO_2 emitted	Greenhouse gas emissions (GHG) (B3)
	1.2 Demand-based CO_2 productivity Real income per unit of energy-related CO_2 emitted	
	2. Energy productivity	
	2.1 Energy productivity – GDP per unit of TPES	Total primary energy supply (G2)
	2.2 Energy intensity by sector (manufacturing, transport, households, services)	Final energy consumption (G1)
	2.3 Share of renewable energy sources in TPES, in electricity production	Renewable energy supply (G4)
Resource productivity	**3. Material productivity (non-energy)**	
	3.1 Demand-based material productivity (comprehensive measure; original units in physical terms) Real income per unit of materials consumed, materials mix	*No corresponding EIs*
	3.2 Production-based (domestic) material productivity GDP per unit of materials consumed, materials mix - Biotic materials: food, other biomass - Abiotic materials: metallic minerals, industrial minerals	*No corresponding EIs*
	3.3 Waste generation intensity and recovery ratios by sector, per unit of GDP or value added, per capita	Waste generation (I1); Waste reuse and recycling (I3)
	3.4 Nutrients flows and balances (N, P) - Nutrients balances in agriculture (N, P) per agricultural land area and change in agricultural output	Fertilizer consumption (F2)

	4. Water productivity Value added per unit of water consumed by sector	Total water use (C3)
Multifactor productivity	**5. Multifactor productivity reflecting environmental services** (comprehensive measure; original units in monetary terms)	*No corresponding EIs*
	The natural asset base	
Natural resource stocks	**6. Index of natural resources** – Comprehensive measure expressed in monetary terms	*No corresponding EIs*
Renewable stocks	**7. Freshwater resources** – Available renewable natural resources (groundwater, surface water) and related abstraction rates (national, territorial)	Renewable freshwater resources (C1); Freshwater abstraction (C2)
	8. Forest resources – Area and volume of forests; stock changes over time	Forests and other wooded land (D3)
	9. Fish resources – Proportion of fish stocks within safe biological limits (global)	*No corresponding EIs*
Non renewable stocks	**10. Mineral resources**: available (global) stocks or reserves – for selected minerals: metallic minerals, industrial minerals, fossil fuels, critical raw materials; and related extraction rates	*No corresponding EIs*
Biodiversity and ecosystems	**11. Land resources**: land cover conversions and cover changes from natural state to artificial state – Land use: state changes	Land uptake (E1); Fertilizer consumption (F2)
	12. Soil resources: degree of topsoil losses on agricultural land, on other land – Agricultural land area affected by water erosion, by class of erosion	Area affected by soil erosion (E2)
	13. Wildlife resources (to be further refined) - Trends in farmland or forest bird populations or in breeding bird populations - Species threat status, in % species assessed or known - Trends in species abundance	Threatened and protected species (D4); Trends in the number and distribution of selected species (D5)
	The environmental dimension of quality of life	
Environmental health and risks	**14. Environmentally induced health problems and related costs** – (e.g. years of healthy life lost from degraded environmental conditions) Population exposure to air pollution	Ambient air quality in urban areas (A2)
	15. Exposure to natural or industrial risks and related economics losses	*No corresponding EIs*
Environmental services and amenities	**16. Access to sewage treatment and drinking water**	
	16.1. Population connected to sewage treatment (at least secondary, in relation to optimal connection rate)	Population connected to wastewater treatment (C14)
	16.2. Population with sustainable access to safe drinking water	Drinking water quality (C9)
	Economic opportunities and policy responses	
Technology and innovation	**17. R&D expenditure of importance to green growth** - Renewable energy sources (% of energy-related R&D) - Environmental technology (% of total R&D, by type) - All-purpose business R&D (% of total R&D)	*No corresponding EIs*
	18. Patents of importance to green growth (% of country applications under the Patent	*No corresponding EIs*

	Cooperation Treaty) - Environment-related and all-purpose patents - Structure of environment-related patents	
	19. Environment-related innovation in all sectors	*No corresponding EIs*
Environmental goods and services	**20. Production of environmental goods and services** (EGS) - Gross value added in the EGS sector (% of GDP) - Employment in the EGS sector (% of total employment)	*No corresponding EIs*
International financial flows	**21. International financial flows of importance to green growth** - % of total flows and % of GNI	*No corresponding EIs*
	21.1. Official development assistance	*No corresponding EIs*
	21.2. Carbon market financing	*No corresponding EIs*
	21.3. Foreign direct investment	*No corresponding EIs*
Prices and transfers	**22. Environmentally related taxation** - Level of environmentally related tax revenue (% of GDP, % of total tax revenues; in relation to labour-related taxes) - Structure of environmentally related taxes (by type of tax base)	*No corresponding EIs*
	23. Energy pricing (share of taxes in end-use prices)	*No corresponding EIs*
	24. Water pricing and cost recovery (tbd) (to be completed with indicators on: Environmentally related subsidies and expenditures)	*No corresponding EIs*

4. CONCLUSION

This paper aims at identifying matches and differences between UNECE EIs and the OECD GGIs. It finds that 11 of the 24 GGIs can be paired with the EIs as they include dataflows, which are also part of the EIs. The majority of GGIs dataflows from the areas of *the environmental and resource productivity of the economy*, *the natural asset base*, and *the environmental dimension of quality of life*, can be calculated based on dataflows from EIs.

Taking the perspective of the UNECE list of EIs, it can be concluded that indicators from the areas of *air pollution and ozone depletion*, *climate change, water, biodiversity, land and soil, agriculture, energy* and *waste* are relevant for the production of GGIs.

In particular the indicators on *Freshwater resources*, *Population connected to sewage treatment*, *Wildlife resources*, *Land uptake and land change*, *Soil erosion*, *Energy productivity*, *Share of renewable energy sources in TPES* and *Waste generation* are compatible to a large degree for both UNECE and OECD sets.

Out of the 13 GGIs that cannot be produced with dataflows from EIs, the majority (eight indicators) belong to the area *economic opportunities and policy responses*, which focuses on economic measures which goes beyond the EIs' attention.

In many fields, policy questions for which the indicators are designed are similar for UNECE and OECD. This is true, among others, for the fields of air pollution, water, and energy. In other cases, however, the indicators used by OECD and UNECE for certain policy areas are different. An example for this is the state of the maritime environment, for which UNECE has indicators on pollutants and nutrients in coastal seawaters while OECD uses the indicator *fish resources.*

In terms of data sources and methodology the paper finds that in some cases (e.g. in the fields of biodiversity and energy) indicators refer to the same data sources, however the production is based on different methodologies. Yet, for some indicators or dataflows, for example in the field of air pollution and water, UNECE and OECD refer to different practices for data collection. Moreover, when data are collected from national agencies and authorities, definitions and measurement methods employed by countries may vary considerably. Therefore, on the country level further efforts to align the national methodological approaches are necessary. In some cases, including the indicators on *Air pollution, Water productivity*, *Forest resources*, *Population with sustainable access to safe drinking water*, the guidelines and standards of the indicators, as well as the terminology applied would have to be aligned to reach full compliance between the EIs and GGIs. However, for the indicators on *Wildlife resources*, for example, an agreement on selecting species as proxies would be sufficient to fully match the indicators.

With regard to the units of measurement that are used in the EIs and GGIs, the paper finds that the units are usually the same or easy to convert in case the dataflows are compatible.

The results of the mapping can be seen as an encouragement for further joint work between OECD, UNECE, and partners with the member countries, to align definitions and measurement methods for the distinct indicator sets.