



Green production indicators

A guide for moving towards sustainable development

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UNITED NATIONS



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Economic Commission for Latin America and the Caribbean (ECLAC)

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United Nations publication
LC/TS.2017/2
Distribution: Limited
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Printed at United Nations, Santiago
S.17-00085

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Introduction

Green production indicators. A guide for moving toward sustainable development, is the outcome of a project entitled “Towards a set of indicators for greener production”, co-financed by ECLAC and the International Development Research Centre (IDRC) of Canada, the objective of which was to develop specific knowledge for promoting the design and compilation of harmonized regional indicators on sustainable production and the incorporation of green technologies in firms of Latin America and the Caribbean. It was prepared by José L. Cervera-Ferri and Mónica Luz Ureña (DevStat – Statistical Consulting Services), under the coordination of Jorge Patiño and Sebastián Rovira (ECLAC). Contributions were also received during its preparation from the Statistics Division of ECLAC and the National Statistics Offices (NSOs) of the following countries in the region: Brazil, Chile, Costa Rica, Colombia, the Dominican Republic, Ecuador Mexico, Panama and Peru.

The guide should be seen as a set of methodological recommendations for voluntary application. Nevertheless, it is hoped that the use of these guidelines will facilitate the production of data (providing instruments that countries can readily adapt) and enhance their comparability.

The production and dissemination of internationally harmonized data on green production will help policymakers in the industrial and environmental areas, as well as businesses and society in general, to understand more thoroughly the environmental processes and practices of firms and allow them to take appropriate decisions for reducing the harmful effects of industrialization, to promote environmentally friendly growth, and to seize new economic opportunities in line with the Sustainable Development Goals (SDGs).

I. Background and objectives

The international community recognizes that a “greener” economy not only has the potential for alleviating the effects of environmental degradation but can also offer an opportunity for overcoming the economic crisis, thanks to its various effects such as renewal of the business fabric, increased public and private investment, and the creation of more and better jobs. In this context, the manner in which the productive sector and firms conduct their work and production is a key factor in determining the possibilities for innovating, improving productivity, and competing on the international market. At the same time, the growing environmental awareness of consumers, and especially those in developed economies, increasingly favours goods and services that are produced and delivered under strict environmental standards and socially responsible practices. This implies an incentive for firms to transform their procedures, processes and products in order to improve not only their environmental performance but also their productivity.

Sustainable production must therefore be a central focus of attention for national authorities and international agencies, and this in turn poses the need for quantifying progress in this area. Official statistics, as an essential tool for evidence-based decision making, recognize this need for information, as can be seen in the intensive work on indicators for monitoring the Sustainable Development Goals.

This report is aimed primarily at the producers of official statistical information in the region and, in particular, at the National Statistics Offices. It may also be useful to other data producers such as ministries and agencies involved with industrial and environmental policies. For their part, data users, including policymakers as well as business sectors and non-governmental organizations devoted to protecting the environment, will find here information that will enhance their understanding of the elements that comprise a more sustainable sort of production. They may also review the scope of the proposed indicators and, naturally, contribute to the continuous improvement of information systems.

Some countries of the region have already expanded their business surveys to include questions that can be used to calculate indicators relating to the adoption of green technologies, investments and expenditures on environmental protection, and the creation of jobs associated with these activities. As most of the statistical estimates at the regional and international levels are based on the data offered by national institutions, it is important to ensure statistical coherence and international comparability, while avoiding an excessive burden on information producers. This guide seeks to provide benchmarks that will help in the production of indicators and the way they are calculated.

In preparing this guide, the authors took into account a number of international initiatives relating to the statistical measurement of environmental and economic aspects. Specifically, they considered conceptual elements in the United Nations System of Environmental-Economic Accounting (SEEA). The guide, then, is the result of a process of technical debate among a group of NSOs, in which were discussed the indicators presented below and the information gathering tool (“green production module”).

The guide is structured as follows:

- Section 2 develops the conceptual framework, presenting the concepts of sustainable economies and green production, as well as the scope of the proposed indicators.
- Section 3 reviews international initiatives to develop indicators concerning the sustainable economy and green production.
- Section 4 presents the proposal (developed in a participatory manner taking into account a series of conceptual and methodological precedents) for the System of Green Production Indicators (SGPI), which comprises a basic set and an expanded set of indicators.
- Section 5 proposes a model questionnaire or “green production module” that can be adopted (and adapted) by countries for collecting information from firms.
- Section 6 spells out the relationship between the system of indicators and the questions (variables) in the module.
- Section 7 discusses some methodological aspects of the surveys on this issue.

The technical annexes detail the proposed indicators (annexes 1 and 2), the survey module (annex 3) and the methodological specifications sheets prepared for each of the indicators (annex 4).

II. Sustainable economy and green production: concept, definitions and coverage

This section presents the conceptual aspects that served as the basis both for selecting the indicators and for preparing the questionnaire to collect data from firms. As it involves a field that is relatively new, this section also includes references to previous work, especially by international organizations.

An understanding of the conceptual framework will give data producers a better grasp of users' information needs¹. While the survey can be conducted independent of its conceptual aspects—especially in the fieldwork phase, i.e. the collection of data—it is recommended that those responsible for producing statistics should be familiar with the terms used.

A broader set of references is included in the bibliographic annex.

1. The concept of sustainable economy, green economy, and green growth

The demand for a new model of the green economy resurfaced in 2009, when the United Nations Environment Programme (UNEP) undertook a research project entitled “Global Green New Deal”. That document interprets this term as a development of the concept of “sustainable economy”, maintaining the three dimensions of sustainable development: economic, social and environmental. Thus, UNEP defines the green economy as “one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.” Summarizing various technical references, we can say that some commonly accepted aspects of this term are:

- It is environmentally friendly.

¹ Bibliographic references to international initiatives should not be regarded as the only source for understanding users' information needs: NSOs should make a practice of maintaining regular dialogue between producers and users of official statistics, geared to specific topics, within the legal frameworks for official statistics in each country.

- It is based on renewable energies and on the use of “clean” fuels.
- Transportation infrastructure and buildings, as well as production, construction and distribution methods, make efficient use of energy and water, limiting the production of waste and emissions, and making use of recycling.

Similarly to the green economy, “green growth” attracted considerable attention as a way of overcoming the economic problems associated with the 2008 financial crisis. The Organization for Economic Cooperation and Development (OECD) proposes the following definition: “Green growth is about fostering economic growth and development while ensuring that the natural assets continue to provide the resources and environmental services on which our well-being relies. To do this it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities.”

In this document the terms “green” and “sustainable” are used interchangeably, and in general it refrains from terminological discussions of the definitions, referring when necessary to the established statistical classifications.

According to O’Ryan (2015), the practical implementation of a global model of the green economy requires changes in countries’ productive matrix, which must be supported through economic incentives as well as by large-scale policy measures that carry international commitment. That author notes that one of the efforts expected of businesses, in the context of the green economy, is to uncouple resource consumption from production. Thus, taking into account the systems of production, firms need to adopt business strategies that will maximize resource efficiency and cleaner production, by adopting “3R” strategies based on “reduce, reuse and recycle”. This requires them, first, to maximize the efficiency with which they use energy and raw materials, through cleaner production, to prevent pollution, and to maximize productivity. The firms themselves can also promote uncoupling, by moving to the use of renewable energy sources and recyclable or reusable materials, for example through the substitution of biomass for fossil fuels in boilers, or the use of solar power. He also points to management systems that take account of human and financial inputs, training, innovation and certification as the most effective means for a firm to ensure the efficient and continuous implementation of 3R strategies.

2. The concept of green production

At the present time there is no internationally accepted definition of green production. Taking as a starting point the UNEP definition of the green economy, however, “green production” can be defined as “one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities” (United Nations, 2011a).

In general, the main advantages of green production can be summarized as follows:

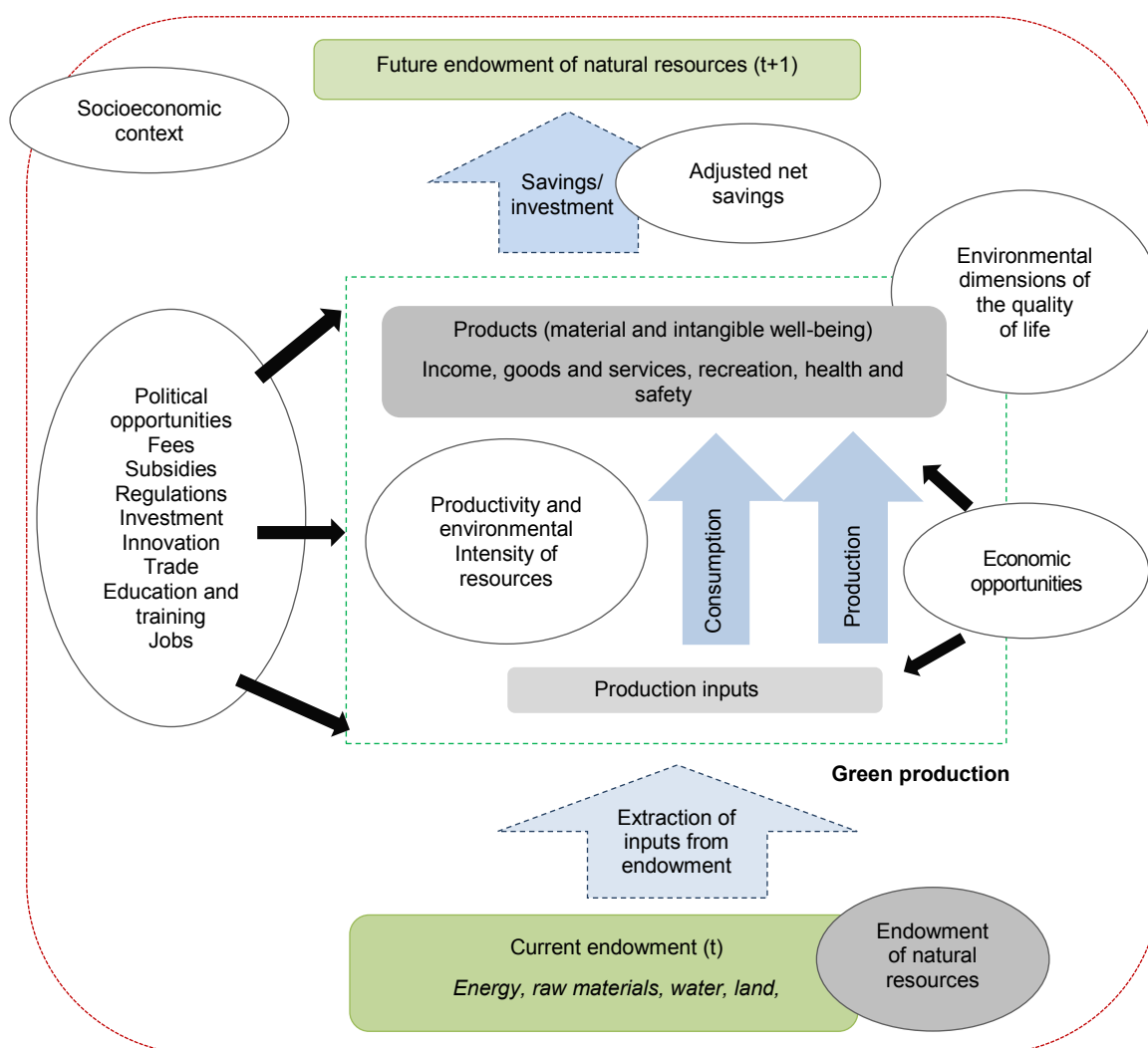
- Less expenditure on raw materials
- Greater security of supply
- Fewer pollution-related risks and expenses
- Greater motivation and cooperation on the part of employees
- Greater awareness of the new “smart” technologies
- Greater capacity for innovation and related skills
- Better trademark recognition and competitive positioning in markets.

Diagram 1 illustrates the proposed conceptual framework for green growth indicators, green economy and wealth accounting, presented by the Green Growth Knowledge Platform, which includes

the Global Green Growth Institute, OECD, the United Nations Environment Programme (UNEP) and the World Bank.

In diagram 1, the area shaded in green embraces the topics that are addressed within the concept of green production.

Diagram 1
Conceptual framework for measuring green production within the green economy



Source: Prepared by the authors, based on Green Growth Platform, Moving towards a Common Approach on Green Growth Indicators, 2013.

3. Sector and thematic coverage

The purpose of the guide is to develop a set of indicators that reflect the evolution of green production in the manufacturing industries, as defined in Section C – Manufacturing of the International Standard Industrial Classification of All Economic Activities (ISIC), Rev. 4, Divisions 10 to 33.

The following topics would be excluded from the statistical measurement of green production covered in this document:

- The natural resource base (inventory of resources and their quality).
- Household and government consumption of natural resources.
- Household and government consumption of environmental goods and services.
- Production of the environmental goods and services sector in general, although the production of environmental goods and services by the manufacturing industry would be included.
- Economic sectors other than the manufacturing industry, such as agriculture and forestry, livestock, fisheries, mining, energy production, services or education.

4. The difference between green production and the environmental industry

To specify the coverage of the indicators it is important not to confuse green industry, which may be defined as industry that carries out green production, with the so-called "environmental industry" which forms part of the environmental goods and services sector.

The environmental goods and services sector, as a specific sector of the economy, has recently engaged the attention of official statistics offices. The System of Environmental-Economic Accounting (SEEA)² contains a definition of "environmental activities" and "environmental goods and services", as well as a description of the statistical indicators on the production of those activities, goods and services and their contribution to the economy, employment, investment and exports.

According to OECD, the environmental industry consists of all activities "which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems" (OECD/Eurostat, 1999).

These activities give rise to the production and delivery of four types of environmental goods and services:

- Services specific to environmental protection and resource management
- Products of exclusively environmental use
- Adapted products
- Environmental technologies

It is very important to note that the System of Green Production Indicators (SGPI) does not examine the environmental goods and services sector specifically (save that portion of the sector that forms part of the manufacturing sector), but rather covers the manufacturing sector in its entirety, with the intention of assessing whether production is in fact becoming increasingly green. Boxes 1, 2 and 3 below set out two examples of green production (examples 1 and 2) as well as an example of the environmental industry (example 3).

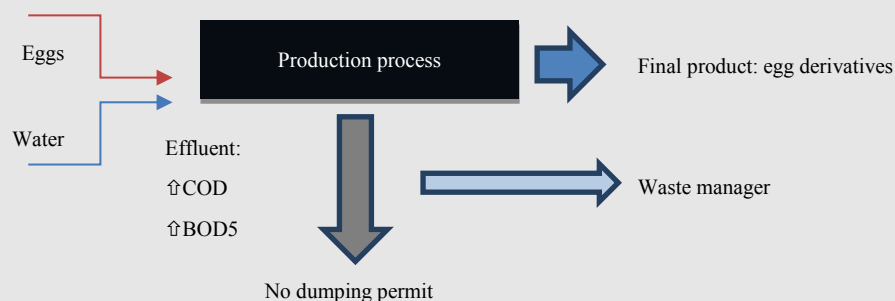
² The United Nations Statistical Commission adopted the System of Environmental-Economic Accounting (SEEA) at its 43rd session (2012).

Box 1

Example 1. Changing the processes of a firm producing egg products

The following diagram illustrates the industrial process of a firm producing egg products. In short, its production process involves obtaining various kinds of egg-derived products for culinary use, using two basic raw materials (water and eggs).

The production process generates liquid effluent with a high organic load —high chemical oxygen demand (COD) and high 5-day biochemical oxygen demand (BOD5)— that does not comply with the limits established in legislation on dumping, even with application of the most advanced water treatment techniques available on the market. Following an inspection visit by the competent authority and the launch of disciplinary proceedings, and given the impossibility of obtaining the required dumping permit under these conditions, the firm was obliged to contract a waste manager for treatment of its liquid effluents. This has entailed a significant additional cost that places the firm's profitability in jeopardy.

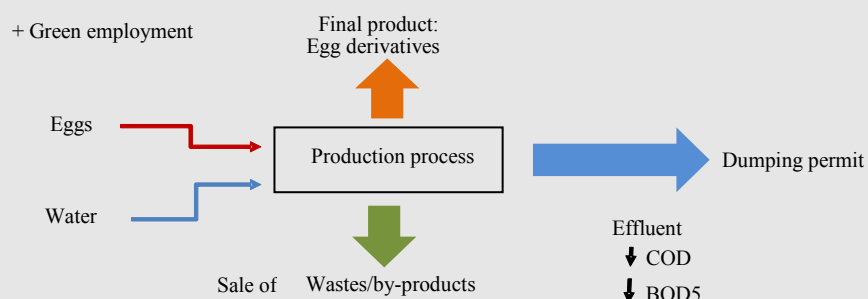


The firm's manager then decides to hire a process engineer to evaluate possible changes to the production process that could improve the current situation. The person hired finds that, by modifying the cleaning processes in the facility where the eggs are transformed into derivative products, it would be possible to reduce water consumption and also to recover a portion of the initial raw material, yielding a final effluent with a lower organic load (COD and BOD5) and thereby making it possible to apply for and obtain the required dumping permit.

Moreover, a study of industries in the sector shows that a portion of the recovered raw materials can be sold to another firm that will use them as inputs for making hair care products. Thus, in terms of green production, by amending its production processes the firm will be able to:

- Cut back its water consumption and thereby reduce supply costs
- Reduce its waste management costs
- Obtain a dumping permit
- Increase its revenues through sale of its wastes and by-products

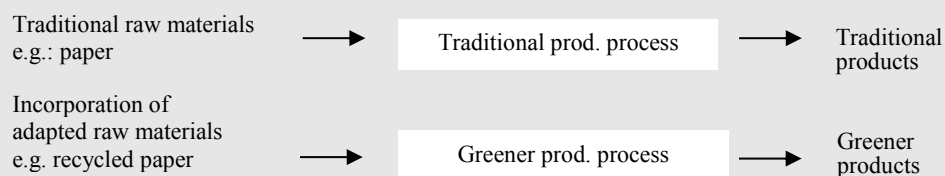
The scheme of the production process, after incorporating the appropriate changes, is outlined below:



Source: Prepared by the authors.

Box 2**Example 2. Green production. Incorporation of adapted products**

An industry that uses paper as a raw material in its production process and decides to shift to the use of recycled paper, with or without changes to the technology employed in the facility, is changing its production system to make it greener.



Source: Prepared by the authors.

Box 3**Example 3. Environmental industry in the environmental goods and services sector**

An industry that manufactures particulate filters for chimneys and smokestacks, with a view to reducing their emissions of particulates into the atmosphere, is an environmental industry and is part of the environmental goods and services sector, as it makes a product geared exclusively to environmental purposes.

Source: Prepared by the authors.

III. Methodology for defining the System of Green Production Indicators

The proposed System of Green Production Indicators (SGPI) presented here has been prepared on the basis of the conceptual framework and sector coverage presented above, through a process that consisted of the following stages:

- Review of systems and lists of indicators related to this topic, drawn from international initiatives (section 3.1)
- A consultative process that involved technical discussion with representatives of regional NSOs in which the priority and the feasibility of those indicators were reviewed (section 3.2)
- Description of the proposed SGPI, together with an analysis of its typology (section 4.3)
- Classification of the indicators into thematic areas (section 4.4)
- Preparation of methodological specifications sheets for the indicators (annex 4)

The methodology used in selecting and preparing the indicators is one that allows the SGPI to expand its scope progressively to other sectors such as agriculture, livestock, mining and quarrying, electricity and water supply.

The correspondence between the indicators and the variables, which can be obtained through a questionnaire or module targeted at firms, is detailed in section 6.

Annexes 1 and 2 present two proposed lists of basic and expanded green production indicators.

1. Review of international initiatives on green production indicators

The international initiatives relating to green production indicators are numerous and varied. Those reviewed include the following:

- The United Nations Sustainable Development Goals (SDGs)

- The United Nations Statistics Division's Project for "Strengthening the capacities of developing countries to measure progress towards a green economy", 2015-2016
- The green growth indicators of OECD
- The green economy indicators of UNEP
- The Latin American and Caribbean Initiative for Sustainable Development (ILAC)
- The International Labour Organization (ILO)
- The green industry initiative of the United Nations Industrial Development Organization (UNIDO)

The proposed indicators were developed on the basis of a study of the indicators proposed in the international initiatives cited above, using the following methodology:

- The indicators in each set were classified by thematic area (physical indicators, demographic and social indicators, legislative and administrative indicators, economic indicators, and economic-environmental indicators), eliminating duplication among systems and employing the recommended breakdowns.
- From among the indicators classified as economic-environmental, we determined which could be calculated on the basis of company surveys. Other indicators, which must be obtained through household surveys or population and housing censuses, were not considered in this work.
- For prioritizing the indicators (basic and expanded sets) we took into account the analysis of the starting position of the various countries of the region in terms of the availability of data on green production.

The review and analysis of those initiatives showed that harmonizing the definition of the indicators is key to ensuring their future usefulness, recognizing that the different statistical systems or systems of indicators use different definitions that can cause confusion among users and can even lead to highly divergent policy decisions (see example 4).

Box 4

Example 4. Differences in the definition of a wastewater indicator

To illustrate this aspect we may cite the indicators relating to wastewater treatment. OECD takes as an indicator "wastewater subjected to a secondary treatment as a minimum", while the ILAC includes as an indicator "wastewater subjected to some type of treatment". The choice of one indicator or the other to reflect the country's current situation and to establish targets will mean a very important difference in the implementation of certain policies, their financing, and the level of water quality that will be pursued.

Source: Prepared by the authors.

On the other hand, the use of insufficiently specific indicators can give rise to erroneous interpretations in evaluating the variables they are supposed to reflect (see example 5). Consequently, in selecting the indicators we have preferred simple and specific ones that reflect relevant and fundamental aspects of green production and that are a direct consequence of industrial production.

Box 5**Example 5. A non-specific indicator of CO₂ emissions**

In a similar manner, we can approximate emissions of CO₂ using the indicator of "national atmospheric emissions of CO₂, less removal by sinks," and can monitor it over time. We could even set a global emissions target linked to that indicator. However, the behaviour of the indicator over time is not readily evaluable (as its scope would include CO₂ sinks and all economic activities taken together: agriculture, industry, households etc.). As this is a composite indicator, environmental improvements resulting from an increase in CO₂ sinks might not be reflected in it if CO₂ emissions from economic activities were to increase to a greater extent. On the other hand, the indicator fails to distinguish the effects flowing from changes in the economic structure. For example, the tertiarization of an economy that keeps its GDP levels stable will reduce its levels of CO₂ emissions and the intensity of emissions, even if the stock of technological capital remains unchanged. However, this uncoupling is only apparent, for in reality the intensity of emissions in each individual sector will not have improved but rather will remain constant. Lastly, this approach does not take into account the effects induced in the emissions of other countries due to changes in the trade balance—influenced by changes in the international value chain and in domestic consumption—since the indicator does not account for emissions incorporated in imports. For example, the substitution of a portion of domestic intermediate consumption by imports will automatically reduce domestic emissions, thereby underestimating the emissions generated in production and overestimating the productivity of the economy in terms of emissions.

Consequently, unless we present it in a more disaggregated way, we cannot know which agents are contributing most to the generation of emissions, and what are the underlying causes. Obviously, in the absence of this information we cannot analyse the behaviour of those contributions over time.

Source: Prepared by the authors.

In light of the initiatives reviewed, the SGPI proposed in the guide is intended to be: i) specific to the manufacturing industry, ii) consistent with the indicators of the various existing international initiatives, iii) concise, for which reason each indicator has been defined using a methodological specifications sheet, and iv) feasible to calculate, by collecting data from firms through a questionnaire.

Following is a summary presentation of the initiatives reviewed for selection of the green production indicators.

1.1. United Nations: Sustainable Development Goals

The Sustainable Development Goals (SDGs) comprise a broad framework for the definition of indicators in many thematic areas. The SDGs mention environmental sustainability in at least 10 of the 17 goals (see table 1).

Table 1
Sustainable Development Goals that make explicit mention of sustainability

Goal 2	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
Goal 6	Ensure availability and sustainable management of water and sanitation for all.
Goal 7	Ensure access to affordable, reliable, sustainable and modern energy for all.
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all.
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation. 9.4. By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.
Goal 11.	Make cities and human settlements inclusive, safe, resilient and sustainable.
Goal 12.	Ensure sustainable consumption and production patterns. 12.6. Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle. 12.a. Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production.
Goal 13	Take urgent action to combat climate change and its impacts.
Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
Goal 15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Source: Prepared by the authors on the basis of United Nations, Sustainable Development Goals, 2017.

It is obvious that, in defining indicators for monitoring the SDGs, it will be important to investigate within the business sector such matters as:

- The resources used in the agriculture, fishing and forestry sectors (goals 2, 14, 15) as well as industry (goal 9)
- The patterns of production in all sectors (goal 12) including the use of sustainable infrastructure (goal 9)
- The adoption of standards, and the dissemination of information on those standards (goal 12.6).

1.2. United Nations: Project to strengthen the capacities of developing countries for measuring progress towards a green economy

The objective of the project entitled “Supporting developing countries’ capacities to measure progress towards achieving a green economy” developed between 2014 and 2015 by the United Nations Statistics Division was to define a set of green economy indicators (GEI) for developing countries. Underlying the project is the idea that the proposed set of GEIs can be adapted to the needs of each country in light of policy priorities as well as to their statistics production programmes.

For reviewing the GEIs, green growth and sustainable development we took into account more than 25 sets of indicators and documents. The OECD list of green growth indicators was supplemented with indicators from other sources, including the United Nations Environment Programme (UNEP), the Economic and Social Commission for Asia and the Pacific (ESCAP), the working groups of sustainable development of the Economic Commission for Europe (ECE) /OECD/Eurostat, the Food and Agriculture Organization of the United Nations (FAO), the Latin American and Caribbean Initiative for Sustainable Development (ILAC), the Millennium Development Goals (MDGs), and the Sustainable Development Goals (SDGs). In all, 156 indicators were considered.

The criteria for their selection and adaptation included relevance, feasibility (possibility of measuring the indicator in developing countries) and comparability (possibility that the indicator could be based on internationally accepted definitions and methodologies). At the present time, the list comprises 97 indicators classified as 44 central indicators (CGEI) and 53 additional indicators (AGEI). It is the central set (CGEI) that is recommended for developing countries, while the additional indicators, although relevant, are expected to require further statistical work to compile them, and could be viable only in certain countries.

The GEI list includes indicators that can be disaggregated in light of data availability, with the objective of providing more specific and meaningful information.

1.3. OECD: green growth indicators

The Organization for Economic Cooperation and Development (OECD) has been a great promoter of green growth since 2009. In that year, a group of industrialized countries representing around 80% of the global economy approved a declaration recognizing that the green economy and green growth could be achieved simultaneously. Countries also asked OECD to formulate a strategy for green growth, incorporating economic, environmental, technological, financial and development aspects within a comprehensive framework.

In 2011, in its report entitled *Towards green growth: monitoring progress*, OECD proposed an initial set of green growth indicators, divided into four interrelated groups. Those indicators were supplemented with generic indicators of the economic context and of certain characteristics of growth.

The initial indicators of green growth were grouped under four main headings:

- The environmental and resource productivity of the economy

- The natural asset base
- The environmental dimension of quality of life
- Economic opportunities and policy responses to green growth

Subsequently, in its report, *Green Growth Indicators 2014*, OECD expanded and updated the measurement framework and the indicators initially proposed (OECD, 2014). This set of indicators is intended to be a flexible list that countries can adapt to varying national contexts.

The list of indicators comprises a set of main indicators and a group of proxy indicators. Each indicator includes an evaluation of the measurability of the underlying data, and thus differentiates three groups of indicators in light of their current or anticipated availability:

- Indicators that can be calculated in the short term: these are the indicators for which basic data are available for nearly all OECD countries.
- Indicators that can be calculated over the medium term: those for which the basic data are partially available, but where further efforts are needed to improve their quality and/or their geographical coverage.
- Indicators that can be calculated only in the long term: here the basic data are not available for a majority of OECD countries, and sustained data collection and conceptual efforts will be required.

Of particular importance for this study are the indicators on the use of resources in production and on economic opportunities.

1.4. UNEP: green economy indicators

The United Nations Environment Programme has since 2008 represented a pioneering initiative of the United Nations to promote the green economy and green growth, as well as to formulate indicators for measuring their progress.

The indicators proposed by UNEP embrace many fields and have had great repercussions, as they were adopted—at least in part—by many entities of the United Nations system.

In 2011 UNEP published a report entitled *Working towards a balanced and inclusive green economy: a United Nations system-wide perspective* (UNEP, 2011). That report called expressly for the establishment of a comprehensive framework for evaluating policies, one that would comprise improved accounting systems for compiling the relevant information and indicators for measuring and monitoring progress.

The 2011 report insisted that the conceptual framework of the green economy indicators must be flexible, so that governments can adapt it to their particular needs and circumstances. The indicators can be divided into three broad groups:

- Green investments, green jobs, and green sectors. These are economic indicators intended to measure the green transformation of sectors of the economy. These indicators focus on investments, production and employment.
- Decoupling the environmental impact from resource efficiency. In this group, the indicators seek to measure the environmental effects of economic activities, by calculating indicators of resource use efficiency. Essentially, these indicators refer to materials, residues, energy, water, land use and ecosystems.
- Aggregate indicators of progress and well-being. These indicators refer to such aspects as poverty, equity, social inclusion, the general well-being, and the distribution of capital resources.

At present, UNEP is working on 41 proposed indicators³.

1.5. ILAC: Indicators from the Latin American and Caribbean Initiative for Sustainable Development

The Latin American and Caribbean Initiative for Sustainable Development (ILAC) was adopted in 2002 as part of the Johannesburg Plan of Implementation of the World Summit on the Environment and Sustainable Development. ILAC is promoting efforts to harmonize the design of a set of indicators on sustainable consumption and production.

UNEP serves as the secretariat for ILAC, and ensures that the indicators proposed by this initiative and by UNEP are compatible.

In order to monitor progress with ILAC, in 2004 an initial set of 38 indicators was defined, grouped under six thematic areas, referred to in the ILAC as "guiding goals":

- Biological diversity
- Water resource management
- Vulnerability, human settlements and sustainable cities
- Social issues such as health, inequity and poverty
- Economic aspects including trade, and production and consumption patterns
- Institutional aspects

At present, these six thematic areas embrace a total of 24 objectives that are broken down into a total of 50 indicators.

1.6. ILO: green employment indicators

The International Labour Organization (ILO) convened a group of experts in 2012 to discuss the first draft of a conceptual framework and a set of operational guidelines for measuring green employment. In 2013, the Conference of Labour Statisticians returned to the issue, approving a concept document (*Proposals for the statistical definition and measurement of green jobs*, 19th Conference of Labour Statisticians, 2013) together with a study on the possible uses of green job statistics.

At that conference a set of nine indicators was presented for measuring green employment. This point of departure has as its final goal the preparation of a list that integrates the new data available and tracks the evolution of the related concepts.

Some countries (see example 6) have estimated green employment by calculating it for individual sectors of "green" products or services. ILO has identified methodological differences in the data compiled to date.

³ In 2014 UNEP published a working paper entitled *Green Economy: Using indicators for green economy policymaking*, in which it proposes that green economy indicators should be classified as a function of the policy formulation cycle, and suggests four groups of indicators:

Indicators for issue identification

Indicators for policy formulation

Indicators for policy assessment

Indicators for policy monitoring and evaluation

This classification is not specific to the green economy.

Box 6**Example 6. Measuring green jobs in the United States**

One experience cited is that of the United States Bureau of Labor Statistics, which defines green jobs as:

Jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources.

Jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources.

Source: Bureau of Labor Statistics, "Overall Approach to Measuring Green Jobs", 2017.

In its *Green Jobs Programme*, ILO (2017) defines green jobs as those that help to reduce the adverse impact on the environment, contributing to the creation of environmentally, economically and socially more sustainable firms and economies. More specifically, green jobs are decent jobs that:

- Reduce the consumption of energy and raw materials
- Limit greenhouse gas emissions
- Minimize residues and pollution
- Protect and restore ecosystems

Table 2
Decent work

Decent work sums up the aspirations of people in their working lives. It involves opportunities for work that is productive and delivers a fair income, security in the workplace and social protection for families, better prospects for personal development and social integration, freedom for people to express their concerns, organize and participate in the decisions that affect their lives and equality of opportunity and treatment for all women and men.

Source: International Labour Organization (ILO), "What is a Green Job?", 2017 [online] http://www.ilo.org/global/topics/green-jobs/news/WCMS_220248/lang--en/index.htm.

It will be noted that the notion of "decent work" adds social aspects to the definition of green jobs. Nevertheless, ILO (2017) considers that the operational definitions of green job and decent work for compiling statistics must be different if these dimensions are to be properly evaluated, either separately or jointly.

ILO proposes the following indicators of green employment:

- Employment in the environmental sector (total or by economic activity), in absolute numbers and as a percentage of total employment.
- Employment by environmental area, according to the SEEA (System of Environmental-Economic Accounting).
- Employment in the environmental sector by type of occupation.
- Employment by economic activity (the sector composition of the national economy determines the challenges and the potential for economic development and environmental sustainability).
- Percentage of establishments using green technologies.
- Employment by type of green technology used (total or by economic activity).
- Wages and hours worked in the production of environmental goods and services (useful for measuring the quality of work in the sector).

In addition, it proposes that the presentation of the indicators should be disaggregated as to age, level of education, and gender.

1.7. UNIDO: Green Industry Initiative for Sustainable Industrial Development

The United Nations Industrial Development Organization (UNIDO) is the specialized agency of the United Nations that promotes industrial development in ways that will reduce poverty, achieve inclusive globalization, and ensure the environmental sustainability of productive activities.

UNIDO proposes a partnership for global action, to serve as a platform for the ecological industry. One of the three pillars of this platform is its statistical database, which also focuses on monitoring the efficient use of resources and on reducing CO₂ emissions.

A report prepared jointly with UNEP, *Enterprise-Level Indicators for Resource Productivity and Pollution Intensity*, published in 2010, proposes a system of indicators specific to small and medium-sized enterprises in developing countries. The system has six absolute indicators, of which three relate to resource use (energy, materials and water) and the other three to polluting emissions (atmospheric emissions, wastewater and residues) and an additional benchmark indicator relating to production. The report also includes another 25 indicators as examples and urges firms to construct specific indicators in light of their type of activity. This initiative stresses the need to promote the use of indicators based on physical units.

In contrast to other initiatives, this system of indicators is intended to serve as a tool in the hands of firms, and to encourage firms to increase their productivity while reducing their adverse impact on the environment.

2. A participatory process for selecting indicators

Countries of the region were consulted on statistical production priorities by means of two regional workshops, with the participation of NSO representatives.

The workshops reviewed national and international statistical experience as well as conceptual and methodological issues, and subsequently identified statistical production priorities, which included the definition of thematic and sectoral fields, and finally the establishment of a list of indicators.

It was also agreed to develop a module with questions concerning implementation of environmental practices in manufacturing, firms which NSOs could adopt as they see fit and adapt to their statistical production systems (company surveys, administrative records, etc.).

The first workshop, "Towards a set of indicators for greener production", was held in Santiago, Chile on 7 and 8 September 2015, with participation by representatives of the NSOs of nine countries of the region: Argentina, Brazil, Chile, Costa Rica, the Dominican Republic, Ecuador, Mexico, Panama and Peru. Representatives of the United Nations Statistics Division also participated along with experts in the area of sustainable development policies. During the workshop it was agreed to review a module for collecting statistical information on green production in firms.

The second workshop, "Green indicators for firms", was held in Rio de Janeiro, Brazil, from 5 to 7 April 2016, with participation by NSO representatives from 10 countries of the region: Brazil, Chile, Costa Rica, Colombia, the Dominican Republic, Ecuador, Mexico, Panama, the Plurinational State of Bolivia and Peru, in addition to representatives of the Regional Centre of Studies for the Development of the Information Society (CETIC) in Brazil. The workshop reached consensus on a basic set and an expanded set of green production indicators (GPI). It also conducted a first review of the module prepared for collecting statistical information for use in calculating those indicators. The topics addressed by the indicators are: consumption and use of natural resources, wastes and wastewater, green technologies, eco-innovation and patents, employment and training, and economic opportunities and legislative and regulatory responses.

The technical discussion conducted by the NSOs during these workshops served as input for the selection of the indicators presented. Subsequently, a draft of the guide was submitted to the NSOs and to the Statistics Division of ECLAC for comment.

IV. Description of the System of Green Production Indicators (SGPI)

This section offers a succinct presentation of a system of green production indicators (SGPI) that can be calculated for countries of Latin America and the Caribbean. As already described in sections 3.1 and 3.2, the indicators were selected and developed on the basis of a study of various international initiatives, and have been discussed in working groups of experts on environmental and business statistics, drawn mainly from the region's NSOs.

The SGPI refers to manufacturing activity, and consequently the information needed for calculating the indicators will have to be gathered in the form of data from firms of the manufacturing sector (see section 5).

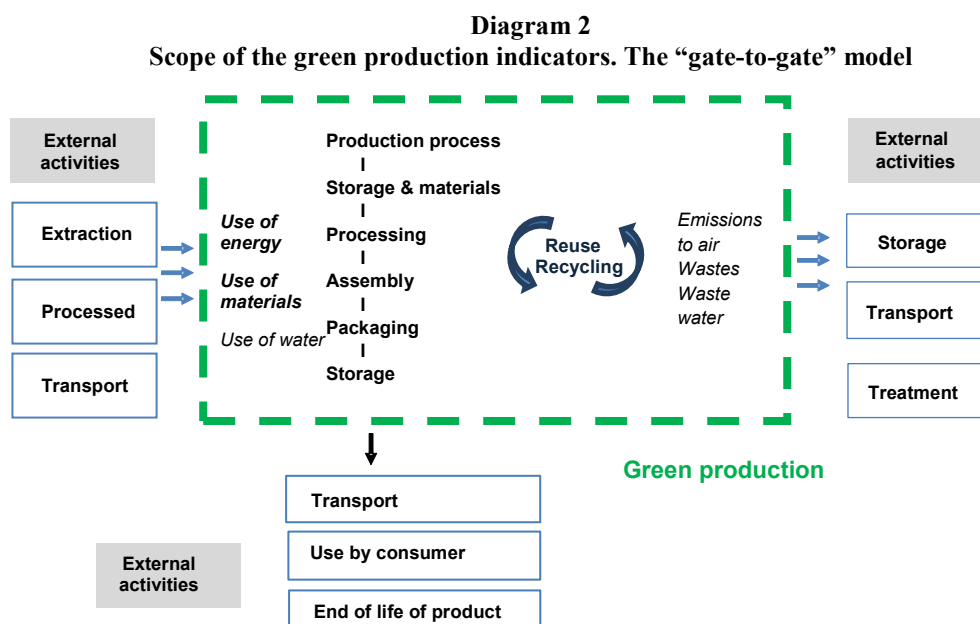
1. Scope of the indicators

The scope of the green production indicators is limited to what is known as the “gate-to-gate” model, where the first gate is the production input boundary and the second is the product boundary (delimited in diagram 1 by the area outlined in green).

- The first gate, as shown in diagram 2, is delimited by the resources (energy, water and raw materials) that are purchased, those that are generated (renewable energies) or those that are recovered in the installation, meaning that any prior and external activity is excluded from that scope. Thus, neither the extraction and other processing nor the transportation of the raw materials that enter as inputs to the firm is included in the scope of the indicators.⁴
- The second gate is defined by the product boundary, which includes manufactured products, services, waste, waste water and atmospheric emissions. The transportation of

⁴ For firms that process raw materials, this processing constitutes their industrial activity and therefore is included within the scope of the indicators.

products, their use by consumers, and the end of those products' useful life, as well as the storage, transportation and any processing of wastes, waste waters and atmospheric emissions are therefore excluded from the scope, when those activities are conducted outside the installation. It is important to remember that, for example, under this scheme the treatment of wastewater prior to discharge into the sewer network falls within the scope of the proposed indicators, while processing by the municipalities of waste waters after they have been discharged does not enter into the scope of the proposed indicators.



Source: Prepared by the authors, on the basis of United Nations Industrial Development Organization (UNIDO)/United Nations Environment Programme (UNEP), *Enterprise-Level Indicators for Resource Productivity and Pollution Intensity. A Primer for Small and Medium-Sized Enterprises*, Vienna, 2010.

2. Green production: thematic areas

The conceptual framework adapted and proposed for green production serves as the basis for defining thematic areas on which a system of statistical indicators can be developed. The two broad themes relating to green production are:

- Environmental and resource productivity/intensity. This topic would include:
 - On one hand, all the indicators concerning the use and productivity of **resources consumed** in economic activities, such as raw materials, water and energy;
 - On the other hand, indicators concerning the implementation of **technologies and processes**, which cover indicators relating to the development and deployment of technologies for making more efficient use of resources and for reducing the environmental impact of productive activities (generation and treatment of pollutant flows, wastes, wastewater and atmospheric emissions, and use of green technologies) as well as environmental management tools (expenditures on R&D, eco-innovation, patents, environmental certifications and eco-labelling).

- Policy responses and economic opportunities. This topic would include, for example, employment related to green production, investments and current expenditures of firms related to resource management and environmental protection, taxes and subsidies to firms, and the relative costs of raw materials.

Consistent with the thematic areas described, the SGPI is structured in two broad blocks, which in turn are divided and described in detail in section 4.4:

- Environmental and resource productivity/intensity
 - Use and consumption of resources
 - Raw materials and other inputs
 - Water
 - Energy
 - Technologies and processes
 - Green technologies
 - Wastes
 - Wastewater
 - Atmospheric emissions
 - Eco-innovation, patents and R&D
 - Environmental management systems, certifications and eco-labelling
- Policy responses and economic opportunities
 - Sustainability reports
 - Green jobs and training in green production.
 - Green jobs
 - Training in green production
 - Revenues, costs and transfers
 - Revenues, current expenses and investments
 - Costs and transfers

3. System of Green Production Indicators (SGPI)

The proposed indicators are structured as a system, rather than a simple list, as they may be considered to have structural interrelationships corresponding to the stages of the production process, and described by the conceptual models of diagrams 1 and 2. For a deeper understanding of the relationships between the indicators it would be necessary to conduct statistical studies (correlation and regression and other multivariate methods) to detect possible relationships that would help in the design of policies with a systemic focus.

The SGPI is structured as a basic set of indicators, including an expanded set. The classification of any indicator in one or another category is based on the discussions that took place in the regional workshops hosted by ECLAC with the NSOs.

First, we propose a basic set of indicators that will give a general idea of the evolution of green production in the manufacturing industries, especially in those countries that currently have restrictions that make it difficult to obtain more information.

Second, we present an expanded set of indicators to support policymaking decisions on the various aspects of green production.

In this way, countries that in an initial stage can address only the calculation of the basic set of indicators could begin to refine and evaluate their green production policies, while at the same time constructing the tools needed for calculating the expanded set of indicators.

Following is a list of the 56 indicators that comprise the expanded set of GPI proposed. Of these, 26 indicators are part of the basic set (indicated with an asterisk). The indicators are analysed by topic in the following section.

In addition, we have developed a specifications sheet for each indicator, with methodological information, as presented in annex 4. We recommend that countries adapt these sheets with specifications of the national methodology used when it comes to disseminating the data, in order to offer more complete information to users.

System of Green Production Indicators *Environmental and Resource Productivity/Intensity*

Use and consumption of resources

Raw materials and other inputs

- GPI 1. **Intensity** of raw material use*
- GPI 2. Material **productivity***
- GPI 3. Proportion of establishments using **hazardous raw materials** in the production process*
- GPI 4. Proportion of hazardous raw materials used
- GPI 5. Intensity of use of **containers and packaging** for the final product
- GPI 6. Proportion of establishments using **recycled** raw materials*
- GPI 7. Proportion of raw material inputs derived from recycling*
- GPI 8. Proportion of establishments using **residues** from other firms as raw material (except energy production)
- GPI 9. Proportion of raw material inputs derived from residues of other firms (except for energy production)
- GPI 10. Proportion of firms purchasing **products with certification or eco-label***
- GPI 11. Proportion of purchases with certification or eco-label

Water

- GPI 12. **Intensity** of water use*
- GPI 13. Water **productivity***
- GPI 14. Total water **use**
- GPI 15. Proportion of **recycled water** used*
- GPI 16. Proportion of establishments using **rainwater**
- GPI 17. Proportion of rainwater used
- GPI 18. Proportion of **desalinated water** used

Energy

- GPI 19. **Energy intensity***
- GPI 20. **Energy productivity***
- GPI 21. Proportion of firms producing **renewable energy***
- GPI 22. Proportion of energy consumption derived from renewable energy generated in the establishment*
- GPI 23. Proportion of energy consumption derived from **residues**
- GPI 24. Proportion of **bioenergy** production (vegetal remnants and wastes)

Technologies and processes

Green technologies

GPI 25. Proportion of establishments using **green technologies***

Wastes

GPI 26. **Intensity** of waste generation*

GPI 27. Proportion of **hazardous wastes** generated

GPI 28. Proportion of **packaging waste** generated

GPI 29. Proportion of **electric and electronic appliance waste** (e-waste) generated

GPI 30. Intensity of e-waste generation

GPI 31. Proportion of wastes **adequately disposed of***

GPI 32. Proportion of non-hazardous wastes adequately disposed of

GPI 33. Proportion of hazardous wastes adequately disposed of

Wastewater

GPI 34. **Intensity** of wastewater generation

GPI 35. Proportion of establishments treating their wastewater*

GPI 36. Proportion of wastewater treated

Atmospheric emissions

GPI 37. **Intensity** of CO₂ generation

GPI 38. Proportion of establishments measuring or treating atmospheric emissions*

Eco-innovation, patents and R&D

GPI 39. Proportion of firms engaged in **eco-innovation***

GPI 40. Proportion of firms engaged in eco-innovation to reduce raw material use and/or energy consumption

GPI 41. Proportion of firms with registered **patents** for green technologies*

GPI 42. Proportion of firms investing in **R&D** for green production purposes*

Environmental management systems, certifications and eco-labelling

GPI 43. Proportion of firms with ISO 14001 **certification***

GPI 44. Proportion of firms with products bearing **eco-labels**

Policy responses and economic opportunities

Sustainability reports

GPI 45. Number of firms publishing sustainability reports

Green jobs and training in green production

Green jobs

GPI 46. Proportion of **green jobs***

GPI 47. Proportion of firms with workers performing green tasks in management, technical or professional positions

Training in green production

GPI 48. Proportion of firms conducting **training** in green production*

Revenues, costs and transfers

Revenues, current expenses and investments

GPI 49. Proportion of firms earning **revenues from the sale of residues**

GPI 50. **Relative cost of water**

GPI 51. **Relative cost of energy**

GPI 52. **Relative cost of wastewater management**

GPI 53. **Relative cost of waste management**

GPI 54. Proportion of firms **investing** in green production*

Transactions with the government sector

GPI 55. Proportion of firms receiving environmental investment **grants**

GPI 56. Proportion of firms receiving **incentives** to use renewable energy sources

4. Thematic description of the indicators

This section describes each of the themes addressed by the green production indicators. To this end, we have compiled definitions for each of the concepts relating to each theme, and classifications that we consider useful for clarifying them.

4.1. Environmental and resource productivity/intensity

4.1.1. Use and consumption of resources

First, it is useful to distinguish between *use* and *consumption* of a resource or input.

- The **use or utilization of a resource** is the quantity of resource incorporated by an economic unit. The use of a resource is the sum of the use of the resource within the economy and the use of the resource by the environment. This concept is sometimes referred to as “non-consumptive use” of the resource, meaning that the resource is not depleted by its use. One example of the use or utilization of the resource relates to water—the water that enters an industrial facility can be used both for cleaning machinery and for irrigating gardens. This resource is then returned to the environment (either through discharge or through its incorporation into the vegetation or groundwater).
- By contrast, the **consumption of a resource** is that portion of the resource’s use that, after being incorporated into the economic unit, is not distributed to other economic units

and has not been returned to the environment, because during its use it was incorporated into products or was consumed. In this case, it is usual to speak of “consumptive use” of the resource. A clear example of resource consumption is energy consumption, as the energy that enters the facility is exhausted in the productive process (except in occasional cases of energy recovery and subsequent use of, for example, high-temperature effluents).

Greener production means reducing the use and consumption of resources per unit of output.

Raw materials and other inputs

The materials that enter into production processes constitute a flow of materials that includes raw materials of natural origin, prepared products, and residues originating with other economic units.

The consumption of materials in production processes entails significant environmental impacts due to their extraction, cultivation, handling and transportation, among other things, as well as the consequent consumption and use of other associated resources, such as energy consumption (e.g. for transportation), water consumption (for crops) or the use of land (for mineral extraction).

The consumption of materials implies a reduction in the reserves of natural resources, energy and water, together with an important increase —given the current state of technologies— in the emission of pollutants into the atmosphere, water and soil. The adverse impacts of materials use also extend to deforestation and the destruction of natural ecosystems, to which must be added the social consequences (forced displacement by ecological disasters, illnesses of environmental origin, food crises, etc.).

The importance and severity of the environmental effects associated with the use of raw materials by economic units depends on many factors that are not related exclusively to the quantity of the resource used but have also to do with certain inherent features (toxicity, flammability, corrosiveness etc.). Depending on their characteristics, raw materials can be classified as hazardous (see table 3).

Table 3
Hazardous raw materials

A hazardous material is any solid, liquid or gaseous substance that, by its physical, chemical or biological characteristics, can cause damage to human beings, the environment, or property.

According to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS), prepared by the United Nations, hazardous materials are classified as follows:

Class 1. Explosive substances. Solid or liquid substances (or mixture of substances) which are in themselves capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.

Class 2. Gases. This class includes compressed gases, chilled liquefied gases, mixtures of one or more gases with one or more vapours of substances of other classes.

Class 3. Flammable liquids. Liquids and mixtures that have a flashpoint lower than 0°C and a boiling point of 35°C or less, and substances and gaseous preparations that, at normal temperatures and pressure, are flammable in contact with the air.

Class 4. Flammable solids. Solids that are readily combustible after a brief contact with an ignition source and that continue to burn or consume themselves once that source is withdrawn.

Class 5. Oxidizing substances and organic peroxides. Substances that, while not necessarily combustible, can release oxygen and thereby stimulate combustion and increase the velocity of a fire in another material.

Class 6. Toxic and infectious substances. Products that in very small quantities can provoke extremely serious, acute or chronic effects, including death.

Class 7. Radioactive materials. Materials that emit radioactive particles in different forms such as alpha, beta and gamma rays.

Class 8. Corrosives. Substances and preparations that, in contact with living tissue, can destroy that tissue. These products are typically acids or alkalis that, when in contact with the skin for even a short time, can cause chemical burns.

Class 9. Miscellaneous hazardous materials. This includes substances and articles that during transport present a risk not covered by other classes.

Source: United Nations, Globally Harmonized System of Classification and Labelling of Chemicals (GHS) (ST/SG/AC.10/30/Rev.4) New York, 2011.

The use of raw materials derived from recycling (table 4) or from wastes originating in other economic units can minimize the extraction of materials from the natural environment, and thereby reduce their negative impacts, thus representing important progress towards the green economy.

Table 4
Recycling

Recycling may be defined as a set of mechanical or chemical processes for transforming wastes into new raw materials. The inputs to the recycling processes are always unsuitable for use in an industrial process, while the product lends itself to further preparation and must be considered an intermediate product or secondary raw material.

Source: United Nations, *System of Environmental-Economic Accounting 2012. Central Framework*, New York, 2014.

This theme also considers the quantity of packaging used in the final presentation of the product, recognizing that over-packaging produces no benefit for the product and yet is harmful to the environment. The European Commission has established a typology of containers that can be used to describe these products (see table 5).

Table 5
Definition and typology of packaging

Packaging means all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. "Non-returnable" items used for the same purposes shall also be considered to constitute packaging.

Packaging consists only of:

- a) "Sales packaging or primary packaging", i.e. packaging conceived so as to constitute a sales unit to the final user or consumer at the point of purchase.
- b) "Grouped packaging or secondary packaging", i.e. packaging conceived so as to constitute at the point of purchase a grouping of a certain number of sales units whether the latter is sold as such to the final user or consumer or whether it serves only as a means to replenish the shelves at the point of sale; it can be removed from the product without affecting its characteristics.
- c) "Transport packaging or tertiary packaging", i. e. packaging conceived so as to facilitate handling and transport of a number of sales units or grouped packagings in order to prevent physical handling and transport damage. Transport packaging does not include road, rail, ship and air containers.

The definition of "packaging" shall be further based on the criteria set out below. The items listed in annex I are illustrative examples of the application of these criteria.

- i) Items shall be considered to be packaging if they fulfil the above-mentioned definition without prejudice to other functions which the packaging might also perform, unless the item is an integral part of a product and it is necessary to contain, support or preserve that product throughout its lifetime and all elements are intended to be used, consumed or disposed of together.
 - ii) Items designed and intended to be filled at the point of sale and "disposable" items sold, filled or designed and intended to be filled at the point of sale shall be considered to be packaging provided they fulfil a packaging function.
 - iii) Packaging components and ancillary elements integrated into packaging shall be considered to be part of the packaging into which they are integrated. Ancillary elements hung directly on, or attached to, a product and which perform a packaging function shall be considered to be packaging unless they are an integral part of this product and all elements are intended to be consumed or disposed of together.
-

Source: European Communities, European Parliament and Council Directive 94/62/EC, 1994.

A decision to produce and use biodegradable packaging represents an effort towards greener production.

On one hand, the manufacture of **bio-packaging** reduces the use of non-renewable fossil fuels such as petroleum, and also cuts emissions of CO₂ linked to such production. On the other hand, **degradable packaging** can overcome environmental problems related to the great durability of traditional packaging, reducing the quantity of waste that is sent to the dumps and allowing its use as fertilizers, compost or inputs for the production of biogas (see table 6).

Table 6
Biodegradable packaging

Biodegradable packaging has two characteristics:

1. It is bio-packaging, i.e. it is made from renewable sources of animal or vegetal origin, either extracted directly from nature, such as cellulose or cotton, or produced by microorganisms such as PHA (polyhydroxyalcanoate). The most widely used bio-packaging is derived from natural monomers that have been polymerized synthetically.

2. It is degradable and complies with the biodegradation and composting standard UNE EN 13432.

Bioplastics or biodegradable plastics are forms of packaging that have both the above characteristics and are used for the manufacture of trays, bottles and flexible pouches, among other products.

Source: Prepared by the authors.

On the other hand, with the development of markets in recent years, we can now find products that are more environmentally friendly and that normally carry a price tag higher than that for the traditional products they replace. Green production implies business decisions in this area, and accordingly the proposed indicators consider this aspect, starting from the concept of “sustainable procurement” (see table 7).

Table 7
Definition of sustainable procurement

“A process whereby organizations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organization, but also to society and the economy, whilst minimizing damage to the environment”.

Sustainable procurement:

Takes into account social, ethical and environmental criteria in addition to economic ones.

It falls within the ambit of corporate social responsibility (United Nations Global Compact).

It includes the purchase of certified products.

Source: United Nations Environment Programme (UNEP), *Sustainable Public Procurement Implementation Guidelines*, Paris, 2012.

Given the anticipated difficulty in measuring all the sustainable procurement purchases made by firms —firms do not necessarily have systems for recording purchases disaggregated by this category— our indicator uses only purchases of products with certifications, which should be more readily identifiable.

Greener production is characterized by i) less use of raw materials, especially those that produce the most severe adverse environmental impacts (hazardous raw materials), both overall and by unit of production; ii) a greater degree of internal recycling; and iii) greater consumption of raw materials derived from recycling. It would also entail a greater portion of purchases classified as sustainable, and less use of packaging combined with greater reliance on biodegradable packaging.

Taking the foregoing into account, we list below those GPIs that seek to summarize the main aspects relating to raw materials and other inputs. The indicators marked with an asterisk are part of the basic set of indicators, while the remaining ones are part of the extended set.

Proposed GPIs relating to raw materials and other inputs	GPI 1. Intensity of raw material use*
	GPI 2. Material productivity*
	GPI 3. Proportion of establishments using hazardous raw materials in their production process*
	GPI 4. Proportion of hazardous raw materials used
	GPI 5. Intensity of use of packaging for the final product.
	GPI 6. Proportion of establishments using raw materials derived from recycling*
	GPI 7. Proportion of raw material inputs derived from recycling*
	GPI 8. Proportion of establishments using residues from other firms as raw materials (except energy production)
	GPI 9. Proportion of raw material inputs derived from residues of other firms (except for energy production)
	GPI 10. Proportion of firms purchasing products with certifications or eco-labelling*
	GPI 11. Proportion of procurement purchases with certifications or eco-labelling

Water

With respect to water as a natural resource, the indicators seek to provide an overview of what happens to this resource from the time it enters the production process until it leaves that process. What is important, in terms of green production, is to evaluate the quantity of water used and actually consumed in the production process (i.e. the proportion that is not returned to the natural environment).

Recognizing that water, and potable water in particular, is a finite resource and that access to this resource is essential for living beings, unnecessary consumption of water reduces the availability of the resource for other purposes.

On the other hand, the extraction and supply of water are associated with the use of other resources such as energy (needed to run water pumps) or chemical products (needed to make water drinkable). Moreover, both the extraction and the supply of water entail significant losses, particularly during transport (leakage).

Minimizing water use and consumption, then, is one of the challenges of green production, and one that can be met through reuse, optimization of industrial processes, and substitution of supply sources, among other measures.

From the economic viewpoint, reducing water use will lower the costs of water purchase and supply and reduce dependence on the resource.

Greener production would show lower indicators of water use and consumption, in total and by unit of production, as well as greater reuse of water.

In light of the above discussion on water use and consumption, we propose below a list of GPIs that summarizes the main aspects of this theme. The indicators marked with an asterisk are part of the basic set of indicators, while the remaining ones are part of the extended set.

Proposed GPIs relating to water use and consumption

- GPI 12. Intensity of water use*
- GPI 13. Water productivity*
- GPI 14. Total water use
- GPI 15. Proportion of recycled water used*
- GPI 16. Proportion of establishments using rainwater
- GPI 17. Proportion of rainwater used
- GPI 18. Proportion of desalinated water used

Energy

It has been demonstrated that the consumption of energy derived from fossil fuels contributes to global warming and gives rise to high concentrations of atmospheric pollutants, locally and regionally. However, the environmental impacts associated with consumption of energy from such sources are not confined to these aspects: the extraction of fuels and their processing and transport also have important adverse environmental effects.

A characteristic of the so-called "green energies" (see table 8) is that they do not deplete the available resources. However, they can also be associated with environmental degradation through, for example, the unsustainable production of bioenergy associated with deforestation; hydroelectric stations that have an adverse impact on aquatic ecosystems, and wind farms that have negative effects on birdlife.

For these reasons, green production must entail a reduction in total energy consumption (along with substitution by renewable energy sources), which can also lead to a significant cost reduction for the firm, depending on the fluctuation of fuel market prices.

Table 8
Renewable energy

Energy from renewable sources is captured from sources that replenish themselves. Renewable energy includes solar (photovoltaic and thermal), hydroelectric, geothermal, tidal action, wave action, marine (non-tidal currents, temperature differences and salinity gradients), wind and biomass energy.

Although its fundamental characteristic is that it is derived from a renewable resource (sun, wind, tides, vegetal residues etc.), within this classification we may distinguish between energy derived from resources that are infinitely renewable (such as solar or wind energy) and energy derived from resources that are renewable only over the medium to long term (such as biomass).

Source: Prepared by the authors, on the basis of United Nations Statistics Division (UNSD), *Framework for the Development of Environment Statistics (FDES 2013)*, 2016.

Following is a proposed list of GPIs that summarizes the main aspects of this theme. The indicators marked with an asterisk (*) are part of the basic set of indicators, while the remaining ones are part of the extended set.

Proposed GPIs relating to energy	GPI 19. Energy intensity*
	GPI 20. Energy productivity*
	GPI 21. Proportion of firms producing renewable energy*
	GPI 22. Proportion of energy consumption derived from renewable energy generated in the establishment*
	GPI 23. Proportion of energy consumption derived from residues
	GPI 24. Proportion of bioenergy production (from vegetal remnants and wastes)

4.1.2. Technologies and processes

Green technologies

According to the definition given in the System of Environmental-Economic Accounting (United Nations and others, 2014), green or environmental technologies are technical processes, installations and equipment (goods) and methods or knowledge (services) the technical nature or purpose of which is environmental protection or resource management (see table 9). It is important to note that some of these technologies may be included in the categories of products of exclusively environmental use, or adapted products.

Table 9
Definition of environmental protection and resource management

Environmental protection activities are those activities whose primary purpose is the prevention, reduction and elimination of pollution and other forms of degradation of the environment.

Resource management activities are those activities whose primary purpose is preserving and maintaining the stock of natural resources and hence safeguarding against depletion.

Source: United Nations, System of Environmental-Economic Accounting 2012. Central Framework, New York, 2014.

SEEA defines green or “cleaner” technologies by environmental area and offers some examples (see table 10).

Table 10
Green or “cleaner” technologies

Within its classification of environmental activities, SEEA describes cleaner technologies for some environmental areas, such as:
Protection of ambient air and climate
Prevention activities consist of replacing an existing production process by a new process designed to reduce the generation of air pollutants during production, storage or transportation, e.g. fuel combustion improvement, recovery of solvents, prevention of spills and leaks through improving air-tightness of equipment, reservoirs and vehicles
Wastewater management
Prevention activities consist of replacing an existing production process by a new process designed to bring about a reduction of water pollutants or wastewater generated during production. These include separation of networks, treatment and reuse of water used in the production process, etc.
Waste management
Prevention activities consist of replacing an existing production process by a new process designed to reduce the toxicity or volume of waste produced during the production process, including by separation and reprocessing.

Source: United Nations, System of Environmental-Economic Accounting 2012. Central Framework, New York, 2014.

Environmental technologies can be classified in the following categories:

- End-of-pipe (pollution treatment) technologies, which are mainly technical installations and equipment produced for measurement, control, treatment and restoration/correction of pollution, environmental degradation, and/or resource depletion. Examples include sewage treatment plants, equipment for measuring air pollution, and facilities for the containment of high-level radioactive waste.
- Integrated (pollution prevention) technologies, which are technical processes, methods or knowledge used in production processes that are less polluting and less resource-intensive than the equivalent “normal” technology used by other producers. Their use is less environmentally harmful than that of relevant alternatives.

When it comes to green technologies, as their purpose is to protect the environment or improve the management of emissions in general, green production will be associated with ever-greater use of technologies of this kind.

A single basic indicator is proposed for green technologies.

Proposed GPI relating
to green technologies

GPI 25. Proportion of establishments using green technologies

Wastes

From the green production viewpoint, wastes (see table 11) represent a portion of raw materials that are not suitable for conversion into a marketable product and that must be eliminated through some type of process.

Table 11
Definitions of wastes

Wastes are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law.
Wastes are materials which do not constitute prime products intended for market, for which those who have generated them have no further use for purposes of their own production, transformation or consumption, and which they wish to dispose of. Residues recycled or reused in the place where they were generated are excluded, as are waste materials that are discharged directly into the water or the atmosphere.

Source: United Nations Environment Programme/Basel Convention, *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*, 2014; and United Nations, *System of Environmental-Economic Accounting 2012. Central Framework*, New York, 2014.

Generally speaking, the costs associated with adequate waste management are significant and, moreover, inadequate waste management can pose significant risks to the environment.

Consequently, minimizing the wastes generated, by optimizing industrial processes and reducing the raw materials used, reusing and recycling are all key elements for progress towards green production.

The environmental impacts of waste generation depend essentially on the type of waste produced, and its type of treatment and final disposal.

First, we may differentiate between non-hazardous and hazardous wastes (see table 12). Hazardous wastes contain elements that can have a highly adverse environmental impact (for example, the eco-toxicity of heavy metals).

Table 12
Hazardous wastes

Hazardous wastes are those that present any of the following characteristics included in Annex III of the Basel Convention:

- Explosives
 - Flammable liquids
 - Flammable solids
 - Substances or wastes liable to spontaneous combustion
 - Substances or wastes which, in contact with water, emit flammable gases
 - Oxidizants
 - Organic peroxides
 - Poisonous (acutely toxic) substances
 - Infectious substances
 - Corrosives
 - Liberation of toxic gases in contact with air or water
 - Toxic (delayed or chronic)
 - Eco-toxic
 - Substances that are capable by any means, after disposal, of yielding another material, e.g. leachate, which possesses any of the characteristics listed above
-

Source: United Nations Environment Programme/Basel Convention, Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 2014.

Of particular interest in measuring green production are business decisions that favour the purchase of raw materials from suppliers who use a lesser quantity of packaging products and who opt for methods for the removal and reuse of packaging.

Another type of waste presenting certain peculiarities is e-waste (comprising electrical and electronic equipment). The growing generation of these wastes, associated with the development of new technologies, is occurring as well in the manufacturing industries. These wastes include wastes classified as hazardous and non-hazardous under international rules, and therefore they are difficult to measure statistically, despite increasing efforts to establish instruments for their quantification. At the present time there are a number of international initiatives under way to define and classify e-waste: one of these is the classification prepared by the United Nations University (see table 13), selected here for its greater ease of application.

Table 13
E-waste

According to the classification prepared by the United Nations University and known as UNU-KEYS, e-wastes present some of the following characteristics:

- They have a high average weight.
- Their composition includes toxic compounds
- At the end of their useful life, they present high concentrations of valuable resources that should be recovered in light of their scarcity
- They are appliances and equipment of broad distribution, and can be found on the market in most countries
- Some examples of wastes of this kind are washing machines, refrigerators, freezer chests, air conditioners, computer equipment, mobile telephones, television screens, portable computers, electronic agenda keepers and tablets.

Source: C.P. Balde and others, *E-waste Statistics: Guidelines on Classifications, Reporting and Indicators*, 2015, Bonn, United Nations University, 2015.

E-wastes are collected essentially through three channels:

- Formal collection performed by authorized agents
- Other collection intended for recycling, through unregistered systems
- The waste bin, with no separation at origin

Obtaining data at origin, i.e. where the firm generating the wastes provides the information, appears to be the most viable alternative, especially where the latter two channels are more frequently used, as is the case in many countries of the region.

Most countries have no data on the generation and treatment of wastes of this kind, and consequently the GPIs can be used to launch this task. NSOs can see whether there is a registry of authorized handlers in the competent national authorities, and can check for the existence of administrative reports that could supply supplementary information on management of the wastes.

Lastly, it is important to consider that the final impact of all wastes generated will depend on how they are managed; ideally, their treatment and final disposal by waste managers will minimize their adverse effects, and may even allow them to be reintroduced in production processes as raw materials, through recycling.

From the green production viewpoint, adequate management of wastes is essential for minimizing the negative impacts on the environment caused by their generation.

On other occasions, economic units can sell their wastes to other units that would use them as raw materials for their production process, replacing raw materials produced for this purpose, and this will reduce the adverse impacts on the environment.

Greener production would entail the generation of ever smaller quantities of wastes (especially hazardous wastes), in absolute terms and by unit of production, and a high proportion of wastes that are properly disposed of.

Following is a proposed list of GPIs that summarizes the main aspects of this theme. The indicators marked with an asterisk are part of the basic indicators set, the rest are part of the expanded set.

Proposed GPIs relating to wastes

- GPI 26. Intensity of waste generation*
- GPI 27. Proportion of hazardous wastes generated
- GPI 28. Proportion of packaging wastes generated
- GPI 29. Proportion of e-waste generated
- GPI 30. Intensity of e-waste generation
- GPI 31. Proportion of wastes adequately disposed of*
- GPI 32. Proportion of non-hazardous wastes adequately disposed of
- GPI 33. Proportion of hazardous wastes adequately disposed of

Wastewater

In most industries, the wastewater generated cannot be dumped directly into the sewers or into the environment, due to its physical and chemical characteristics, and it will therefore have to undergo more or less complex treatment before it is dumped. The environmental impacts linked to the generation of wastewater in production processes will depend on the composition of that water, as well as its treatment and final disposal. Generally speaking, it is the biodegradable organic pollutants present in wastewater that will have the least severe impact, while the presence of nutrients, metals, heavy metals, toxic substances or extreme water temperatures can give rise to significant adverse effects on the receiving medium.

In some cases, the characteristics of the wastewater generated will be such that it cannot be treated and will have to be considered as liquid waste.

The costs of treating and discharging industrial wastewater can be significant, and will depend not only on the quantity of water treated and dumped but also on its composition, which will to a great extent limit the type of treatment necessary to obtain water with characteristics that allow it to be dumped under proper conditions.

From the green production viewpoint, wastewater treatment involves the consumption of energy and reagents, and minimizing its generation is therefore essential for reducing consumption of these resources. Once wastewater is generated, its treatment will minimize the adverse environmental impacts of its final disposal.

Table 14 below describes briefly the different types of wastewater treatment.

Table 14
Types of wastewater treatment (primary, secondary and tertiary)

The treatment of wastewater consists of a series of physical, chemical and/or biological processes intended to eliminate the pollutants present in wastewater. The treatment of wastewater can be classified into:

- Primary treatment: a set of physical-chemical processes that eliminate a portion of the pollutants present in wastewater, essentially solid sediments and grease.
- Secondary treatment: includes biological treatment of the organic material dissolved in the water, distinguishing between aerobic and anaerobic treatments depending on the type of microorganisms used.
- Tertiary treatment: includes additional operations that reduce the concentration of specific pollutants in the wastewater.

Source: Prepared by the authors.

Greener production would entail less generation of wastewater, a greater proportion of firms that treat their wastewater, and a larger volume of water treated.

Three indicators are proposed below to summarize the main aspects of this theme: two of these are basic indicators.

Proposed GPIs relating
to wastewater

- GPI 34. Intensity of wastewater generation*
- GPI 35. Proportion of establishments that treat their wastewater*
- GPI 36. Proportion of wastewater treated

Atmospheric emissions

Production processes commonly involve the release of gases and particulates to the atmosphere, as the consequence of fuel burning and other industrial processes. The environmental effects of such emissions can have adverse impacts on fauna, flora and human beings, and on materials.

The transnational dimension of the effects linked to atmospheric emissions has given rise to a number of international agreements, the objective of which is to reduce those emissions. The agreement reached in Paris in December 2015, during the twenty-first session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 21) is the first global agreement for combating climate change. One of the major challenges it poses for the region is to deploy technologies that will reduce atmospheric emissions.

Table 15 below defines briefly the concepts of measurement and treatment of emissions.

Table 15
Definitions of measurement and treatment of atmospheric emissions

The treatment of emissions into the atmosphere includes all the processes intended to eliminate or reduce the emissions of particulates or other pollutants into the atmosphere. Examples of treatment equipment are filters, catalysts, and post-combustion carbon capture.

The measurement of atmospheric emissions includes all the activities involved in monitoring the concentration of exhaust gases, particulates and air quality. These activities embrace services for measuring exhaust gases and particulate matter from vehicles and heating systems, measuring greenhouse gases and indoor air quality, and any other gases or particulate matter emitted as a consequence of industrial processes. They do not include meteorological stations.

Source: United Nations, System of Environmental-Economic Accounting 2012. Central Framework, New York, 2014.

Greener production would be characterized by lower generation of emissions (in total and by unit of production) and a greater proportion of firms that control and treat their emissions into the atmosphere.

Below we propose two basic indicators summarizing the principal aspects of this theme.

Proposed GPIs relating to atmospheric emissions

GPI 37. Intensity of CO₂ generation*

GPI 38. Proportion of establishments that are measuring or treating their atmospheric emissions*

Eco-innovation, patents and R&D

This heading embraces aspects relating to business decisions that could lead to a “greener” functioning of the firm, such as technological and organizational innovation, including the acquisition of patents and the conduct of R&D activities. These aspects can be measured in qualitative terms and also quantitatively in relation to the expenditures incurred.

Eco-innovation

The *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data* defines an innovation as the implementation of a new or significantly improved product, process, marketing method, or organizational method. An eco-innovation or green innovation can be defined, then, as the introduction of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations that will generate environmental benefits in comparison with the alternatives.

- The environmental benefits may be the primary objective of the innovation or the result of other innovation objectives.
- The environmental benefits of an innovation may occur during the production of a good or service or in the after-sales stage, in the use of the good or service by the final consumer.

Starting from the above definition, a statistical measurement of eco-innovation is linked to green production, as it provides information on the importance of this activity for the different manufacturing industries.

According to the Oslo Manual, firms that are the first to introduce innovations may be considered as drivers of the innovation process. Information on the degree of novelty⁵ of an eco-renovation can be used to identify developers and adopters of innovations, to examine patterns of diffusion, and to draw a distinction between market leaders and followers (see table 16).

Table 16
Eco-innovation that is new to the market

An innovation is new to the market when the firm is the first to introduce it on its market. The market is simply defined as the firm and its competitors and it can refer to a geographical region or product line. The geographical scope of “new to the market” is thus subject to the firm’s own view of its operating market, and may include both domestic and international firms.

Source: Organization for Economic Cooperation and Development (OECD), *Sustainable Manufacturing and Eco-Innovation. Framework, Practices and Measurement. Synthesis Report*, Paris, 2009.

Patents

The green inventory of the International Patent Classification (IPC) compiles patents in relation to environmentally friendly technologies (see table 17).

Table 17
Classification of patents included in the Green Inventory of the International Patent Classification

Alternative energy production	Biofuels
	Integrated gasification combined cycle (IGCC)
	Fuel cells
	Pyrolysis or gasification of biomass
	Harnessing energy from man-made waste
	Hydro energy
	Ocean thermal energy conversion (OTEC)
	Wind energy
	Solar energy
	Geothermal energy
	Other production or use of heat not derived from combustion, e.g. natural heat
	Using waste heat
	Devices for producing mechanical power from muscle energy
Transportation	Vehicles in general
	Vehicles other than rail vehicles
	Rail vehicles
	Marine vessel propulsion
Energy conservation	Cosmonautic vehicles using solar energy
	Storage of electrical energy
	Power supply circuitry
	Measurement of electricity consumption
	Storage of thermal energy
	Low-energy lighting
	Thermal building insulation, in general
	Recovering mechanical energy

⁵ The degree of an innovation’s novelty can be difficult for the respondent to evaluate: according to the Oslo Manual, innovation may be *new to the firm*, *new to the market* or *new to the world*, and this requires a market knowledge that may not be available in the firm, especially in more closed and less innovative markets. We shall not enter into a methodological discussion of innovation in this document, bearing in mind the revisions of the Oslo Manual currently under way in OECD and Eurostat.

Table 17 (conclusión)

Waste management	Waste disposal Treatment of waste Consuming waste by combustion Reuse of waste materials Pollution control
Agriculture/forestry	Forestry techniques Alternative irrigation techniques Pesticide alternatives Soil improvement
Administrative, regulatory or design aspects	Commuting, e.g. HOV, teleworking etc. Carbon/emissions trading, e.g. pollution credits Static structure design
Nuclear power generation	Nuclear engineering Gas turbine power plants using heat source of nuclear origin

Source: World Intellectual Property Organization (WIPO), *International Patent Classification (IPC)*, 2017.

With respect to green production, firms that apply for, obtain or purchase what we might call “green patents” are likely to be further advanced towards green production.

As an alternative to collecting data through a questionnaire, NSOs can investigate the national coverage of international patent databases, such as those of the World Intellectual Property Organization (WIPO).

R&D related to green production

When it comes to R&D related to green production, we assume that the firms that invest most in these activities are those that have the most active role in this production trend.

R&D for green production includes creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this knowledge to devise new applications in the field of natural resource management and savings and environmental protection. Table 18 presents the classification of R&D activities from SEEA.

Table 18
R&D activities for resource management

Classification of R&D activities for resource management:
- Mineral and energy resources: R&D activities exclusively related to energy sources (non-renewable and renewable) and minerals.
- Timber resources: R&D activities exclusively related to natural timber resources.
- Aquatic resources: R&D activities exclusively related to aquatic resources.
- Other biological resources: R&D activities exclusively related to other biological resources (excluding timber and aquatic resources).
- Water resources: R&D activities exclusively related to water resources.
- Other R&D activities for natural resource management: other R&D activities concerning other natural resources (not specified).

Source: United Nations, System of Environmental-Economic Accounting 2012. Central Framework, New York, 2014.

R&D geared towards environmental protection includes identification and analysis of sources of pollution and mechanisms of dispersion of pollutants in the environment, as well as their effects on human beings, species and the biosphere. This heading covers R&D for the prevention and elimination of all forms of pollution, as well as R&D geared to equipment and instruments for pollution measurement and analysis. The fields in which R&D for environmental protection is pursued are shown in table 19.

Table 19
R&D fields related to environmental protection

Protection of ambient air and climate: includes protection of ambient air, the atmosphere and climate
Protection of water
Wastes
Protection of soil and groundwater
Abatement of noise and vibration
Protection of species and habitats
Protection against radiation
Other research on the environment

Source: United Nations, System of Environmental-Economic Accounting 2012. Central Framework, New York, 2014.

A green economy will have greater numbers of eco-innovative firms and more activity in R&D and patents related to green technologies.

In line with the above discussion of this topic, following is a proposed list of GPIs that summarizes their main aspects. The indicators marked with an asterisk (*) are part of the basic indicators set.

Proposed GPIs relating to patents and R&D	GPI 39. Proportion of firms engaged in eco-innovation*
	GPI 40. Proportion of firms engaged in eco-innovation to reduce raw materials use and/or energy consumption
	GPI 41. Proportion of firms with registered patents in green technologies*
	GPI 42. Proportion of firms investing in R&D of importance for green production*

Systems of environmental management, certification and eco-labelling

Green production frequently requires new approaches to business management. In some cases, the process may be adjusted to certain criteria established in environmental management systems, they may be subject to certification, and they may give rise to the award of eco-labels for manufactured products. For this reason, these three instruments are considered representative of a firm's progress in green production.

Environmental management systems

An environmental management system is a voluntary tool intended for firms or organizations seeking to achieve a high level of environmental protection in the context of sustainable development. Specifically, they must create a series of procedures and work habits and they must have documented all the environmental actions they are taking, in order to demonstrate proper compliance with the requirements of the management system. Compliance with these rules can be certified by an audit conducted by an accredited audit firm. If that audit finds that the firm complies with the established standards, the corresponding environmental certificate will be awarded.

Table 20 summarizes the main advantages of implementing environmental management systems.

Table 20
Advantages that environmental management systems offer an organization

Environmental management quality.
Environmental risk reduction.
Lower financial burdens due to active management approach to reducing pollution, minimizing environmental taxes, and avoiding fines for non-compliance with legislation.
Resource savings.
Financial advantages through better control of operations.
Proof of compliance with environmental legislation.
Possibility of learning from the examples of other firms and organizations.
Business opportunities in markets where clean production processes are important.
Credibility and trust with public authorities, clients and citizens.
Better workplace quality and incentive to foster employee participation.
Market advantages and improved image for the firm if its relationship with pressure groups is more positive.

Source: SINERGIA Project LIFE03 ENV/E/000085.

Today, a firm that applies proper environmental management will enjoy added value in its production, as there will be a decisive influence both on its corporate image and on the quality of its product, as well as on its costs, its marketing and, in short, its global competitiveness. From the theoretical viewpoint, the firm's incentives to reduce its environmental impacts can be summarized schematically by saying that its costs can be reduced and its revenues increased, as shown in table 21.

Table 21
Potential effects of implementing an environmental management system

Following is a summary of the potential effects of implementing an environmental management system, in terms of its economic repercussions:
Lower costs through:
- Savings in raw materials and energy
- Better business management and control
- Lower costs in terms of fees, taxes, fines and compensation
- Better allocation of capacities and resources
- Reduced risk of penalties, lawsuits and liability
Increased revenues through:
- Greater efficiency in production processes
- Better image for the firm
- Better relations with third parties
- Greater competitiveness within the sector

Source: Prepared by the authors.

Certifications and eco-labelling

Generally speaking, there are various types of environmental certifications:

- **Environmental management certifications.** These identify efficient and controlled management of all environmental aspects inherent to a firm: there is currently an international environmental management system regulated by ISO standard 14001, and certification of eco-design management regulated by ISO standard 14006.
- **Environmental certifications of energy efficiency,** which recognize a firm's use of different energy sources in a sustainable manner, such as the energy management system regulated by ISO standard 50001.

- **Environmental certifications in forestry**, which recognize that a forestry firm, or the raw material it uses, or both, have been managed in a sustainable manner according to environmental criteria.
- **Environmental certifications of products or eco-labels** (see table 22).

Table 22
Eco-labels

Eco-labels are a system of consumer product labelling that measures the sustainability of a given product or service for consumers. The idea is simple enough, and in effect converts consumers into active players in green production, so that when they see a certain label on the package they will immediately have information on the ecological footprint of the consumer good. Generally speaking, such labels are optional for the manufacturer, except in those cases such as energy efficiency labelling where they are mandatory in many countries.

Source: Prepared by the authors.

Given its scope, certification in accordance with ISO standard 14001 has been taken as the benchmark for the GPIs, together with eco-labelling, due to its ease of identification.

Greener production would see more firms certifying or labelling their products or processes in accordance with sustainability criteria.

Following are two proposed indicators (one of them basic) that summarize the main aspects of this topic.

Proposed GPIs relating to
environmental management,
certifications and eco-labelling

GPI 43. Proportion of firms with ISO 14001 certification*
GPI 44. Proportion of firms with products bearing an eco-label

4.1.3. Policy responses and economic opportunities

4.1.3.1. Sustainability reporting

Sustainability reports are currently a very important communication tool for firms as part of corporate social responsibility. The origin of these documents dates back to the environmental reports that some major firms began to publish in the 1990s in response to greater environmental awareness and the need for strategic communication to enhance their market standing. In 1997, the *Global Reporting Initiative* was launched as an independent institution: it created the first global standard of guidelines for the preparation of sustainability reports by companies seeking to evaluate their economic, environmental and social performance. It is an official centre of cooperation within the United Nations Environment Programme (UNEP).

With respect to green production, the annual publication of sustainability reports demonstrates a business interest that typically goes hand-in-hand with the implementation of improvements in production, with positive effects on the environment.

Following is a proposed indicator of green production related to sustainability reporting by firms as a communication tool in this context. The indicator is part of the expanded set.

Proposed GPIs relating to
publication of sustainability
reports

GPI 45. Number of firms publishing sustainability reports.

4.1.3.2. Green jobs and training in green production

Green jobs

Without going into detail on the measurement of employment by sector, which would be beyond the scope of this paper, we highlight some methodological aspects recommended by the International Labour Organization (ILO) for preparing indicators on green employment:

- The statistical unit is the job, not the person.
- The concept refers both to formal and informal jobs and should be measured in full-time equivalents.
- The observation unit is typically the establishment.

The ILO definition of green jobs, as well as a graph explaining the concept, are presented in table 23.

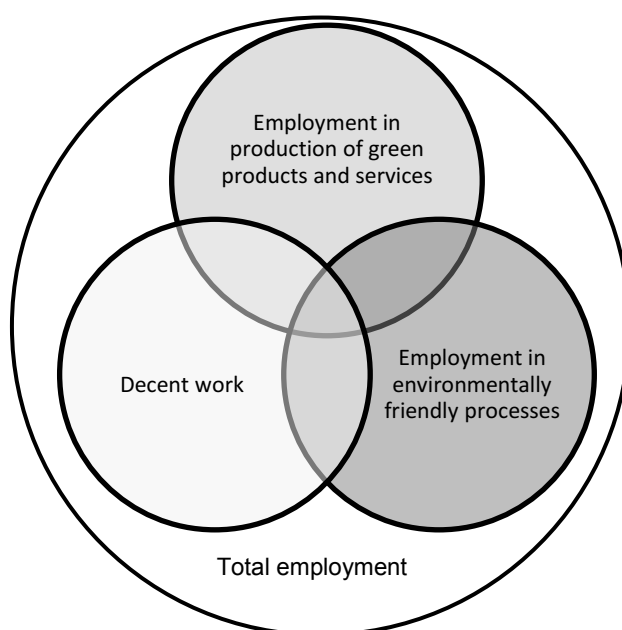
Table 23
Definition of green jobs

According to the International Labour Organization (ILO) “jobs are green when they help reduce negative environmental impact ultimately leading to environmentally, economically and socially sustainable enterprises and economies.”]

From the ILO viewpoint, in compiling statistics the concepts of green job and decent work can be treated separately. In the case of industries belonging to the environmental goods and services sector, employment is computed as total employment.

Source: International Labour Organization (ILO) “What is a Green Job?” [online] http://www.ilo.org/global/topics/green-jobs/news/WCMS_220248/lang--en/index.htm).

Diagram 3
What is a green job?



Source: International Labour Organization (ILO) “What is a Green Job?” [online] http://www.ilo.org/global/topics/green-jobs/news/WCMS_220248/lang--en/index.htm).

According to ILO, green jobs are decent jobs that contribute to preserving or restoring the environment, be they in traditional sectors such as manufacturing and construction, or in new, emerging green sectors such as renewable energy and energy efficiency. Green jobs help to:

- Improve energy and raw materials efficiency
- Limit greenhouse gas emissions
- Minimize waste and pollution
- Protect and restore ecosystems
- Support adaptation to the effects of climate change

The strategy for statistical measurement of green employment must distinguish those jobs that contribute to the production of environmental goods and services for consumption by other economic units (final product perspective) and those that contribute to more environmentally friendly production processes in firms (process perspective). Thus, employment in environmental processes refers not only to employment in the environmental sector but also to employment in any industry where these processes help to improve resource management and environmental protection. The measurement of these jobs entails some major methodological problems.

Therefore, employment related to green production and manufacturing industries is deemed to include:

- Employment associated with the management of natural resources, in all manufacturing industries.
- Employment associated with protection of the environment, in all manufacturing industries.
- Employment in manufacturing industries included in the environmental goods and services sector, also known as “environmental employment”.

On this point, it is very important to differentiate clearly between “green employment” and employment in the environmental sector or “environmental employment”, as the two concepts can be confused. Green employment is a broader term that includes decent jobs in the environmental sector, together with decent jobs devoted to environmental protection and the management of resources in other activities.

Strictly speaking, it must be recognized that the production of environmental goods and services by the environmental sector is not always based on production processes and technologies that protect the environment and guarantee optimal resource management, in line with the criteria established by ILO.

The disaggregation of employment by occupation makes it easier to identify the type of training needed for performing a given occupation. With use of an international classification for occupations, such as the International Standard Classification of Occupations (ISCO-08), the data can be combined with those for the entire economy in a comparable manner. Given the nature of environmental activities, we have adopted an aggregate version of that classification.

Greener production means a greater proportion of green jobs in relation to total employment, and a broader distribution of that employment across the business sector.

Consistent with the explanation regarding green employment, we propose two indicators, one of them basic.

Proposed GPI relating
to green jobs

GPI 46. Proportion of green jobs

GPI 47. Proportion of firms that have workers performing green tasks in management, technical or professional positions.

Training in green production

The training of employees is a key factor for firms in making the transition to greener production processes. Some countries of the region have already included questions on this practice in their surveys.

Green production training includes formative activities intended to impart training related to the management of environmental resources and protection of the environment (air protection, wastewater management, wastes, soils, noise, biodiversity etc.). The absence of a statistical classification for “green skills” makes it necessary to establish a question that firms can respond to easily. Thus we have opted to relate training to environmental protection objectives.

In the GPIs proposed, we have assumed that the firms that devote resources (economic or employee time) to training in matters related to green production are those that have the greatest environmental involvement and awareness.

In addition to the number of employees trained, we might ask about the number of employees deemed to need such training (although this is not considered for the SGPI indicators), classified by level of training or occupation. This would allow environmental decision makers and educators to work together in planning training policies, in the firm and at the national level, for the transition to a green economy.

In relation to training in green production, a basic indicator is proposed.

Proposed GPI relating to green
production training

GPI 48. Proportion of firms conducting training in green production*

4.1.3.3. Revenues, costs and transfers

Generally speaking, firms may earn revenues and incur costs and transfers linked to the consumption of raw materials and to the environmental protection activities that they may perform or not. The standard form of accounting for the various concepts in firms does not allow us to evaluate their final repercussions in terms of resources.

As shown in table 24, by way of example, flows and transfers are highly diverse, as are their repercussions on green production. Sums paid in fines are not the same as those earmarked for maintenance of equipment for treating pollution.

Table 24
Example of revenues, costs and transfers associated with the use, consumption and disposal of water

Water consumption brings with it costs of supply that will depend on the source used, as well as the volume extracted. (Use of a proprietary well is not the same thing as the costs associated with a water supply network.)
On the other hand, wastewater generated may be treated in the installation, which will entail associated costs, and will then be discharged. In the discharge of wastewater, the costs will depend on the place of discharge, the volume, and the final characteristics of the water. A portion of wastewater, treated or not, may eventually be sold for use by another economic unit.
In addition, the firm may receive subsidies associated with the installation of wastewater treatment processes, or it may be penalized for failing to comply with the established conditions of discharge.
Potential expenses and revenues:
– Charge for delivery of water through a supply network
– Cost per volume supplied
– Fee for regularization of a well at the installation
– Costs associated with pre-treatment of water extracted from the well to make it potable
– Fee for discharge into a watercourse
– Fee for discharge into a sewer network
– Cost per volume discharged
– Revenue from the sale of wastewater
– Subsidy, investment grant or tax deduction for installation of a wastewater treatment facility
– Fine for noncompliance with dumping regulations

Source: Prepared by the authors.

This theme, then, can be addressed from two perspectives: on one hand, the revenues, investments and current expenses related to resource management and environmental protection and, on the other hand, other operations (revenues and expenses) related to governments and public entities managing environmental services.

From the green production viewpoint, firms with the greatest revenues, investments and current expenses are those that make a greater effort at environmental protection overall, while in the case of other operations the relationship depends on the type of operation in question.

Revenues, current expenses and investments

Revenues

In the green production context, the revenues to be identified are those associated with the sale of wastes and wastewater, as these sales permit external reutilization of the resources, and hence a reduction in their extraction from the environment.

Current expenses

The following current expenses related to green production are differentiated:

- Purchases of environmental protection services from other firms.
- Expenses associated with environmental protection equipment (including repair and maintenance and consumption of energy and raw materials).
- Other current expenses, e.g. total outlay on water paid to the supply company.

In the first two cases, the expenses may be broken down as a function of the environmental activity to which they refer (see table 25).

Table 25
Environmental activities

Taking as a basis the classification of environmental activities in the United Nations System of Environmental-Economic Accounting (United Nations and others, 2014), the following classes of environmental activity areas can be identified:

1. Protection of ambient air and climate
 2. Wastewater management
 3. Waste management
 4. Protection and remediation of soil, groundwater and surface water.
 5. Noise and vibration abatement (excluding workplace protection)
 6. Protection of biodiversity and landscapes
 7. Protection against radiation (excluding external safety)
 8. R&D for environmental protection and resource management
 9. Training in green production
-

Source: Prepared by the authors.

With respect to environmental services, table 26 presents a definition, defines its objectives, and offers some examples.

Table 26
Environment-specific services

Environmental protection specific services are environmental protection services produced by economic units for sale or own use. Consistently with the definition of environmental protection and resource management activities, environmental specific services are those services that have the main purpose of:

- i) Preventing or minimizing pollution, degradation or depletion of natural resources (including production of energy from renewable sources).
 - ii) Treating and managing pollution, degradation and depletion of natural resources.
 - iii) Repairing damage to air, soil, water, biodiversity and landscapes.
 - iv) Carrying out other activities such as measurement and monitoring, control, research and development, education, training, information and communication related to environmental protection or resource management.
- Waste management and wastewater treatment activities, or activities geared to saving energy or water are examples of this type of service.

Source: United Nations, System of Environmental-Economic Accounting 2012. Central Framework, New York, 2014.

Investments

According to SEEA, investments can be classified as:

- Equipment and installations integrated into the production process (pollution prevention).
- Equipment and installations independent of the production process (pollution treatment). These operate outside the production process and are intended to reduce the discharge of pollutants originating in the process.

In a manner similar to current expenses, investments can also be broken down by area of environmental activity.

Greener production implies a greater proportion of firms receiving revenues from the sale of residues, with reduced costs in terms of water, energy, waste and wastewater management, as well as a greater proportion of firms investing in making their production greener.

In light of the above, we propose below a list of GPIs that summarizes its main aspects. Only one of these is a basic indicator.

Proposed GPIs relating to revenues, costs and transfers	GPI 49. Proportion of firms receiving revenues through sale of residues
	GPI 50. Relative cost of water
	GPI 51. Relative cost of energy
	GPI 52. Relative cost of wastewater management
	GPI 53. Relative cost of waste management
	GPI 54. Proportion of firms investing in green production*

Transactions with the government sector

Business decisions related with green production can be affected by the charges and benefits established in this area. The purpose of the indicators for this theme will be (within the framework of all the other indicators) to evaluate the effectiveness of employing incentives or penalties to promote green production.

This section includes taxes, charges and fees paid under various aspects of resource management and environmental protection, as well as the revenues earned through incentives, subsidies, investment grants and tax deductions relating to resource management and environmental protection.

Table 27 compiles definitions of the principal concepts related to these transactions.

Table 27
Definition of transactions with the government sector

–	Subsidies: current unrequited payments that government units make to firms on the basis of the levels of their production activities or the quantities or values of the goods or services that they produce, sell or import.
–	Investment grants: capital transfers made by governments to other units to finance all or part of the costs of their acquisition of fixed assets.
–	Environmental investment grants: grants that have environmental protection or resource management as their primary objective or purpose.
–	Taxes: compulsory unrequited payments that institutional units make to government units.
–	Environmental taxes: taxes for which the tax base is a physical unit (or a proxy thereof) that has a proven negative impact on the environment.
–	Sales of goods and services: payments made to government units that supply goods and services such as payments to government units responsible for waste collection and disposal.
–	Fines and other penalties: compulsory payments imposed by courts of law or quasi-judicial bodies.
–	License fees for use of environmental assets: fees paid for the acquisition of permits, licenses or analogous mechanisms conveying rights to access, extract or use environmental assets.

Source: United Nations, System of Environmental-Economic Accounting 2012. Central Framework, New York, 2014.

In addition to the above, another aspect to be considered in green production is fiscal incentives, which are increasingly used in this area. Fiscal incentives, in the form of tax reductions or exemptions, can encourage firms to undertake certain actions or activities deemed of general or public interest. Environmental fiscal incentives are those that are granted in recognition of activities intended to protect the environment or to improve management of natural resources.

NSOs can look for the existence of fiscal registers of firms that have received public grants for industrial transformation.

The context in which government subsidy or incentive policies are applied needs to be analysed in detail, as it may correspond to higher or lower levels of green technology use.

In light of the above, we propose two indicators that summarize the main aspects of this theme.

Proposed GPI relating to transactions with the government sector	GPI 55. Proportion of firms receiving environmental investment grants
	GPI 56. Proportion of firms receiving incentives for renewable energy sources

4.1.4. Preparation of methodological specifications sheets for the indicators

With a view to facilitating the description of the indicators, both for producers and for data users, we have established a model methodological specifications sheet.

This model takes as its basis those used in other international initiatives, as well as some national initiatives within the region. The methodological sheets present the scheme that is developed below, and which can be subdivided into four broad blocks: identification, definition, calculation methodology, and relationship with the module.

First, the sheets present an identification of the indicator, which includes the following fields:

- **Numbering.** Each indicator is assigned a code with the heading GPI (Green Production Indicator), followed by the serial number of the indicator (e.g. GPI 13).
- **Name of the indicator.** This field contains the full name of the indicator. In the case of indicators that are part of the basic set of proposed indicators, the name will be followed by an asterisk “*”. Following the previous example, the indicator GPI 13 corresponds to “Water productivity*”, and it is a basic indicator.

- **Thematic area.** According to the methodological framework proposed for the GPI system, the indicators are organized in two thematic areas:
 - Environmental and resource productivity/intensity
 - Policy responses and economic opportunities

Following the above example, indicator GPI 13, Water productivity*, belongs to the thematic area "Environmental and resource productivity/intensity."

- **Thematic sub-area.** The thematic areas are in turn divided into sub-areas according to the proposed methodological framework. The sub-areas corresponding to each thematic area are the following:
 - Environmental and resource productivity/intensity
 - Use and consumption of resources
 - Raw materials and other inputs
 - Water
 - Energy
 - Technologies and processes
 - Green technologies
 - Wastes
 - Wastewater
 - Atmospheric emissions
 - Eco-innovation, patents and R&D
 - Environmental management systems, certifications and eco-labelling
 - Policy responses and economic opportunities
 - Sustainability reports
 - Green jobs and training in green production
 - Green jobs
 - Training in green production
 - Revenues, costs and transfers
 - Revenues, current expenses and investments
 - Costs and transfers

In the example of indicator GPI 13, Water productivity*, the thematic sub-area is "Use and consumption of resources – water".

- **Priority.** Priority refers to the classification that has been made as to the need and importance of calculating the different indicators. There are two types of priority:
 - **High**, for the 26 indicators that make up the proposed basic set of GPIs and that are always marked by an asterisk.
An example of a basic indicator is GPI 1, Intensity of raw material use*.
 - **Low**, for the 30 indicators that make up the expanded set of indicators and that are not basic indicators. An example of this type is GPI 4, Proportion of hazardous raw materials used.

In a second block, the specification sheets include the aspects relating to the precise definition of the indicator, via the following fields:

- **Definition.** For each indicator the scope is defined precisely, with a view to delineating what the indicator is intended to measure, and ensuring its harmonization.
- **Units of measure.** The units of measure or expression of the indicator reflect the units of measure proposed for allowing comparability of the various indicators, and are based on the International System of Units.

- **Definition of the variables that comprise the indicator.** Here we provide a series of supplementary definitions to clarify each of the concepts that appear in the indicator's definition.
- **Relevance of the indicator.** The indicator's relevance includes, first, its objective, followed by its role in green production policies and in international initiatives that have considered this indicator or aspects linked to it.

Thirdly, the specification sheets incorporate the methodology for calculating the indicators, as well as the criteria for interpreting them and the limitations they present. The sheets therefore include the following fields:

- **Calculation.** For each indicator there is a clear and concise explanation of how it should be calculated, indicating the variables involved in that calculation, as well as the mathematical operations to be performed. The calculation is also expressed as a mathematical formula for each of the indicators. The indicators are either absolute or relative, and may be obtained as a combination of two variables (see table 28). For example, the indicator GPI 3 % = [(number of establishments surveyed had used hazardous raw materials/total number of establishments surveyed)]* 100.

Table 28
Typology of indicators according to their calculation formula

In line with the system of the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Programme (UNEP), the indicators used for measuring and evaluating changes relating to green production can be grouped under various types:

- **ABSOLUTE INDICATORS** are those that measure basic data for a given period of time, normally one year, such as the number of firms publishing sustainability reports.
- **RELATIVE INDICATORS**, also known as standardized indicators, are those that present an absolute measure of a variable in reference to one or more other variables. In the case of environmental performance, the key relative indicators are:
 - **Productivity ratios.** These quantify the value of output per unit of resource used. For example, material productivity is the gross aggregate value generated per ton of raw material used. In line with green production criteria, productivity ratios must show a rising trend over time, so as to produce an ever-higher value of output per unit of resources consumed.
 - **Intensity ratios.** These are the inverse measure of productivity, and they quantify the amount of resources used or the total of emissions produced per unit of value of production. For example, waste generation intensity is a measure of the tons of waste generated per unit of value of production. In line with green production criteria, intensity ratios must show a downward trend over time, so as to generate less environmental pollution per unit of value of production.

Relative indicators can also be used to relate various physical and monetary units, such as the relative cost of treating wastewater.

As one of the objectives of the proposed SGPI is to allow comparisons between different countries of the region, in our selection we have given preference to relative indicators.

Source: Prepared by the authors, on the basis of United Nations Environment Programme (UNEP), Green Economy: A Guidance Manual For Green Economy Indicators, 2014.

- **Interpretation.** To ensure proper interpretation of the results obtained for each indicator, this section presents the indicator's expected trend in a green production scenario. For example, for the above indicator GPI 3, in a scenario that favours green production, the indicator should have a downward trend, as the consumption of hazardous raw materials should gradually be replaced by non-hazardous and less polluting materials, provided the industrial processes allow this with the existing technology available.
- **Limitations.** In some cases, interpretation of the results may require some nuancing, as in comparisons between regions or between different countries of the region. The limitations of the indicators, then, can be a useful tool for taking into consideration other aspects related to the indicator but not included in it. In the foregoing example, for the indicator GPI 3, the technology needed to reduce the consumption of hazardous materials may not be equally available and accessible across regions or countries, and this aspect will have to be borne in mind in interpreting the results of the indicator.

- **Disaggregation.** In order to complete the interpretation of the indicators, we propose some possible breakdowns for each of the indicators. In the most relevant cases, these breakdowns have already been incorporated into the proposed module in order to facilitate its implementation. In other cases, as in the breakdowns by region or geographical zone, this can be done in light of the available data.

Lastly, the specification sheets include a section that relates the indicators with the proposed information gathering module. The sheets include the following fields:

- **Proposed data source.** This field specifies, for each indicator, the most appropriate source of data, distinguishing between company or firm-level surveys and establishment-level surveys.
- **Model questions.** The methodological sheets contain standard questions proposed in the module for the different variables involved in calculating the indicators. These questions must be considered as proposals that can be adapted to the circumstances of each country, provided their final meaning is maintained.
- **Periodicity.** The proposed frequency is annual for information derived from surveys of establishments, and every two years for information derived from surveys of firms (company surveys). The periodicity recommendations must be understood as minimums, recognizing that a greater frequency, especially for information derived from firms, would allow closer monitoring of the indicator trends and thus enhance the probability of evaluating or implementing policies correctly.

Following is the consolidated structure of the methodological sheet (see diagram 4).

Diagram 4
Structure of the proposed methodological specifications sheet

INDICATOR	
Number (GPI X)	Name
Thematic area Thematic sub-area	
Priority	High / Low
Definition	
Units of measurement or expression of the indicator	
Definition of the variables that comprise the indicator	
Relevance of the indicator	
Calculation	
Interpretation	
Limitations	
Disaggregations	
Proposed data source	Company surveys / Establishment surveys
Model questions	
Proposed frequency	Annual / Every 2 years

Source: Prepared by the authors.

The methodological sheets for the SGPI indicators are presented in annex 4.

V. Module on green production

This section presents a proposal for the contents and format of a module or survey on green production to be administered to firms and their establishments. The module is intended to serve as an instrument for collecting primary data supplied by firms in the manufacturing sector for calculating the SGPI.

This section is structured as follows:

- The process of constructing the questionnaire or survey module is described in section 5.1, which includes examples of national surveys conducted in the region.
- The thematic sections of the module are described in section 5.2.
- The questions for the module that refer to the firm as a whole, i.e. as an information unit, are presented in the section “Companies Module” (section 5.3).
- The questions that refer to each of the firm’s establishments (local units) are presented in the section “Submodule for establishments” (section 5.4). This differentiation is necessitated by the nature of the information sought, and is discussed in greater detail in section 7.3.
- The questions used for identifying the firm, which are common to the business surveys normally conducted, are described in section 5.5.

Annex 3 presents the consolidated survey module, including the section for firms and that for each of the firm’s establishments.

1. The process of constructing a questionnaire or survey module

A new statistical operation will normally require the design of a specific questionnaire for a new survey.⁶ However, preparation of a specific module on green production for insertion in a broader

⁶ The trend to modernization of NSO processes entails the elimination of independent surveys, facilitating the interrelationship among different surveys, the use of standardized variables in different statistical operations, and in general the avoidance of new surveys that increase the cost and time burden of responding.

survey—a survey vehicle—is a feasible option, especially for NSOs with scarce resources. On the other hand, use of a specific module avoids reiteration of requests for the same information in different formats, which can lead to lower response rates.

Use of a module responds to general considerations on the evaluation of alternative statistical sources (see section 7.1). In some countries there may be other data sources that can meet the need for information and that should be evaluated in advance.

Adoption of a common system of indicators and the use of a standardized questionnaire would allow for more effective international harmonization of statistics on green production, and it is therefore suggested that interested NSOs should consider adapting these instruments to their statistical systems. NSOs should ensure that the questionnaire is applied under conditions consistent with other company surveys conducted in the country, and in particular they should:

- Guarantee that the metadata used are coherent with those from other surveys and statistical operations (for example, industrial surveys, SEEA and the System of National Accounts).
- Ensure that the sampling framework used is consistent with that used in other sampling surveys.
- Make use of existing infrastructure and systems to gather data (pollster networks, systems for sending questionnaires by post and e-mail, computerized systems for collecting and entering data).
- Use coding systems consistent with those used in other statistical operations.

Given the non-prescriptive nature of this document, it is not possible to define rules that national statistics offices should apply in collecting information from the viewpoint of the national organization. The module described in this document remains a recommendation for promoting international harmonization and for facilitating the development of statistics operations at the national level, using practices identified in the more advanced countries.⁷

2. Thematic sections of the module on green production

The company questionnaires are generally structured in thematic sections to facilitate the response, which at times will be distributed among different reporters (general manager, finance officer or accountant, human resources manager, technology manager, etc.).

Given the complexity of environmental statistics and the problems that reporters face in supplying the data, the organization of the module seeks essentially to facilitate response by companies and establishments.

The sections into which the questionnaire is structured cover the following themes:

Companies module

- Section A. Environmental management systems, certifications and sustainability reports
- Section B. Eco-innovation and patents
- Section C. Renewable energy

⁷ This kind of approach to a new topic has proven its value in the region in the case of statistics on ICT use in businesses, under the leadership of ECLAC. Development of a regional module on this topic has promoted the production of statistics in nearly all countries, with the consequent gains in international comparability.

- Section D. Green jobs and training in green production
- Section E. Sustainable procurement and products with certification
- Section F. Environmental goods and services produced
- Section G. Revenues, expenses and other operations (at the company level)

Establishments submodule

- Section A. Use and consumption of environmental resources, raw materials and other inputs
- Section B. Wastes, wastewater and atmospheric emissions
- Section C. Green technologies
- Section D. Expenses, investments and other operations (at the establishment level)

In order to avoid placing an unnecessary burden on respondents, the current proposal should be examined in light of other surveys or existing information sources in each country. NSOs should check for the inclusion of the proposed or similar questions in other surveys to avoid duplication of responses and inconsistencies among sources.

The relationship between the variables in the questionnaire and the proposed indicators is detailed in section 6. The proposed module can be used to obtain not only the selected indicators for the SGPI but also other indicators, including disaggregations, as well as more complete information drawn from cross-comparison of the module's different variables.

3. Companies module

3.1. Section A. Environmental management systems, certifications and sustainability reports

In some cases it may be possible to obtain information on certifications from administrative data of the certifying agencies. Other cases will require the inclusion of questions on this topic, as is already done in some countries of the region (example 7).

Box 7

Example 7. Environmental information survey of firms in Ecuador

This survey asks about the adoption and certification of environmental standards. The possible responses are:

Environmental impact assessment approved
Valid environmental certificate
Valid environmental permit
ISO 14001 certification
Valid environmental license
Entity issuing the environmental license

Source: National Statistics and Census Institute, Environmental information survey, 2009.

The module is designed to obtain information on the firm's implementation of various environmental management mechanisms, such as environmental audits, the setting of internal operating objectives, or international and national certifications.

The proposed questions on this theme are the following:

Environmental management instruments

As of 31/12/2016, does your firm have procedures in place for identifying and periodically reducing the environmental impacts it generates? (For example, the conduct of periodic environmental audits, establishment of operating objectives, ISO 14001 certification, etc.)	Yes / No
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Typology of environmental management instruments

<p>Indicate the type of environmental management instrument used in your firm at 31/12/2016.</p> <ul style="list-style-type: none"> • ISO 14001 certification • Other international certifications (ISO 14006 or ISO 50001). • Other national certifications related to green production • Products with eco-labels or seals associated with high-quality environmental management (except energy-related certifications) • Energy-related certifications of products • An environmental management system or periodic environmental audits 	Yes / No
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Sustainability reports

<p>Sustainability reports</p> <p>Does your company publish annual sustainability reports?</p>	Yes / No
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3.2. Section B. Eco-innovation and patents

Box 8 Eco-innovation

An eco-innovation or green innovation can be defined as the introduction of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations that will generate environmental benefits in comparison with the alternatives.

Source: Prepared by the authors, on the basis of Organization for Economic Cooperation and Development (OECD), *Sustainable Manufacturing and Eco-Innovation: Framework, Practices and Measurement. Synthesis Report*, Paris, 2009.

Statistics on innovation in Latin America and the Caribbean have been the object of harmonization initiatives, including the work of the Regional Network of Science and Technology Indicators (RICYT)⁸ and the preparation of a regional manual (Bogota Manual), broadly based on the Oslo Manual (OECD). These efforts have also been supported by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Inter-American Development Bank (IDB), which in 2014 published a Manual on Implementation of Innovation Surveys (IDB, 2014). That guide does not specify, however, whether the technologies or processes adopted are “green”, nor whether the objective of the innovation is to achieve “greener” products or services.

⁸ See [online] www.ricyt.org.

Many countries in the region conduct innovation surveys or collect such data through broader surveys (survey vehicles), generally targeted at the manufacturing sector. Data collection on eco-innovation should be coordinated with those surveys in order to avoid overlaps.

Box 9

Example 8. Importance of the impacts of product or process innovations in the Technological Innovation Survey of Brazil, Colombia and Uruguay

The Technological Innovation Surveys in countries such as Brazil, Colombia and Uruguay ask about the objectives and the impact of product or service innovations, and offer the following multiple-choice responses. Some are clearly related to green production:

- Introduction of environmentally clean products (goods or services)
- Reduction of raw material consumption
- Reduction of energy consumption
- Reduction of water consumption
- Reduction of environmental impact or control of health and safety aspects

Source: Prepared by the authors, on the basis of information from the Brazilian Geographical and Statistical Institute (IBGE), the National Administrative Department of Statistics (DANE) of Colombia and the National Institute of Statistics of Uruguay.

The module covers the following aspects of eco-innovation:

- Environmental benefits of eco-innovation, distinguishing benefits from the production of goods and services in the firm and benefits of after-sale use of goods and services by the final consumer.
- Characteristics of the eco-innovation, in particular whether the innovation was new to the market.
- Incentives and barriers to eco-innovation.

Following are the proposed questions for this section:

Environmental benefits from the production of goods and services in your firm	Yes/No
Reduction in raw material use per unit of output.	
Reduction in energy use per unit of output.	
Reduction in water consumption per unit of output.	
Reduction in the CO ₂ footprint (total production of CO ₂) in your firm.	
Substitution of raw materials by other, less polluting or less hazardous materials.	
Reduction in soil, water, noise or air pollution.	
Recycling of wastes, wastewater or reuse of materials.	

Environmental benefits for the final consumer from after-sale use of a good or service	Yes/No
Reduction in energy use.	
Reduction in air, water, soil and acoustic (noise) pollution.	
Improved process for recycling the product after use.	

Characteristics of the eco-innovation

Was the eco-innovation new to the market for the product?	Yes/No
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Incentives for eco-renovation

During the period of reference, indicate whether your firm introduced an eco-innovation in response to: Existing environmental regulations or pollution taxes. Environmental regulations or taxes that you expect to be introduced in the future. Availability of government subsidies, grants or other financial incentives to environmental innovation. Market demand (actual or expected) on the part of consumers for environmental innovations. Voluntary agreements or codes of good environmental practice in your sector	Yes/No
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Barriers to eco-innovation

During the period of reference, indicate the principal barriers that your firm encountered in developing eco-innovation. High cost of the innovation process. Innovation entails excessive risks. Lack of financing (own funds or external financing). Insufficient demand by consumers. Lack of qualified or sufficiently knowledgeable personnel. Lack of information on markets or technology. Lack of adequate infrastructure for carrying out innovation. No legal or regulatory protection. No fiscal incentives.	Yes/No
--	--------

Patents

Patents of interest for green production are those for green or environmental technologies.

Green or environmental technologies include technical processes, facilities and equipment (goods), and methods or knowledge (services), the purpose or technical nature of which is environmental protection or resource management. These are classified as:

- End-of-pipe (pollution treatment) technologies, intended for measurement, control, treatment and restoration/correction of pollution, environmental degradation, and/or resource depletion (for example, sewage treatment plants or equipment for measuring air pollution).
- Integrated (pollution prevention) technologies used in production processes that are less polluting and less resource-intensive (United Nations and others, 2014)

The following question is proposed:

Has your firm been granted or applied for patents on green technologies?	Yes/No
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3.3. Section C. Renewable energy

Production of renewable energy

The companies module requests information on the production of renewable energy, indicating the type of energy produced. This section will enable evaluation of the responses of establishments to the submodule, as well as the information gathered on the company's perception of subsidies or economic incentives associated with the production of renewable energy.

The questions are structured as follows:

Production of renewable energy

Does your firm produce renewable energy? If so, indicate the types of renewable energy produced by the firm: Renewable energy produced Solar photovoltaic energy Solar thermal energy Wind energy Hydroelectric energy Geothermal energy Tidal, wave or ocean energy Biomass (vegetal residues and residues)	Yes / No
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3.4. Section D. Employment and training in green production

Employment in green production

With respect to employment, the module is organized to compile information on the number of employees (or full-time equivalents) performing tasks related to resource management and environmental protection, as well as their level of occupation. It is important to note that jobs data refer exclusively to employees of the firm itself and not to workers in other firms who may occasionally perform tasks under some kind of subcontracting.

For a better understanding of the type of activities conducted in relation to green production, respondents are also asked to indicate the fields in which such employment is concentrated.

Training in green production

The module compiles information on training provided to employees during the period of reference. Training may be conducted by the firm itself or by other firms, and may take place within the facilities of the economic unit or in another facility. In some cases, training may entail no cost to the firm (United Nations and others, 2014).

Training in green production includes learning activities related to environmental resource management and environmental protection (protection of the air, wastewater management, wastes, soils, noise, biodiversity etc.).

The questions proposed for this section are the following:

Employment in resource management and environmental protection activities.

Decimals may be used in the response if the activity involves only a portion of the working day.

Number of employees Total number of employees in the firm Number of employees (in FTE) dedicated to resource management and environmental protection activities Number of employees (in FTE) dedicated to resource management and environmental protection activities who receive a salary and have social security and pension coverage. Number of employees by occupation Number of employees dedicated to resource management and environmental protection, by occupation Directors and managers. Professional and scientific staff. Middle-level professionals and technical staff. Administrative support staff. Journeymen, labourers and machinists and assemblers. Elementary occupations	In full-time equivalents (FTE)
--	--------------------------------

Number of employees by occupation Number of employees dedicated to resource management and environmental protection, by occupation Directors and managers. Professional and scientific staff. Middle-level professionals and technical staff. Administrative support staff. Journeymen, labourers and machinists and assemblers. Elementary occupations	In full-time equivalents (FTE)
--	--------------------------------

Fields of employment related to green production

Indicate the fields in which the installation's employees are working. Protection of ambient air and climate. Wastewater management. Waste management. Protection and remediation of soils, ground waters and surface waters. Noise and vibration abatement (excluding workplace protection). Protection of biodiversity and landscapes. Protection against radiation (excluding external safety). R&D for environmental protection. Innovation in environmental protection and resource management activities. Other environmental management activities.	Yes / No
--	----------

Training in green production

Has your firm provided training in green production to its employees? (Only if answer is Yes) Number of employees who received green training. Expenditure on green training (monetary units). Do you anticipate that your employees will need some kind of green production training in the coming years? How many of your employees feel that they need this type of training?	Yes / No
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3.5. Section E. Sustainable procurement and certified products

Sustainable procurement is a process whereby organizations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organization but also to society and the economy, while minimizing damage to the environment (UNEP, 2012).

Data on sustainable procurement as well as purchases of certified products are requested in monetary units. It is important to note that at the present time none of the concepts is treated independently in the accounting systems, and they may therefore be some major difficulties in data collection. However, business people and accountants need to start taking into account their involvement in green production.

The questions included in the company's module on this topic are:

Sustainable procurement and certified product purchases	(Monetary units)
Total of sustainable purchases Of which: purchases of certified or eco-labelled products	

3.6. Section F. Environmental goods and services produced

With a view to obtaining information for assessing whether an industry is part of the environmental goods and services sector, and correctly estimating its contribution to employment in green production, we include a few questions on the goods produced and services delivered and their importance in relation to the company's total sales.

Are any of the products manufactured or services delivered by the firm intended for environmental protection and management or for incorporation into other environmental goods and services?	Yes / No
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Describe these goods and services	% of the firm's turnover
Total % of the firm's turnover	

3.7. Section G. Revenues, expenses and other transactions

This section of the company's module asks for information on:

- Revenues from sale of residues to other firms.
- R&D spending by the firm on resource management and environmental protection activities.
- Transactions with the government sector, including subsidies, investment grants, tax deductions and incentives in connection with resource management and environmental protection, with special emphasis on those relating to renewable energy.

The proposed blocks of questions are shown below:

Revenues

Does your firm earn revenues from the sale of residues to other firms?	Yes / No
--	----------

R&D expenditure

Expenditure on R&D related with resource management and environmental protection	Expenditures (monetary units)
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Transactions with the government sector

Item	Amount (monetary units)
Subsidies and investment grants received for environmental protection (except those for renewable energy production) Tax deductions associated with investments in resource management and environmental protection (except those for renewable energy production) Incentives for renewable energy sources	

4. Submodule for establishments

4.1. Section A. Use and consumption of resources, raw materials and other inputs

As a general rule, surveys of the business sector, especially the manufacturing sector, including questions on inputs for production, and therefore should cover some of the needs for information on the environmental resources used (see example 9).

Calculation of the proposed GPIs will require data essentially from consumers of raw materials, water and energy.

Box 10

Example 9. Questions on consumption of environmental resources in the Annual Manufacturing Industry Survey of Chile

The survey gathers quantitative information (in physical and monetary units) on the following inputs:

Electricity:

- Electricity purchased
- Electricity generated
- Electricity sold

Water:

- Water purchased
- Water abstracted (proprietary wells etc.)

Fuels:

- Coal and charcoal
- Metallurgical coke
- Fuel oil
- Diesel oil
- Gasoline
- Kerosene
- Liquefied petroleum gas
- Natural gas
- Methanol
- Wood (includes biomass)
- Grease and lubricating oils
- Other

Source: National Institute of Statistics, Annual Industry Survey, Santiago, 2016.

To avoid duplication of the response burden, before including questions on resource consumption it will be necessary to investigate the relevance of the information already collected in these surveys. We also recommend using the classification of energy types proposed in the international standards such as those of the United Nations Statistics Division and the International Energy Agency and, in any case, establishing coherence with the classification used in the integrated economic and environmental accounts.

Raw materials and other inputs

The submodule asks for information on raw material consumption (distinguishing between hazardous and non-hazardous materials), on those used for packaging (specifying biodegradable packaging) and those derived from recycling or residues originating in other economic units. In all cases, the information is requested in physical quantities (tons).

The questions proposed for compiling information on raw materials are the following:

Use of raw materials and other inputs	(Tons)
Total use of raw materials. Of which: non-hazardous raw materials Of which: hazardous raw materials Use of packaging materials for presentation of the final product (including packaging purchased and manufactured) Of which: biodegradable packaging (e.g. bio-plastics) Use of raw materials derived from recycling Residues obtained from other firms that are used as raw material in the production process (for uses other than energy production)	

Water

Questions on water use distinguish between water supplied by other economic units (through the supply network, by tanker truck or from other establishments not included in the foregoing categories) and water withdrawn from the environment directly by the economic unit itself. In the latter case, the data are disaggregated by origin of the resource (surface water, groundwater, rainwater and desalinated seawater).

To complete the above information, information should be requested on water sold or passed on to other economic units, and the water recycled within the establishment itself.

The information is requested in physical units (cubic metres) and in monetary units.

In the expenditures column, respondents should indicate the amounts paid annually for water supplied and extracted, including fixed costs of the service and costs proportionate to the volume used.

Information on water use in the establishment could be obtained through the following questions:

Water use

		Volume (<i>cubic metres</i>)	Expenditure (<i>monetary units</i>)
Water supplied by other entities	Supply network Tanker truck Other establishments		
Water supplied by the economic unit itself	Surface water (lakes, rivers, creeks, wetlands etc.) Groundwater Rainwater Seawater desalinated in the establishment itself		

	Volume (<i>cubic metres</i>)	revenues (<i>monetary units</i>)
Water sold or given to other economic units (excludes reused water: wastewater supplied to other economic units for reuse)		
Water recycled within the establishment itself		

Energy

It is important to distinguish between two broad aspects relating to energy: on one hand, fuel consumption by the establishment, and on the other hand the generation, consumption and possible sale of energy derived from renewable energy generated by the establishment.

The variables should be compiled in physical units and in monetary units, and if any fuel is generated within the installation, this must be indicated as zero cost (e.g. in the case of gaseous biofuels produced within the installation through anaerobic fermentation).

In the first case, fuels consumed will include electric power from the network, for which only the amount consumed, and not the origin, will be known.

As the set of proposed indicators includes an indicator of CO₂ emissions, the submodule contains a specific breakdown of energy consumption by type of fuel, making it possible to calculate the total consumption of energy.

The proposed breakdown for energy consumption by type of fuel is based on the Standard International Energy Product Classification contained in the International Recommendations for Energy Statistics.

With regard to the information requested, it is important to note that it should not include consumption of fuels associated with the transportation of the firm's final products, as the scope of the GPIs does not cover such transport, thereby allowing firms' production processes to be compared regardless of whether firms arrange product transportation for their own account or whether they outsource this service.

In any case, the disaggregations used by countries can be retained, provided they make it possible to calculate the total energy consumption of economic units.

The proposed formulation of these questions is presented below:

Energy consumption by type of fuel (except consumption of energy used for transportation of the final product, if this is performed by the establishment itself).

Fuels	Physical units	Quantity	Expenditure on fuel purchases (<i>monetary units</i>)
Electricity (from the network)	KWh		
Wood, except vegetal residues	m3		
Coal and coke	kg		
Natural gas	m3		
Gasoline	Litres		
Diesel	Litres		
Fuel oil	litres		
Other fuels: specify			

Biofuels and residues	Physical units	Quantity	Expenditure on fuel purchases (<i>monetary units</i>)
Biofuels			
Solid biofuels (wood residues and vegetal materials)	m3		
Liquid biofuels (biogasoline, biodiesel, bioethanol)	litres		
Gaseous biofuels (biogas from anaerobic fermentation or chemical processes)	m3		
Residues used as fuel			
Residues purchased from other units	kg		
Residues generated in the installation	kg		

Renewable energy generated in the establishment

Renewable energy	Production (kWh)	Consumption (kWh)	Sales (kWh)	Revenues (monetary units)
Solar photovoltaic energy				
Solar thermal energy				
Wind energy				
Hydroelectric energy				
Geothermal energy				
Tidal, wave or ocean energy				
Biomass (vegetal remnants and residues)				

4.2. Section B. Wastes, wastewater and atmospheric emissions

Wastes

Wastes are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law.

Wastes are materials which do not constitute products intended for market, for which those who have generated them have no further use for purposes of their own production, transformation or consumption, and which they wish to dispose of. Residues recycled or reused in the place where they were generated are excluded, as are waste materials that are discharged directly into ambient water or air (UNEP/Basel Convention, 1989; United Nations and others, 2014).

For calculating the GPIs, information must be gathered on the generation of wastes, distinguishing between hazardous and non-hazardous wastes.

In the case of hazardous wastes, the classification proposed is that of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, as the international standard of reference.

Hazardous wastes are those that, either directly or by giving origin to another substance, present any of the following characteristics:

- Explosives
- Oxidizants
- Flammables
- Organic peroxides
- Toxic or eco-toxic substances
- Infectious substances
- Substances liable to spontaneous combustion
- Corrosives
- Substances which, in contact with water, emit flammable gases
- Substances which, in contact with air or water, release toxic gases (Annex I of the Basel Convention)

Given their importance in green production, the submodule contains a category for packaging wastes generated as well as for electrical and electronic appliance wastes (e-waste).

Packaging means all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. “Non-returnable” items used for the same purposes shall also be considered to constitute packaging (European Communities, 1994).

Some examples of **e-waste** are washing machines, refrigerators, freezer chests, air conditioners, computer equipment, mobile telephones, television screens, portable computers, electronic agenda keepers and tablets (United Nations University, n/d).

When it comes to waste management, a distinction is drawn between delivery to waste management firms, disposal of wastes in containers located in the public way for removal by the municipal services, wastes deposited directly into unsupervised areas, whatever their proximity to the installation, and an additional, open category to be completed in case of any other type of final disposal of wastes (in any case, these categories do not include use of residues for energy generation, which is already included in the energy section).

In a complementary manner, the submodule includes a question on possible revenues received by the establishment from the sale of residues to other units.

The proposed questions on wastes are detailed below:

Generation of wastes

Generation of wastes	Tons
Total wastes generated.	
Non-hazardous wastes.	
Hazardous wastes.	
Packaging wastes.	
E-wastes	

Waste management (which does not include energy use of residues in the installation itself, to be reported in the energy section).

	Non-hazardous wastes (tons)	Hazardous wastes (tons)
Wastes delivered to an authorized manager or disposal points.		
Wastes deposited in containers for removal by the municipal services.		
Wastes deposited directly into unsupervised areas (for example vacant lands or abandoned farms).		
Other: specify		

Income from sale of residues

	Currency
Income from sale of residues to other economic units	

Wastewater

This category includes the in-house generation and treatment of wastewater. It excludes the treatment of wastewater outside the industrial installation by other economic units.

Wastewater, treated or not, is discharged into a receiving medium which may be the sea, a surface or underground water body, or a sewage network.

Finally, the submodule considers the reuse of wastewater by units other than the establishment itself. In this case, volume data will be accompanied by revenues from that exchange measured in monetary units.

Types of wastewater treatment

- Primary treatment: a set of physical-chemical processes that eliminate a portion of the pollutants present in wastewater, essentially solid sediments and grease.
- Secondary treatment: includes biological treatment of the organic material dissolved in the water, distinguishing between aerobic and anaerobic treatments depending on the type of micro-organisms used.
- Tertiary treatment: includes additional operations that reduce the concentration of specific pollutants in the wastewater (United Nations and others, 2014).

Reused water is wastewater delivered to a user who will continue using it, with or without prior treatment. It excludes recycling within an industrial establishment (UNSD, 2016).

The questions in the submodule relating to wastewater are shown below:

Generation and treatment of wastewater	Annual volume (<i>m3/year</i>)
Total wastewater generated	
Wastewater treated in the installation itself	
With primary treatment	
With secondary treatment	
With tertiary treatment	
Wastewater not treated in the installation itself	

Discharge of wastewater	Annual volume (<i>m3/year</i>)
Wastewater discharged:	
into the sea	
into a surface water body	
infiltration into the ground or injection into an underground water body	
into a sewer network	

	Volume (<i>m3</i>)	Revenues (<i>monetary units</i>)
Water reused		

Atmospheric emissions

The submodule includes information on the measurement or treatment of atmospheric emissions.

The proposed question is phrased as follows:

Does your establishment:	Yes / No
Measure atmospheric emissions (gases and/or particulates)?	
Treat atmospheric emissions (gases and/or particulates)?	

4.3. Section C: Green technologies

The topic of green technologies is introduced at this point of the questionnaire, with the understanding that it will be easier to complete the section once the appropriate respondent has been identified.

Green technologies should include end-of-pipe technologies (intended essentially for the treatment of pollution) as well as integrated technologies (intended to prevent pollution). In addition to a general question, the questionnaire asks for a listing of the green technologies used in the establishment with a view to evaluating the initial response, bearing in mind the complexity that this question may pose for some respondents.

Green or environmental technologies are technical processes, facilities and equipment (goods), and methods or knowledge (services) the purpose or technical nature of which is environmental protection or resource management. These are classified as:

- End-of-pipe or pollution treatment technologies, intended for measurement, control, treatment and restoration/correction of pollution, environmental degradation, or resource depletion (for example wastewater treatment plants or equipment for measuring air pollution).
- Integrated or pollution prevention technologies used in production processes that are less polluting and less resource-intensive (United Nations and others, 2014).

Are green technologies used in the establishment?	Yes / No
List the green technologies used in the establishment: 1. 2. 3. 4.	

4.4. Section D: Current expenses, investments and other operations (at the level of the establishment)

Current expenses

Current expenses are differentiated by thematic area:

- Purchases of environmental protection services from other firms
- Expenses associated with environmental protection equipment

Following are the proposed questions concerning current expenditures:

Purchases of environmental protection services from other firms	Expenses (monetary units)
Measurement and treatment of atmospheric pollution Cleaning of septic tanks, analysis and treatment of wastewater Removal and treatment of non-hazardous wastes by handlers (not by the municipality) Removal and treatment of hazardous wastes by authorized handlers Measurement and remediation of soils and groundwater and surface water Noise measurement Other (biodiversity, landscape etc.)	
Expenses associated with environmental protection equipment (repair and maintenance, energy and raw material consumption)	Expenses (monetary units)
Production of renewable energy Emissions to the air (gases and particulates) Wastewater Wastes Soil, groundwater and surface water Noise Other (biodiversity, landscape etc.)	

Investments

Investments are differentiated by thematic area:

- Investments in equipment and installations integrated into the production process for preventing pollution.
- Investments in equipment and installations independent of the production process for treating pollution.

In the submodule presented we have opted for two separate tables of questions relating to each type of investment in order to include examples that will help respondents in completing the questionnaire.

Investments in equipment and installations integrated into the production process for preventing pollution

Area	Investment (<i>monetary units</i>)
Reduction of atmospheric pollution and odours Reuse of water and reduction of water consumption and wastewater production Reuse of materials and reduction of raw material consumption and waste production Noise and vibration abatement Reduction of energy consumption or use of less polluting energy (except renewable energy) Production of renewable energy Use of less polluting raw materials Application of more costly and less polluting processes	

Investments in equipment and installations independent of the production process for treating pollution

Area	Investment (<i>monetary units</i>)
Emissions to the air and odours (treatment, elimination or measurement) Wastewater (storage, transportation, treatment or measurement) Wastes (storage, transportation, treatment or measurement) Soils, groundwater and surface water (remediation, treatment or measurement) Noise and vibrations (abatement or measurement) Biodiversity and landscape (repopulation, restoration of landscapes, protection of fauna etc.)	

Transactions with the government sector

Transactions with the government sector include fees, levies, taxes, subsidies, tax deductions, investment grants and other incentives paid or received in connection with green production.

To wrap up, we present the questions proposed in the submodule for this area:

Type of transaction	Amount (<i>monetary units</i>)
Taxes or fees on atmospheric pollution Sewage and sanitation Discharge into public water bodies (river, lake) Municipal treatment of wastewater Municipal trash removal (excludes payments to waste managers) Taxes or fees on wastes Other environmental taxes or fees not covered above	

5. Identification of the firm/establishment

In the case of a module inserted in a broader survey vehicle, the general section will not be necessary, as this information will already be included in the questionnaire for that survey. In the case of an independent survey, it will be necessary to obtain the usual information so as to identify the statistical unit for purposes of managing the fieldwork and the statistical methodology (calculation of sampling weightings, extrapolation, linkage to other data files).

It is worth recalling at this point that the module proposed is targeted at firms included under the heading of manufacturing (section C of the International Standard Industrial Classification of All Economic Activities (ISIC) Rev 4).

This general section covers:

- Identification of the firm and its establishments (including geo-referencing)
- Economic activities (principal, secondary and ancillary)
- Legal organization
- Type of ownership
- Status of the firm and its establishments (active, at the pre-operating stage, in liquidation, other).
- Personnel employed by occupation/sex
- Contact data on the respondent
- Response burden (time required to complete the module)

In any case, the design of this section must correspond to that used by the NSO in other surveys. The use of single identifiers for firms and establishments can facilitate the combination of microdata from various surveys and administrative records.

Additionally, in order to allow calculation of the proposed indicators, the following economic information will have to be provided:

- GVA (gross value added), a macroeconomic indicator derived from the national accounts
- Total purchases made
- Total employment

In terms of inputs, in addition to those of special interest for this module on green production, it may be useful to consider gross fixed capital formation.

With respect to personnel, information is typically compiled on type of occupation, type of contract, and gender.

We recommend that the questionnaire should follow the guidelines of the United Nations *International recommendations for industrial statistics 2008*, in order to have a common language for defining the concepts covered by this type of statistics. In particular, we recommend using the following international classifiers:

- International Standard Industrial Classification of All Economic Activities (ISIC) Rev 3 or Rev 4, for organizing industrial activities.
- http://unstats.un.org/unsd/publication/seriesM/seriesm_4rev4s.pdf.
- Central Product Classification (CPC) 1.1 or 2.
- <http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=3&Lg=3>

VI. Correspondence between the system of indicators and the proposed module

Table 29 summarizes the correspondence between the SGPI and the questions in the module. The nomenclature used for each of the variables in the module can be consulted in annex 3, which presents the consolidated module.

As this is a summary table, calculation of each of the indicators will require reference to the methodological sheets prepared for each of them, containing clarifications and recommendations for harmonizing the calculation.

Table 29
Correspondence between the SGPI and the questions in the module

Indicator	Variables in the module ^a
Environmental and resource productivity/intensity	
Use and consumption of resources	
Raw materials and other inputs	
GPI1. Intensity of raw material use*	$GPI1 = S1-1 / GVA$ (with disaggregation for S1-2 and S1-3)
GPI2. Material productivity*	$GPI2 = GVA / S1-1$
GPI3. Proportion of establishments using hazardous raw materials in the production process*	$GPI3 = (\text{Number of establishments with } S1-3 > 0) / \text{Total number of establishments} * 100$
GPI4. Proportion of hazardous raw materials used	$GPI4 = S1-3 / S1-1 * 100$
GPI5. Intensity of use of containers and packaging for the final product	$GPI5 = S1-4 / GVA$ (with disaggregation for S1-5)
GPI6. Proportion of establishments using recycled raw materials*	$GPI6 = (\text{Number of establishments with } S1-6 > 0) / \text{Total number of establishments} * 100$
GPI7. Proportion of raw material inputs derived from recycling*	$GPI7 = S1-6 / S1-1 * 100$
GPI8. Proportion of establishments using residues from other firms as raw material (except energy production)	$GPI8 = (\text{Number of establishments with } S1-7 > 0) / \text{Total number of establishments} * 100$
GPI9. Proportion of raw material inputs derived from residues from other firms (except for energy production)	$GPI9 = S1-7 / S1-1 * 100$
GPI10. Proportion of firms purchasing products with certification or eco-label*	$GPI10 = (\text{Number of firms with } M16-2 > 0) / \text{Total number of firms} * 100$

Table 29 (continuation)

Indicator	Variables in the module ^a
GPI11. Proportion of purchases with certification or eco-label	GPI 11 = M16-2 / Total purchases made * 100
Water	
GPI12. Intensity of water use*	$GPI12 = [\text{Sum of } (S2-Xv)] - (S3-1v) / GVA$
GPI13. Water productivity*	$GPI13 = GVA / [\text{Sum of } (S2-Xv)] - (S3-1v)$
GPI14. Total water use.	$GPI14 = \text{Sum of } [(S2-Xv) - (S3-1v)]$
GPI15. Proportion of recycled water used*	$GPI15 = S-3-2v / GPI14 * 100$
GPI16. Proportion of establishments using rainwater	$GPI 16 = (\text{Number of establishments with } S2-6v > 0) / (\text{Total number of establishments}) * 100$
GPI17. Proportion of rainwater used	$GPI17 = S2-6v / GPI14 * 100$
GPI18. Proportion of desalinated water used	$GPI 18 = S2-7v / GPI14 * 100$
Energy	
GPI19. Energy intensity*	$GPI19 = (\text{Sum of } S4-Xc + S5-2c + S5-3c + S6-8 + S6-9 + S6-10 + S6-11 + S6-12 + S6-13 + S6-14c) / GVA$ <i>The variables relating to fuels require prior conversion to energy</i>
GPI20. Energy productivity*	$GPI 20 = GVA / (\text{Sum of } S4-Xc + S5-2c + S5-3c + S6-8 + S6-9 + S6-10 + S6-11 + S6-12 + S6-13 + S6-14c)$ <i>The variables relating to fuels require prior conversion to energy.</i>
GPI21. Proportion of firms producing renewable energy*	$GPI21 = (\text{Number of firms with } M10 = "SI") / (\text{Total number of firms}) * 100$
GPI22. Proportion of energy consumption derived from renewable energy generated in the establishment*	$GPI22 = (S6-8 + S6-9 + S6-10 + S6-11 + S6-12 + S6-13 + S6-14) / (\text{Sum of } S4-Xc + S5-2c + S5-3c + S6-8 + S6-9 + S6-10 + S6-11 + S6-12 + S6-13 + S6-14) * 100$ <i>The variables relating to fuels require prior conversion to energy.</i>
GPI23. Proportion of energy consumption derived from residues.	$GPI 23 = \text{Sum } (S5-4c + S5-5c) / (\text{Sum of } S4-Xc + S5-2c + S5-3c + S6-8 + S6-9 + S6-10 + S6-11 + S6-12 + S6-13 + S6-14) * 100$ <i>The variables relating to fuels require prior conversion to energy.</i>
GPI24. Proportion of bioenergy production (vegetal remnants and wastes).	$GPI 24 = S6-14 / (S6-8 + S6-9 + S6-10 + S6-11 + S6-12 + S6-13 + S6-14) * 100$
Technologies and processes	
Green technologies	
GPI25. Proportion of establishments using green technologies*	$GPI 25 = (\text{Number of establishments with } S14 = "SI") / (\text{Total number of establishments}) * 100$
Wastes	
GPI26. Intensity of waste generation*	$GPI 26 = S7-1 / GVA$
GPI27. Proportion of hazardous wastes generated.	$GPI27 = S7-3 / S7-1 * 100$
GPI28. Proportion of packaging waste generated	$GPI 28 = S7-4 / S7-1 * 100$
GPI29. Proportion of electric and electronic appliance waste (e-waste) generated	$GPI29 = S7-5 / S7-1 * 100$
GPI30. Intensity of e-waste generation	$GPI30 = S7-5 / GVA$
GPI31. Proportion of wastes adequately disposed of *	$GPI 31 = (\text{Sum of } S8-1 + S8-2 + S8-5 + S8-6) / S7-1$ <i>Depending on the response, the numerator may also contain the variables S8-4 and S8-8.</i>
GPI32. Proportion of non-hazardous wastes adequately disposed of	$GPI32 = (\text{Sum of } S8-1 + S8-2) / S7-2$ <i>Depending on the response, the numerator may also contain the variable S8-4</i>
GPI33. Proportion of hazardous wastes adequately disposed of	$GPI33 = (\text{Sum of } S8-5 + S8-6) / S7-3$ <i>Depending on the response, the numerator may also contain the variable S8-8</i>

Table 29 (continuation)

Indicator	Variables in the module ^a
Wastewater	
GPI34. Intensity of wastewater generation*.	$GPI34 = S10-1 / GVA$
GPI35. Proportion of establishments treating their wastewater*	$GPI35 = (\text{Number of establishments with } S10-2 > 0) / (\text{Total number of establishments}) * 100$
GPI36. Proportion of wastewater treated.	$GPI36 = S10-2 / S10-1 * 100$
Atmospheric emissions	
GPI37. Intensity of CO ₂ generation	$GPI37 = [\text{Sum of } (S4-Xc + S5-Xc)] / GVA$ <i>The energy variables must first be converted to tons of CO₂ emitted</i>
GPI38. Proportion of establishments measuring or treating atmospheric emissions*	$GPI38 = (\text{Number of establishments with } S13-1 > 0 \text{ or } S13-2 > 0) / (\text{Total number of establishments}) * 100$
Eco-innovation, patents and R&D	
GPI39. Proportion of firms engaged in eco-innovation*	$GPI39 = (\text{Number of firms with } M4-X = \text{"SI"} \text{ or } M5-X = \text{"SI"} / \text{Total number of firms}) * 100$
GPI40. Proportion of firms engaged in eco-innovation to reduce raw material use and/or energy consumption	$GPI40 = (\text{Number of firms with } M4-1 = \text{"SI"} \text{ or } M4-2 = \text{"SI"} / \text{Total number of firms}) * 100$
GPI41. Proportion of firms with registered patents for green technologies*	$GPI41 = (\text{Number of firms with } M9 = \text{"SI"} / \text{Total number of firms}) * 100$
GPI42. Proportion of firms investing in R&D for green production purposes*	$GPI42 = (\text{Number of firms with } M20 = \text{"SI"} / \text{Total number of firms}) * 100$
Environmental management systems, certifications and eco-labelling	
GPI43. Proportion of firms with ISO 14001 certification*	$GPI43 = (\text{Number of firms with } M2-1 = \text{"SI"} / \text{Total number of firms}) * 100$
GPI44. Proportion of firms with eco-labelled products	$GPI44 = (\text{Number of firms with } M2-4 = \text{"SI"} / \text{Total number of firms}) * 100$
Policy responses and economic opportunities	
Sustainability reports	
GPI45. Number of firms publishing sustainability reports	$GPI45 = \text{Number of firms where } M3-1 = \text{"SI"}$
Green jobs and training in green production	
Green jobs	
GPI46. Proportion of green jobs*	$GPI46 = (\text{Sum } M12-3 + M18-1 \% \text{ of } M12-1) / M12-1 * 100$
GPI47. Proportion of firms with workers performing green tasks in management, technical or professional positions	$GPI47 = (\text{Number of firms with } M13-1 > 0 \text{ or } M13-2 > 0 \text{ or } M13-3 > 0) / \text{Total number of firms} * 100$
Training in green production	
GPI48. Proportion of firms conducting training in green production*	$GPI48 = (\text{Number of firms with } M15-1 = \text{"SI"} / \text{Total number of firms}) * 100$
Revenues, costs and transfers	
Revenues, current expenses and investments	
GPI49. Proportion of firms earning revenues from the sale of residues	$GPI49 = (\text{Number of firms with } M19 = \text{"SI"} / \text{Total number of firms})$
GPI50. Relative cost of water	$GPI50 = \text{Sum of } (S2-Xm - S3-1m) / GPI14$
GPI51. Relative cost of energy	$GPI51 = (\text{Sum of } S4-Xm + S5-Xm + S16-1 - S6-15m - S6-16m - S6-17m - S6-18m - S6-19m - S6-20m - S6-21m) / \text{Sum of } (S4-Xc + S5-2c + S5-3c + S6-8 + S6-9 + S6-10 + S6-11 + S6-12 + S6-13 + S6-14)$ <i>The variables relating to fuels require prior conversion to energy.</i>
GPI52. Relative cost of wastewater management	$GPI52 = (\text{Sum of } S15-2 + S16-3 + S19-2 + S19-3 + S19-4 - S12-1m) / S10-1$
GPI53. Relative cost of waste management	$GPI53 = (\text{Sum of } S15-3 + S15-4 + S16-4 + S19-5 + S19-6 - S9-1) / S7-1$
GPI54. Proportion of firms investing in green production*	$GPI54 = (\text{Number of firms with } S17-X > 0 \text{ or } S18-X > 0) / \text{Total number of firms} * 100$

Table 29 (conclusion)

Indicator	Variables in the module ^a
Transactions with the government sector	
GPI55. Proportion of firms receiving environmental investment grants	$GPI55 = (\text{Number of firms with } M21-1 > 0) / \text{Total number of firms}$
GPI56. Proportion of firms receiving incentives to use renewable energy sources	$GPI56 = (\text{Number of firms with } M21-3 > 0) / \text{Total number of firms}$

Source: Prepared by the authors.

^a M refers to variables in the module, S to variables in the submodule.

VII. Other methodological aspects

This section discusses other methodological aspects concerning the collection of data on green production, and deals in particular with alternative sources of information, the population covered by the survey (object of the study) and the selection of the sample, the choice of survey vehicle, and the response burden. It also offers recommendations on evaluating the quality of the surveys.

1. Evaluating alternative information sources

Once the need for information has been determined, and before undertaking a statistical operations through a survey (which entails costs of data collection and a considerable burden on the responding firms), it will be necessary to verify the relevance of existing sources for use in producing the desired statistics. As the coordination agencies for the National Statistical System, the NSOs are responsible for ex ante evaluation of the costs and benefits of a new statistical operation.

The efficiency and effectiveness of the data collection system can be evaluated from the viewpoints of various stakeholders in the statistics system, namely data producers, data providers, and data users:

- Data producers are interested in obtaining high-quality data as inexpensively and as *promptly* as possible. Data collection costs include outlays for preparing the collection instruments (generally questionnaires), training interviewers and other personnel, and the costs of collecting and capturing the data. After the collection phase, there are the additional costs of processing and disseminating the data.
- Data providers (those responding to the questionnaires) seek to minimize the *response burden*, in terms of the costs and time involved in collecting the requested data and completing the questionnaire.
- From the data user's viewpoint, a data collection system will be satisfactory to the extent that, in the final analysis, it provides relevant and reliable information in an accessible and timely manner.

Countries have available various sources for compiling the information needed to calculate the green production indicators. In the specific case of information on firms, we distinguish between administrative sources, business records, questions or modules in survey vehicles, and independent

data collection. These sources do not have the same potential for producing basic data for calculating the GPI, and the appropriateness of each source will be determined in large part by the balance between the type of information sought (which reflects users' needs) and the resources available. The choice of a specific source or survey in each country must take into account the resources of the national statistics system and its multiyear work plans, the needs of policymakers, and the technical and financial resources available.

As in other fields of statistical information on firms, the possible sources are *administrative data* (such as administrative licenses for economic activity, lists of firms receiving subsidies for technological innovation, etc.), and *business registers* (for sources such as financial statements or data on contributions to social security systems).

Administrative sources can be useful, but they are not likely to satisfy the information needs in full.

Business registers or directories are a key element of the statistical infrastructure in most NSOs. Their function is to keep an up-to-date record of the companies in the country (generally the companies and their establishments), with information on their location, contact details and other characteristics such as type of industry and size. Business registers are used in the statistical process for compiling enterprise demographic data and generating population frameworks for company surveys. In developing economies, the importance of the informal sector means that a large part of economic activity falls outside the administrative framework (for example, businesses with no license or tax control). Economic agents involved in activities of this kind are generally excluded from the business registers. This guide does not attempt to measure green production in the informal sector of the economy (see example 10).

Box 11

Example 10. Characterization of the informal recycling sector in Latin America and the Caribbean

A study entitled "Inclusive recycling in Latin America and the Caribbean" (2015) portrayed the recycling situation in 15 countries. Its main conclusion was that the population of informal recyclers in the region amounts to some 4 million individuals, in a sector that is growing strongly. Moreover, it indicates that informal recyclers are viewed as a social problem, and their work goes unrecognized despite the environmental, social and economic benefits it generates. On the other hand, it recognizes that there is little information about the recycling market, scant transparency, and a lack of adequate and inclusive regulation and policies for integrating informal recyclers.

Source: Regional Inclusive Recycling Initiative (IRR), *El reciclaje inclusivo en América Latina y el Caribe*, 2013.

The accounting balances of firms, generally reported to the tax administration, chambers of commerce or notary offices, contain economic and financial information on firms. The possibility of accessing those records by the NSOs, and of linking them to statistical records, is generally determined in the statistical legislation of each country.

In these cases, statistical information on green production can be produced at very low cost. However, the indicators that can be produced in this manner are generally limited, in number as in other aspects. For example, in the data on water supply, no breakdown by size of firm or industry is possible. It must also be noted that in many developing countries administrative information of this kind is not available, as administrative sources are generally inadequate for collecting data on green production at the company level.

Economic censuses covering the entire economy (or portions thereof)

Economic censuses are comprehensive studies of the business sector (or parts of it), the purpose of which is to gather statistical information on all firms in the country that fall within the

scope of the census. In some countries they also include economic activities performed by households. They are sometimes used to construct population frameworks for business sampling surveys.

Given their exhaustive nature, the costs of economic censuses are very high (data collection may require a detailed mapping exercise) and their frequency tends to be low (every 5 to 10 years). This makes them inappropriate for ongoing monitoring of rapid changes such as those occurring in green production.

Economic censuses, although they provide great detail on the population of businesses studied, are costly and infrequent. Some countries have included questions on green production in their economic censuses (see example 11). Nevertheless, the number of questions that can be included in a census questionnaire is necessarily limited, and it does not seem feasible to deduce green production indicators from census data.

Box 12

Example 11. Economic Census of the Manufacturing Industry in Mexico

The questionnaire for Mexico's 2013 Economic Census of the Manufacturing Industry includes some general variables on the environment, such as:

- Expenditures on water consumption
- Expenditures on electricity consumption
- Expenditures on consumption of fuels and lubricants for transportation equipment
- Expenditures on energy consumption in the production process

Moreover, the questionnaire includes a module on the environment, with 11 specific questions, from which information can be obtained for calculating certain indicators of green production. Some of these variables are also included in the Monthly Survey of the Manufacturing Industry in Mexico.

Examples of variables include:

- Number of persons dedicated to the protection of the environment and natural resources, and average monthly hours worked
- Use of recycled materials (such as raw materials, packaging materials, etc.)
- Separation of residues or wastes generated, and type (paper and cardboard, textiles, wood, metal, glass, plastic, organic waste and others)
- Destination of wastes or residues (sanitary landfill, delivery to firms handling and transporting residues, recycling in production processes, etc.)
- Current expenditures and investment intended to:
 - Reduce energy consumption or make use of alternative energies
 - Reduce water consumption
 - Reduce residues generated in processes
 - Manage, transport and segregate hazardous and non-hazardous residues
 - Sewage, drainage and sanitation
 - Protection of forests and ecosystems
 - Noise mitigation or reduction
 - Treatment of wastewater generated in processes
 - Inspection of vehicles, trucks and transportation equipment
 - Current expenditures or investments to reduce atmospheric emissions or wastewater pollutants, and their quantity
 - Treatment of wastewater and principal use of treated water (in the production process, in cooling systems, in gardening and cleaning, and discharges to the public sewer network or other receptacles, etc.)

Source: National Institute of Statistics and Geography (INEGI), Censo económico de la industria manufacturera de México, Mexico City.

Specific surveys on the topic of interest

Independent surveys on green production can collect much more information than can modules included in other surveys. This is the best option in terms of information coverage, but it is not the most efficient in light of its high costs. Moreover, NSOs generally seek to reduce the reporting burden on respondents, and adding a new survey would increase that burden.

Independent surveys have been designed in particular for compiling information on various topics of interest in measuring green production, such as environmental or green employment aspects, which generally exceed the possibilities of a module inserted into an existing business survey.

A number of developing countries have implemented independent surveys on the environment and green employment in the business sector (see examples 12, 13 and 14). Generally speaking, in countries that have conducted independent surveys on the environment and the green economy, there is high demand for green production indicators on the part of policymakers, the market, and society at large.

Box 13

Example 12. Costa Rica's survey of skills and competencies for working in a green economy

The objective of the survey is to explore the principal green occupations and skills needed in the business sector in Costa Rica, in order to anticipate labour market demand over the coming years and to generate recommendations for forging cooperation partnerships between the Chamber of Industry of Costa Rica and the domestic institutions responsible for creating the conditions to promote green employment.

The survey was administered to a limited sample of 100 firms, stratified by size (four groups depending on number of employees) and economic sector. The 10 sectors included in the study were agro-industry, food, construction, lithography, woodworking, metallurgy, plastics, chemicals, services and textiles.

The principal aspects covered in the questionnaire were:

- Data on firms' environmental certification
- Linkage of firms to other exporting firms
- Knowledge of green economy initiatives
- Degree of employee training in green issues
- Projected needs for green occupations and skills
- Education level required for green workers in coming years
- Principal green occupations for the coming years
- Principal technical skills for the coming years
- Education and training in skills and abilities for occupations in a green economy.
- Importance of education and training for the coming years
- Degree of firms' concurrence with internal training programmes, institutional partnerships and government support for education and training

Source: German Agency for International Cooperation (GIZ)/Chamber of Industry of Costa Rica, "Habilidades y competencias para los empleos en una economía verde", 2013 [online] http://www.elfinanciero.cr.com/biblioteca/Habilidades-competencias-economia-verde_ELFFIL201_40306_0001.pdf.

Box 14

Example 13. The Environment Industry Survey of Colombia

The Environment Industry Survey of Colombia has as its background the Environmental Module created in 1993 to record environmental protection expenditures by the country's industrial sector. In 2007, following a pilot study, the Environmental Module was redesigned as the Industrial Environmental Survey. It currently involves a survey based on a sampling of industrial establishments of any size located in one of the six defined industrial corridors.

The variables covered in the survey deal with the following themes:

- Identification and general data
- Investment and expenditure by environmental category, other payments and outlays
- Green employment
- Generation of industrial solid residues (hazardous and non-hazardous)
- Water resource management (consumption of water and wastewater)
- Environmental management instruments

Source: National Administrative Department of Statistics (DANE), Environment Industry Survey of Colombia, Bogota, 2007.

Box 15

Example 14. The Economic Environmental Information Survey of Companies in Ecuador

This survey was created in 2010 in response to the need for environmental statistics, in particular on firms' expenditure and investment in the environmental area. It is a sampling survey targeted at economic establishments with more than 10 employees included in nine economic sectors, according to the International Standard Industrial Classification (ISIC-4) and its geographical coverage embraces the 24 provinces of Ecuador.

The topics addressed in the questionnaire for this survey are:

- Identification and location
- Principal activity and other general data (days worked, sources of energy)
- Functioning of the firm (environmental licenses, certifications)
- Personnel employed in the establishment
- Employment in environmental protection activities
- Revenues and expenses relating to environmental protection
- Investment in environmental protection
- Current expenditures related to environmental protection
- Solid residues (hazardous and non-hazardous)
- Water (source, consumption, use and treatment)
- Data on the respondent

Source: National Statistics and Census Institute, Encuesta de información ambiental económica en empresas de Ecuador, Quito, 2013.

In some cases the surveys may be conducted by organizations outside the statistical system, generally linked to institutions responsible for designing green production policies. It is risky, and not recommended, to conduct independent surveys of green production outside the National Statistical System, given the limitations in terms of use of key statistical infrastructure such as business registers, data collection systems (call centres, interviewers trained in regional and municipal offices etc.), the sampling methodology, and the possibility that the methodologies will not be harmonized with those of the national statistics system (which are generally linked to international statistical standards).

Ongoing economic surveys in which a module on the topic of interest could be included

Experience in the region suggests that the two most promising sources are specific surveys and specific modules linked to an ongoing survey. The module proposed in this guide can be used by NSOs to supplement ongoing economic surveys, adapting the questions to those that may already exist in the survey vehicle (see following section).

The alternative of a module offers some advantages over other forms of compiling the information, including:

- **Methodological transparency.** The indicator should be capable of construction in a simple and reliable manner from the data that respondents provide, minimizing the use of assumptions for calculating estimates.
- **Lower cost.** The possibility of including modules in existing national surveys is an option that can minimize the cost of obtaining the information, in terms of both human and financial resources. The cost of collecting data on green production through modules is generally marginal in relation to the cost of the survey vehicle, as the bulk of the survey cost has to do with data collection (including fieldwork, where necessary). In addition, staff involved in collecting and processing the data have already been trained and merely require additional training on the questions concerning green production.
- **Greater harmonization.** Including the same module in different countries makes it possible to share experience with the compilation and treatment of data, and makes for better comparability of the calculated values of the indicators.

- **Data linkage.** The possibility of relating these variables referring to green production with those already included in the survey vehicle.
- **Policy relevance.** The adaptability of the module to national characteristics makes it possible to assess whether national, regional and local policies are producing results over the short and medium term, and can thus serve as a basis for decision-making.
- **Continuity.** The possibility of conducting periodic surveys ensures the continuous capture of data over time.

Table 30 summarizes the characteristics of the alternative sources, the indicators for which they are probably appropriate, and indications as to their relative cost.

Table 30
Statistical sources for the collection of data for calculating green
production indicators, with indication of their costs

Type of source	Indicators that can be compiled	Indication of costs
Administrative sources	A limited number of GPIs, e.g. those relating to certification of environmentally friendly technological processes (green residue management systems etc.).	No cost (result of administrative activities).
Economic censuses	Economic censuses provide much detail on the population of firms studied, but they are infrequent and do not include many questions on a given topic. It does not seem feasible, then, to deduce green production indicators from census data.	Given their all-embracing nature, the costs of economic censuses are very high.
Modules or questions on green production included in existing sample surveys or censuses (these are generally economic surveys, e.g. of the manufacturing sector)	A limited number of green production indicators referring to business activities, with selected breakdowns (size, sector) determined by the sample design of the survey vehicle. Allows production of indicators that combine the topic of interest with other variables already included in the survey.	Generally, only marginal costs compared to the cost of the survey of which it is part (design of entry systems, validation, tabulation and dissemination of data in the module).
Independent (specific) surveys on green production	A great many green production indicators referring to business activities with selected breakdowns (size, sector).	High cost of design, data collection (which may include fieldwork) and processing. May require design of new entry systems, validation, tabulation and dissemination of survey data.

Source: Prepared by the authors.

Judging from experience in other information areas (for example, surveys on innovation or use of ICTs in firms), the simplest way of obtaining the required information is through a specific module included in surveys targeted at firms. The use of the module presented here will facilitate harmonization of results and make for international comparability. Implementation of this module with a defined frequency would yield a time series for tracking the evolution of green production.

2. Target population, definition of statistical units, and selection of the sample

The target population of a statistical operation (whether a sampling survey or a census) is the group of statistical units of interest. The target population is defined by the scope of the survey, which is based on the attributes of the units. In the case of company surveys, the scope is generally defined in terms of:

- Economic activity

- Size of the firm (expressed in terms of number of persons employed and/or business turnover)
- Geographical location

The target populations for green production surveys must be adjusted to the country's economic reality, as well as to the available resources and users' demand for information. For example, it could be decided to launch the study in the manufacturing sector in order to expand it later to other areas of interest (e.g. mining, energy and water distribution, services etc.).

The use of international classifications such as the International Standard Industrial Classification (ISIC) to define the type of industry to which the activity belongs enhances the inter-country comparability of the statistical results. Most classifications in the Latin America and Caribbean region have established correspondence with regional classifications such as the Statistical Classification of Economic Activities in the European Community (NACE) or the North American Industry Classification System (NAICS) or with the ISIC (Rev. 4).⁹

Without going into detail on application of the ISIC, we should note that the activities that must be coded include both the principal and the secondary activities of the firm. The economic activities are defined on the basis of four criteria:

- Inputs used
- Production processes and technology
- Product characteristics
- Intended use

For a green production survey, while all the firm's activities are of interest for the study, it may be advisable to classify firms according to their principal activity, but to compile information on all their activities in order to understand more closely the industrial profile of those that are making the transition to green production.

The proposed module is targeted at firms whose activity falls within the manufacturing industries (section C of the International Standard Industrial Classification, ISIC Rev.4).

Other sections of the ISIC that could be of interest because of their impact on the green economy are the following:

- Section B. Mining and quarrying
- Section D. Electricity, gas, steam and air conditioning supply
- Section E. Water supply, sewerage, waste management and remediation activities.
- Section H. Transportation and storage

It is important to note that the correspondence between economic activities and products is not strictly one-to-one: connectivity can give rise to various products, while a product may be the outcome of several production processes.

The correct identification of a firm's economic activity or activities is a fundamental task of the NSO, as part of the process of ensuring statistical quality. Thus it is important that company registers and statistical operations alike should provide for the ongoing update of this information.

When it comes to the size of firms, some surveys restrict their target population (and hence the sample) to those with more than a given number of employees. However, in developing and

⁹ See [online] http://unstats.un.org/unsd/publication/seriesM/seriesm_4rev4s.pdf.

transition countries, micro-enterprises (those with fewer than 10 workers) may constitute a very significant proportion of the economy, and they should be investigated by sampling, at least.

3. Statistical units, design of the framework and of the sample

The design of the sampling framework and the choice of the sample are fundamental stages in data collection. The sampling framework and the choice of sample both apply to a given type of statistical unit.

The basic data collection unit is the firm or enterprise. According to the System of National Accounts 2008 (SNA 2008), “an enterprise is the view of an institutional unit as a producer of goods and services”, and an industry “consists of a group of establishments engaged in the same or similar kinds of activity” (United Nations, 2009a).

Nevertheless, while the firm is the central unit of the survey, bearing in mind the diversity of the proposed indicators and recognizing that for some indicators the productive technology used in a given installation plays an important role, we take into account smaller statistical units, establishments or local units that complement the information system.

Thus, the module includes a submodule targeted at establishments, which the SNA 2008 defines as follows: “An establishment is an enterprise or part of an enterprise that is situated in a single location and in which only a single productive activity is carried out or in which the principal productive activity accounts for most of the value added” (United Nations, 2009a).

In the case of firms with only one establishment, the module and the submodule are completed together, while in the case of firms with multiple establishments, the submodule must be completed for each of the establishments. To obtain statistical information at subnational or territorial levels (something of particular importance for the larger countries or those with great regional differences in degrees of industrialization), it is important to consider the geo-referencing of data on establishments during the survey phase. Consequently, a questionnaire or module on green production should include as well a section identifying data as they relate to the location and nature of the different establishments of the firm and whether it belongs to a multinational group.

The NSO should accompany the identification of the units with the maintenance of a companies register.

In the case of surveys of the enterprise sector, the population framework is usually extracted from the business register that lists the economic agents operating in the economy. The business registers for statistical purposes (which should be distinguished from registers for other administrative purposes) are generally established and maintained by the NSOs and are based both on external sources (such as tax records) and internal ones (such as those resulting from “unit studies” under way or other research on units). The business registers constitute the key infrastructure of the statistical system and the quality of the business statistics will depend significantly on the quality of the underlying register. Ideally, this register will contain all the units in the economy, properly identified, together with ancillary information needed for designing a sample, such as stratification variables (economic activity, size). The business register is used as a sampling framework from which the sample for the study is extracted at random.

The quality of the business register is crucial for the final quality of the results. Thus, depending on the coverage of the framework with respect to the target population of the survey, levels

of under-coverage or over-coverage will be defined. This document will not go into detail on the techniques of maintaining business registers, as this issue is common to all economic surveys.¹⁰

To ensure that the sample is representative, the selection should be done using probabilistic techniques. Only with probabilistic or random sampling is it possible to calculate estimations of sampling error, which is defined as the deviation from true value attributable to the fact that only a sample of the population was observed. The design of a random sample must be based on consideration of the structure of the company population (its stratification), the cost of data collection, and the maximum statistical error acceptable in the estimates. In the case of modules annexed to a business survey, it will not be possible to gear the design fully to the needs for information on green production: rather this it will be determined by the design of the survey vehicle.

The design of the sample in a business survey typically includes all the larger firms, while the smaller ones are sampled in such a way that the sampling rate is lower for micro-enterprises. The sample will usually be stratified by sector of economic activity and by size of the firm, i.e. it is constituted by simple random samples in each of the strata. We shall not discuss here the sample design of the surveys/modules on green production, as this issue is common to other business surveys.¹¹

4. Choice of survey vehicle

Once it is decided to use a questionnaire circulated to firms and establishments, if this involves a module included in an existing survey vehicle, it will be important to choose that survey vehicle carefully.

Some survey vehicles that have been selected by various countries of the region with experience in green economy statistics are:

- Business surveys that embrace the entire economy: these surveys are generally conducted to monitor the productive sector, and they have secondary uses such as the preparation of input-output tables and national accounts. Some countries conduct exhaustive studies of the entire economy (censuses), but their frequency tends to be low.
- Surveys of the manufacturing sector: most countries conduct such surveys on an annual basis. Some countries investigate certain manufacturing industries in greater depth, given their importance for the economy.
- Surveys of the services sector: in many developing countries, the services sector is investigated through a series of surveys by sector (for example trade, transportation, tourism, financial services).

In the Latin America and Caribbean region, although the content of industrial surveys has not been fully harmonized, we may conclude that coverage of the production process and financial aspects, as well as identification of the unit and its establishments, is sufficiently broad to consider them as candidates for survey vehicles.

Once an existing survey has been chosen as the vehicle for a module on green production, the module will have to be redesigned (with redrafting of the questions and definitions to be used). The design of the sample permits the scope of the survey vehicle sample to be expanded in certain sectors and classes according to their size, in order to obtain more reliable data.

Nevertheless, control over the survey vehicle methodology may be limited.

¹⁰ See Eurostat (2010 and 2014).

¹¹ A useful reference is Eurostat (2014).

5. Methods of gathering data and validating the information

There are various possibilities in terms of data collection techniques: personal interviews, questionnaires sent by mail, telephone interviews, computer-assisted interviews, or a combination of these. Country practices depend greatly on costs (of interviewers, transportation and communications) as well as on the existing infrastructure (call centres, regional or municipal offices, reliable business registers, etc.).

The needs of respondents and users must be considered in selecting survey vehicles and data collection methods. The best option for data collection is usually to offer users a variety of response methods.

Ideally, a green production survey or module will use the most up-to-date techniques available to an NSO. In any case, it is important to test the techniques on a pilot basis before launching a large-scale survey.

For various reasons, the statistical information provided by firms may contain errors. These include erroneous or missing data, incorrect classifications, and incoherent or illogical responses. In order to minimize such errors, data validation techniques should be applied to optimize the effectiveness of the instruments and the procedures for capturing data. In addition, sound editing (verification) techniques should be used to transform the gross data provided by respondents into “clean” (valid and coherent) data that can be used to produce aggregate statistics.

Data validation techniques include the following:

- Verification of arithmetic consistency: for example, numerical values such as the number of employees disaggregated by sex, educational or occupational levels must coincide with the total figures.
- Verification of logical consistency: for example, if a variable used as a filter, such as the question “was your firm economically active in year t-1?”, is answered with a “no”, the respondent should be directed to the end of the questionnaire, and not to further questions.
- Statistical verification: outliers (extremely high or low values) for a variable —e.g. an abnormally high business turnover figure divided by the number of employees in a given sector of activity— may indicate an error. Such verifications require a knowledge of the sector of activity, and must be performed by specialists.

The preparation of validation rules will be determined by the final format of the questionnaire. Countries may share experience in validating data from different business surveys.

Given the novelty of surveys of this kind, it will be of particular interest for countries to compare the cognitive tests that must be performed as part of the pilot phase before launching a questionnaire. This means examining whether the respondents (or a sample thereof) have correctly understood the concepts on which they are being questioned. Experience with innovation surveys may be useful, with due regard to the following considerations:

- Cognitive tests of questionnaires do not provide a vision of a representative sample of respondents.
- The preparation of “snapshots” with descriptions of some processes may help in understanding the concepts in question.
- Cognitive tests on innovation show that process innovations (for example, introduction of a green technology) are sometimes indistinguishable from organizational or marketing innovations. In this respect, the questionnaire should explain the different sections and topics clearly and separately.

- The pilot stage of a questionnaire should consider the possibility of designing and testing different physical formats (hard copy or electronic) before a definitive version is launched.

6. Evaluating the statistical operation

No statistical operation should be deemed complete without evaluating the quality both of the process and of its results. Some international statistics offices, such as Eurostat,¹² and the majority of NSOs (above all those with more highly developed statistical systems) have adopted standards for evaluating statistical quality. In addition to statistical quality, information must be compiled on fulfilment of business plans, costs and application of procedures. Some NSOs in the region have highly advanced systems of quality management and can serve as a model for other countries.

There is broad agreement in the international statistics community on the dimensions of statistical quality, which include the following:¹³

- **Relevance:** degree to which the statistical information satisfies the real needs of users.
- **Accuracy:** degree to which the statistical information describes correctly the phenomenon to be measured.
- **Timeliness:** time elapsed between the period of reference and the date of dissemination.
- **Accessibility:** ease with which users can access the statistical information.
- **Comparability:** degree to which the statistical information allows for comparisons across space (countries) or over time.
- **Consistency:** degree of consistency of the statistical information with information from other sources, within a broad analytical framework and over time.
- **Comprehensiveness (or coverage):** degree to which the statistical information covers the phenomenon to be described.

There are international standards for preparing quality indicators based on the foregoing dimensions.¹⁴ In any case, we recommend that NSOs should apply the same standards to green production surveys as they do for other business surveys. Given the novelty of the issue, sharing quality reports with other countries could enhance implementation.

In addition to quality measurement instruments, other actions are recommended, including these:

- Improve relations with users by introducing systems to measure satisfaction of their information needs.
- Improve relations with reporting units, by offering them a support service for resolving doubts, offering various means of communication (paper questionnaires, Web, personal interviews) and establishing a close relationship with those that are most important for the quality of the final results (such as large firms or industrial groups).
- Use process management tools such as checklists for survey managers.¹⁵

¹² See, for example, Eurostat (2015).

¹³ See, for example, ECLAC (2003), for a definition of quality dimensions.

¹⁴ Within the region, examples are MERCOSUR (2009) and the various documents of the Statistical Conference of the Americas of ECLAC on this topic.

¹⁵ One possible model is Eurostat's DESAP: see Eurostat (n/d).

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Annexes

Annex 1

Basic set of green production indicators for the manufacturing industries

Following are the 26 indicators that comprise the proposed basic set of GPIs.

Environmental and Resource Productivity/Intensity

Use and consumption of resources

Raw materials and other inputs

GPI 1. **Intensity** of raw material use*

GPI 2. Material **productivity***

GPI 3. Proportion of establishments using **hazardous raw materials** in the production process*

GPI 6. Proportion of establishments using **recycled** raw materials*

GPI 7. Proportion of raw material inputs derived from recycling*

GPI 10. Proportion of firms purchasing **products with certification or eco-label***

Water

GPI 12. **Intensity** of water use*

GPI 13. Water **productivity***

GPI 15. Proportion of **recycled water** used*

Energy

GPI 19. **Energy intensity***

GPI 20. **Energy productivity***

GPI 21. Proportion of firms producing renewable energy*

GPI 22. Proportion of energy consumption derived from renewable energy generated in the establishment*

Technologies and processes

Green technologies

GPI 25. Proportion of establishments using **green technologies***

Wastes

GPI 26. Intensity of waste generation*

GPI 31. Proportion of wastes properly disposed of*

Wastewater

GPI 34. **Intensity** of wastewater generation*

GPI 35. Proportion of establishments treating their wastewater*

Atmospheric emissions

GPI 38. Proportion of establishments measuring or treating atmospheric emissions*

Eco-innovation, patents and R&D

GPI 39. Proportion of firms engaged in **eco-innovation***

GPI 41. Proportion of firms with registered **patents** for green technologies*

GPI 42. Proportion of firms investing in **R&D** for green production purposes*

Environmental management systems, certifications and eco-labelling

GPI 43. Proportion of firms with ISO 14001 **certification***

*Policy responses and economic opportunities***Green jobs and training in green production****Green jobs**

GPI 46. Proportion of **green jobs***

Training in green production

GPI 48. Proportion of firms conducting **training** in green production*

*Revenues, costs and transfers***Revenues, current expenses and investments**

GPI 54. Proportion of firms **investing** in green production*

Annex 2

Expanded set of green production indicators for the manufacturing industries

Below are listed the 56 indicators that comprise the proposed expanded set of GPIs. The indicators that are part of the basic set are those marked with an asterisk, and are already listed in annex 1.

Environmental and Resource Productivity/Intensity

Use and consumption of resources

Raw materials and other inputs

- GPI 1. **Intensity** of raw material use*
- GPI 2. Material **productivity***
- GPI 3. Proportion of establishments using **hazardous raw materials** in the production process*
- GPI 4. Proportion of hazardous raw materials used
- GPI 5. Intensity of use of **containers and packaging** for the final product
- GPI 6. Proportion of establishments using recycled raw materials*
- GPI 7. Proportion of raw material inputs derived from recycling*
- GPI 8. Proportion of establishments using **residues** from other firms as raw material (except energy production)
- GPI 9. Proportion of raw material inputs derived from **residues** from other firms (except for energy production)
- GPI 10. Proportion of firms purchasing **products with certification or eco-label***
- GPI 11. Proportion of purchases with certification or eco-label

Water

- GPI 12. **Intensity** of water use*
- GPI 13. Water **productivity***
- GPI 14. Total water **use**
- GPI 15. Proportion of **recycled water** used*
- GPI 16. Proportion of establishments using **rainwater**
- GPI 17. Proportion of rainwater used
- GPI 18. Proportion of **desalinated water** used

Energy

- GPI 19. **Energy intensity***
- GPI 20. **Energy productivity***
- GPI 21. Proportion of firms producing **renewable energy***
- GPI 22. Proportion of energy consumption derived from renewable energy generated in the establishment*
- GPI 23. Proportion of energy consumption derived from **residues**

GPI 24. Proportion of **bioenergy** production (vegetal remnants and wastes)

Technologies and processes

Green technologies

GPI 25. Proportion of establishments using **green technologies***

Wastes

GPI 26. **Intensity** of waste generation*

GPI 27. Proportion of **hazardous wastes** generated

GPI 28. Proportion of **packaging waste** generated

GPI 29. Proportion of **electric and electronic appliance waste** (e-waste) generated

GPI 30. Intensity of e-waste generation

GPI 31. Proportion of **wastes properly disposed of***

GPI 32. Proportion of non-hazardous wastes properly disposed of

GPI 33. Proportion of hazardous wastes properly disposed of

Wastewater

GPI 34. **Intensity** of wastewater generation*

GPI 35. Proportion of establishments treating their wastewater*

GPI 36. Proportion of wastewater treated

Atmospheric emissions

GPI 37. **Intensity** of CO₂ generation

GPI 38. Proportion of establishments measuring or treating atmospheric emissions*

Eco-innovation, patents and R&D

GPI 39. Proportion of firms engaged in **eco-innovation***

GPI 40. Proportion of firms engaged in eco-innovation to reduce raw material use and/or energy consumption

GPI 41. Proportion of firms with registered **patents** for green technologies*

GPI 42. Proportion of firms investing in **R&D** for green production purposes*

Environmental management systems, certifications and eco-labelling

GPI 43. Proportion of firms with ISO 14001 **certification***

GPI 44. Proportion of firms with products bearing **eco-labels**

*Policy responses and economic opportunities***Sustainability reports**

GPI 45. Number of firms publishing sustainability reports

*Green jobs and training in green production**Green jobs*

GPI 46. Proportion of **green jobs***

GPI 47. Proportion of firms with workers performing green tasks in management, technical or professional positions

Training in green production

GPI 48. Proportion of firms conducting **training** in green production*

*Revenues, costs and transfers***Revenues, current expenses and investments**

GPI 49. Proportion of firms earning **revenues from the sale of residues**

GPI 50. **Relative cost of water**

GPI 51. **Relative cost of energy**

GPI 52. **Relative cost of wastewater management**

GPI 53. **Relative cost of waste management**

GPI 54. Proportion of firms **investing** in green production*

Transactions with the government sector

GPI 55. Proportion of firms receiving **grants** for environmental investment

GPI 56. Proportion of firms receiving **incentives** to use renewable energy sources

Annex 3

Module on green production

Identification of variables

The first step is to identify each of the variables in the module. To facilitate this task, the following rules have been observed:

- All the variables included in the module begin with the letter “M” and the variables included in the submodule begin with the letter “S”.
- Each table is numbered sequentially: the model contains 21 tables numbered as M1, M2... up to M21 and the submodule has 19 tables, numbered as S1, S2... up to S19.
- Within each table, the variables are also numbered sequentially: each variable number is preceded by a hyphen “-”, so that, for example, in the first table of the module the variables are M1-1, M1-2 and M1-3.
- In cases where the variables are requested in various units the name of the variable is supplemented with a letter referring to the unit of measurement: for example, water supplied to an establishment by a tank truck is requested in volume (v) and in monetary units (m), so that the variables are identified as S2-2v and S2-2m.

Following is a presentation of the module with the name of each of its variables:

Part 1: Companies module

This section of the questionnaire should be answered with information referring to the firm as a whole.

Section A: Environmental management systems, certifications and sustainability reports

Environmental management instruments

M1. As of 31/12/2016, does your firm have procedures in place for identifying and periodically reducing the environmental impacts it generates? (For example, the conduct of periodic environmental audits, establishment of operating objectives, ISO 14001 certification, etc.)	Yes/No
Yes	M1-1
No	M1-2

Typology of environmental management instruments

M2. Indicate the type of environmental management instrument used in your firm at 31/12/2016.	Yes/No
ISO 14001 certification	M2-1
Other international certifications (ISO 14006 or ISO 50001)	M2-2
Other national certifications related to green production	M2-3
Products with eco-labels or seals associated with high-quality environmental management (except energy-related certifications)	M2-4
Energy-related certifications of products	M2-5
An environmental management system or periodic environmental audits	M2-6

Sustainability reporting

M3. Sustainability reports	Yes/No
Does your company publish annual sustainability reports?	M3-1

Section B: Eco-innovation and patents**Eco-innovation**

An eco-innovation or green innovation is the introduction of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations that will generate environmental benefits in comparison with the alternatives (OECD, 2005; United Nations and others, 2014).

M4. Environmental benefits from the production of goods and services in your firm	Yes/No
Reduction in raw material use per unit of output	M4-1
Reduction in energy use per unit of output	M4-2
Reduction in water consumption per unit of output	M4-3
Reduction in the CO2 footprint (total production of CO2) in your firm.	M4-4
Substitution of raw materials by other, less polluting or less hazardous materials	M4-5
Reduction in soil, water, noise or air pollution	M4-6
Recycling of waste, waste water or reuse of materials	M4-7

M5. Environmental benefits for the final consumer from after-sale use of a good or service	Yes/No
Reduction in energy use	M5-1
Reduction in air, water, soil and acoustic (noise) pollution.	M5-2
Improved process for recycling the product after use	M5-3

Characteristics of the eco-innovation

M6. Characteristics of the eco-innovation	Yes/No
Were the product eco-innovations new to the market?	M6-1

Incentives to eco-innovation

M7. During the period of reference, indicate whether your firm introduced an eco-innovation in response to:	Yes/No
Existing environmental regulations or pollution taxes	M7-1
Environmental regulations or taxes that you expect to be introduced in the future	M7-2
Availability of government subsidies, grants or other financial incentives to environmental innovation.	M7-3
Market demand (actual or expected) for environmental innovations on the part of consumers.	M7-4
Voluntary agreements or codes of good environmental practice in your sector.	M7-5

Barriers to eco-innovation

M8. During the period of reference, indicate the principal barriers that your firm encountered in developing eco-innovation.	Yes/No
High cost of the innovation process	M8-1
innovation entails excessive risks	M8-2
Lack of financing (own funds or external financing).	M8-3
Insufficient consumer demand	M8-4

Lack of qualified or sufficiently knowledgeable personnel	M8-5
Lack of information on markets or technology	M8-6
Lack of adequate infrastructure for carrying out innovation	M8-7
No legal or regulatory protection.	M8-8
No fiscal incentives	M8-9

Green technology patents

Green or environmental technologies include technical processes, facilities and equipment (goods), and methods or knowledge (services) the purpose or technical nature of which is environmental protection or resource management. These are classified as:

- End-of-pipe (pollution treatment) technologies, intended for measurement, control, treatment and restoration/correction of pollution, environmental degradation, and/or resource depletion (for example wastewater treatment plants or equipment for measuring air pollution).
- Integrated (pollution prevention) technologies used in production processes that are less polluting and less resource-intensive (United Nations, 2014).

M9. Green technology patents	Yes/No
Has your firm applied for or patents been granted on green technologies?	M9-1

Section C: Renewable energy

Production of renewable energy

M10. Production of renewable energy	Yes/No
Does your firm produce renewable energy?	M10-1

If so, indicate the types of renewable energy produced by the firm:

M11. Renewable energy produced	Yes/No
Solar photovoltaic energy	M11-1
Solar thermal energy	M11-2
Wind energy	M11-3
Hydroelectric energy	M11-4
Geothermal energy	M11-5
Tidal, wave or ocean energy	M11-6
Biomass (vegetal residues and wastes)	M11-7

Section D: Employment and training in green production

Employment in resource management and environmental protection activities

M12. Number of employees	In full-time equivalents (<i>FTE</i>)
Total number of employees in the firm	M12-1
Number of employees (in <i>FTE</i>) dedicated to resource management and environmental protection activities	M12-2
Number of employees (in <i>FTE</i>) dedicated to resource management and environmental protection activities who receive a salary and have social security and pension coverage.	M12-3

M13. Number of employees by occupation Number of employees dedicated to resource management and environmental protection, by occupation	In full-time equivalents (FTE)
Directors and managers	M13-1
Professional and scientific staff	M13-2
Middle-level professionals and technical staff	M13-3
Administrative and support staff	M13-4
Journeymen, labourers and machinists and assemblers	M13-5
Elementary occupations	M13-6

Fields of employment related to green production

M14. Indicate the fields in which the installation's employees are working	Yes/No
Protection of ambient air and climate	M14-1
Wastewater management	M14-2
Waste management	M14-3
Protection and the mediation of soils, ground waters and surface waters	M14-4
Noise and vibration abatement (excluding workplace protection).	M14-5
Protection of biodiversity and landscapes	M14-6
Protection against radiation (excluding external safety)	M14-7
R&D for environmental protection	M14-8
Innovation in environmental protection and resource management activities	M14-9
Other environmental management activities	M14-10

Training in green production

Green production training includes formative activities intended to impart training related to the management of environmental resources and protection of the environment (air protection, wastewater management, wastes, soils, noise, biodiversity etc.).

Training may be conducted by the firm itself or by other firms, and may take place within the facilities of the economic unit or in another facility (United Nations and others 2014).

M15. Training in green production	Yes/No
Has your firm provided training in green production to its employees? (Only if answer is Yes)	M15-1
Expenditure on green training (monetary units).	M15-2
Expenditure on green training (monetary units).	M15-3
Do you anticipate that your employees will need some kind of green production training in the coming years?	M15-4
How many of your employees feel that they need this type of training?	M15-5

Section E: Sustainable procurement and certified products

Sustainable procurement is “a process whereby organizations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organization but also to society and the economy, while minimizing damage to the environment” (UNEP, 2012).

M16. Sustainable procurement and certified product purchases	(Monetary units)
Total of sustainable purchases	M16-1
Of which: purchases of certified or eco-labelled products	M16-2

Section F: Environmental goods and services produced

M17. Environmental goods and services produced	Yes/No
Are any of the products manufactured or services delivered by the firm intended for environmental protection and management or for incorporation into other environmental goods and services?	M17-1

M18. Describe these goods and services	% of the firm's turnover
	M18-1
	M18-2
	M18-3
	M18-4
Total % of the firm's turnover	M18-5

Section G: Revenues, expenses and other transactions

Revenues

M19. Revenues	Yes/No
Does your firm earn revenues from the sale of residues to other firms?	M19-1

R&D expenditure

M20. R&D	Expenses (monetary units)
Expenditure on R&D related with resource management and environmental protection	M20-1

Transactions with the government sector

Transactions with the government sector include subsidies, investment grants, tax deductions and incentives in connection with resource management and environmental protection.

M21. Item	Amount (monetary units)
Subsidies and investment grants received for environmental protection (except those for renewable energy production)	M21-1
Tax deductions associated with investments in resource management and environmental protection (except those for renewable energy production)	M21-2
Incentives for renewable energy sources	M21-3

Part 2: Establishments submodule

This section of the questionnaire should be answered with information referring to each of the firm's establishments.

Section A: Use and consumption of resources, raw materials and other inputs

Raw materials and other inputs

S1. Use of raw materials and other inputs	(Tonnes)
Total use of raw materials	S1-1
of which: non-hazardous raw materials	S1-2
of which: hazardous raw materials	S1-3
Use of packaging materials for presentation of the final product (including packaging purchased and manufactured)	S1-4
of which: biodegradable packaging (e.g. bio-plastics)	S1-5
Use of raw materials derived from recycling	S1-6
Residues obtained from other firms that are used as raw material in the production process (for uses other than energy production).	S1-7

Water use

S2. Water supply		Volume (cubic metres, m ³)	Expenditure (monetary units)
Water supplied by other entities	Supply network	S2-1v	S2-1m
	Tank truck	S2-2v	S2-2m
	Other establishments	S2-3v	S2-3m
Water supplied by the economic unit itself	Surface water (lakes, rivers, creeks, wetlands etc.).	S2-4v	S2-4m
	Groundwater	S2-5v	S2-5m
	Rainwater	S2-6v	S2-6m
	Seawater desalinated in the establishment itself	S2-7v	S2-7m

S3. Water sold and recycled	Volume (cubic metres, m ³)	Revenues (monetary units)
Water sold or given to other economic units (excludes reused water: wastewater supplied to other economic units for reuse)	S3-1v	S3-1m
Water recycled within the establishment itself	S3-2v	

Energy consumption by type of fuel (except consumption of energy used for transportation of the final product, if this is performed by the establishment itself).

S4. Fuels	Physical units	Quantity	Expenditure on fuel purchases (monetary units)
Electricity (from the network)	KWh	S4-1c	S4-1m
Wood, except vegetal residues	m ³	S4-2c	S4-2m
Coal and coke.	Kg	S4-3c	S4-3m
Natural gas	m ³	S4-4c	S4-4m
Gasoline	Litres	S4-5c	S4-5m
Diesel	Litres	S4-6c	S4-6m
Fuel-oil	Litres	S4-7c	S4-7m
Other fuels: specify:		S4-8c	S4-8m

S5. Biofuels and residues	Physical units	Quantity	Expenditure on fuel purchases (<i>monetary units</i>)
Biofuels			
Solid biofuels (wood residues and vegetal materials)	m ³	S5-1c	S5-1m
Liquid biofuels (biogasoline, biodiesel, bioethanol)	Litres	S5-2c	S5-2m
Gaseous biofuels (biogas from anaerobic fermentation or chemical processes)	m ³	S5-3c	S5-3m
Residues used as fuel			
Residues purchased from other units	Kg	S5-4c	S5-4m
Residues generated in the installation	Kg	S5-5c	S5-5m

Renewable energy generated in the establishment

S6. Renewable energy	Production (KWh)	Consumption (KWh)	Sales (KWh)	Revenues (<i>monetary units</i>)
Solar photovoltaic energy	S6-1	S6-8	S6-15v	S6-15m
Solar thermal energy	S6-2	S6-9	S6-16v	S6-16m
Wind energy	S6-3	S6-10	S6-17v	S6-17m
Hydroelectric energy	S6-4	S6-11	S6-18v	S6-18m
Geothermal energy	S6-5	S6-12	S6-19v	S6-19m
Tidal, wave or ocean energy	S6-6	S6-13	S6-20v	S6-20m
Biomass (vegetal remnants and residues)	S6-7	S6-14	S6-21v	S6-21m

Section B: Wastes, wastewater and atmospheric emissions

Generation of wastes

Wastes are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law.

Waste are materials that are not prime products (that is, products made for the market) for which the generator has no further use for own purposes of production, transformation or consumption, and which he wants to dispose of. Residues recycled or reused at the place of generation are excluded. Also excluded are waste materials that are directly discharged into ambient water or air (UNEP/Basel Convention, 2014; United Nations and others, 2014).

Hazardous wastes are those that, either directly or by giving origin to another substance, present any of the following characteristics:

- Explosives
- Oxidizants
- Flammables
- Organic peroxides
- Toxic or eco-toxic substances
- Infectious substances
- Substances liable to spontaneous combustion
- Corrosives
- Substances which, in contact with water, emit flammable gases
- Substances which, in contact with air or water, release toxic gases (Annex I of the Basel Convention)

Packaging means all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. “Non-returnable” items used for the same purposes will also be considered to constitute packaging (European Communities, 1994).

Some examples of electric and electronic equipment wastes (e-waste) are washing machines, refrigerators, freezer chests, air conditioners, computer equipment, mobile telephones, television screens, portable computers, electronic agenda keepers and tablets (Balde and others, 2015).

S7. Generation of wastes	(Tonnes)
Total wastes generated	S7-1
Non-hazardous wastes	S7-2
Hazardous wastes	S7-3
Packaging wastes	S7-4
E-wastes	S7-5

Waste management

This does not include energy use of residues in the installation itself, to be reported in the energy section.

S8. Waste management	Non-hazardous wastes (Tonnes)	Hazardous wastes (Tonnes)
Wastes delivered to an authorized manager or disposal points	S8-1	S8-5
Wastes deposited in containers for removal by the municipal services	S8-2	S8-6
Wastes deposited directly into unsupervised areas (for example vacant lands or abandoned farms)	S8-3	S8-7
Other: specify	S8-4	S8-8

Revenues from sale of residues

S9. Revenues from sale of residues	(Monetary units)
Revenues from the sale of residues to other economic units	S9-1

Wastewater

The treatment of wastewater excludes the treatment of wastewater outside the industrial installation by other economic units.

Types of wastewater treatment

- Primary treatment: a set of physical-chemical processes that eliminate a portion of the pollutants present in wastewater, essentially solid sediments and grease.
- Secondary treatment: includes biological treatment of the organic material dissolved in the water, distinguishing between aerobic and anaerobic treatments depending on the type of micro-organisms used.
- Tertiary treatment: includes additional operations that reduce the concentration of specific pollutants in the wastewater (definitions adapted from SEEA).

S10. Generation and treatment of wastewater	Annual volume (<i>m3/year</i>)
Total wastewater generated	S10-1
Wastewater treated in the installation itself	S10-2
With primary treatment	S10-3
With secondary treatment	S10-4
With tertiary treatment	S10-5
Wastewater not treated in the installation itself	S10-6

S11. Discharge of wastewater	Annual volume (<i>cubic metres/year</i>)
Into the sea	S11-1
Into a surface water body	S11-2
Infiltration into the ground or injection into an underground water body	S11-3
Into a sewer network	S11-4

Reused water is wastewater delivered to a user for further use with or without prior treatment. It excludes recycling within an industrial establishment (UNSD, 2016).

S12. Reused water	Volume (<i>cubic metres, m3</i>)	Revenue (<i>monetary units</i>)
Water reused	S12-1v	S12-1m

Atmospheric emissions

S13. Does your establishment	YES/NO
Measure atmospheric emissions (gases and/or particulates)?	S13-1
Treat atmospheric emissions (gases and/or particulates)?	S13-2

Section C: Green technologies

Green or environmental technologies are technical processes, facilities and equipment (goods), and methods or knowledge (services) the purpose or technical nature of which is environmental protection or resource management. These are classified as:

- End-of-pipe or pollution treatment technologies, intended for measurement, control, treatment and restoration/correction of pollution, environmental degradation, or resource depletion (for example wastewater treatment plants or equipment for measuring air pollution).
- Integrated or pollution prevention technologies used in production processes that are less polluting and less resource-intensive (United Nations and others, 2014).

S14. Green technologies	YES/NO
Does the establishment make use of green technologies?	S14-1

List of the green technologies used in your establishments

1. _____
2. _____
3. _____
4. _____

Section D: Current expenses, investments and other operations

Current expenses

S15. Purchases of environmental protection services from other firms	EXPENSES (<i>monetary units</i>)
Measurement and treatment of atmospheric pollution	S15-1
Cleaning of septic tanks, analysis and treatment of wastewater	S15-2
Removal and treatment of non-hazardous wastes by handlers (not by the municipality)	S15-3
Removal and treatment of hazardous wastes by authorized handlers	S15-4
Measurement and remediation of soils and groundwater and surface water	S15-5
Noise measurement	S15-6
Other (biodiversity, landscape etc.)	S15-7

S16. Expenses associated with environmental protection equipment (repair and maintenance, energy and raw material consumption)	EXPENSES (<i>monetary units</i>)
Production of renewable energy	S16-1
Emissions to the air (gases and particulates)	S16-2
Wastewater	S16-3
Wastes	S16-4
Soil, groundwater and surface waters	S16-5
Noise	S16-6
Other (biodiversity, landscape etc.)	S16-7

Investments in equipment and installations integrated into the production process for preventing pollution

S17. Area	Investment (<i>monetary units</i>)
Reduction of atmospheric pollution and odours	S17-1
Reuse of water and reduction of water consumption and wastewater production	S17-2
Reuse of materials and reduction of raw material consumption and waste production	S17-3
Noise and vibration abatement	S17-4
Reduction of energy consumption or use of less polluting energy (except renewable energy)	S17-5
Production of renewable energy	S17-6
Use of less polluting raw materials	S17-7
Application of more costly and less polluting processes	S17-8

Investments in equipment and installations independent of the production process for treating pollution

S18. Area	Investment (<i>monetary units</i>)
Emissions to the air and odours (treatment, elimination or measurement)	S18-1
Wastewater (storage, transportation, treatment or measurement)	S18-2
Wastes (storage, transportation, treatment or measurement).	S18-3
Soils, groundwater and surface water (remediation, treatment or measurement)	S18-4
Noise and vibrations (abatement or measurement)	S18-5
Biodiversity and landscape (repopulation, restoration of landscapes, protection of fauna etc.)	S18-6

Transactions with the government sector

S19. Item	Amount (<i>monetary units</i>)
Taxes or fees on atmospheric pollution	S19-1
Sewage and sanitation	S19-2
Discharge into public water bodies (river, lake)	S19-3
Municipal treatment of wastewater	S19-4
Municipal trash removal (excludes payments to waste managers)	S19-5
Taxes or fees on wastes	S19-6
Other environmental taxes or fees not covered above. Specify	S19-7

Annex 4

Methodological specification sheets for the green production indicators

GPI1.	Intensity of raw material use*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources - Raw materials and other inputs
Priority:	High
Definition: The intensity of raw material use is the quantity of raw materials used to generate one unit of gross value added (GVA).	
Units of measurement or expression of the indicator: Tonnes of raw materials used/monetary unit of gross value added in production	
Definition of the variables that comprise the indicator: The <u>raw materials and materials</u> that enter into production processes constitute a flow of materials that includes raw materials of natural origin, prepared products, and residues originating with other economic units. The <u>use</u> of raw materials is the quantity of raw materials incorporated by an economic unit. The <u>gross value added</u> of production is the value created or added in the production process.	
Relevance of the indicator: The objective of this indicator is to determine whether there is a decoupling of resource consumption and the pollution derived from it. This aspect is recognized in the Sustainable Development Goals approved by the United Nations. The enterprise-level indicators for resource productivity and pollution intensity proposed by UNIDO-UNEP also consider this indicator.	
Calculation: The intensity of raw material used is calculated by dividing the quantity of raw materials used in one year by the gross value added (GVA) in production for that year. The quantity of raw materials used in one year is calculated as the sum of the initial stock and purchases made, less the final stock. $GPI1 = \text{quantity of raw materials used} / \text{GVA}$	
Interpretation: According to green production criteria, the intensity of raw material use should tend to decline over time, implying less use of raw materials to achieve the same or greater output.	
Limitations: Calculation of the indicator must consider only the raw materials actually used, which means taking into account the initial stock, raw materials acquired, and the final stock. Failure to take account of initial and final stocks may yield results that do not reflect the reality of the productive activity.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of raw material used	
Proposed data source: Establishment surveys	
Model question: What is the quantity of raw materials used in one year in your establishment?	
Proposed frequency: Annual	

GPI2.	Material productivity*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources - Raw materials and other inputs
Priority:	High
Definition: Material productivity is the gross value added per unit of raw materials used	
Units of measurement or expression of the indicator: monetary units of gross value added in production /tonnes of raw materials used	
Definition of the variables that comprise the indicator: The <u>raw materials and materials</u> that enter into production processes constitute a flow of materials that includes raw materials of natural origin, prepared products, and residues originating with other economic units. The <u>use</u> of raw materials is the quantity of raw materials incorporated by an economic unit. The <u>gross value added</u> of production is the value created or added in the production process.	
Relevance of the indicator: The objective of this indicator is to determine whether there is a decoupling between production and the use of raw materials, as material productivity is a measure of the efficiency with which natural resources are used. This indicator is included in the list of indicators proposed for evaluating fulfillment of the Sustainable Development Goals approved by the United Nations. Specifically, this indicator is included under Goal Promote inclusive and sustainable economic growth, employment and decent work for all. The target set in the SDG is to achieve a progressive improvement in global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation. The material productivity indicator is covered in other international initiatives such as the OECD green growth indicators and the enterprise-level indicators for resource productivity and pollution intensity proposed by UNIDO-UNEP.	
Calculation: Material productivity is calculated by dividing the gross value of production in one year by the quantity of raw materials used in that year. $GPI2 = GVA / \text{quantity of raw materials used}$	
Interpretation: According to green production criteria, material productivity is a measure of the efficiency with which resources are used, and it should tend to rise over time, implying greater output from the same or lesser quantity of raw materials used.	
Limitations: Calculation of the indicator must consider only the raw materials actually used, which means taking into account the initial stock, raw materials acquired, and the final stock. Failure to take account of initial and final stocks may yield results that do not reflect the reality of the productive activity	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of raw material used	
Proposed data source: Establishment surveys	
Model question: What is the volume of raw materials used in one year in your establishment?	
Proposed frequency: Annual	

GPI3.	Proportion of establishments using hazardous raw materials in their production process *
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources - Raw materials and other inputs
Priority:	High
Definition: Proportion of industrial establishments using hazardous materials in their production process.	
Units of measurement or expression of the indicator: Percentage (%) of industrial establishments using hazardous materials in their production process.	
Definition of the variables that comprise the indicator: A hazardous material is any solid, liquid or gaseous substance that, by its physical, chemical or biological characteristics, can cause damage to human beings, the environment, or property (United Nations, 2011b). The <u>use or utilization</u> of raw materials is the quantity of raw materials incorporated by an economic unit	
Relevance of the indicator: The objective of this indicator is to evaluate the tendency to less use of hazardous materials and industrial processes. Environmental policies should encourage a reduction in environmental pollution at source, and making less use of hazardous materials is related to less production of hazardous wastes, lower emissions of hazardous pollutants into the air and water, and consequently a reduction in the negative environmental effects of industrial activity. A number of international initiatives highlight the importance of reducing, eliminating and managing hazardous materials and residues properly. An example is the Green Industry Initiative of UNIDO.	
Calculation: The percentage of establishments using hazardous materials is calculated by dividing the number of industrial establishments using hazardous materials by the total number of establishments surveyed, and multiplying the result by 100. $\text{GPI3 \%} = [(\text{number of establishments using hazardous materials})/(\text{total number of establishments surveyed})]*100$	
Interpretation: Green production should tend to reduce or eliminate the use of hazardous materials, provided industrial processes so permit with the technology available at a given moment	
Limitations: The technology needed for reducing the use of hazardous materials may not be equally available and accessible in different countries of the region or in the various regions of the same country, an aspect that must be taken into account in interpreting the results of the indicator. On the other hand, the type of final product produced will in some cases determine the need to use such materials, a factor that must also be taken into account when comparing the results of the indicator across the different regions of a country, and across countries.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of product produced	
Proposed data source: Establishment surveys	
Model question: Does your establishment use hazardous materials in its production process?	
Proposed frequency: Annual	

GPI4.	Proportion of hazardous raw materials used
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources - Raw materials and other inputs
Priority:	Low
Definition:	Hazardous raw materials used as a proportion of total raw materials used.
Units of measurement or expression of the indicator:	Percentage (%) of hazardous raw materials used compared to total raw materials used.
Definition and clarifications:	<p>A hazardous material is any solid, liquid or gaseous substance that, by its physical, chemical or biological characteristics, can cause damage to human beings, the environment, or property (United Nations, 2011b).</p> <p>The <u>use or utilization</u> of raw materials is the quantity of raw materials incorporated by an economic unit</p>
Relevance of the indicator:	<p>The objective of this indicator is to evaluate the magnitude of hazardous raw materials used in industrial processes. Environmental policies should encourage a reduction in environmental pollution at source. One of the principal ways for achieving this is to reduce the quantity of hazardous materials used in industrial processes, as these are associated with negative environmental effects.</p> <p>A number of international initiatives highlight the importance of reducing, eliminating and adequately managing hazardous materials and the hazardous residues they generate. An example is the green industry initiative of UNIDO.</p>
Calculation:	<p>The percentage of hazardous materials used is calculated by dividing the quantity of hazardous materials used in industrial establishments by the total quantity of raw materials used and then multiplying the result by 100.</p> $\text{GPI4 \%} = \left[\frac{\text{quantity of hazardous materials used}}{\text{total quantity of raw materials used}} \right] * 100$
Interpretation:	Green production should tend to reduce or eliminate the use of hazardous materials as far as possible, provided industrial processes so permit with the technology available at a given moment.
Limitations:	<p>The technology needed for reducing the use of hazardous materials may not be equally available and accessible in different countries of the region or in the various regions of the same country, an aspect that must be taken into account in interpreting the results of the indicator.</p> <p>On the other hand, the type of final product produced will determine the need to use such materials, a factor that must also be taken into account when comparing the results of the indicator across regions or countries</p>
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of product produced
Proposed data source:	Establishment surveys
Model questions:	What is the quantity of raw materials used in one year in your establishment? What is the total quantity of hazardous raw materials used in your establishment in one year
Proposed frequency:	Annual

GPI5.	Intensity of use of containers and packaging for the final product
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources - Raw materials and other inputs
Priority:	Low
Definition:	The intensity of packaging use for the final product is the quantity of packaging purchased or manufactured in the establishment and used for the sole purpose of presenting the final product for distribution and marketing, by unit of gross value added.
Units of measurement or expression of the indicator:	Tonnes of packaging materials acquired or manufactured/monetary units of gross value of production
Definition of the variables that comprise the indicator:	<p>Packaging means all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. "Non-returnable" items used for the same purposes will also be considered to constitute packaging (European Communities, 1994).</p> <p>The gross value added of production is the value created or added in the production process.</p>
Relevance of the indicator:	<p>In the context of green production, minimizing the packaging used for the final product means reducing the raw materials used and the quantity of wastes generated after final consumption of the products, with a consequent reduction in the associated adverse environmental effects.</p> <p>There are currently a number of policy initiatives seeking to reduce multiple packaging of the same product, recognizing that over-packaging does not increase the value of the product. Legislative initiatives can be a useful tool for promoting a change in this area.</p> <p>An example of international initiatives concerning this indicator is the Green Industry Initiative of UNIDO.</p>
Calculation:	<p>The intensity of packaging use is calculated by dividing the quantity of packaging used in one year by the gross value of production in that year.</p> <p>$GPI5 = \text{quantity of packaging materials used} / \text{GVA}$</p>
Interpretation:	This indicator should tend to decline over time, with a consequent reduction in the unnecessary use of raw materials destined for packaging of products.
Limitations:	this indicator does not take into account the type of packaging used or its characteristics: consequently, a breakdown to determine whether the packaging proceeds from recycled materials and to assess its degree of biodegradability is recommended wherever possible.
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of container and packaging materials, and specifically for those that are biodegradable.
Proposed data source:	Establishment surveys
Model question:	What is the quantity of packaging used in one year for the presentation of the final product produced in your establishment?
Proposed frequency:	Annual

GPI6.	Proportion of establishments using recycled raw materials*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources - Raw materials and other inputs
Priority:	High
Definition:	Proportion of Industrial establishments using recycled raw materials.
Units of measurement or expression of the indicator:	Percentage (%) of industrial establishments using recycled raw materials.
Definition of the variables that comprise the indicator:	<p>The <u>raw materials and materials</u> that enter into production processes constitute a flow of materials that includes raw materials of natural origin, prepared products, and residues originating with other economic units.</p> <p><u>Recycling</u> may be defined as a set of mechanical or chemical processes capable of transforming wastes into new raw materials (United Nations and others, 2014).</p>
Relevance of the indicator:	<p>The objective of this indicator is to determine whether the new products derived from recycling are being incorporated into the production processes.</p> <p>In the green production context, encouraging the separation of wastes at origin and their subsequent recycling should result in the incorporation of the recycled materials into the production processes. In some cases, government intervention may be needed to ensure that this cycle is complete.</p>
Calculation:	<p>The percentage of industrial establishments using recycled raw materials is calculated by dividing the number of industrial establishments using recycled raw materials by the total number of establishments surveyed, and multiplying the result by 100.</p> $\text{GPI6 \%} = [(\text{number of establishments using recycled raw materials})/(\text{total number of establishments surveyed})]*100$
Interpretation:	The use of recycled raw materials minimizes the extraction of materials from the natural environment and hence their negative impacts, meaning significant progress toward green production.
Limitations:	The increasingly widespread use of some products derived from recycling, for example recycled paper, may distort the interpretation of this indicator, and consequently indicator GPI7 must be taken into account to obtain an overall view of the use of these raw materials of lesser environmental impact.
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of product produced. Breakdown by type of raw material used.
Proposed data source:	Establishment surveys
Model question:	Does your establishment use recycled raw materials?
Proposed frequency:	Annual

GPI7.	Proportion of recycled raw materials used *
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources - Raw materials and other inputs
Priority:	High
Definition:	Recycled raw materials used as a proportion of total raw materials used.
Units of measurement or expression of the indicator:	Percentage (%) of total raw materials used that are derived from recycling
Definition of the variables that comprise the indicator:	<p>The <u>raw materials and materials</u> that enter into production processes constitute a flow of materials that includes raw materials of natural origin, prepared products, and residues originating with other economic units.</p> <p><u>Recycling</u> may be defined as a set of mechanical or chemical processes capable of transforming wastes into new raw materials (United Nations and others, 2014).</p>
Relevance of the indicator:	<p>The objective of this indicator is to determine the degree to which products derived from recycling are being incorporated into the production processes.</p> <p>In the green production context, encouraging the separation of wastes at origin and their subsequent recycling should result in the incorporation of recycled materials into the production processes. In some cases, government intervention may be needed to ensure that this cycle is complete.</p> <p>This indicator is included among the indicators of the UNIDO Green Industry Initiative.</p>
Calculation:	<p>The percentage of raw materials derived from recycling is calculated by dividing the quantity of recycled raw materials used by the total quantity of raw materials used, and then multiplying the result by 100.</p> <p>$GPI7 \% = [(quantity\ of\ recycled\ raw\ materials\ used)/(total\ quantity\ of\ raw\ materials\ used)] * 100$</p>
Interpretation:	<p>At the present time, the common use of some products derived from recycling may distort the interpretation of the GPI6 indicator. Consequently, this indicator is intended to supplement the previous one and to offer a quantitative measure of the degree to which recycled raw materials are being used in production processes.</p>
Limitations:	<p>In some industrial processes it is not possible, with the current technology, to use recycled raw materials, a point that must be borne in mind in interpreting the indicator.</p>
Disaggregations:	<p>Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of product produced. Breakdown by type of raw material used</p>
Proposed data source:	Establishment surveys
Model question:	What is the quantity of recycled raw materials used in your establishment in the previous year?
Proposed frequency:	Annual

GPI8.	Proportion of establishments using residues from other firms as raw material (except for energy production)
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources - Raw materials and other inputs
Priority:	Low
Definition: Proportion of industrial establishments using residues from other firms as raw material in their production process, except for their use in producing energy.	
Units of measurement or expression of the indicator: Percentage (%) of industrial establishments using wastes from other firms as raw materials.	
Definition of the variables that comprise the indicator: <u>Residues</u> are materials that are of no use to the economic unit that generated them in terms of its own production, transformation or consumption, and which it wants to dispose of. Residues differ from wastes in that they are marketed to another firm for incorporation into its production process. The <u>raw materials and materials</u> that enter into production processes constitute a flow of materials that includes raw materials of natural origin, prepared products, and residues originating with other economic units.	
Relevance of the indicator: The objective of this indicator is to evaluate the importance of intercompany trade in residues for incorporation into production processes. The exchange of residues between firms can take place voluntarily, or it can be ordered and organized through government intervention.	
Calculation: The percentage of industrial establishments using residues from other firms as raw materials is calculated by dividing the number of such industrial establishments by the total of firms surveyed and multiplying the result by 100. $\text{GPI8 \%} = [(\text{number of establishments using residues from other firms as raw materials}) / (\text{total number of establishments surveyed})] * 100$	
Interpretation: The growing use of residues by companies is related to the greening of industrial production, as it reduces the extraction of natural resources and minimizes the amount of wastes generated, as well as the need to manage those wastes. The interpretation of this indicator must take into account the evolution of GPI49. It is important to note that this indicator does not include the exchange of residues between different establishments of the same firm, as this practice is subject to different considerations than the exchange of residues among distinct firms. Nor does it include exchanges for the purpose of energy production.	
Limitations: Circumstances beyond a firm's control may sometimes impede the use of residues in industrial processes (for example, there may be no suitable residues available nearby, the firm may be unaware of their existence, or there may be no regulation governing such use). These aspects must be taken into account in comparing the results of the indicator across regions of a country and between countries.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of product produced.	
Proposed data source: Establishment surveys	
Model question: Does your establishment use raw materials derived from residues of other firms?	
Proposed frequency: Annual	

GPI9.	Proportion of raw material inputs derived from residues of other firms (except for energy production).
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources - Raw materials and other inputs
Priority:	Low
Definition: Raw material inputs derived from the residues of other firms as a proportion of total raw materials used, except those intended for energy production.	
Units of measurement or expression of the indicator: Percentage (%) of total raw material inputs that are derived from the residues of other firms, except those intended for energy production.	
Definition of the variables that comprise the indicator: <u>Residues</u> are materials which are of no use to the economic unit that generated them in terms of its own production, transformation or consumption, and which it wants to dispose of. Residues differ from wastes in that they are marketed to another firm for incorporation into its production process. The <u>raw materials and materials</u> that enter into production processes constitute a flow of materials that includes raw materials of natural origin, prepared products, and residues originating with other economic units.	
Relevance of the indicator: The objective of this indicator is to evaluate the importance of intercompany exchanges of wastes for incorporation into production processes (except those intended for energy production). The scale of these exchanges as a proportion of total raw material inputs will reflect their true repercussions on the environment. The exchange of residues between firms can take place voluntarily, or it can be ordered and organized through government intervention.	
Calculation: The percentage of raw materials derived from residues of other firms (except those intended for energy production) is calculated by dividing the quantity of such materials by the total quantity of raw materials used, and then multiplying the result by 100. $\text{GPI9 \%} = [\text{quantity of raw materials derived from residues of other firms, except those intended for energy production}] / [\text{total quantity of raw materials used}] * 100$	
Interpretation: The growing use of residues by companies is related to the greening of industrial production, as it reduces the extraction of natural resources and minimizes the amount of wastes generated, as well as the need to manage those wastes. It is important to note that this indicator does not include the exchange of residues between different establishments of the same firm, as this practice is subject to different considerations than the exchange of residues among distinct firms. Nor does it include exchanges for the purpose of energy production.	
Limitations: Circumstances beyond a firm's control may sometimes impede the use of residues in industrial processes (for example, there may be no suitable residues available nearby, the firm may be unaware of their existence, or there may be no regulation governing such use). These aspects must be taken into account in comparing the results of the indicator across regions of the country and between countries.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of product produced.	
Data sources:	Establishment surveys
Model questions: What is the quantity of raw materials derived from the residues of other firms used in your establishment in the previous year? What is the total quantity of raw materials used in the previous year?	
Proposed frequency: Annual	

GPI10.	Proportion of firms purchasing products with certification or eco-label *
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources - Raw materials and other inputs
Priority:	High
Definition: Firms purchasing products with certification or eco-label as a proportion of all firms.	
Units of measurement or expression of the indicator: Percentage (%) of firms purchasing products with certification or eco-label.	
<p>Definition of the variables that comprise the indicator:</p> <p><u>Purchases of products with certification or eco-label</u> are those purchases that take into account the environmental criterion and not only the economic one.</p> <p><u>Environmental certifications</u> are granted by accredited certifying agencies to those firms that comply with certain procedures and work habits that take into account environmental protection and sustainable development, under what is known as a system of environmental management.</p> <p><u>Eco-labelling</u> is a system of consumer product certification that consumers can recognize as reflecting sustainability in the production of such products.</p>	
<p>Relevance of the indicator. The objective of this indicator is to evaluate the importance of the market for products with certifications and eco-labels, and the extent to which firms are giving priority to incorporating these products into their production processes.</p> <p>The results of this indicator can be used to evaluate national policies for regulating products that have been produced in accordance with certain sustainability criteria. If there is no observed increase over time in purchases of products of this kind, this may pose the need to intervene in various ways (improve information on such products, improve their publicity, or reduce taxes on them in order to lower their final price).</p> <p>This indicator takes as reference the sustainable procurement indicator developed by UNEP as one of its green economy indicators. It is confined to certified or eco-labelled products, recognizing the current limitations on the sustainable procurement concept.</p>	
<p>Calculation: The percentage of firms purchasing certified or eco-labelled products is calculated by dividing the number of such by the total number of firms surveyed, and multiplying the result by 100.</p> $\text{GPI10 \%} = [(\text{number of firms purchasing certified or eco-labelled products}) / (\text{total number of firms surveyed})] * 100$	
<p>Interpretation: Procurement of sustainable products in general, and of certified or eco-labelled products in particular, can reveal a firm's environmental awareness in this regard, recognizing that the prices of certified products are generally higher than those for products produced in a less sustainable manner.</p>	
<p>Limitations: Certified or eco-labelled products are not uniformly available in all countries of the region, and a cross-country comparison of the results of this indicator must take this circumstance into account. Moreover, in some countries certification or eco-labelling may be mandatory for some products (e.g. energy certifications for certain appliances) and this too must be taken into account in comparing the indicator across countries.</p>	
<p>Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of product produced. Breakdown by category of certified or eco-labelled product.</p>	
Proposed data source: Company surveys	
Model questions: Does your firm purchase certified or eco-labelled products? Does your firm use certified or eco-labelled products?	
Proposed frequency: Every two years	

GPI11.	Proportion of purchases with certification or eco-label
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources - Raw materials and other inputs
Priority:	Low
Definition: Purchases of certified or eco-labelled products as a proportion of total procurement.	
Units of measurement or expression of the indicator: Percentage (%) of a firm's total procurement that consists of products with certification or eco-label	
<p>Definition of the variables that comprise the indicator:</p> <p><u>Purchases of products with certification or eco-label</u> are those purchases that take into account the environmental criterion and not only the economic one.</p> <p><u>Environmental certifications</u> are granted by accredited certifying agencies to those firms that comply with certain procedures and work habits that take into account environmental protection and sustainable development, under what is known as a system of environmental management.</p> <p><u>Eco-labelling</u> is a system of consumer product certification that consumers can recognize as reflecting sustainability in the production of such products. Source: Prepared by the authors.</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to evaluate the scope of purchases of products with certifications and eco-labels, in order to assess the extent to which firms are giving priority to incorporating these products into their production processes.</p> <p>The results of this indicator can be used to evaluate national policies for regulating products that have been produced in accordance with certain sustainability criteria. If there is no observed increase over time in purchases of products of this kind, this may pose the need to intervene in various ways (improve information on such products, improve their publicity, or reduce taxes on them in order to lower their final price).</p> <p>This indicator takes as a benchmark the sustainable procurement indicator developed by UNEP as one of its green economy indicators. It is confined to certified or eco-labelled products, recognizing the current limitations on the sustainable procurement concept.</p>	
<p>Calculation: The percentage of purchases of certified or eco-labelled products is calculated by dividing expenditure on procurement of such products by total procurement outlays, and multiplying the result by 100.</p> $\text{GPI11 \%} = [(\text{expenditure on purchases of certified or eco-labelled products})/(\text{total procurement expenditure})] \times 100$	
<p>Interpretation: The scale of procurement of sustainable products in general, and of certified or eco-labelled products in particular, can reveal a firm's environmental awareness in this regard, recognizing that the prices of certified products are generally higher than those for products produced in a less sustainable manner. This indicator supplements the interpretation of indicator GPI10.</p>	
<p>Limitations: Certified or eco-labelled products are not uniformly available in all countries of the region, and a cross-country comparison of the results of this indicator must take this circumstance into account. Moreover, in some countries certification or eco-labelling may be mandatory for some products (e.g. energy certifications for certain appliances) and this too must be taken into account in comparing the indicator across countries.</p>	
<p>Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of product produced. Breakdown by category of certified or eco-labelled product.</p>	
Data source:	Company surveys
<p>Model questions: What was the monetary value of purchases of certified or eco-labelled products in the previous year? What was the monetary value of total procurement by the firm in that same period?.</p>	
Proposed frequency: Every two years	

GPI12.	Intensity of water use*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Water
Priority:	High
Definition: the intensity of water use is the annual volume of water used in the production process per unit of gross value added in production.	
Units of measurement or expression of the indicator: cubic metres of water used/gross value added in monetary units	
<p>Definition of the variables that comprise the indicator:</p> <p><u>Water used</u> in an industrial establishment includes water supplied by other economic units (delivered for example via the supply network or by tank truck) and water supplied by the economic unit itself (from surface or groundwater, rainwater and seawater desalinated in the establishment itself). Water used does not include water sold or given to other economic units.</p> <p><u>Gross value added of production</u> is the value created or added in the production process</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to determine whether there is a decoupling between water use and production. In a green production context, production must require increasingly less use of water in order to minimize extraction of the resource, the discharge of wastewater, and the treatment of wastewater.</p> <p>It is important to note that the list of indicators proposed for evaluating fulfillment of the Sustainable Development Goals approved by the United Nations includes an indicator of the percentage change in the efficiency of water use, within Goal 6, Ensure access to water and sanitation for all.</p>	
<p>Calculation:</p> <p>The intensity of water use is calculated by dividing the volume of water used in one year by the gross value of production generated in that same period of time.</p> <p>Water used is the sum of water supplied by other economic units plus water supplied by the economic unit itself less water sold or given to other economic units.</p> <p>$GPI12 = \text{Water used} / GVA = [(\text{water supplied by other economic units} + \text{water supplied by the economic unit itself}) - \text{Water sold or given to other units}] / GVA$</p>	
<p>Interpretation: Consistent with the green production criteria, the intensity of water use should tend to decline over time, meaning that greater production is derived from the same or lesser volume of water used. For a correct interpretation, the value of indicator GPI14 concerning total water use in industrial installations should be taken into account.</p>	
<p>Limitations: Calculation of the indicator must consider all the water used in the entire industrial activity, and not only in the production process. Thus, depending on the case, it will include water used in ancillary operations such as in the cleaning and hosing down of installations, activities that can consume considerable volumes of water. This may give rise to erroneous interpretations in situations where production processes consume little water and other processes use greater volumes of water.</p>	
<p>Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of product produced. Breakdown by origin of the water used (water supplied by other units or water supplied by the economic unit itself).</p>	
Proposed data source: Establishment surveys	
<p>Model questions:</p> <p>What is the volume of water used annually in your establishment? What is the volume of water supplied annually to your establishment by other economic units? What is the annual volume of water abstracted from the natural environment by your establishment? What is the volume of water sold or given to other economic units?</p>	
Proposed frequency: Annual	

GPI13.	Water productivity*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Water
Priority:	High
Definition:	Water productivity is the gross value added generated per unit by volume of water used.
Units of measurement or expression of the indicator:	Monetary units of gross value added in production/cubic metres of water used
Definition of the variables that comprise the indicator:	<p><u>Water used</u> in an industrial establishment includes water supplied by other economic units (delivered for example via the supply network or by tank truck) and water supplied by the economic unit itself (from surface or groundwater, rainwater and seawater desalinated in the establishment itself). Water used does not include water sold or given to other economic units.</p> <p><u>Gross value added of production</u> is the value created or added in the production process</p>
Relevance of the indicator:	<p>The objective of this indicator is to determine whether there is a decoupling between water use and production. In a green production context, production must require increasingly less use of water in order to minimize extraction of the resource, the discharge of wastewater, and the treatment of wastewater</p> <p>A number of international initiatives have addressed this theme. In particular, the list of indicators proposed for evaluating fulfillment of the Sustainable Development Goals approved by the United Nations includes an indicator of the percentage change in the efficiency of water use, within Gal 6, Ensure availability and sustainable management of water and sanitation for all. The theme is also included in other initiatives such as the UNIDO-UNEP company-level indicators for resource productivity and pollution intensity and the OECD green growth indicators.</p>
Calculation:	<p>Water productivity is calculated by dividing the gross value of production generated in one year by the volume of water used in one year. Water used is the sum of water supplied by other economic units plus water supplied by the economic unit itself less water sold or given to other economic units.</p> <p>$GPI13 = GVA / \text{Water used} = [(\text{water supplied by other economic units} + \text{water supplied by the economic unit itself}) - \text{Water sold or given to other units}]$</p>
Interpretation:	Consistent with the green production criteria, water productivity should tend to rise over time, meaning that greater production is derived from the same or lesser volume of water used. For a correct interpretation, the value of indicator GPI14 concerning total water use in industrial installations should be taken into account.
Limitations:	Calculation of the indicator must consider all the water used in the entire industrial activity, and not only in the production process. Thus, depending on the case, it will include water used in ancillary operations such as in the cleaning and hosing down of installations, activities that can consume considerable volumes of water. This may give rise to erroneous interpretations in situations where production processes consume little water and other processes use greater volumes of water
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of product produced. Breakdown by origin of the water used (water supplied by other units or water supplied by the economic unit itself).
Proposed data source:	Establishment surveys
Model questions:	What is the volume of water used annually in your establishment? What is the volume of water supplied annually to your establishment by other economic units? What is the annual volume of water abstracted from the natural environment by your establishment? What is the volume of water sold or given to other economic units?
Proposed frequency:	Annual

GPI14.	Total water use
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Water
Priority:	Low
Definition:	Total water use is the total amount of water used annually by the manufacturing industry
Units of measurement or expression of the indicator:	Total cubic metres of water used
Definition of the variables that comprise the indicator:	<p><u>Water used</u> in an industrial establishment includes water supplied by other economic units (delivered for example via the supply network or by tank truck) and water supplied by the economic unit itself (from surface or groundwater, rainwater and seawater desalinated in the establishment itself). Water used does not include water sold or given to other economic units.</p>
Relevance of the indicator:	<p>The objective of this indicator is to evaluate whether there is an absolute decoupling with respect to the water resource, i.e. to determine whether output grows in a manner parallel to a reduction in the volume of water used. This makes it possible to evaluate the extent to which the resource is being used responsibly.</p> <p>Water management policies should give priority to reducing water use in absolute terms.</p> <p>Some international initiatives include indicators on this point. They include the UNIDO Green Industry Initiative and indicators of the Latin American and Caribbean Initiative for Sustainable Development (ILAC)</p>
Calculation:	<p>Total water use is calculated as the sum of water supplied by other units plus water abstracted from the natural environment by the economic unit itself, less water sold or supplied to other units.</p> <p>$GPI14 = [(Water\ supplied\ by\ other\ units + Water\ self-supplied - Water\ sold\ or\ supplied\ to\ other\ units)]$</p>
Interpretation:	<p>The change in water use will show whether there is an absolute decoupling of production from use of this resource. Absolute decoupling implies that production rises as water use declines.</p>
Limitations:	<p>As this indicator offers no information on production, in order to evaluate its trend correctly, water use must be compared with the gross value of production. In a green production context, production should rise over time while water consumption declines.</p>
Disaggregations:	<p>Breakdown by region or by geographical zone. Break down by economic activity. Breakdown by source of water (distinguishing between water supplied and water abstracted, and by origin of water abstracted).</p>
Proposed data source:	Establishment surveys
Model questions:	<p>How much water does your establishment abstract from the natural environment? How much water is supplied by other economic units? How much water is sold or supplied to other economic units?</p>
Proposed frequency:	Annual

GPI15.	Proportion of recycled water used*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Water
Priority:	High
Definition:	Recycled water used as a proportion of total water used.
Units of measurement or expression of the indicator:	Percentage (%) of recycled water in total water used by the manufacturing sector.
Definition of the variables that comprise the indicator:	<p><u>Water used</u> in an industrial establishment includes water supplied by other economic units (delivered for example via the supply network or by tank truck) and water supplied by the economic unit itself (from surface or groundwater, rainwater and seawater desalinated in the establishment itself). Water used does not include water sold or given to other economic units.</p> <p><u>Recycled water</u> is water that is reused within the same establishment for the same or other industrial process (United Nations and others, 2014).</p>
Relevance of the indicator:	<p>Information on the proportion of water recycled is useful for analyzing the efficiency of water use. Generally speaking, an increase in the volume of recycled water presupposes a decrease in other sources of water supply and a lower volume of wastewater generated and treated, with the consequent savings in energy and materials in each of these phases.</p> <p>This indicator is included in the set of indicators of the UNIDO Green Industry Initiative.</p>
Calculation:	<p>The proportion of recycled water used is calculated by dividing the total volume of recycled water used by the total volume of water used, and multiplying the result by 100.</p> $\text{GPI15 \%} = [(\text{volume of recycled water used})/(\text{total volume of water used})]*100$ $\text{GPI15 \%} = [(\text{volume of recycled water used})/\text{GPI14}]*100$
Interpretation:	In a green production context, the proportion of recycled water to the total volume of water used should increase over time.
Limitations:	<p>It is not legally or technically feasible to use recycled water in some processes (such as in the manufacture of bottled beverages), and the interpretation of the indicator must take this factor into account. Moreover, it must be borne in mind that the abundance of water in some countries or regions discourages its recycling.</p> <p>Lastly, the price of water can influence the industrial decision to implement water recycling, and therefore the impact of water pricing must be taken into consideration</p>
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity.
Proposed data source:	Establishment surveys
Model questions:	How much recycled water does your establishment use annually? What is the total volume of water used?
Proposed frequency:	Annual

GPI16.	Proportion of establishments using rainwater
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Water
Priority:	Low
Definition:	Proportion of all industrial establishments that use rainwater in their installations.
Units of measurement or expression of the indicator:	Percentage (%) of total industrial establishments that use rainwater.
Definition of the variables that comprise the indicator:	<u>Rainwater</u> is water that comes from natural precipitation and is characterized by having passed through an atmospheric column.
Relevance of the indicator:	<p>The objective of this indicator is to assess the extent to which rainwater is used as a source of water supply in industrial installations.</p> <p>There may on occasion be regulatory, technical and market rigidities that impede the installation of innovative technologies, including those for using rainwater. Because of this, policymakers may promote policies for improving water management and encouraging the use of alternative resources such as this one.</p>
Calculation:	<p>The percentage of industrial establishments using rainwater is calculated by dividing the number of such industrial establishments by the total number of establishments surveyed, and multiplying the result by 100.</p> <p>$GPI16 \% = [(number\ of\ establishments\ using\ rainwater)/(total\ number\ of\ establishments\ surveyed)] * 100$</p>
Interpretation:	<p>The conventional use of rainwater will yield a basic result for this indicator. However, its evolution over time will show the extent to which this resource is being used as an alternative resource and whether it is becoming an important source of water in the manufacturing industry. For a correct interpretation of the indicator, GPI 17 should be taken into account.</p> <p>.</p>
Limitations:	<p>In some countries, this indicator may have low values because of scarce rainfall, the technology available, or lack of a habit of using this resource. A correct assessment of this indicator may require additional information on the real reason for low usage of this source of supply.</p>
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity
Proposed data source:	Establishment surveys
Model questions:	Does your establishment make use of rainwater? Does it have facilities for collecting and storing rainwater?
Proposed frequency:	Annual

GPI17.	Proportion of rainwater used
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Water
Priority:	Low
Definition: Rainwater use as a proportion of total water use	
Units of measurement or expression of the indicator: Rainwater use as a percentage (%) of total water use in the manufacturing sector	
Definition of the variables that comprise the indicator: <u>Rainwater</u> is water that comes from natural precipitation and is characterized by having passed through an atmospheric column. <u>Water used</u> in an industrial establishment includes water supplied by other economic units (delivered for example via the supply network or by tank truck) and water supplied by the economic unit itself (from surface or groundwater, rainwater and seawater desalinated in the establishment itself). Water used does not include water sold or given to other economic units	
Relevance of the indicator: The objective of this indicator is to evaluate the degree to which rainwater is used as a source of water supply in industrial installations. There may on occasion be regulatory, technical and market rigidities that impede the installation of innovative technologies, including those for using rainwater. Because of this, policymakers may promote policies for improving water management and encouraging the use of alternative resources such as this one. The importance of using alternative resources such as this has been recognized in various international initiatives. Specifically, this indicator is included in the UNIDO Green Industry Initiative.	
Calculation: The proportion of rainwater use is calculated by dividing the volume of rainwater used by the total volume of water used and multiplying the result by 100. $\text{GPI17 \%} = [(\text{volume of rainwater used})/(\text{total volume of water used})]*100$ $\text{GPI 17 \%} = [(\text{volume of rainwater used})/ \text{GPI14}]*100$	
Interpretation: The conventional use of rainwater will yield a basic result for this indicator. However, its evolution over time will show the extent to which this resource is being used as an alternative resource and whether it is becoming an important source of water in the manufacturing industry. For a correct interpretation of the indicator, GPI 16 should be taken into account.	
Limitations: In some countries, this indicator may have low values because of scarce rainfall, the technology available, or lack of a habit of using this resource. A correct assessment of this indicator may require additional information on the real reason for low usage of this source of supply	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity.	
Proposed data source: Establishment surveys	
Model questions: What volume of rainwater does your establishment used annually? What is the total volume of water used?	
Proposed frequency: Annual	

GPI18.	Proportion of desalinated water used
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Water
Priority:	Low
Definition: Desalinated water use as a proportion of total water use	
Units of measurement or expression of the indicator: Desalinated water use as a percentage (%) of total water used in the manufacturing sector	
Definition of the variables that comprise the indicator: <u>Desalinated water</u> is water obtained by subjecting seawater or brackish water to a process for eliminating salts. <u>Water used</u> in an industrial establishment includes water supplied by other economic units (delivered for example via the supply network or by tank truck) and water supplied by the economic unit itself (from surface or groundwater, rainwater and seawater desalinated in the establishment itself). Water used does not include water sold or given to other economic units	
Relevance of the indicator: Current technology allows seawater or brackish water to be desalinated to yield water that can be used in virtually any industrial process. The relative importance of this resource varies as a function of many factors, but it is clear that desalinated water is being increasingly used as an alternative source of water supply. This indicator is one of those proposed in the Latin American and Caribbean Initiative for Sustainable Development (ILAC).	
Calculation: The proportion of desalinated water used is calculated by dividing the total annual volume of desalinated water used by the total annual volume of water used, and multiplying the result by 100. $\text{GPI18 \%} = [(\text{annual volume of desalinated water used})/(\text{total volume of water used})]*100$ $\text{GPI18 \%} = [(\text{annual volume of desalinated water used})/\text{GPI14}]*100$	
Interpretation: In general, in a green production context, the use of alternative water supply sources is related to a lesser environmental impact of productive activities. Consequently, the increase in the volume of desalinated water used must be interpreted as positive, as it implies a reduction in freshwater abstraction thereby releasing a portion of that resource for other purposes.	
Limitations: The high costs of desalination make this process viable only under certain conditions and for certain firms. In addition, the requirement for a suitable geographical situation limits the possibility of using seawater and brackish water as a source of supply. These two factors are very important for interpreting the results of the indicator correctly.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity.	
Proposed data source: Establishment surveys	
Model questions: What volume of desalinated water is used in your establishment annually? What is the total volume of water used?	
Proposed frequency: Annual	

GPI19.	Energy intensity*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Energy
Priority:	High
Definition: energy intensity is the quantity of energy consumed in generating one unit of gross value added in production.	
Units of measurement or expression of the indicator: Megajoules (MJ) of energy consumed / monetary unit of gross value of production	
<p>Definition of the variables that comprise the indicator:</p> <p><u>Energy consumption</u> is the total quantity of energy incorporated into the production process, and includes electric power from the network, energy generated from conventional fuels (coal, wood, natural gas, gasoline etc.), energy generated by the combustion of biofuels and residues, and renewable energy generated in the installation itself. Excluded from this concept is energy consumed in transportation of the final product if this is done by the establishment itself: this exclusion allows for comparability of the results regardless of whether transportation of final products is outsourced or not.</p> <p><u>The gross value added of production</u> is the value created or added in the production process.</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to determine whether there is a decoupling between energy consumption and production. The list of indicators proposed for evaluating fulfillment of the Sustainable Development Goals approved by the United Nations includes an indicator of energy intensity measured in terms of primary energy, with the objective of assessing the improvement in energy consumption efficiency. This indicator refers to Goal 7, Ensure access to affordable, reliable, sustainable and modern energy for all.</p> <p>This indicator is included in the set of indicators in the UNIDO Green Industry Initiative, in the Green Economy United Nations Development Account project, and in the OECD green growth indicators.</p>	
<p>Calculation: energy intensity is calculated by dividing the quantity of energy consumed in one year by the gross value of production generated in that same year.</p> <p>$GPI19 = \text{Energy consumed in one year} / \text{GVA}$</p>	
<p>Interpretation: According to green production criteria, energy intensity should tend to decline over time, implying lower consumption of energy to obtain the same or greater production.</p>	
<p>Limitations:</p> <p>Because the indicator includes different sources of energy, it cannot be used to determine the environmental effect of each source. The use of fuels such as coal or wood and the production of solar energy entail very different environmental effects that are not taken into account in this indicator. Consequently, a correct interpretation of the indicator must take into account indicators GPI21, GPI22, GPI23 and GPI 24.</p> <p>Moreover, because it covers total consumption, it does not identify consumption associated with ancillary activities, nor does it distinguish between the purposes of consumption (for example, for heating or cooling) and thus comparisons across regions and countries must take into account these possible differences.</p>	
<p>Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of fuel used or type of renewable energy.</p>	
<p>Proposed data source: Establishment surveys</p>	
<p>Model questions:</p> <p>What is the total quantity of energy consumed in one year? What is the annual consumption by type of fuel ?</p>	
<p>Proposed frequency: Annual</p>	

GPI20.	Energy productivity*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Energy
Priority:	High
Definition: Energy productivity is the gross value added of production generated per unit of energy consumed.	
Units of measurement or expression of the indicator: monetary units of gross value added of production / Megajoules (MJ) of energy consumed	
<p>Definition of the variables that comprise the indicator:</p> <p><u>Energy consumption</u> is the total quantity of energy incorporated into the production process, and includes electric power from the network, energy generated from conventional fuels (coal, wood, natural gas, gasoline etc.), energy generated by the combustion of biofuels and residues, and renewable energy generated in the installation itself. Excluded from this concept is energy consumed in transportation of the final product if this is done by the establishment itself: this exclusion allows for comparability of the results regardless of whether transportation of the final product is outsourced or not.</p> <p><u>The gross value added of production</u> is the value created or added in the production process.</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to determine whether there is a decoupling between total energy consumption and production of the manufacturing sector.</p> <p>Energy productivity is an indicator included in numerous international initiatives such as the UNIDO Green Industry Initiative, the Green Economy United Nations Development Account project, the OECD green growth indicators, the enterprise-level indicators for resource productivity and pollution intensity (UNIDO-UNEP), the indicators proposed by the Latin American and Caribbean Initiative for Sustainable Development (ILAC) and the Green economy indicators developed by the United Nations Environment Programme (UNEP).</p>	
<p>Calculation:</p> <p>Energy productivity is calculated by dividing gross value added by energy consumed in one year.</p> <p>$GPI20 = GVA / \text{energy consumed in one year}$</p>	
<p>Interpretation: According to green production criteria, energy productivity should tend to rise over time, implying lower consumption of energy to achieve the same or greater production</p>	
<p>Limitations:</p> <p>Because the indicator includes different sources of energy, it cannot be used to determine the environmental effect of each source. The use of fuels such as coal or wood and the production of solar energy entail very different environmental effects that are not taken into account in this indicator. Consequently, a correct interpretation of the indicator must take into account indicators GPI21, GPI22, GPI23 and GPI 24.</p> <p>Moreover, because it covers total consumption, it does not identify consumption associated with ancillary activities, nor does it distinguish between the purposes of consumption (for example, for heating or cooling) and thus comparisons across regions and countries must take into account these possible differences.</p>	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of fuel used or type of renewable energy	
Proposed data source: Establishment surveys	
Model questions: What is the total quantity of energy consumed in one year? What is the annual consumption by type of fuel?	
Proposed frequency: Annual	

GPI21.	Proportion of firms producing renewable energy*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Energy
Priority:	High
Definition:	Firms producing renewable energy in their installations as a proportion of all firms
Units of measurement or expression of the indicator:	Percentage (%) of firms producing renewable energy.
Definition of the variables that comprise the indicator:	<u>Renewable energy</u> is captured from sources that replenish themselves. It includes solar (photovoltaic and thermal), hydroelectric, geothermal, tidal action, wave action, marine (non-tidal currents, temperature differences and salinity gradients), wind and biomass energy (UNSD, 2016).
Relevance of the indicator:	<p>The objective of this indicator is to reveal the degree of implementation of renewable energy production in the manufacturing sector.</p> <p>Energy policies should encourage the production of renewable energy with a view to reducing dependence on fossil fuels. To encourage this production governments may, among other things, introduce financial subsidies for the investment necessary for their implementation.</p> <p>This indicator is considered in various international initiatives such as the Green Economy United Nations Development Account project and the OECD green growth indicators</p>
Calculation:	<p>The percentage of firms producing renewable energy is calculated by dividing the number of such firms by the total of firms surveyed, and multiplying the result by 100.</p> $\text{GPI21 \%} = [(\text{number of firms producing renewable energy})/(\text{total number of firms surveyed})]*100$
Interpretation:	One of the pillars of green production is a reduction in energy dependence on nonrenewable fossil fuels. To this end, the production of renewable energy should rise in a context of green production. The evolution of this indicator will reveal whether policies to encourage greater resort to renewable energy are proving useful in the manufacturing sector.
Limitations:	As this is an aggregate indicator, it does not provide sufficient information on the type of renewable energy promoted. Moreover, in making comparisons of the results of the indicator across different geographical zones and countries it will be particularly important to consider the potential viability of resort to renewable energy, taking into account local environmental conditions (for example, for the production of wind, solar or geothermal energy) and the accessibility of the technologies needed for its production
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by type of renewable energy. Breakdown by economic activity
Proposed data source:	Company surveys
Model question:	Does your firm produce renewable energy?
Proposed frequency:	Every two years

GPI22.	Proportion of energy consumption derived from renewable energy generated in the establishment *
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Energy
Priority:	High
Definition: Energy derived exclusively from renewable energy generated in the establishment as a proportion of total energy consumed	
Units of measurement or expression of the indicator: Percentage (%) of energy consumed in industrial establishments derived from renewable energy generated in those establishments.	
Definition of the variables that comprise the indicator: <u>Renewable energy</u> is captured from sources that replenish themselves. It includes solar (photovoltaic and thermal), hydroelectric, geothermal, tidal action, wave action, marine (non-tidal currents, temperature differences and salinity gradients), wind and biomass energy. (UNDS, 2016).	
Relevance of the indicator: This indicator is intended to monitor the capacity for energy self-sufficiency in the manufacturing sector. Energy policies should encourage the production of renewable energy with a view to reducing dependence on nonrenewable fossil fuels. To encourage this production governments may, among other things, introduce financial subsidies for the investment necessary for their implementation The proportion of energy derived from renewable sources is a topic addressed by various indicators included in numerous international initiatives such as the UNIDO Green Industry Initiative, the Green Economy United Nations Development Account project, the OECD green growth indicators, the indicators proposed by the Latin American and Caribbean Initiative for Sustainable Development (ILAC) and the Green economy indicators developed by the United Nations Environment Programme (UNEP).	
Calculation: The percentage of energy consumption derived from renewable energy generated in the establishment is calculated by dividing the annual quantity of such consumption by the total annual quantity of energy consumed, and multiplying the result by 100. $\text{GPI22 \%} = \left[\frac{\text{quantity of energy consumption derived from renewable energy generated in the establishment}}{\text{total quantity of energy consumed}} \right] * 100$	
Interpretation: As the proportion of energy consumption derived from renewable energy generated in industrial installations rises, the environmental effects associated with the production and distribution of energy from conventional sources will be less, and the energy Independence of the sector will be greater. This indicator does not evaluate the quantity of energy consumption derived from renewable energy generated in facilities outside industrial establishments.	
Limitations: As this is an aggregate indicator, it does not provide sufficient information on the type of renewable energy promoted. Moreover, in making comparisons of the results of the indicator across different geographical zones and countries it will be particularly important to consider the potential viability of resort to renewable energy, taking into account local environmental conditions (for example, for the production of wind, solar or geothermal energy) and the accessibility of the technologies needed for its production	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by type of renewable energy. Breakdown by economic activity.	
Proposed data source: Establishment surveys	
Model question: What is the quantity of energy consumption derived from renewable sources generated in your establishment?	
Proposed frequency: Annual	

GPI23.	Proportion of energy consumption derived from residues
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Energy
Priority:	Low
Definition:	Energy consumption derived exclusively from residues as a proportion of total energy consumption
Units of measurement or expression of the indicator:	Percentage (%) of energy consumption derived from residues.
Definition of the variables that comprise the indicator:	<p><u>Residues</u> are flows of materials that establishments generate in the processes of production, consumption or accumulation</p> <p><u>Energy derived from residues</u> must include energy produced from residues generated in the establishment itself as well as that produced from residues acquired from or passed on by other economic units.</p>
Relevance of the indicator:	<p>The objective of this indicator is to assess the degree to which residues generated in the manufacturing sector are being reused for energy purposes, thereby helping to reduce the sector's energy dependency.</p> <p>This indicator is included in the UNIDO Green Industry Initiative for Sustainable Industrial Development.</p>
Calculation:	<p>The proportion of energy consumption derived from residues is calculated by dividing the annual quantity of such energy consumed by the total annual quantity of energy consumed and multiplying the result by 100.</p> $\text{GPI23 \%} = \left[\frac{\text{quantity of energy consumption derived from residues}}{\text{total quantity of energy consumed}} \right] * 100$
Interpretation:	<p>The use of residues as an energy source should tend to increase over time, from a green production perspective. This will serve three objectives: it will increase the reuse of residues for energy purposes, it will reduce energy dependence on non-renewable fossil fuels, and it will enhance the management of residues at origin, thereby reducing the effects caused by their transportation and their disposal by other means, e.g. in supervised dumps.</p>
Limitations:	<p>This indicator does not consider measures to guarantee that energy conversion of residues is done in ways that minimize adverse environmental effects, particularly with respect to the treatment of the atmospheric emissions generated. In some cases, then, studies of this aspect may be advisable.</p>
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity
Proposed data source:	Establishment surveys
Model question:	How much energy derived from residues does your establishment consume?
Proposed frequency:	Annual

GPI24.	Proportion of bioenergy production (vegetal remnants and wastes).
Thematic area	Environmental and resource productivity/intensity
Sub-area	Use and consumption of resources – Energy
Priority:	Low
Definition:	Bioenergy production as a proportion of total renewable energy produced.
Units of measurement or expression of the indicator:	Bioenergy production as a percentage (%) of total renewable energy produced
Definition of the variables that comprise the indicator:	<p><u>Bioenergy</u> is energy obtained from the combustion of biomass, which includes vegetal remnants and residues.</p> <p><u>Renewable energy</u> is captured from sources that replenish themselves. It includes solar (photovoltaic and thermal), hydroelectric, geothermal, tidal action, wave action, marine (non-tidal currents, temperature differences and salinity gradients), wind and biomass energy (UNSD, 2016).</p>
Relevance of the indicator:	<p>The objective of this indicator is to assess the relative importance of bioenergy among all types of renewable energy production, and hence its contribution to reducing the sector's energy dependence.</p> <p>This indicator is included in various international initiatives such as the Green Economy United Nations Development Account project and the agri-environmental indicators of FAO.</p>
Calculation:	<p>The proportion of bioenergy production is calculated by dividing the annual quantity of such production by the total annual quantity of renewable energy produced, and multiplying the result by 100.</p> <p>$GPI24 \% = [(quantity\ of\ bioenergy\ produced) / (quantity\ of\ renewable\ energy\ produced)] * 100$</p>
Interpretation:	<p>The production of bioenergy, i.e. the use of biomass as an energy source, should tend to increase over time from a green production perspective, thereby increasing the energy reuse of residues and vegetal remnants and reducing energy dependence on non-renewable fossil fuels</p>
Limitations:	<p>This indicator does not consider measures to guarantee that bioenergy production is done in ways that minimize adverse environmental effects, particularly with respect to the treatment of the atmospheric emissions generated. In some cases, then, studies of this aspect may be advisable.</p>
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity
Proposed data source:	Establishment surveys
Model question:	How much energy derived from biomass (vegetal remnants and residues) is produced in your establishment?
Proposed frequency:	Annual

GPI25.	Proportion of establishments using green technologies *
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– green technologies
Priority:	High
Definition:	Establishments using green technologies as a proportion of total establishments.
Units of measurement or expression of the indicator:	Percentage (%) of establishments using green technologies.
Definition of the variables that comprise the indicator:	Green or environmental technologies are technical processes, installations and equipment (goods) and methods or knowledge (services) the technical nature or purpose of which is environmental protection or resource management (United Nations and others, 2014).
Relevance of the indicator:	The objective of this indicator is to evaluate the use of green technologies in the manufacturing sector. This indicator is considered in the list of green employment indicators of the International Labour Organization (ILO).
Calculation:	The percentage of establishments using green technologies is calculated by dividing the number of such establishments by the total number of establishments surveyed, and multiplying the result by 100. $\text{GPI25 \%} = [(\text{number of establishments using green technologies})/(\text{total number of establishments surveyed})]*100$
Interpretation:	As the purpose of green technologies is to protect the environment or improve waste management, green production is associated with growing use of such technologies.
Limitations:	The use of green technologies may be conditioned by existing legislation and regulations (for example, concerning the treatment of wastewater) and such provisions must be taken into account for proper comparisons across countries and regions.
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of green technology used.
Proposed data source:	Establishment surveys
Model question:	Does your establishment make use of green technologies?
Proposed frequency:	Annual

GPI26.	Intensity of waste generation*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– wastes
Priority:	High
Definition: The intensity of waste generation is the quantity of wastes generated per unit of gross value added in production.	
Units of measurement or expression of the indicator: Tonnes of wastes generated/monetary unit of gross value of production	
<p>Definition of the variables that comprise the indicator:</p> <p>Wastes are materials which do not constitute products intended for market, for which those who have generated them have no further use for purposes of their own production, transformation or consumption, and which they wish to dispose of. Residues recycled or reused in the place where they were generated are excluded, as are waste materials that are discharged directly into the water or the atmosphere (United Nations and others, 2014).</p> <p>The <u>gross value added of production</u> is the value created or added in the production process.</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to determine whether there is a decoupling of waste generation and production. There is now a general consensus that the only way to ensure that economic growth is sustainable is to decouple it from the generation of polluting emissions, including wastes, wastewater and atmospheric emissions.</p> <p>A number of international initiatives consider this indicator. They include the UNIDO Green Industry Initiative, the enterprise-level indicators for resource productivity and pollution intensity (UNIDO-UNEP), the OECD green growth indicators, and the green economy indicators developed by the United Nations Environment Programme (UNEP).</p>	
<p>Calculation:</p> <p>The intensity of waste generation is calculated by dividing the total quantity of waste generated in one year by the gross value of production in that year.</p> <p>$GPI26 = \text{quantity of wastes generated} / GVA$</p>	
<p>Interpretation:</p> <p>According to green production criteria, the intensity of waste generation should decline over time, implying lesser generation of wastes to achieve the same or greater production.</p>	
<p>Limitations:</p> <p>The calculation of the indicator does not differentiate between types of wastes, and in particular makes no distinction between hazardous wastes and non-hazardous wastes, the environmental effects of which differ widely in their relative importance. A correct assessment of the results of the indicator, then, should take into account the results obtained for indicators GPI27, GPI28, GPI29 and GPI30.</p>	
<p>Disaggregations:</p> <p>Breakdown by region or by geographical zone. Breakdown by economic activity.</p>	
Proposed data source: Establishment surveys	
<p>Model question:</p> <p>What is the quantity of wastes generated annually in your establishment?</p>	
Proposed frequency: Annual	

GPI27.	Proportion of hazardous wastes generated
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– wastes
Priority:	Low
Definition: Hazardous wastes as a proportion of total wastes generated.	
Units of measurement or expression of the indicator: Hazardous wastes as a percentage (%) of total wastes generated	
<p>Definition of the variables that comprise the indicator:</p> <p>Wastes are materials which do not constitute products intended for market, for which those who have generated them have no further use for purposes of their own production, transformation or consumption, and which they wish to dispose of. Residues recycled or reused in the place where they were generated are excluded, as are waste materials that are discharged directly into the water or the atmosphere (United Nations and others, 2014).</p> <p><u>Hazardous wastes</u> are those that present any of the characteristics included in Annex III of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989).</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to evaluate the generation of hazardous wastes as a proportion of total wastes generated.</p> <p>The list of indicators proposed for evaluating achievement of the Sustainable Development Goals approved by the United Nations includes an indicator concerning the treatment, generation and management of hazardous wastes, within Target 12.4: "By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their lifecycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.". This target falls under Goal 12, "Ensure sustainable consumption and production patterns".</p> <p>The UNIDO Green Industry Initiative also includes this indicator</p>	
<p>Calculation:</p> <p>The percentage of hazardous wastes generated is calculated by dividing the quantity of such wastes by the total of wastes generated, and multiplying the result by 100.</p> $\text{GPI27 \%} = [(\text{quantity of hazardous wastes generated})/(\text{total quantity of wastes generated})] * 100$	
<p>Interpretation:</p> <p>In a green production context, the proportion of hazardous wastes should tend to decline with the decreasing use of hazardous raw materials and the employment of more efficient technologies. Thus, to the extent the technology so permits, the generation of hazardous residues and should diminish in overall terms over time.</p>	
<p>Limitations:</p> <p>The technology needed to reduce the generation of hazardous wastes may not be universally available and accessible in different regions of the country, or across different countries of the region, and this aspect must be taken into account in interpreting the results of the indicator. In addition, the type of final product produced will determine the need to use hazardous raw materials, and will thus be linked to the production of hazardous wastes, a factor that must be considered in evaluating the results of the indicator across regions or countries.</p>	
<p>Disaggregations:</p> <p>Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of hazardous waste of special interest.</p>	
Proposed data source: Establishment surveys	
<p>Model questions:</p> <p>What is the quantity of hazardous wastes generated annually? What is the total quantity of wastes generated annually?</p>	
Proposed frequency: Annual	

GPI28.	Proportion of packaging waste generated
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Wastes
Priority:	Low
Definition: Packaging waste generated as a proportion of total wastes generated	
Units of measurement or expression of the indicator: Packaging waste as a percentage (%) of total wastes generated	
<p>Definition of the variables that comprise the indicator:</p> <p>Wastes are materials which do not constitute products intended for market, for which those who have generated them have no further use for purposes of their own production, transformation or consumption, and which they wish to dispose of. Residues recycled or reused in the place where they were generated are excluded, as are waste materials that are discharged directly into the water or the atmosphere (United Nations and others, 2014).</p> <p><u>Packaging</u> means all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. "Non-returnable" items used for the same purposes will also be considered to constitute packaging (European Communities, 1994).</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to evaluate the amount of packaging waste generated as a proportion of total wastes generated.</p> <p>In a green production context, minimizing the use of packaging for presenting the final product implies reducing raw material use and the quantity of wastes generated after final consumption of the products, with the consequent reduction in the associated adverse environmental effects.</p> <p>This indicator is also included in the UNIDO Green Industry Initiative.</p>	
<p>Calculation:</p> <p>The percentage of packaging waste generated is calculated by dividing the quantity of such waste by the total of wastes generated, and multiplying the result by 100.</p> $\text{GPI28 \%} = [(\text{quantity of packaging waste generated})/(\text{total quantity of wastes generated})]*100$	
<p>Interpretation:</p> <p>in a green production context, the proportion of packaging waste generated should tend to decline, with the decreasing use of containers and packaging for products. This indicator can show the extent to which public policies for reducing packaging use are being effective.</p>	
<p>Limitations: This indicator does not take into account the characteristics or the composition of packaging wastes generated, and therefore does not show whether packaging is derived from recycled materials or the extent to which it is biodegradable. For purposes of evaluating policies, then, this issue must be analyzed jointly with GPI 5.</p>	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity	
Proposed data source: Establishment surveys	
Model questions: What is the quantity of packaging waste generated annually? What is the total quantity of wastes generated annually?	
Proposed frequency: Annual	

GPI29.	Proportion of e-waste generated
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Wastes
Priority:	Low
Definition: Electric and electronic appliance wastes generated as a proportion of total wastes generated	
Units of measurement or expression of the indicator: E-waste generated as a percentage (%) of total wastes generated	
<p>Definition of the variables that comprise the indicator:</p> <p>Wastes are materials which do not constitute products intended for market, for which those who have generated them have no further use for purposes of their own production, transformation or consumption, and which they wish to dispose of. Residues recycled or reused in the place where they were generated are excluded, as are waste materials that are discharged directly into the water or the atmosphere (United Nations and others, 2014).</p> <p>According to the classification prepared by the United Nations University and known as UNU-KEYS, e-wastes present some of the following characteristics: they have a high average weight, their composition includes toxic compounds, at the end of their useful life they present high concentrations of valuable resources that should be recovered in light of their scarcity, and they are appliances and equipment of broad distribution, and can be found on the market in most countries.</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to assess the amount of e-waste generation as a proportion of total wastes generated.</p> <p>At the present time, the growing generation of wastes of this kind associated with the development of new technologies and the lack of infrastructure for their proper handling imply a significant challenge for the national environmental authorities.</p> <p>This indicator is intended as a benchmark for evaluating the problem associated with wastes of this kind in each country and region.</p>	
<p>Calculation:</p> <p>The percentage of e-waste generated is calculated by dividing the quantity of such wastes by the total quantity of wastes generated, and multiplying the result by 100.</p> $\text{GPI29 \%} = [(\text{quantity of e-wastes generated})/(\text{total quantity of wastes generated})]*100$	
<p>Interpretation: In a green production context, the proportion of e-waste generated should tend to decline. However, current trends show an increase in generation of wastes of this kind, an issue that will have to be studied by the environmental authorities. This indicator provides an ideal benchmark for this purpose. GPI 30 can be used in a complementary way to dimension the importance of the generation of these residues.</p>	
<p>Limitations: E-waste includes a great variety of typologies that are not taken into consideration in the indicator, and accordingly the indicator can be disaggregated as needed to reflect the type of appliance to be analyzed.</p>	
<p>Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of electric and electronic appliance of special interest.</p>	
<p>Proposed data source: Establishment surveys</p>	
<p>Model questions: What is the quantity of e-waste generated annually? What is the total quantity of wastes generated annually?</p>	
<p>Proposed frequency: Annual</p>	

GPI30.	Intensity of e-waste generation
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Wastes
Priority:	Low
Definition: The intensity of e-waste generation is the quantity of e-waste generated per unit of gross value added in production.	
Units of measurement or expression of the indicator: Tonnes of e-waste generated / monetary unit of gross value of production.	
<p>Definition of the variables that comprise the indicator:</p> <p>Wastes are materials which do not constitute products intended for market, for which those who have generated them have no further use for purposes of their own production, transformation or consumption, and which they wish to dispose of. Residues recycled or reused in the place where they were generated are excluded, as are waste materials that are discharged directly into the water or the atmosphere (United Nations and others, 2014).</p> <p>According to the classification prepared by the United Nations University and known as UNU-KEYS, e-wastes present some of the following characteristics: they have a high average weight, their composition includes toxic compounds, at the end of their useful life, they present high concentrations of valuable resources that should be recovered in light of their scarcity, and they are appliances and equipment of broad distribution, and can be found on the market in most countries.</p> <p>The <u>gross value added of production</u> is the value created or added in the production process.</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to determine whether there is a decoupling between the generation of e-waste and production.</p> <p>There is now a general consensus that the only way to ensure that economic growth is sustainable is to decouple it from the generation of polluting emissions, including wastes, wastewater and atmospheric emissions.</p> <p>Today, the growing generation of wastes of this kind associated with the development of new technologies and the lack of infrastructure for their proper handling imply a significant challenge for the national environmental authorities. This indicator is intended as a benchmark for evaluating the problem associated with wastes of this kind in each country and region</p>	
<p>Calculation: The intensity of e-waste generation is calculated by dividing the total quantity of e-waste generated in one year by the gross value of production in that year.</p> <p>$GPI10 = \text{Quantity of e-waste generated} / \text{GVA}$</p>	
<p>Interpretation: According to green production criteria, the intensity of e-waste generation should tend to decline over time, which implies a lesser generation of this type of waste to achieve the same or greater production .</p> <p>However, current trends show an increase in generation of wastes of this kind, an issue that will have to be studied by the environmental authorities. This indicator provides an ideal benchmark for this purpose. GPI 29 can be used in a complementary way to dimension the importance of the generation of these residues.</p>	
<p>Limitations: E-waste includes a great variety of typologies that are not taken into consideration in the indicator, and accordingly the indicator can be disaggregated as needed to reflect the type of appliance to be analyzed</p>	
<p>Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of electric and electronic appliance.</p>	
<p>Proposed data source: Establishment surveys</p>	
<p>Model question: What is the quantity of e-waste generated annually in your establishment?</p>	
<p>Proposed frequency: Annual</p>	

GPI31.	Proportion of wastes adequately disposed of *
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Wastes
Priority:	High
Definition: Wastes adequately disposed of as a proportion of total wastes generated	
Units of measurement or expression of the indicator: Percentage (%) of wastes adequately disposed of in the manufacturing sector	
<p>Definition of the variables that comprise the indicator:</p> <p>Wastes are materials which do not constitute products intended for market, for which those who have generated them have no further use for purposes of their own production, transformation or consumption, and which they wish to dispose of. Residues recycled or reused in the place where they were generated are excluded, as are waste materials that are discharged directly into the water or the atmosphere (United Nations and others, 2014).</p> <p>The <u>adequate disposal of wastes</u> includes their delivery in such a manner that, consistent with their characteristics, their final handling conforms to prevailing environmental legislation and the adverse environmental effects of that handling are minimized as far as possible.</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to determine the degree to which wastes generated in the manufacturing sector are adequately managed.</p> <p>The final impact of wastes generated depends on how they are managed. Their treatment and final disposal by authorized waste handlers (including municipalities) should minimize their adverse effects, while allowing them as appropriate to be reintroduced in production processes as raw materials through recycling processes.</p> <p>This is a topic of great importance that is highlighted in the Sustainable Development Goals approved by the United Nations, which include specific indicators for urban and hazardous wastes.</p>	
<p>Calculation: The percentage of wastes adequately disposed of is calculated by dividing the quantity of wastes adequately disposed of by the total of wastes generated, and multiplying the result by 100.</p> <p>$GPI31 \% = [(quantity\ of\ wastes\ adequately\ disposed\ of)/(total\ quantity\ of\ wastes\ generated)] * 100$</p>	
Interpretation: From a green production perspective, adequate management of wastes is essential for minimizing their adverse impacts on the environment, and accordingly the value of this indicator should rise over time.	
Limitations: The indicator does not differentiate between hazardous wastes and non-hazardous wastes, yet the environmental impact of inadequate disposal of these two types of wastes is very different. Consequently, whenever possible, the analysis of this topic should be supplemented by indicators GPI32 and GPI33.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of disposal.	
Proposed data source: Establishment surveys	
Model questions: What is the quantity of wastes that have been adequately disposed of in the last year? What is the total quantity of wastes generated annually?	
Proposed frequency: Annual	

GPI32.	Proportion of non-hazardous wastes adequately disposed of
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Wastes
Priority:	Low
Definition: non-hazardous wastes adequately disposed of, as a proportion of total wastes generated.	
Units of measurement or expression of the indicator: Percentage (%) of non-hazardous wastes adequately disposed of in the manufacturing sector.	
<p>Definition of the variables that comprise the indicator:</p> <p>Wastes are materials which do not constitute products intended for market, for which those who have generated them have no further use for purposes of their own production, transformation or consumption, and which they wish to dispose of. Residues recycled or reused in the place where they were generated are excluded, as are waste materials that are discharged directly into the water or the atmosphere (United Nations and others, 2014).</p> <p>The <u>adequate disposal of wastes</u> includes their delivery in such a manner that, consistent with their characteristics, their final handling conforms to prevailing environmental legislation and the adverse environmental effects of that handling are minimized as far as possible.</p> <p><u>Non-hazardous residues</u> are those that present none of the characteristics included in Annex III of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989).</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to determine the degree to which non-hazardous wastes are properly handled in the manufacturing sector.</p> <p>The list of indicators proposed for evaluating fulfillment of the Sustainable Development Goals approved by the United Nations includes an indicator for the “proportion of solid waste regularly collected and with adequate final discharge out of total urban solid waste generated by cities”. This indicator relates to Goal 11, Make cities and human settlements inclusive, safe, resilient and sustainable.</p>	
<p>Calculation:</p> <p>The percentage of non-hazardous wastes adequately disposed of is calculated by dividing the quantity of such wastes by the total of wastes generated, and multiplying the result by 100</p> <p>GPI32 % = [(quantity of non-hazardous wastes adequately disposed of)/(total quantity of wastes generated)]*100</p>	
Interpretation: From a green production perspective, adequate management of non-hazardous wastes is essential for minimizing their adverse impacts on the environment, and accordingly the value of this indicator should rise over time	
Limitations: The indicator does not differentiate among types of non-hazardous wastes or the different types of waste disposal that are possible. However, these aspects can be analyzed by disaggregating the indicator for these categories, provided the data are available.	
<p>Disaggregations:</p> <p>Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of non-hazardous waste. Breakdown by type of disposal performed.</p>	
Proposed data source: Establishment surveys	
Model questions: What is the quantity of non-hazardous wastes that were adequately disposed of in the last year? What is the total quantity of wastes generated annually?	
Proposed frequency: Annual	

GPI33.	Proportion of hazardous wastes adequately disposed of
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Wastes
Priority:	Low
Definition: Hazardous wastes adequately disposed of, as a proportion of total wastes generated	
Units of measurement or expression of the indicator: Percentage (%) of hazardous wastes adequately disposed of in the manufacturing sector.	
<p>Definition of the variables that comprise the indicator:</p> <p>Wastes are materials which do not constitute products intended for market, for which those who have generated them have no further use for purposes of their own production, transformation or consumption, and which they wish to dispose of. Residues recycled or reused in the place where they were generated are excluded, as are waste materials that are discharged directly into the water or the atmosphere (United Nations and others, 2014).</p> <p>The <u>adequate disposal of wastes</u> includes their delivery in such a manner that, consistent with their characteristics, their final handling conforms to prevailing environmental legislation and the adverse environmental effects of that handling are minimized as far as possible.</p> <p><u>Hazardous wastes</u> are those that present any of the characteristics included in Annex III of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989).</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to determine the degree to which hazardous wastes are properly managed in the manufacturing sector.</p> <p>The list of indicators proposed for evaluating fulfillment of the Sustainable Development Goals approved by the United Nations includes an indicator on the treatment, generation and management of hazardous wastes, within the target of achieving, by 2020, the environmentally sound management of chemicals and all wastes throughout their lifecycle, in accordance with agreed international frameworks, and significantly reducing their release to air, water and soil in order to minimize their adverse impacts on human health and the environment. This indicator refers to Goal 12, Ensure sustainable consumption and production patterns.</p>	
<p>Calculation:</p> <p>The percentage of hazardous wastes adequately disposed of is calculated by dividing the quantity of such wastes by the total of wastes generated, and multiplying the result by 100.</p> $\text{GPI33 \%} = [(\text{quantity of hazardous wastes adequately disposed of})/(\text{total quantity of wastes generated})]*100$	
<p>Interpretation:</p> <p>From a green production perspective, adequate management of hazardous wastes is essential for minimizing their adverse impacts on the environment, and accordingly the value of this indicator should rise over time.</p>	
<p>Limitations: The indicator does not differentiate among types of hazardous wastes or the different types of waste disposal that are possible. However, these aspects can be analyzed by disaggregating the indicator for these categories, provided the data are available.</p>	
<p>Disaggregations and classification. Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of hazardous waste. Breakdown by type of disposal</p>	
<p>Proposed data source: Establishment surveys</p>	
<p>Model questions: What is the quantity of hazardous wastes that were adequately disposed of in the last year? What is the total quantity of wastes generated annually?</p>	
<p>Proposed frequency: Annual</p>	

GPI34.	Intensity of wastewater generation*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Wastewater
Priority:	High
Definition:	The intensity of wastewater generation is the volume of wastewater generated per unit of gross value added in production.
Units of measurement or expression of the indicator:	Cubic metres of wastewater generated/monetary unit of gross value of production
Definition of the variables that comprise the indicator:	<p><u>Wastewater</u> is defined as water that is of no further immediate value for the purpose for which it was used or in the pursuit of which it was produced, because of quality, quantity or time of its occurrence (United Nations and others, 2014).</p> <p><u>Gross value added of production</u> is the value created or added in the production process.</p>
Relevance of the indicator:	<p>The objective of this indicator is to determine whether there is a decoupling between wastewater generation and production. There is now a general consensus that the only way to ensure that economic growth is sustainable is to decouple it from the generation of polluting emissions, including wastes, wastewater and atmospheric emissions.</p> <p>This indicator is considered in the UNIDO Green Industry Initiative .</p>
Calculation:	<p>The intensity of wastewater generation is calculated by dividing the total volume of wastewater generated in one year by the gross value of production in that same year.</p> <p>$GPI34 = \text{quantity of wastewater generated} / \text{GVA}$</p>
Interpretation:	According to green production criteria, the intensity of wastewater generation should tend to decline over time, implying less generation of wastewater to achieve the same or greater production
Limitations:	The indicator does not consider the characteristics of the wastewater generated, nor whether it is subjected to treatment before discharge. As the environmental effects of wastewater generation and its discharge depend on these factors, the results of indicators GPI35 and GPI36 should be considered in parallel with this indicator.
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity. Break down by type of product produced.
Proposed data source:	Establishment surveys
Model question:	What is the volume of wastewater generated annually in your establishment?
Proposed frequency:	Annual

GPI35.	Proportion of establishments treating their wastewater*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– wastewater
Priority:	High
<p>Definition: Industrial establishments that treat the wastewater generated in the production process as a proportion of total industrial establishments. This treatment is performed before the wastewater is discharged, whether into the natural environment or into a sewage network.</p> <p>.</p>	
<p>Units of measurement or expression of the indicator:</p> <p>Establishments that treat their wastewater as a percentage (%) of total industrial establishments.</p>	
<p>Definition of the variables that comprise the indicator:</p> <p><u>Wastewater</u> is defined as water that is of no further immediate value for the purpose for which it was used or in the pursuit of which it was produced, because of quality, quantity or time of its occurrence (United Nations and others, 2014).</p> <p>The <u>treatment of wastewater</u> consists of a series of physical, chemical and/or biological processes intended to eliminate the pollutants present in wastewater.</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to evaluate the degree to which establishments treat the wastewater they generate. The environmental impacts of wastewater generation in production processes depend on the composition of the water as well as on its treatment and final destination. The costs of treating wastewater can be significant, and the discharge limits established in environmental legislation will determine whether such treatment is needed.</p>	
<p>Calculation:</p> <p>The percentage of establishments that treat their wastewater is calculated by dividing the number of such establishments by the total of establishment survey, and multiplying the result by 100</p> $\text{GPI35 \%} = [(\text{number of establishments treating their wastewater})/(\text{total number of establishments surveyed})]*100$	
<p>Interpretation:</p> <p>From a green production perspective, the proportion of establishments treating their wastewater should tend to rise over time.</p> <p>In comparing the results between regions of a given country and across countries, it must be remembered that the need for establishments to treat their water will normally be determined by legislation, a point that should be considered in analyzing the results.</p>	
<p>Limitations: The indicator provides no information on the type of treatment to which wastewater is subjected (primary, secondary or tertiary), and this information may sometimes be useful for evaluating the degree of a firm's commitment to environmental protection.</p>	
<p>Disaggregations:</p> <p>Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of wastewater treatment (primary, secondary or tertiary)</p>	
Data source:	Establishment surveys
Model question: Does the wastewater generated in the establishment receive treatment?	
Proposed frequency: Annual	

GPI36.	Proportion of wastewater treated
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Wastewater
Priority:	Low
Definition: Wastewater that is treated in the industrial establishments themselves, as a proportion of total wastewater generated.	
Units of measurement or expression of the indicator: Percentage (%) of wastewater subjected to pre-discharge treatment in the manufacturing sector.	
Definition of the variables that comprise the indicator: <u>Wastewater</u> is defined as water that is of no further immediate value for the purpose for which it was used or in the pursuit of which it was produced, because of quality, quantity or time of its occurrence (United Nations and others, 2014). The <u>treatment of wastewater</u> consists of a series of physical, chemical and/or biological processes intended to eliminate the pollutants present in wastewater.	
Relevance of the indicator: The objective of this indicator is to evaluate the degree to which wastewater is being treated. The list of indicators proposed for evaluating fulfillment of the Sustainable Development Goals approved by the United Nations includes an indicator on the percentage of wastewater adequately treated, within Goal 6, Ensure access to water and sanitation for all. Among the international initiatives that consider this indicator are the UNIDO Green Industry Initiative, the enterprise-level indicators for resource productivity and pollution intensity (UNIDO-UNEP), and the indicators proposed for the Latin American and Caribbean Initiative for Sustainable Development (ILAC).	
Calculation: The proportion of wastewater that receives treatment is calculated by dividing the volume of treated wastewater by the total volume of wastewater generated, and multiplying the result by 100. $\text{GPI36 \%} = [(\text{total volume of wastewater receiving treatment})/(\text{total volume of wastewater generated})]*100$	
Interpretation: Generally speaking, a greater proportion of wastewater treated at source will imply a reduction in the discharge of pollutants and their associated environmental effects, and a higher quality of life for the public. .	
Limitations: The need to treat wastewater will sometimes be determined not only by the physical and chemical characteristics of the water but also by the limits established in national or regional legislation and regulations. Accordingly, these aspects should be considered in comparing the results obtained in different geographical zones or countries. This indicator does not distinguish between the type of wastewater treatment used, and so a more detailed breakdown of the indicator is advisable.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of wastewater treatment (primary, secondary or tertiary).	
Proposed data source: Establishment surveys	
Model questions: What is the total volume of wastewater generated annually? What is the annual volume of wastewater that is treated before discharge?	
Proposed frequency: Annual	

GPI37.	Intensity of CO2 generation
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Atmospheric emissions
Priority:	Low
Definition: The intensity of CO2 emissions is the quantity of CO2 emitted per unit of gross value added in production.	
Units of measurement or expression of the indicator: Tonnes of CO2 equivalent / monetary unit of gross value added in production.	
<p>Definition of the variables that comprise the indicator:</p> <p><u>CO2 generated</u> is the quantity of carbon dioxide emitted into the atmosphere as a result of the combustion of different fuels in industrial installations. CO2 emissions can be estimated by determining the carbon content of the fossil fuels used.</p> <p>The <u>gross value added of production</u> is the value created or added in the production process.</p>	
<p>Relevance of the indicator:</p> <p>The objective of this indicator is to determine whether there is a decoupling between atmospheric emissions of CO₂ and production.</p> <p>There is now a general consensus that the only way to ensure that economic growth is sustainable is to decouple it from the generation of polluting emissions, including wastes, wastewater and atmospheric emissions.</p> <p>The list of indicators proposed for assessing fulfillment of the Sustainable Development Goals approved by the United Nations includes an indicator relating to CO₂ emissions per unit of value added. This indicator refers to Goal 9, Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.</p> <p>Among the international initiatives that include this indicator are the UNIDO Green Industry Initiative, the OECD green growth indicators, the green economy indicators developed by UNEP, and the indicators proposed for the Latin American and Caribbean Initiative for Sustainable Development (ILAC).</p>	
<p>Calculation:</p> <p>The intensity of CO₂ generation is calculated by dividing the total quantity of CO₂ emitted into the atmosphere in one year by the gross value of production.</p> <p>GPI37 = quantity of CO₂ emitted/ GVA</p>	
<p>Interpretation:</p> <p>According to green production criteria, the intensity of CO2 generation should tend to decline over time, implying lower emissions of CO2 into the atmosphere to achieve the same or greater production.</p>	
<p>Limitations:</p> <p>This indicator does not discriminate in terms of the existence of systems for treating emissions prior to their release. Consequently, to supplement the interpretation of this indicator the results of GPI 38 should be consulted.</p>	
<p>Disaggregations:</p> <p>Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of fuel used.</p>	
Proposed data source: Establishment surveys	
Model question: What is the annual consumption of energy by type of fuel?	
Proposed frequency: Annual	

GPI38. Proportion of establishments measuring or treating atmospheric emissions*	
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Atmospheric emissions
Priority:	Low
Definition: Industrial establishments that measure or treat atmospheric emissions as a proportion of total industrial establishments. The measuring may be done by employees of the establishment or by firms contracted for this purpose.	
Units of measurement or expression of the indicator: Establishments that measure or treat atmospheric emissions as a percentage (%) of total industrial establishments.	
Definition of the variables that comprise the indicator: <u>Atmospheric emissions</u> are all the gases and particulates released into the atmosphere or ambient air The <u>measurement</u> of atmospheric emissions includes all the activities involved in monitoring the concentration of exhaust gases, particulates and air quality. These activities embrace services for measuring exhaust gases and particulate matter from vehicles and heating systems, measuring greenhouse gases and indoor air quality, and any other gases or particulate matter emitted as a consequence of industrial processes. They do not include meteorological stations The <u>treatment</u> of atmospheric emissions and particulates includes all the processes intended to eliminate or reduce the emissions of particulates or other polluting substances into the atmosphere.	
Relevance of the indicator: The objective of this indicator is to evaluate the extent to which the manufacturing sector is implementing processes to measure or treat atmospheric emissions. Industrial production typically involves the emission of gases or particulates into the atmosphere as a result of fuel burning and other industrial processes. The environmental effects of such emissions can have adverse impacts on fauna, flora and human beings, and on materials.	
Calculation: The proportion of establishments that measure or treat atmospheric emissions is calculated by dividing the number of such establishments by the total number of establishments surveyed, and multiplying the result 100. $\text{GPI38 \%} = [(\text{number of establishments that measure or treat atmospheric emissions}) / (\text{total number of establishments surveyed})] * 100$	
Interpretation: From a green production perspective, the proportion of establishments that measure or treat atmospheric emissions should rise over time. Normally these activities will reflect obligations imposed by environmental legislation and regulations, and this indicator can therefore serve to evaluate the effectiveness of such provisions.	
Limitations: The indicator does not differentiate between the measurement and treatment of atmospheric emissions, and accordingly the indicator should, where possible, be disaggregated into these categories.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of fuel used. Breakdown by measurement/treatment of atmospheric emissions.	
Proposed data source: Establishment surveys	
Model question: Are atmospheric emissions measured or treated?	
Proposed frequency: Annual	

GPI39.	Proportion of firms engaged in eco-innovation*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technology and processes– Eco-innovation, patents and R&D
Priority:	High
Definition: Firms engaged in eco-innovation as a proportion of all firms	
Units of measurement or expression of the indicator: Firms engaged in eco-innovation as a percentage (%) of all firms in the manufacturing sector.	
Definition of the variables that comprise the indicator: An eco-innovation or green innovation can be defined as the introduction of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations that will generate environmental benefits in comparison with the alternatives (OECD/Eurostat, 2005).	
Relevance of the indicator: The objective of this indicator is to assess the degree to which firms in the manufacturing sector are engaged in eco-innovation The theme of this indicator has been included in the OECD green growth indicators.	
Calculation: The percentage of firms engaged in eco-innovation is calculated by dividing the number of such firms by the total number of firms surveyed, and multiplying the result by 100. $\text{GPI39 \%} = [(\text{number of firms engaged in eco-innovation})/(\text{total number of firms surveyed})]*100$	
Interpretation: In a context of green production, the proportion of firms engaged in eco-innovation should tend to rise over time, reflecting a growing concern on the part of firms to improve the environmental aspects of their production.	
Limitations: This indicator does not reveal whether the environmental benefits from the eco-innovation are the primary objective or the result of other innovation objectives, nor whether the environmental benefits of the innovation occur during production of a good or service or in the after-sale stage, in the use of the good or service by the final consumer. Where possible, then, this indicator should be disaggregated for a fuller interpretation of the results.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of environmental benefits of the eco-innovation. Breakdown by innovations new to the market.	
Proposed data source: Company surveys	
Model question: Has your firm engaged in eco-innovation activities in the last two years?	
Proposed frequency: Every two years	

GPI40.	Proportion of firms engaged in eco-innovation to reduce raw material use and/or energy consumption
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes – Eco-innovation, patents and R&D
Priority:	Low
Definition: Firms engaged in eco-innovation to reduce raw material use and/or energy consumption, as a proportion of all firms in the manufacturing sector.	
Units of measurement or expression of the indicator: Firms engaged in eco-innovation to reduce raw material use and/or energy consumption, as a percentage (%) of all firms.	
<p>Definition of the variables that comprise the indicator:</p> <p>An eco-innovation or green innovation can be defined as the introduction of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations that will generate environmental benefits in comparison with the alternatives (OECD/Eurostat, 2005).</p> <p>The <u>raw materials and materials</u> that enter into production processes constitute a flow of materials that includes raw materials of natural origin, prepared products, and residues originating with other economic units.</p> <p>The <u>use of raw materials</u> is the quantity of raw materials incorporated by an economic unit</p> <p><u>Energy consumption</u> is the total quantity of energy incorporated into the production process, and includes electric power from the network, energy generated from conventional fuels (coal, wood, natural gas, gasoline etc.), energy generated by the combustion of biofuels and residues, and renewable energy generated in the installation itself. Excluded from this concept is energy consumed in transportation of the final product if this is done by the establishment itself: this exclusion allows for comparability of the results regardless of whether transportation of the final product is outsourced or not.</p>	
<p>Calculation: The percentage of firms engaged in eco-innovation to reduce raw material use and/or energy consumption is calculated by dividing the number of such firms by the total number of firms surveyed, and multiplying the result by 100.</p> <p>$\text{GPI40 \%} = [(\text{number of firms engaged in eco-innovation to reduce raw material use and/or energy consumption}) / (\text{total number of firms surveyed})] * 100$</p>	
Interpretation: In a green production context, the proportion of firms engaged in eco-innovation to reduce raw material use and/or energy consumption should tend to rise over time, reflecting a growing concern on the part of firms to improve the environmental aspects of their production.	
<p>Limitations: This indicator does not reveal whether the environmental benefits from eco-innovation to reduce raw material use and/or energy consumption are the primary objective or the result of other innovation objectives, nor whether the environmental benefits of the innovation occur during production of a good or service or in the after-sale stage, in the use of the good or service by the final consumer. Where possible, then, this indicator should be disaggregated for a fuller interpretation of the results</p>	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity	
Proposed data source: Company surveys	
Model question: In the last two years, has your firm engaged in eco-innovation activities to reduce raw material use and/or energy consumption?	
Proposed frequency: Every two years	

GPI41.	Proportion of firms with registered patents in green technologies *
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Eco-innovation, patents and R&D
Priority:	High
Definition: Firms that have applied for and obtained patents in green technologies as a proportion of total firms in the manufacturing sector.	
Units of measurement or expression of the indicator: Percentage (%) of firms with registered patents in green technologies.	
Definition of the variables that comprise the indicator: Green or environmental technologies are technical processes, installations and equipment (goods) and methods or knowledge (services) the technical nature or purpose of which is environmental protection or resource management (United Nations and others, 2014).	
Relevance of the indicator: The objective of this indicator is to reveal the proportion of firms that have applied for and obtained patents in green technologies. The list of indicators proposed for evaluating fulfillment of the Sustainable Development Goals approved by the United Nations includes an indicator of the proportion of green patent applications qualified, related to the target of supporting developing countries in strengthening their scientific and technological capacity to move toward more sustainable patterns of consumption and production. This indicator refers to Goal 12, Ensure sustainable consumption and production patterns. This theme is also included in the OECD green growth indicators.	
Calculation: The percentage of firms with registered patents in green technologies is calculated by dividing the number of such firms by the total number of firms surveyed, and multiplying the result by 100. $\text{GPI41 \%} = [(\text{number of firms with registered patents for green technologies}) / (\text{total number of firms surveyed})] * 100$	
Interpretation: In a green production context, firms that apply for, obtain and/or purchase green technology patents are presumed to be moving toward greener production, and therefore the result of this indicator should tend to increase over time.	
Limitations: This indicator does not reveal the thematic area of patents or their processing status, aspects which could be included in a subsequent disaggregation of the indicator, if this is deemed useful.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by thematic area of the patents. Breakdown by processing status of the patents.	
Proposed data source: Company surveys As an alternative source, the national coverage of international patent databases, such as those of the World Intellectual Property Organization (WIPO), can be consulted.	
Model questions: Has your firm applied for and been granted patents for green technologies?	
Proposed frequency: Every two years	

GPI42.	Proportion of firms investing in R&D of importance for green production *
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Eco-innovation, patents and R&D
Priority:	High
Definition: Proporción of firms in the manufacturing sector that are investing in R&D related to resource management and environmental protection	
Units of measurement or expression of the indicator: Percentage (%) of firms investing in R&D of importance for green production.	
Definition of the variables that comprise the indicator: R&D for green production includes creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this knowledge to devise new applications in the field of natural resource management and savings and environmental protection (United Nations and others, 2014).	
Relevance of the indicator: The objective of this indicator is to determine the extent to which firms are conducting R&D of importance for green production. The list of indicators proposed for assessing fulfillment of the Sustainable Development Goals approved by the United Nations includes an indicator relating to R&D expenditure is a proportion of GDP, with the target of enhancing scientific research and upgrading the technological capabilities of industrial sectors in all countries, in particular developing countries, including by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending. This indicator refers to Goal 9, Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. This theme has been addressed in international initiatives such as the OECD green growth indicators and the green economy indicators developed by UNEP.	
Calculation: The percentage of firms engaged in R&D for green production is calculated by dividing the number of such firms by the total number of firms surveyed, and multiplying the result by 100. $\text{GPI42 \%} = [(\text{number of firms engaged in R\&D for green production})/(\text{total number of firms surveyed})]*100$	
Interpretation: With respect to R&D for green production, it is assumed that the firms that employ the greatest quantity of resources in these activities are those that have a more active role in this production trend, and accordingly the indicator should tend to increase over time.	
Limitations: The indicator does not provide any information on R&D investments for green production by environmental area. If feasible, then, the indicator could be disaggregated by environmental area.	
Disaggregations: Breakdown by region or by geographical zone. Rates down by economic activity. Breakdown by environmental area.	
Proposed data source:	Company surveys
Model question: Has your firm invested in R&D for green production in the last two years?	
Proposed frequency:	Every two years

GPI43.	Proportion of firms with ISO 14001 certification*
Thematic area	Environmental and resource productivity/intensity
Sub-area	Technologies and processes– Environmental management systems, certifications and eco-labelling.
Priority:	High
Definition:	Proporción of firms in the manufacturing sector that have ISO 14001 certification
Units of measurement or expression of the indicator:	Percentage (%) of all firms with ISO 14001 certification.
Definition of the variables that comprise the indicator:	<u>ISO 14001 certification</u> is a certification that a firm can obtain when it has an environmental management system that complies with the ISO 14001 international standard.
Relevance of the indicator:	<p>The objective of this indicator is to assess the degree to which firms in the manufacturing sector have acquired ISO 14001 certification.</p> <p>This theme has been addressed by the indicators proposed for the Latin American and Caribbean Initiative for Sustainable Development (ILAC).</p>
Cálculación:	<p>The proportion of firms with ISO 14001 certification is calculated by dividing the number of such firms by the total number of firms surveyed, and multiplying the result by 100.</p> $IVE43 \% = [(number\ of\ firms\ with\ ISO\ 14001\ certification)/(total\ number\ of\ firms\ surveyed)]*100$
Interpretation:	As having an environmental management system certified in accordance with the ISO 14001 standard is a voluntary step taken by firms or organizations that wish to achieve a high level of environmental protection in a context of sustainable development and green production, the proportion of firms with ISO 14001 certification should tend to rise over time.
Limitations:	There are environmental certifications other than ISO14001 that are not reflected in this indicator, and they could be examined if necessary
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity.
Proposed data source:	Company surveys
Model question:	Does your firm have ISO 14001 certification?
Proposed frequency:	Every two years.

IPV44.	Proportion of firms with products bearing an eco-label
Thematic area: Environmental and resource productivity/intensity	
Sub-area: Technologies and processes— Environmental management systems, certifications and eco-labelling.	
Priority: Low	
Definition: Proportion of firms in the manufacturing sector with eco-labels on their products	
Units of measurement or expression of the indicator : Percentage (%) of all firms with eco-labels on their products.	
Definition of the variables that comprise the indicator: The <u>eco-label</u> is a consumer product labelling system that measures the sustainability of a product or service for the information of consumers.	
Relevance of the indicator: The objective of this indicator is to assess the degree of eco-labelling of the products of firms in the manufacturing sector. The eco-label seeks to make consumers active players in green production, so that when they see a certain label on the package they immediately have information on the ecological footprint of the consumer good, and will take this information into account in their decision to purchase.	
Calculation: The proportion of firms with eco-labelled products is calculated by dividing the number of such firms by the total number of firms surveyed, and multiplying the result by 100. $\text{IPV44 \%} = [(\text{number of firms with eco-labelled products})/(\text{total number of firms surveyed})]*100$	
Interpretation: In light of the growing pressure on consumers in the market to favour products that are environmentally less polluting, the result of this indicator should tend to rise over time, in parallel with green production.	
Limitations: In general, eco-labelling is optional for manufacturing firms, except in some cases such as energy efficiency labelling, which is now mandatory in many countries. This fact may distort interpretation of the indicator, requiring a prior study of compulsory eco-labelling systems in each country or region.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity	
Proposed data source: Company surveys	
Model question. Does your firm have products with eco-labelling?	
Proposed frequency: Every two years	

GPI45.	Number of firms publishing sustainability reports
Thematic area	Policy responses and economic opportunities
Sub-area	Sustainability reports
Priority:	Low
Definition: Number of firms publishing annual sustainability reports on their business activity	
Units of measurement or expression of the indicator: number of firms publishing sustainability reports.	
Definition of the variables that comprise the indicator: <u>Sustainability reports</u> evaluate the economic, environmental and social performance of firms against the objective of sustainable development.	
Relevance of the indicator: The objective of this indicator is to reflect the number of firms publishing annual sustainability reports. The list of indicators proposed for evaluating fulfillment of the Sustainable Development Objectives approved by the United Nations includes an indicator on the number of firms publishing sustainability reports. This indicator refers to Goal 12, Ensure sustainable consumption and production patterns.	
Calculation: The number of firms publishing sustainability reports is calculated by counting the number of such firms. GPI45 = Number of firms publishing annual sustainability reports	
Interpretation: In a green production context, the annual publication of sustainability reports shows a business interest that tends to run parallel with improvements in production that have positive effects on the environment. Therefore, the results of the indicator should tend to rise over time.	
Limitations: The publication of sustainability reports is relatively recent and is not yet widely adopted as a communication tool in small and medium-sized enterprises. It is possible, then, that the indicator will reflect essentially the results from large firms.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity	
Proposed data source: Company surveys	
Model question: Does your firm publish annual sustainability reports?	
Proposed frequency: Every two years	

GPI46.	Proportion of green jobs*
Thematic area	Policy responses and economic opportunities
Sub-area	Green employment and training in green production– Green employment
Priority:	High
Definition: Proportion of all jobs occupied by workers who perform tasks or activities related to resource management or environmental protection	
Units of measurement or expression of the indicator: Percentage (%) of green jobs in the manufacturing sector	
Definition of the variables that comprise the indicator: Jobs are green when they help reduce negative environmental impact ultimately leading to environmentally, economically and socially sustainable enterprises and economies (ILO, 2016).	
<p>Relevance of the indicator: The objective of this indicator is to assess the importance of green employment in relation to total employment in firms of the manufacturing sector.</p> <p>This indicator is included in various international initiatives such as the UNIDO Green Industry Initiative, the indicators proposed for the Latin American and Caribbean Initiative for Sustainable Development (ILAC) and the green employment indicators of the International Labour Organization (ILO).</p>	
<p>Calculation: The proportion of green jobs is calculated by dividing the number of green jobs by the total number of employees, and multiplying the result by 100.</p> $\text{GPI46 \%} = [(\text{number of green jobs})/(\text{total number of employees})]*100$	
<p>Interpretation: Green jobs are decent jobs that contribute to preserving or restoring the environment, be they in traditional sectors such as manufacturing and construction, or in new, emerging green sectors such as renewable energy and energy efficiency (ILO). In a green production context, the proportion of green jobs is expected to increase over time. In any case, for a correct interpretation of the indicator's results, GPI 47 should be taken into account for evaluating green employment as a function of the level of occupation.</p>	
<p>Limitations: The indicator does not differentiate between level of occupation, level of education and instruction, type of green technology or the environmental area in which the activity is performed. Consequently, additional breakdowns are proposed that could be used to produce more comprehensive reports on this thematic area</p>	
<p>Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by level of occupation. Breakdown by level of education and instruction. Breakdown by type of green technology. Breakdown by environmental area.</p>	
Data source:	Company surveys
<p>Model questions: What is the total number of employees in the firm? What is the total number of employees dedicated to resource management and environmental protection activities who receive a salary and have social security and pension coverage?</p>	
Proposed frequency: Every two years	

GPI47.	Proportion of firms that have workers performing green tasks in management, technical or professional positions
Thematic area	Policy responses and economic opportunities
Sub-area	Green employment and training in green production– Green employment
Priority:	Low
Definition: Proportion of firms in the manufacturing sector with workers performing green tasks in management, technical or professional positions.	
Units of measurement or expression of the indicator: Percentage (%) of firms with workers performing green tasks in management, technical or professional positions.	
<p>Definition of the variables that comprise the indicator:</p> <p>Jobs are green when they help reduce negative environmental impact ultimately leading to environmentally, economically and socially sustainable enterprises and economies (ILO, 2016).</p> <p><u>Management, technical or professional positions</u> are occupations aggregated from the International Standard Classification of Occupations.</p>	
<p>Relevance of the indicator: The objective of this indicator is to reveal the extent to which green employment is performed in occupations that require a great deal of training.</p> <p>The disaggregation of indicator GPI46 by occupation is proposed in the green employment indicators of ILO.</p>	
<p>Calculation: The percentage of firms with workers performing green tasks in management, technical or professional positions is calculated by dividing the number of such firms by the total number of firms, and multiplying the result by 100.</p> <p>$\text{GPI47 \%} = \frac{[(\text{number of firms with workers performing green tasks in management, technical or professional positions})/(\text{total number of firms})] * 100}{1}$</p>	
<p>Interpretation: In a green employment context, the proportion of firms with workers performing green tasks in management, technical or professional positions should tend to rise over time.</p> <p>The disaggregation of green employment by occupation also makes it possible to identify more closely the type of training needed for performing such employment and can help in the planning of such training at the company level and within national education systems.</p> <p>In any case, GPI 46 should be taken into account for a correct interpretation of the indicator's results</p>	
<p>Limitations: This indicator does not provide information by level of education and instruction, or by type of green technology or environmental area. If necessary, this indicator can be broken down to reflect some of these factors.</p>	
<p>Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by level of education and instruction. Breakdown by type of green technology. Breakdown by environmental area.</p>	
Proposed data source: Company surveys	
Model question: Does your firm have workers performing green tasks in management, technical or professional positions?	
Proposed frequency: Every two years	

GPI48.	Proportion of firms conducting training in green production *
Thematic area	Policy responses and economic opportunities
Sub-area	Green employment and training in green production– Training in green production
Priority:	High
Definition:	Proportion of firms in the manufacturing sector that provide training for their employees in green production
Units of measurement or expression of the indicator:	Percentage (%) of firms providing training in green production.
Definition of the variables that comprise the indicator:	Green production training includes formative activities intended to impart training related to the management of environmental resources and protection of the environment (air protection, wastewater management, wastes, soils, noise, biodiversity etc.).
Relevance of the indicator:	<p>The objective of this indicator is to assess the degree to which firms in the manufacturing sector provide training in green production for their employees.</p> <p>This indicator is included in the green economy indicators developed by UNEP.</p>
Calculation:	<p>The percentage of firms providing training in green production is calculated by dividing the number of such firms by the total number of firms surveyed, and multiplying the result by 100.</p> <p>$GPI48 \% = [(number\ of\ firms\ providing\ training\ in\ green\ production)/(total\ number\ of\ firms\ surveyed)] * 100$</p>
Interpretation:	The growing involvement of firms in green production, together with the increasingly strict requirements of environmental legislation, should translate into greater demand for training in green production on the part of businesses in the manufacturing sector. As training for workers is a crucial factor in firms' transition to greener production processes, the trend of this indicator should rise over time
Limitations:	This indicator does not provide information on the level of education or occupation of employees who require training in green production. This information could be relevant in some cases, as it would allow environmental and education decision-makers to plan the firm's training policies jointly and, at the national level, would help the transition to a green economy.
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity
Proposed data source:	Company surveys
Model question:	Has your firm provided training in green production to its employees?
Proposed frequency:	Every two years

GPI49.	Proportion of firms receiving revenues through sale of residues
Thematic area	Revenues, costs and transfers
Sub-area	Revenues, current expenses and investments related to green production
Priority:	Low
Definition: Proportion of firms that sell a portion or all of the residues they generate to other firms.	
Units of measurement or expression of the indicator: Percentage (%) of firms receiving revenues from the sale of residues	
Definition of the variables that comprise the indicator: <u>Residues</u> are materials which are of no use to the economic unit that generated them in terms of its own production, transformation or consumption, and which it wants to dispose of. Residues differ from wastes in that they are marketed to another firm for incorporation into its production process.	
Relevance of the indicator: The objective of this indicator is to assess the extent to which residues are exchanged among industries. These voluntary exchanges, which have important environmental benefits if they are properly handled, can be promoted by governments through various policies or regulatory instruments. Some countries have established publicly supervised "residue exchanges" to promote sales of this kind. The theme of this indicator has been included in the UNIDO-UNEP company-level indicators for resource productivity and pollution intensity.	
Calculation: The percentage of firms receiving revenues from sales of residues is calculated by dividing the number of such firms by the total number of firms surveyed, and multiplying the result by 100. $\text{GPI49 \%} = [(\text{number of firms receiving revenues from residues sales})/(\text{total number of firms surveyed})]*100$	
Interpretation: The sale of residues, and their consequent purchase by other firms for use as raw materials, reduces the extraction of materials from the natural environment and thereby diminishes the adverse impact, representing important progress in terms of the green economy. This indicator should tend to rise over time, provided there are mechanisms to facilitate this exchange. The interpretation of this indicator should take into account the evolution of GPI 8.	
Limitations: Circumstances beyond a firm's control may sometimes impede the use of residues in industrial processes (for example, there may be no suitable residues available nearby, the firm may be unaware of their existence, or there may be no regulation governing such use). These aspects must be taken into account in comparing the results of the indicator across regions of the country and between countries.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity.	
Proposed data source: Company surveys	
Model question: Has your firm received revenues from the sale of residues?	
Proposed frequency: Every two years	

GPI50.	Relative cost of water
Thematic area	Revenues, costs and transfers
Sub-area	Revenues, current expenses and investments related to green production
Priority:	Low
Definition:	The relative cost of water is the total cost to the firm for water use per unit of volume of water used.
Units of measurement or expression of the indicator:	monetary units/cubic metres of water used
Definition of the variables that comprise the indicator:	<u>Water used</u> in an industrial establishment includes the water supplied by other economic units (Inc. for example through the supply network or by tank truck) and the water supplied by the economic unit itself (drawn from surface water, groundwater, rainwater and seawater desalinated in the establishment itself). Water used does not include water sold or transferred to other economic units.
Relevance of the indicator:	<p>The objective of this indicator is to quantify the economic effort that firms make in relation to the water they use. Internalizing the environmental effects through prices and costs of raw materials is important from the green production perspective, as it can encourage steps to improve natural resource management and environmental protection.</p> <p>Governments and environmental authorities can play a very important role in this area. This theme is present in the OECD green growth indicators, although only from the viewpoint of water prices.</p> <p>.</p>
Calculation:	<p>The relative cost of water is calculated by summing the amount paid to other units for water supply (including the amounts paid to the water supply utility through the network and the amounts paid to other economic units for other forms of supply, e.g. tank truck) plus the amounts paid for supply of water by the economic unit itself (including surface water, groundwater, rainwater and desalinated seawater) less the amounts received for sale of water to other economic units, and dividing this total by the total of water used (GPI14).</p> $\text{GPI50} = (\text{amounts paid for supply} + \text{amounts paid for self-supply} - \text{amounts received for sale of water}) / \text{GPI14}$
Interpretation:	The trend of the relative cost of water provides information on the internalization of environmental aspects in relation to this resource. Its trend over time will depend on many factors, and must be interpreted together with the trend in total water use in the manufacturing sector (GPI14).
Limitations:	This indicator provides no information on the various sources of water, and accordingly a correct interpretation of the indicator will require supplementary studies of the main sources of supply at the regional and national level.
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity.
Proposed data source:	Establishment surveys
Model questions:	<p>How much is paid to the water supply utility?</p> <p>How much is paid for self-supply of water?</p> <p>What are the revenues received from sale of water to other economic units?</p>
Proposed frequency:	Annual

GPI51.	Relative cost of energy
Thematic area	Revenues, costs and transfers
Sub-area	Revenues, current expenses and investments related to green production
Priority:	Low
Definition: The relative cost of energy is the total cost to the firm for energy consumption by unit of energy consumed	
Units of measurement or expression of the indicator: monetary units/Megajoules (MJ) of energy consumed	
Definition of the variables that comprise the indicator: <u>Energy consumption</u> is the total quantity of energy incorporated into the production process, and includes electric power from the network, energy generated from conventional fuels (coal, wood, natural gas, gasoline etc.), energy generated by the combustion of biofuels and residues, and renewable energy generated in the installation itself. Excluded from this concept is energy consumed in transportation of the final product if this is done by the establishment itself: this exclusion allows for comparability of the results regardless of whether transportation of final products is outsourced or not.	
Relevance of the indicator: The objective of this indicator is to quantify the economic effort that firms make in relation to the energy they consume. Governments and environmental authorities can play a very important role in this area. This theme is present in the OECD green growth indicators, although only from the viewpoint of energy prices	
Calculation: The relative cost of energy is calculated by summing the amount paid for fuel purchases (including fossil fuels, biofuels and residues purchased from other economic units), plus the expenses associated with energy and raw material consumption, repair and maintenance of equipment for producing renewable energies, less all the revenues received from sale of renewable energies produced in the installation, and dividing this total by total energy consumed GPI51 = (amounts paid for fuel purchases + current costs of equipment for producing renewable energy – amounts received from sale of renewable energy) / total energy consumption	
Interpretation: The trend of the relative cost of energy provides information on the internalization of environmental aspects in relation to this resource. Its trend over time will depend on many factors, including energy consumption and renewable energy production.	
Limitations: As this is a complex indicator, its interpretation should consider the trend in energy consumption as well as the relative importance of each type of renewable energy. Moreover, by including the total consumption of energy, it does not discriminate consumption associated with ancillary activities, nor does it distinguish the purpose of consumption (for example heating or cooling), and these factors must be taken into account in drawing comparisons across regions or countries.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity.	
Proposed data source: Establishment surveys	
Model questions: How much is paid for fuel purchases? What are the current costs of equipment for producing renewable energy? What are the revenues received from sale of renewable energy? What is the total quantity of energy consumed in one year?	
Proposed frequency: Annual	

GPI52.	Relative cost of wastewater management
Thematic area	Revenues, costs and transfers
Sub-area	Revenues, current expenses and investments related to green production
Priority:	Low
Definition: The relative cost of wastewater management is the cost to firms in the manufacturing sector for wastewater management per unit of volume of wastewater generated.	
Units of measurement or expression of the indicator: monetary units/cubic metres of wastewater generated	
Definition of the variables that comprise the indicator: <u>Wastewater</u> is defined as water that is of no further immediate value for the purpose for which it was used or in the pursuit of which it was produced, because of quality, quantity or time of its occurrence (United Nations and others, 2014).	
Relevance of the indicator: The objective of this indicator is to quantify the economic effort that firms make in relation to managing the wastewater they generate. Internalizing the environmental effects through prices and costs of municipal sewage and sanitation services is important from the green production perspective, as it can encourage steps to improve natural resource management and environmental protection. Governments and environmental authorities can play a very important role in this area. This theme is present in the OECD green growth indicators.	
Calculation: The relative cost of wastewater management is calculated by summing expenses for cleaning septic tanks, analysis and treatment of wastewater performed by the firm itself or by third parties, plus the expenses associated with environmental protection equipment for treating wastewater, plus the amount of municipal sewage and sanitation fees, plus amounts paid for municipal treatment of wastewater, plus an amount paid for discharge into public watercourses, less the amounts received from sale of water for reuse by other firms, and dividing the total by the volume of wastewater generated. GPI 52 = [(amount of expenses for cleaning septic tanks, analysis and treatment of wastewater + expenses on equipment for treating wastewater + amount of municipal sewage and sanitation fees + charges for municipal treatment of wastewater + charges for discharge into public watercourses – amounts received for sale of water for reuse) / volume of wastewater generated)].	
Interpretation: The trend of the relative cost of wastewater management provides information on the internalization of the environmental aspects related to this resource. Its trend over time will depend on many factors, and must be interpreted jointly with the trend of total water use in the manufacturing sector (GPI14).	
Limitations: This indicator provides no information on the types of wastewater treatment, and supplementary studies of this aspect may occasionally be useful.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of product produced.	
Proposed data source: Establishment surveys	
Model questions: What are the expenses for cleaning septic tanks, analysis and treatment of wastewater? What are the expenses associated with environmental protection equipment for treating wastewater? What is the amount of municipal sewage and sanitation fees? What are the amounts charged for municipal treatment of wastewater? What are the amounts charged for discharge into public watercourses? What are the amounts received from sale of water for reuse in other firms? What is the volume of wastewater generated?.	
Proposed frequency: Annual	

GPI53.	Relative cost of waste management
Thematic area	Revenues, costs and transfers
Sub-area	Revenues, current expenses and investments related to green production
Priority:	Low
Definition:	The relative cost of waste management is the cost to firms in the manufacturing sector of managing wastes per unit of waste generated
Units of measurement or expression of the indicator:	monetary units/tonnes of waste generated
Definition of the variables that comprise the indicator:	Wastes are materials which do not constitute products intended for market, for which those who have generated them have no further use for purposes of their own production, transformation or consumption, and which they wish to dispose of. Residues recycled or reused in the place where they were generated are excluded, as are waste materials that are discharged directly into the water or the atmosphere (United Nations and others, 2014).
Relevance of the indicator:	<p>The objective of this indicator is to quantify the economic effort that firms make in relation to managing the wastes they generate. Internalizing the environmental effects through prices and costs of management services is important from the green production perspective, as it can encourage steps to improve natural resource management and environmental protection.</p> <p>Governments and environmental authorities can play a very important role in this area.</p> <p>This theme is present in the OECD green growth indicators</p>
Calculation:	<p>The relative cost of waste management is calculated by summing the amounts charged for removal and treatment of wastes (hazardous and non-hazardous) by authorized managers, plus the expenses associated with environmental protection for treating wastes, plus the amount charged for municipal waste removal, plus the taxes and fees charged on wastes, less the amounts received from sale of residues to other firms, and dividing that total by the quantity of wastes generated.</p> <p>GPI 53 = [(cost of waste removal and treatment by authorized managers + expenses associated with environmental protection equipment for treatment of wastes + i amount charged for municipal waste removal + taxes and fees charged on wastes - amounts received from sale of residues to other firms) / quantity of wastes generated].</p>
Interpretation:	The trend of the relative cost of waste management provides information on the internalization of environmental aspects related to this resource. Its trend over time will depend on many factors, and must be interpreted jointly with the trend of the intensity of waste generation (GPI26).
Limitations:	Calculation of the indicator does not differentiate between types of wastes, and in particular it makes no distinction between hazardous and non-hazardous wastes, which have environmental effects of quite different importance.
Disaggregations:	Breakdown by region or by geographical zone. Breakdown by economic activity
Proposed data source:	Establishment surveys
Model questions:	<p>What are the expenses for removal and treatment of wastes by authorized managers?</p> <p>What are the expenses associated with environmental protection equipment for treatment of wastes?</p> <p>What is the amount charged for municipal removal of wastes?</p> <p>What are the amounts paid in taxes and fees on wastes?</p> <p>What are the amounts received from sale of residues to other firms?</p> <p>What is the quantity of wastes generated annually in your establishment?</p>
Proposed frequency:	Annual

GPI54.	Proportion of firms investing in green production *
Thematic area	Revenues, costs and transfers
Sub-area	Revenues, current expenses and investments related to green production
Priority:	High
Definition:	Proportion of firms in the manufacturing sector that invest in green production.
Units of measurement or expression of the indicator:	Percentage (%) of firms investing in green production.
Definition of the variables that comprise the indicator:	<u>Investment in green production</u> covers investments in equipment and installations integrated into the production process for preventing pollution, and investments in equipment and installations independent of the production process for treating pollution (United Nations and others, 2014).
Relevance of the indicator:	<p>The objective of this indicator is to evaluate the extent to which firms in the manufacturing sector make investments in green production.</p> <p>The transition to green production requires major efforts on the part of firms in order to adapt their processes to proper resource and environmental management. Investment in equipment is a very important aspect to bear in mind when assessing firms' progress with green production.</p>
Calculation:	<p>The percentage of firms investing in green production is calculated by dividing the number of such firms by the total number of firms surveyed, and multiplying the result by 100.</p> $\text{GPI54 \%} = [(\text{number of firms that have invested in green production})/(\text{total number of firms surveyed})]*100$
Interpretation:	It seems reasonable to expect that investments in green production will tend to increase over time. However, certain policies that favour investment at specific periods of time (for example, subsidies or tax reductions) can distort the values obtained, and these aspects must be taken into account in interpreting the indicator.
Limitations:	<p>This indicator provides no information on the type of equipment (independent or integrated) in which the green production investment is made. This aspect could be considered relevant in evaluating certain policies introduced by governments, in which case the indicator could be disaggregated to meet these needs</p> <p>.</p>
Disaggregations:	breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of investment (in equipment and installations integrated into the production process to prevent pollution or independent of that process for treating pollution).
Proposed data source:	Company surveys
Model questions:	<p>Has your firm made investments in equipment and installations integrated into the production process for preventing pollution?</p> <p>Has your firm made investments in equipment and installations independent of the production process for treating pollution?</p>
Proposed frequency:	Every two years

GPI55.	Proportion of firms receiving environmental investment grants
Thematic area	Revenues, costs and transfers
Sub-area	Transactions with the government sector
Priority:	Low
Definition: Proportion of firms in the manufacturing sector receiving grants for environmental investments. The scope of this indicator excludes subsidies related to renewable energy sources.	
Units of measurement or expression of the indicator: Percentage (%) of firms receiving environmental investment grants.	
Definition of the variables that comprise the indicator: <u>Subsidies</u> are current unrequited payments that government units make to firms on the basis of the levels of their production activities or the quantities or values of the goods and services they produce, sell or import. <u>Investment grants</u> are capital transfers made by governments to other units to finance all or part of the costs of their acquisition of fixed assets. Environmental investment grants are grants that have environmental protection or resource management as their primary objective or purpose (United Nations and others, 2014).	
Relevance of the indicator: The objective of this indicator is to reveal the proportion of firms in the manufacturing sector that benefit from environmental investment grants. For firms to be able to benefit from such support, the grants must exist, they must be known to firms, they must be readily accessible to firms, and the firms must make investments in environmental protection. This indicator is considered among the green economy indicators developed by UNEP.	
Calculation: The percentage of firms receiving environmental investment grants (except those relating to renewable energy production) is calculated by dividing the number of firms receiving such subsidies by the total number of firms surveyed, and multiplying the result by 100. $\text{GPI55 \%} = [(\text{number of firms receiving environmental investment grants}) / (\text{total number of firms surveyed})] * 100$	
Interpretation: Business decisions relating to green production can be affected by the benefits established in this area. This indicator can be used to assess the effectiveness of employing subsidies as incentives for fostering green production	
Limitations: This indicator does not identify the environmental thematic areas in which the subsidies are received, and a disaggregation of the indicator to reflect this aspect may be useful for evaluating specific subsidies or policies.	
Disaggregations: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by thematic area	
Proposed data source: Company surveys An alternative source of information could be the fiscal registers of companies that have received subsidies for industrial transformation.	
Model question: Has your firm received current grants for environmental investments (except those related to renewable energy production)?	
Proposed frequency: Every two years	

GPI56.	Proportion of firms receiving incentives for energy from renewable sources
Thematic area	Revenues, costs and transfers
Sub-area	Transactions with the government sector
Priority:	Low
Definition: Proportion of firms in the manufacturing sector that receive incentives to use energy from renewable sources. The incentives include subsidies and tax reductions or exemptions.	
Units of measurement or expression of the indicator: Percentage (%) of firms receiving incentives for energy from renewable sources.	
Definition of the variables that comprise the indicator: <u>Energy from renewable sources</u> is captured from sources that replenish themselves. Renewable energy includes solar (photovoltaic and thermal), hydroelectric, geothermal, tidal action, wave action, marine (non-tidal currents, temperature differences and salinity gradients), wind and biomass energy (UNSD, 2016). <u>Incentives</u> for energy from renewable sources include subsidies and tax reductions or exemptions relating to renewable energy.	
Relevance of the indicator: The objective of this indicator is to reveal the proportion of firms in the manufacturing sector that benefit from incentives relating to renewable energy. One of the pillars of green production is a reduction in energy dependence on nonrenewable fossil fuels. Energy policies must encourage the production of renewable energy, with the objective of reducing dependence on fossil sources. If firms are to benefit from such incentives, those incentives must exist, they must be known to firms, they must be readily accessible by firms, and the firms must make investments in renewable energy. This indicator is considered among the green economy indicators developed by UNEP.	
Calculation: The percentage of firms receiving incentives for use of energy from renewable sources is calculated by dividing the number of such firms by the total number of firms surveyed, and multiplying the result by 100. $\text{GPI56 \%} = [(\text{number of firms receiving incentives for energy from renewable sources}) / (\text{total number of firms surveyed})] * 100$	
Interpretation: Business decisions related with green production can be affected by the benefits established in this area. This indicator can be used to assess the effectiveness of employing incentives to encourage renewable energy.	
Limitations: As this is an aggregate indicator, it does not provide sufficient information on the type of renewable energy promoted. Moreover, in making comparisons of the results of the indicator across different geographical zones and countries it will be particularly important to consider the potential viability of resort to renewable energy, taking into account local environmental conditions (for example, for the production of wind, solar or geothermal energy) and the accessibility of the technologies needed for its production.	
Disaggregations and classification: Breakdown by region or by geographical zone. Breakdown by economic activity. Breakdown by type of renewable energy	
Proposed data source: Company surveys An alternative source of information could be the fiscal registers of companies that have received incentives for industrial transformation.	
Model question: Has your firm received incentives related to use of energy from renewable sources?	
Proposed frequency: Every two years	

Annex 5

Glossary

Environmental protection activities

Environmental protection activities are those activities whose primary purpose is the prevention, reduction and elimination of pollution and other forms of degradation of the environment (United Nations and others, 2014).

Resource management activities

Resource management activities are those activities whose primary purpose is preserving and maintaining the stock of natural resources and hence safeguarding against depletion (United Nations and others, 2014).

Recycled water

Recycled water is water that is returned to use within an economic unit (United Nations and others, 2014).

Precipitation

Precipitation consists of the volume of atmospheric precipitation (rain, snow, hail, etc.) on the territory of reference during the accounting period before evapotranspiration takes place (United Nations and others, 2014).

Wastewater

Wastewater is discarded water that is no longer required by the owner or user. Water discharged into drains or sewers, water received by water treatment plants and water discharged directly to the environment are all considered wastewater. Wastewater includes return flows of water which are flows of water direct to the environment, with or without treatment. All water is included regardless of the quality of the water, including returns from hydroelectric power generators. Wastewater also includes reused water which is wastewater supplied to a user for further use, with or without treatment (United Nations and others, 2014).

Reused water

Reused water is wastewater supplied to a user for further use with or without prior treatment, excluding the reuse (or recycling) of water within economic units (United Nations and others, 2014).

Sustainable procurement

Sustainable procurement is a process whereby organizations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organization but also to society and the economy, while minimizing damage to the environment (UNEP, 2012).

Wastes

Wastes are substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law (UNEP/Basel Convention, 2014).

Waste electrical and electronic equipment (e-waste)

E-wastes present some of the following characteristics: they have a high average weight, their composition includes toxic compounds, at the end of their useful life they present high concentrations of valuable resources that should be recovered in light of their scarcity, and they are appliances and equipment of broad distribution, and can be found on the market in most countries (Balde and others, 2015).

Non-hazardous wastes

Non-hazardous wastes are those that present none of the characteristics included in Annex III of the Basel Convention (UNEP/Basel Convention, 2014).

Hazardous wastes

Hazardous wastes are those that, either directly or by giving origin to another substance, present any of the following characteristics: explosives, oxidizants, flammables, organic peroxides, toxic or eco-toxic substances, infectious substances, substances liable to spontaneous combustion, corrosives, substances which, in contact with water, emit flammable gases, substances which, in contact with air or water, release toxic gases (UNEP/Basel Convention).

Eco-innovation

An eco-innovation or green innovation is the introduction of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations that will generate environmental benefits in comparison with the alternatives (OECD/Eurostat, 2005).

Emissions to air

Emissions to air are gaseous and particulate substances released to the atmosphere by establishments and households as a result of production, consumption and accumulation processes. By convention, emissions to air exclude the release of steam or water through evaporation (United Nations and others, 2014).

Green jobs

Green jobs are decent jobs that help to reduce the adverse impact on the environment, contributing to the creation of environmentally, economically and socially more sustainable firms and economies (ILO, 2016).

Renewable energy

Renewable energy is captured from sources that replenish themselves. It includes solar (photovoltaic and thermal), hydroelectric, geothermal, tidal action, wave action, marine (non-tidal currents, temperature differences and salinity gradients), wind and biomass energy. All are replenished naturally, although their flow may be limited (United Nations and others, 2014).

Packaging

Packaging means all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. “Non-returnable” items used for the same purposes are also considered to constitute packaging (European Communities, 1994).

Taxes

Taxes are compulsory, unrequited payments, in cash or in kind, made by institutional units to government units (United Nations and others, 2014).

Environmental taxes

Environmental taxes are taxes whose tax base is a physical unit (or a proxy of it) of something that has a proven, specific negative impact on the environment (United Nations and others, 2014).

Sustainability reporting

A sustainability report is a report published by a company or organization about the economic, environmental and social impacts caused by its everyday activities. A sustainability report also presents the organization's values and governance model, and demonstrates the link between its strategy and its commitment to a sustainable global economy (GRI, 2017).

Hazardous raw materials

A hazardous material is any solid, liquid or gaseous substance that, by its physical, chemical or biological characteristics, can cause damage to human beings, the environment, or property (United Nations, 2011b).

Measurement of atmospheric emissions and particulates

The measurement of atmospheric emissions includes all activities aimed at monitoring the concentration of exhaust gases, particulates and air quality (United Nations and others, 2014).

Fines and penalties

Fines and penalties are distinguished from taxes by being compulsory payments imposed on institutional units by courts of law or quasi-judicial bodies (United Nations and others, 2014).

Payments for permits and licenses to use environmental assets

These are payments made to acquire permits, licenses or similar mechanisms that convey rights of access to environmental assets, their extraction or use (United Nations and others, 2014).

Subsidies

Subsidies are current unrequited payments that government units, including non-resident government units, make to enterprises on the basis of the levels of their production activities or the quantities or values of the goods and services that they produce, sell or import (United Nations and others, 2014).

Investment grants

Investment grants consist of capital transfers made by governments to other resident units or non-resident units to finance all or part of the costs of their acquisition of fixed assets (United Nations and others, 2014).

Environmental investment grants

These are investment grants where the government primary objective or purpose is that the resources be used for environmental protection or resource management (United Nations and others, 2014).

Environmental technologies

Environmental technologies are technical processes, installations and equipment (goods), and methods or knowledge (services), whose technical nature or purpose is environmental protection or resource management (United Nations and others, 2014).

End-of-pipe (pollution treatment) technologies

These are mainly technical installations and equipment produced for measurement, control, treatment and restoration/correction of pollution, environmental degradation, and/or resource depletion (United Nations and others, 2014).

Integrated (pollution prevention) technologies

These are technical processes, methods or knowledge used in production processes that are less polluting and less resource-intensive than the equivalent “normal” technology used by other producers. Their use is less environmentally harmful than that of relevant alternatives (United Nations and others, 2014).

Wastewater treatment

Wastewater treatment designates any process for rendering wastewater fit to meet applicable environmental standards or other quality norms (United Nations and others, 2014).

Treatment of atmospheric emissions and particulates

This includes all activities involving the installation, maintenance and operation of end-of-pipe equipment for the removal and reduction of emissions of particulate matter or other air-polluting substances. Also included are activities aimed at increasing the dispersion of gases so as to reduce concentrations of air pollutants (United Nations and others, 2014).

Primary treatment of wastewater


Includes mechanical treatment of wastewater, which designates processes of a physical and mechanical nature that result in decanted effluent and separate sludge [...] The activity is aimed at separating materials in suspension by the use of screens (large solids) or through sedimentation eventually assisted by chemicals or flotation (United Nations and others, 2014).

Secondary treatment of wastewater

Includes biological treatment of wastewater, which designates processes that employ aerobic or anaerobic microorganisms and result in decanted effluent and separate sludge containing microbial mass together with pollutants. This activity is designed to eliminate pollution from oxidizable materials through the use of bacteria (United Nations and others, 2014).

Tertiary treatment of wastewater

Includes treatment of wastewater by advanced technologies, which designates processes capable of reducing specific constituents in wastewater not normally achieved by other treatment options. This activity is aimed at eliminating oxidizable non-biodegradable matter at a higher level, as well as metals, nitrate, phosphorus, etc. (United Nations and others, 2014).



Today the international community recognizes that a greener economy has the potential to mitigate the effects of environmental degradation and can offer an opportunity to overcome the economic crisis, given the positive effects it can have in areas such as renewing the business fabric, boosting investment, promoting innovation and creating more and better jobs. In that context, the working and production methods of the productive sector and businesses are a key factor in ascertaining innovation potential, improving productivity and competing on the international market.

National authorities and international bodies should therefore focus on sustainable production, which will, in turn, require progress in this area to be quantified. Bodies responsible for official statistics, an essential tool for evidence-based decision-making, are aware of this considerable need for information. This document is intended as a contribution to these efforts.

The document *Green production indicators. A guide for moving towards sustainable development* is the product of the joint work undertaken by the Economic Commission for Latin America and the Caribbean (ECLAC) and the International Development Research Centre (IDRC) of Canada as part of the project “Towards a set of indicators for greener production”. Its objective is to develop specific expertise to foster the development and compilation of harmonized regional indicators on sustainable production and the mainstreaming of green technology in Latin American and Caribbean firms.