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Technical Project



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1 Introduction

In recent years, the INE (National Statistics Institute) has produced seven new environmental accounts: emissions to the atmosphere, material flows, environmental taxes, waste, environmental protection expenditure, energy, and environmental goods and services.

These accounts complement the traditional statistics that the INE has been conducting in the environmental field for years, in terms of waste generation and treatment, water, and environmental protection expenditure.

From the mentioned statistics and accounts, it is possible to have a broad set of highly relevant environmental indicators for users and decision-making in the field of ecological transition.

However, it is challenging for users to have an overall view that allows them to analyse synthetically the situation and evolution of the various indicators published by the INE in terms of waste, energy, emissions, material consumption and productivity, environmental taxation, growth, green employment, and much more.

In particular, many of the indicators produced by the INE provide information for measuring the objectives of the European Green Pact, the 2030 Agenda for Sustainable Development, the European Biodiversity Conservation Strategy 2030, the RePowerEU Plan and the Spanish Circular Economy Strategy.

This series of experimental statistics is inspired by the desire to monitor these objectives through indicators that can reflect the national position on an annual basis in relation to the established limits and in comparison with the trends of the European average.

The project will enable the quantification of the set objectives and provide full flexibility to incorporate new indicators as new measurement needs are identified, given the rapid evolution of environmental needs.

2 International and European Context

Europe is considered a pioneer in the transition to climate neutrality, the circular economy and reducing the ecological footprint, thanks to the adoption of policies such as the European Green Deal, its first Circular Economy Action Plan, the European Climate Law, the REPowerEU Plan, the 'Fit for 55' package, and numerous strategies and roadmaps for savings, diversification, and circularity at regional, national, and local levels.

The following presents the international and European framework that motivates this project.

2.1 European Green Deal

Beyond the proposals and results of the Paris Agreement, adopted in December 2015, the European Commission presented the European Green Deal in 2019¹. With this package of policies focused on the ecological transition, the EU committed to achieving climate neutrality by 2050. This new strategy highlighted the importance of adopting an integrated and cross-sectoral approach in which all areas of action contribute to that final goal. The Commission committed to reviewing and adapting the EU regulatory framework to climate objectives, reducing net GHG (greenhouse gas) emissions by at least 55% by 2030 (compared to 1990 levels), and making the climate neutrality goal a legal obligation, forming a society resilient to climate change and its inevitable consequences, recovering Europe's biodiversity by 2030, creating a sustainable model in the food system, and promoting industry as a driver of change and innovation to achieve climate neutrality and digitalisation.

The Green Deal is an integral part of this strategy of the Commission to implement the 2030 Agenda and the United Nations Sustainable Development Goals. To advance the European Green Deal, the key points are:

- A higher level of EU climate ambition for 2030 and 2050.
- Provision of clean, affordable, and secure energy.
- Mobilisation of industry for a clean and circular economy.
- Efficient use of energy and resources in building and renovation.
- Accelerating the transition to sustainable and smart mobility.
- From farm to fork: devising a fair, healthy, and environmentally friendly food system.
- Preserving and restoring ecosystems and biodiversity.
- Aspiring to zero pollution for a toxic-free environment.

The Eighth Environmental Action Programme² (8th EAP) until 2030 aims to accelerate the green transition and ensure decisive actions that protect and restore the environment. The 8th EAP builds on the objectives of the European Green Deal, which is the EU's growth strategy to achieve a climate-neutral, resource-efficient, non-toxic, resilient, and competitive circular economy in a fair and inclusive manner. The programme is also fundamental to achieving climate and environmental objectives

¹ https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_es

² https://ec.europa.eu/commission/presscorner/detail/es/IP_22_4667

within the framework of the United Nations 2030 Agenda, its Sustainable Development Goals (SDGs), and multilateral environmental and climate agreements.

The environmental indicators proposed in this project are aligned with the European-level indicators, forming the basis of the monitoring framework to measure progress towards achieving the priority objectives in the areas of climate change, circular economy, energy, and biodiversity, detailed below.

2.2 The European Climate Law

One of the main objectives of the European Green Deal is a higher level of climate ambition for 2030 and 2050, specifically aiming to achieve climate neutrality in the EU by 2050.

In this experimental statistic, the 'Climate Change' action axis is introduced, one of the main international initiatives, in response to the need to measure the objectives set out in the Paris Agreement and the European Climate Law.

The Paris Agreement¹ is an international treaty on climate change, adopted by world leaders at the United Nations Climate Change Conference (COP21) in Paris. The Agreement sets long-term goals as a guide:

- Substantially reduce greenhouse gas emissions to limit the global temperature increase this century to 2 °C, preferably to just 1.5 °C.
- Review country commitments every five years.
- Provide funding to developing countries to help them mitigate climate change and improve their capacity to adapt to its impacts.

Currently, 192 countries, in addition to the European Union, have signed the Paris Agreement. The agreement includes commitments from all countries to reduce their emissions and collaborate on adapting to the impacts of climate change, as well as calls for these countries to increase their commitments over time. It also provides a framework for transparent monitoring and reporting on the climate targets of developed countries, and its implementation is crucial for achieving the Sustainable Development Goals.

Furthermore, the European Commission approved the European Climate Law² in 2021, which establishes and defines the goal of climate neutrality in the EU by 2050 and provides a framework to advance efforts to adapt to the impacts of climate change. All member states must implement adaptation strategies and plans.

The Law also sets a binding target for the Union to reduce net greenhouse gas emissions (emissions once absorptions are deducted) by at least 55% by 2030 compared to 1990 levels. To ensure sufficient measures are taken to reduce and avoid emissions by 2030, the Climate Law introduces a limit of 225 million tonnes of CO₂ equivalent as the contribution of absorptions to this target.

Under this Law, the 'Fit for 55' plan has also been agreed upon, which is a package of measures aimed at reviewing and updating EU legislation and launching new initiatives to ensure EU policies align with agreed climate targets.

¹ <https://www.un.org/es/climatechange/paris-agreement>

² <https://eur-lex.europa.eu/legal-content/ES/TXT/?uri=CELEX%3A32021R1119>

Therefore, it is essential to add a line of action that can monitor improvements related to climate change. In this project, environmental indicators are proposed to measure progress at the national and European levels concerning climate targets.

2.3 European Circular Economy Action Plan

The transition towards a circular economy is a priority at both European and global levels. Concern about the depletion of available natural resources and the reduction of waste generated in production and consumption processes has raised the need to change traditional economic models towards a model that optimises the use of available resources, materials, and products. This aims to ensure economic growth, greater well-being for our societies, and the preservation of natural capital.

The current economic system is based on a linear model, in which raw materials are extracted to manufacture products, which are then produced and eventually disposed of. This 'Extract - Produce - Consume - Dispose' model involves intensive use of natural resources and exerts high pressure on the environment, generating a large volume of waste, greenhouse gases, and pollution of soil and water, neglecting sustainability.

Circular economy is proposed as an alternative to this traditional model and its goal is to maintain the value of products, materials, and resources for as long as possible, returning them to the production cycle at the end of their use, while minimising waste generation. This means producing with the least possible environmental impact.

Besides promoting environmental sustainability, the circular economy offers opportunities to innovate and improve the economy, making it more sustainable and competitive. This includes developing more innovative and efficient forms of production and consumption, creating jobs, optimizing waste management by promoting recycling and reducing landfill, and saving energy. These actions benefit the environment in terms of climate change, biodiversity, and air, water, and soil quality, while generating sustainable competitive advantages for Europe.

Research and innovation play a crucial role in this shift towards a circular economy, as only through developing new technologies and expanding scientific knowledge can the linear production and consumption process be transformed into a circular model with high material recyclability. Therefore, boosting research, development, and innovation in the circular economy is essential and contributes to improving industrial competitiveness in Europe and Spain.

To achieve a sustainable, resource-efficient, increasingly decarbonised, and competitive economy, the European Commission has established specific action plans for the circular economy¹, addressing the entire product life cycle, from production and consumption to waste management and the secondary raw materials market. These plans focus on key sectors and aim to decouple economic growth from resource use, achieve circularity in production, and prevent waste generation through a coherent legislative approach consistent with the waste hierarchy. Additionally, the participation of businesses and consumers in this transition process towards a circular economy is promoted.

¹ https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

The circular economy is closely related to the EU's climate and energy objectives and contributes to the EU's sustainability and sustainable development commitments, particularly Sustainable Development Goal 12, which seeks to promote sustainable consumption and production patterns. The European Commission has established a monitoring framework to measure progress towards a circular economy through indicators that cover all stages of the resource, product, and service life cycle.

Spanish Strategy for the Circular Economy

Like other countries in our surroundings, Spain has already designed its strategies and action plan for the coming years in terms of the circular economy. The Circular Economy Strategy, *España Circular 2030*¹, developed by the Ministry for the Ecological Transition and the Demographic Challenge, represents the adaptation of the community framework and the necessary mechanism to carry out the transition towards the circular economy in Spain. In this strategy, collaboration between administrations, the productive sector, and society is essential.

The Spanish Circular Economy Strategy 2030 (EEEC2030, per its Spanish acronym) establishes the groundwork to move beyond the linear economy and foster a new production and consumption model which aims to maintain the value of products, materials, and resources within the economy for as long as possible, minimise waste generation, and maximise the use of waste that cannot be avoided. The strategy sets goals for this decade, which will, among other things, allow for a 30% reduction in national material consumption, a 10% improvement in water use efficiency, a 15% cut in waste generation compared to 2010, and a reduction in greenhouse gas emissions below 10 million tonnes by 2030.

The INE has collaborated with the Ministry for the Ecological Transition and the Demographic Challenge (MTED, per its Spanish acronym) in selecting indicators that will allow monitoring of the EEEEC2030 in the coming years. As a result of this collaboration, an initial set of about 30 indicators has been designed, but the methodological development of the indicators that will complete those selected in this first phase remains pending.

The new experimental statistic on Environmental Indicators will provide a unique compendium that will encompass this set of indicators, most of which are produced by the INE, and, in turn, monitor the Spanish Circular Economy Strategy 2030.

2.4 Biodiversity Strategy

In the European Commission's Green Deal document, approved in 2019, various transformative policies are highlighted, including the preservation and restoration of ecosystems and biodiversity. However, the European Union has not achieved some of the most important targets set for 2020, and biodiversity continues to decline at an alarming rate worldwide, underscoring the importance of halting biodiversity loss.

The EU Biodiversity Strategy for 2030² is a comprehensive and ambitious long-term plan aiming to protect nature and reverse ecosystem degradation. This strategy builds

¹ <https://www.miteco.gob.es/es/calidad-y-evaluacion-ambiental/temas/economia-circular/estrategia/>

² https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_es

on the goals set until 2020 and seeks to place European biodiversity on a recovery path by 2030. It proposes to achieve this through concrete measures and commitments that will benefit people, the climate, and the planet as a whole.

The strategy has a holistic approach. It is not only about protecting species and habitats, but also about reducing pressures on biodiversity. It is based on three pillars:

- Conservation: Protecting and restoring habitats and species.
- Reducing pressures on biodiversity: Reducing the impact of human activities on nature.
- Restoration of biodiversity: Restoring degraded ecosystems.

The EU Biodiversity Strategy is an important step in protecting nature and an opportunity to create a more sustainable future in Europe. However, its success will depend on the effective implementation of the proposed actions and the concerted effort of all sectors of society.

To achieve these goals, the strategy proposes a series of actions, including:

- Protecting at least 30% of the EU's land and marine surface.
- Reducing pollution and pesticide use.
- Promoting sustainable agriculture and forestry.
- Protecting endangered species.

Additionally, it is important to consider that forest ecosystems are experiencing increasing pressure due to climate change. For this reason, one of the EU's policies is to improve both the quality and quantity of forested areas. To this end, a new forestry strategy in the EU is proposed, aiming to preserve and restore forests across Europe.

The introduction of biodiversity indicators in the new experimental statistic on Environmental Indicators will help measure compliance with the goals established in the Nature Restoration Law.

2.5 Energy Strategy

The energy strategy of the European Union (UE)¹ is based on several key goals and principles aimed at ensuring a secure, sustainable, and competitive energy supply for all member countries. Here are some fundamental elements of the EU's energy strategy:

- **Transition to clean energy:** One of the EU's most prominent goals is to reduce greenhouse gas emissions and move towards a low-carbon economy. This is achieved by promoting renewable energy sources such as solar, wind, and biomass, and improving energy efficiency. To support this clean transition, we must better leverage our own industry, from hydrogen to chemicals, from biotechnology to nanotechnology.

¹https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowerEU-affordable-secure-and-sustainable-energy-europe_es#saving_energy

- **Single energy market:** The EU strives to create a single, competitive energy market across the region, which involves interconnecting electricity grids and removing trade barriers to ensure a reliable and affordable energy supply.
- **Energy security:** The EU seeks to reduce its dependence on energy imports and enhance its energy security. This includes diversifying supply sources, investing in infrastructure and technology, and developing its energy storage capacity.
- **Energy efficiency:** An essential component of the EU's energy strategy is to improve energy efficiency in all sectors, from buildings to transport and industrial production. Specific targets have been established to reduce energy consumption.
- **Decarbonisation:** The EU is committed to decarbonising its economy and achieving carbon neutrality by 2050. This entails a complete transition to clean energies and a drastic reduction in greenhouse gas emissions.
- **Research and innovation:** The EU promotes research and innovation in advanced energy technologies to accelerate the transition to a more sustainable energy system. This includes the development of energy storage solutions, smart grids, and electric mobility.
- **International cooperation:** The EU closely collaborates with other countries and regions to address global energy challenges, such as fighting against climate change and promoting clean energies. It also participates in international agreements and conferences, such as the Paris Agreement.

In summary, the new environmental indicators statistic will monitor progress towards meeting the energy objectives set by the EU's energy strategy. This strategy focuses on transitioning to cleaner and more sustainable energy, creating a single and competitive energy market, improving energy efficiency, and ensuring supply security. These objectives align with the EU's broader efforts to address climate change and promote sustainable economic development.

2.6 Sustainable Development Goals (SDGs)

The Sustainable Development Goals¹ (SDGs) are a universal call to action to end poverty, protect the planet, and improve the lives and prospects of people worldwide. In 2015, the 193 Member States of the United Nations adopted 17 Goals and 169 specific targets as part of the 2030 Agenda for Sustainable Development. This Agenda outlines a plan to achieve the Goals over 15 years through the action of all societal actors.

These 17 goals are integrated and indivisible, recognising that actions in one area will affect outcomes in others. Moreover, development must encompass the social, economic, and environmental dimensions. The SDGs need to be implemented in an integrated manner to help countries address complex challenges and chart a more sustainable future.

To achieve integrated solutions, countries must focus on four specific work areas: Integrated policies and programming, innovation and learning, data analysis and financing. These areas do not focus solely on individual SDGs but on the gaps between them and how to bridge these to fulfil the 2030 Agenda.

¹ <https://sdgs.un.org/2030agenda>

The climate emergency is affecting every country on every continent. It is disrupting national economies and affecting the quality of life and health of their inhabitants. The SDGs include indicators to monitor the problem. Notably: SDG 13 (Climate Action), SDG 11 (Sustainable Cities and Communities), SDG 7 (Affordable and Clean Energy).

The concepts of Circular Economy and Sustainable Development Goals are linked in the quest for social and economic prosperity to achieve sustainability at all levels (local, national, and global) and to protect the planet. Circular Economy practices can be applied as methods to achieve some of the goals proposed in the 2030 Agenda.

A fundamental pillar of the Circular Economy—the principle of reducing raw material consumption, extending the life of resources, and recirculating them—is the basis for achieving one of the sustainable development indicators: SDG 12 (Responsible Consumption and Production). This is one of the SDGs most related to the Circular Economy, but beyond this goal, the proposed indicators in this project are also directly related to: SDG 8 (decent work, and economic growth).

The preservation and restoration of ecosystems and biodiversity is another major focus of the Sustainable Development Goals. Global goals include protecting marine ecosystems, significantly reducing marine pollution, ensuring the conservation, restoration and sustainable use of terrestrial ecosystems (forests, wetlands, mountains, drylands), ending deforestation and global reforestation. In relation to biodiversity, the following are prominent: SDG 14 (Life Below Water) and SDG 15 (Life on Land).

Finally, the Sustainable Development Goals allow for monitoring the fundamental elements of the energy strategy, particularly through SDG 7 (Affordable and Clean Energy). The proposed objectives include significantly increasing the share of renewable energy in the energy mix and improving energy efficiency.

The global framework of indicators accepted by the United Nations must be complemented with European, national, and sub-national indicators. The strategic objectives of the statistical production process described by National Institute of Statistics (INE, per its Spanish acronym) in the Action Plan for the period 2021-2023 include the 'Development of the Indicators of the 2030 Agenda for Sustainable Development.' It is one of the six thematic strategic goals of statistical production.

This point specifies the need to continue working on developing statistical indicators that monitor the 2030 Agenda, enhancing their dissemination and data expansion, not only of indicators but also of their possible disaggregations.

The objectives described in the Action Plan are:

1. Develop work related to the development of SDG indicators. Initiatives undertaken to develop SDG indicators.
2. Development and publication of SDG indicators. Number and percentage of SDG indicators published on the 2030 Agenda platform.

3 Research areas

3.1 Population scope

The series of indicators present in this experimental statistic refer to the entire Spanish economy.

As a synthesis operation that collects information from different statistics, a single statistical population cannot be indicated. The statistical population corresponds to the statistics used as sources of information.

First, in the Climate Change axis, emissions information, which presents a breakdown by National Classification of Economic Activities (NACE) and pollutants and renewable energy, will be fundamental. Economic magnitudes (Gross Value Added (GVA), employment) will also be relevant.

Second, in the Circular Economy axis, a key part of these indicators focuses on raw materials, for which a breakdown by material types is proposed. Another part of these indicators focuses on waste management. Various economic magnitudes are also relevant.

For the Biodiversity axis, the extent of various types of ecosystems according to their level of conservation, protection, and presence of biodiversity will be studied.

Finally, the Energy axis will study the type of energy consumption by households, the different energy sources and the economic sectors that use this energy, related in some cases to various economic magnitudes.

3.2 Geographical scope

The indicators refer to the entire national territory and the European Union. Generally, values for both regions are considered in all indicators except in some cases where data is only taken at the national level.

3.3 Time scope

The time coverage is for the period 2010-2021.

Most indicators are annual, except for waste generation excluding mineral waste (annual at the national level, biennial at the European level), the recycling rate of waste excluding mineral waste (annual at the national level, biennial at the European level), forest area as a percentage of total area (triennial) and the proportion of important sites for terrestrial and freshwater biodiversity covered by protected areas, by ecosystem type (triennial).

3.4 Scope of study

Four strategies and action plans within the European Green Deal are considered: Climate Change, Circular Economy, Energy, and Biodiversity. New strategies, such as those related to water or agricultural system sustainability, may be included in the project in future development phases.

- **Climate change**

Climate change and environmental degradation are existential threats facing Europe and the rest of the world. To overcome these challenges, the European Green Deal will transform the EU into a modern, resource-efficient, and competitive economy, ensuring that: net greenhouse gas emissions are eliminated by 2050; economic growth is decoupled from resource use; no person or place is left behind.

The European Commission has adopted a set of proposals to adapt EU policies on climate, energy, transport, and taxation to reduce net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels.

The monitoring indicators included in this summary statistic are framed, following the structure of the 8th EAP, within the following specific priority objectives:

- **Environmental pressures related to EU production and consumption.** Climate neutrality: reduce net GHG emissions by at least 55% by 2030 compared to 1990 levels.
- **Climate impact meters.** A European target for sustainable energy is set: at least 45% of energy from renewable sources in the gross final energy consumption by 2030.
- **Climate change mitigation.** Priority and effective, rapid, and full implementation of climate and environmental strategies through environmental taxes and subsidies, transition financing, and sustainable investments and innovation.
- **Favourable conditions and adaptation to climate change. Respecting the planet's boundaries.** Sustainable competitiveness: increasing the shares of the green economy and green employment in the overall economy.

- **Circular Economy**

The European Commission has established the monitoring framework to measure progress towards a circular economy through a set of indicators that cover the different stages of the resource, product, and service life cycle. These monitoring indicators are grouped into four lines of action according to the different stages and aspects of the circular economy:

- **Production and consumption.** España Circular 2030 lays the foundations for promoting a new production and consumption model in which the value of products, materials, and resources is maintained in the economy for as long as possible, where waste generation is minimised and unavoidable waste is used to the greatest extent possible. It focuses on the design of products, from their conception to their manufacture, to make them more easily repairable, with a longer lifespan, easily recyclable, and free of harmful substances. Furthermore, it seeks to reverse the current consumption culture to focus on more responsible consumption, reducing waste generation, and promoting quality recycling.
- **Waste management.** Effectively apply the waste hierarchy principle by promoting the prevention of waste generation, fostering preparation for reuse, strengthening recycling, and recovering energy or other value from waste that cannot be recycled; and ensuring traceability, reducing landfill disposal and abandonment of waste in the environment, and preventing waste from reaching the sea.

- **Secondary raw materials.** The use of secondary raw materials will enable a more sustainable use of natural resources, as well as build consumer confidence towards responsible consumption forms. The purpose of recycling is its introduction into secondary markets; without its incorporation into the production process, all operations of material separation and recovery from waste are meaningless. Determining the degree of market participation in raw materials allows for the improvement of a set of instruments to encourage their use, thus closing the cycle.
- **Competitiveness and innovation.** Promote research and innovation both in the public sector and in the business sector, and particularly in public-private collaboration, as engines of change and transition towards a sustainable production and social model, facilitating the creation of knowledge, its transfer, and adoption of new technologies.

- **Energy**

The EU's energy strategy is realised in a series of objectives, which include:

- **Promoting energy efficiency and reducing energy consumption.** Energy efficiency and savings is the cheapest, safest, and cleanest way of reducing our external dependence and ensuring an affordable energy supply. Additionally, investment in renewable energies improves the climate and energy independence while also ensuring supply security and creating jobs within the EU. The specific goals are:
 - Reduce gas consumption by at least 15% during 2023.
- **Diversifying energy supply and reducing dependence on fossil fuels.** In response to the difficulties and disturbances in the global energy market caused by the Russian invasion of Ukraine, the European Commission is implementing the REPowerEU plan, which primarily focuses on this objective. With the following further goals:
 - Reduce greenhouse gas emissions in the energy sector by 55% by 2030.
 - Increase renewable energy production to 40% of final energy consumption by 2030.
 - Binding target for 2030 of a 42.5% increase in renewable energy capacity (with the intention to reach 45%, nearly doubling the Union's current share of renewable energy).

- **Biodiversity**

One of the fundamental components of the European Green Deal is the preservation and restoration of ecosystems and biodiversity.

The monitoring indicators included in this experimental statistic are framed, following the structure of the 8th Environmental Action Programme (EAP), within the following specific priority objectives:

- **Biodiversity and Ecosystems.** The EU aims to protect nature: legally protect at least 30% of the EU's land area and 30% of its marine area by 2030.
- **Environmental pressures related to EU production and consumption.** Sustainable agriculture: 25% of the EU's agricultural land should be dedicated to organic farming by 2030.

4 Indicators: Description and Method of Development

The indicators for each area of study are described below, ready for each of the previously defined action axes. However, this project is based on the principle of continuous improvement, constantly seeking to enhance the methodology and develop more relevant indicators as they become available. An annual review of the progress and improvements made will be conducted, informing the Higher Council of Statistics about the results obtained.

4.1 Climate Change

Environmental pressures related to EU production and consumption

- **Greenhouse gas emissions per capita.** Total greenhouse gas (GHG) emissions of residential unit by inhabitant.
- **Greenhouse gas emissions per GDP.** Total greenhouse gas (GHG) emissions of residential unit by GDP. It is possible to consider disaggregating by economic sectors as well.
- **Proportion of fossil fuels in the total energy supply.** It is a measurement of the amount of energy originating from fossil fuels compared to the total amount of energy consumed. To calculate the proportion of fossil fuels indicator, the amount of energy produced from fossil fuels is divided by the total amount of energy consumed. The result is expressed as a percentage.

Climate impact meters

- **Climate related economic losses.** Economic damages and losses caused by extreme weather events, such as droughts, floods, storms, and heatwaves. These losses can impact various sectors, including agriculture, tourism, infrastructure, and health.
- **Annual mean levels of fine particulate matter PM10 in cities (population weighted).** It's a measurement of air quality in urban areas. These calculations are based on data from urban air quality monitoring stations. High levels of suspended particles in cities can negatively impact human health. PM10 particles can penetrate the lungs and cause respiratory issues, such as asthma, bronchitis, and pneumonia. They can also increase the risk of heart and cerebrovascular diseases.
- **Premature deaths due to exposure to fine particles (PM2.5).** Exposure to fine particle pollution can also increase the risk of premature death.

Climate change mitigation

- **Shares of environmental taxes in total tax revenues.** Share of energy from renewable sources over gross final energy consumption.
- **Passenger ground transport by type of transport.** This indicator measures the share of different modes of transport in the performance of passenger land transport, expressed in passenger-kilometres (pkm). Passenger land transport includes transport by cars, buses, coaches, and trains. All data is based on movements within national territories, regardless of the nationality of the vehicle. Other modes of passenger transport, such as inland waterway transport, tram and metro systems, or passenger transport by sea and air, are not represented in the indicator.

Favourable conditions and adaptation to climate change. Respecting the planet's boundaries

- **R&D expenditure intensity.** Experimental research and development (R&D) comprise creative and systematic work carried out to increase the stock of knowledge, including knowledge of humanity, culture, and society, and to devise new applications of available knowledge. The R&D intensity indicator measures the percentage of GDP that a country spends on research and development. This indicator is an important measure of a country's commitment to innovation and economic growth.
- **Domestic expenditure in environmental protection by institutional sector and percentage of GDP.** It represents the total economic resources that a nation dedicates to environmental protection. It is calculated to avoid double counting and is comparable with national account aggregates. In the European methodological model followed in the estimates, National Environmental Protection Expenditure is defined as the sum of the uses of environmental protection services by resident units (final consumption, intermediate consumption), plus gross fixed capital formation, minus funding from the rest of the world.
- **Gross value added in environmental goods and services sector (% of GDP).** It represents the contribution of the production of environmental goods and services to GDP. This is the difference between the value of production and intermediate consumption.
- **Employment in the sector of environmental goods and services (% of total economy).** Full-time equivalent jobs dedicated to the production of environmental goods and services. Full-time equivalent is defined as the total hours worked divided by the annual average of hours worked in a full-time job.

4.2 Circular Economy

Production and consumption

- **Domestic material consumption.** It measures the amount of solid, liquid, and gaseous materials (excluding air and water) directly used by the economy. This indicator is included in **tonnes per capita and in relation to the GDP** of the economy.
- **Physical trade balance.** Physical imports and exports encompass all imported or exported goods, in mass units. The exchanged goods include goods in all stages of transformation, from base products to finished goods.
- **Municipal waste generation per capita.** It measures the waste collected by or on behalf of municipal authorities and disposed of through the waste management system. It largely consists of household waste, although similar waste from sources such as commerce, offices, and public institutions can also be included.
- **Waste generation (excluding major mineral wastes) with respect to the GDP.** All waste generated in a country (in mass units), excluding major mineral waste, per unit of GDP.
- **Food waste generation per capita.** The amount of food waste generated per year (in kilograms), divided by the average population of the country.

Waste management

- **Waste recycling rate, excluding major mineral wastes.** It covers both hazardous (hz) and non-hazardous (nh) waste from all economic sectors and households, including waste from waste treatment (secondary waste), but excluding most mining waste. Excluding significant mineral waste is essential to avoid situations where trends in the generation of ordinary waste might be overshadowed by massive fluctuations in waste generation in the extraction and processing sector of minerals. This indicator is presented in tonnes per inhabitant per day.
- **Recycling rate of packaging waste.** Share of recycled packaging waste compared to the packaging waste generated. Container waste encompasses discarded material used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the user or consumer, excluding production waste. Packaging waste is divided into “paper and cardboard packaging,” “plastic packaging,” “wood packaging,” “metal packaging,” and “glass packaging.” An ‘adjusted recycling rate’ for two types of waste material (plastic and wood) is included:
 - The recycling rate of plastic packaging waste counts exclusively the material that is recycled back into plastic (recycling/generation of material).
 - The recycling rate of wood packaging waste includes the repair of wood packaging waste (recycling + repair / generation + repair).
- **Recycling rate of electrical appliances and electronic goods.** Waste electrical and electronic equipment (WEEE), also known as e-waste, such as computers, televisions, refrigerators or mobile phones, is one of the fastest growing waste streams in the EU. WEEE includes hazardous substances (such as cadmium, mercury, lead, hazardous oils or polluting gases, among others) and valuable materials that represent an important resource and whose recycling must be improved.

Secondary Raw Materials

- **Trade in recyclable raw materials.** It measures the quantities of selected categories of waste and by-products that are shipped between EU Member States (within the EU) and across EU borders (outside the EU). Five classes have been selected: plastic; paper and cardboard; precious metal; iron and steel; copper, aluminium and nickel. The indicator includes the following variables: intra-EU trade of selected recyclable raw materials (measured as imports from EU countries); imports from non-EU countries; exports to non-EU countries of selected recyclable raw materials (concerning extra-community trade).

Competitiveness and Innovation

- **Gross investment in tangible goods.** The investment during the reference year in all physical assets. This includes new and existing tangible capital assets, whether purchased from third parties or produced for own use (i.e. capitalised production of tangible capital assets), which have a service life of more than one year, including non-produced material tangible assets, like soil. Investments in intangible and financial assets are excluded.
- **Number of employees in the circular economy.** Jobs are expressed in number of people employed and as a percentage of total employment. The number of people employed is defined as the total number of people working in the observation unit,

that is, the company (including working owners, partners who regularly work in the unit and unpaid family workers), as well as people who work outside the unit that belong to it and are paid by it, in the Circular Economy. One of the challenges of this experimental statistic is to delve into the employment indicator in the Circular Economy. Firstly, being able to disaggregate by NACE (National Classification of Economic Activities) codes, considering the economic activities directly related to the circular economy. Secondly, including a disaggregation by gender. To obtain this level of detail, joint work will be carried out with the departments of the National Statistics Institute (INE) responsible for the economic and employment data used as the basis for these environmental indicators.

4.3 Energy

Promoting energy efficiency and reducing energy consumption.

- **Primary energy consumption.** It quantifies the total amount of energy consumed in a specific region or country. This indicator considers all primary energy sources, such as oil, natural gas, coal, nuclear, hydroelectric, solar, wind, among others, and represents their consumption in a single unit, equivalent to the amount of energy contained in one tonne of crude oil. It is an important measure in the evaluation of energy efficiency and environmental sustainability, as a higher consumption of primary energy can be associated with greater greenhouse gas emissions and other environmental impacts.
- **Household final consumption per capita.** This indicator, which is measured in Terajoules, breaks down the final energy consumption of households in several specific use categories, allowing for an understanding of which areas consume the most energy in households. Common usage categories include: Heating / Cooling (The amount of energy consumed to control the indoor space of the dwelling), Transport and Others (Energy consumption for electricity and lighting and related to food handling or heating water for domestic uses, such as showers, washing machines, and dishwashers).
- **Energy intensity measured as a function of net domestic energy use per unit of GDP.** The net internal use of energy represents the net amount of energy used in a country for production and consumption activities, and can be used to evaluate trends in energy consumption by resident units. This aggregate, linked with monetary accounts data, helps calculate the energy intensity indicator disaggregated by 7 branches of activity. This provides important information about the amount of energy used in each sector to generate one unit of GDP.
- **Energy efficiency in the construction of Nearly Zero-Energy Buildings.** Within the production associated with construction of new nearly zero-energy buildings, it measures the part of such production specifically related to the energy efficiency measures implemented during the construction of these buildings.

Diversifying energy supply and reducing dependence on fossil fuels.

- **Energy imports dependency of fossil fuels.** It is used to evaluate to what extent a country or region depends on the internal production, import and export of fossil fuels, such as oil, natural gas, and coal, in order to meet its energy needs. This indicator is calculated as the ratio between the balance in foreign trade of fossil fuels (imports minus exports) and Primary Energy Consumption. It provides important information

about energy security and a country's vulnerability to significant price fluctuations or supply disruptions of these resources. This indicator is relevant for energy planning, energy security, and decision-making related to the diversification of energy sources and the transition to cleaner, more sustainable sources. Reducing dependence on fossil fuels is a key objective in many countries to mitigate climate change and increase energy resilience.

- **Energy mix in electricity generation.** Composition or proportion of different energy sources used to generate electricity in a country or region at a given time. Each country has a different energy mix, depending on various factors such as the availability of natural resources, available technology, energy policy, and production costs. This indicator is important to understand the diversity of energy sources used in electricity generation and their impact on environmental sustainability and energy security. The electrification of the economy involves the use of electricity to meet the energy demand of all sectors, from transport to industry. This has a positive environmental impact, as it reduces greenhouse gas emissions. However, for the electrification of the economy to be truly sustainable, the energy mix must be based on renewable energy. Renewable energies are clean and sustainable energy source that does not generate greenhouse gas emissions. An energy mix with a high share of renewable energy sources will ensure that the electricity generated is clean and sustainable.
- **Renewable energy share in gross final energy consumption.** It measures the proportion of renewable energy sources in energy consumption by economic sectors. In general, developed countries have a more diversified energy mix, which includes a higher share of renewable energies. In contrast, developing countries often have an energy mix more dependent on fossil fuels.

To achieve climate neutrality, it will be necessary to continue increasing the share of renewable energy and reduce the dependence on fossil fuels in both final consumption and electricity production.

4.4 Biodiversity

Environmental pressures related to EU production and consumption

- **Forest area in proportion to total area.** This indicator measures the forest area (based on the FAO-FRA definition) as a proportion of the total national area. This data is calculated in the Forest Map of Spain and published in the Spanish Inventory of Natural Heritage and Biodiversity (IEPNB, per its Spanish acronym) and the Forestry Statistics Yearbook.
- **Average marine acidity (pH).** The indicator shows the worldwide average yearly acidity of surface seawater, expressed in pH. The decrease in pH observed on a global scale corresponds to an increase in the acidity of ocean water and vice versa. Ocean acidification is very dangerous for marine life and this impacts biodiversity and the food chain.
- **Red List Index.** It is a measure of the extinction risk of wild species. It is calculated based on data from the UICN Red List, which is an assessment of the conservation status of species worldwide. It can be broken down into Amphibians, Birds, Invertebrates, Mammals, Fish, Non-vascular Plants, Vascular Plants, and Reptiles.

- **Proportion of land that is degraded over total land area.** This indicator is measured as the proportion of land that is in a state of degradation relative to the total land area.
- **Number of vulnerable marine ecosystem areas.** A vulnerable marine ecosystem is a marine ecosystem that is particularly susceptible to human and natural impacts (coral reefs, mangroves, seabed, abyssal plains, etc.).
- **Marine protected area.** It is a marine or ocean area designated for biodiversity conservation and ecosystem services.
- **Proportion of large sites for terrestrial and freshwater biodiversity which are part of protected areas, by type of ecosystem.** This indicator observes, by ecosystem type (agricultural, forests, grasslands, urban settlements, wetlands, and other lands), the trend in the percentage of agricultural land included in protected areas as recorded in the Spanish Inventory of Natural Heritage and Biodiversity.
- **Proportion of agricultural surface area where ecological agriculture is carried out.** It measures the proportion of agricultural land (crops, meadows, and pastures) dedicated to organic production.

5 Dissemination of information

In the European Green Deal, the European Commission specifies raising awareness and disseminating information regarding the transition to a circular economy as a priority to monitor progress towards achieving each of the Green Deal objectives. Therefore, it is necessary to develop a series of new indicators that consider all these objectives.

Following the Commission's guidelines on Climate Change and the pursuit of climate neutrality, the Circular Economy, and the reduction of the ecological footprint, the protection of Ecosystems and the conservation of Biodiversity, and the transition to clean and efficient energy, an interactive dashboard will be published with the evolution of the selected indicators and the result tables with their time series.

The interactive dashboard will be divided by the previously established axes (**Climate Change, Circular Economy, Energy, and Biodiversity**) and can be navigated from one to another using the publication headers.

In a more detailed third level of navigation, the visualisation of the indicators will be provided with the maximum possible 'customisation' opportunities in the query through filters that allow the selection of variables (Geographic scope, materials, gender, years, NACEs...). This will foster an individualised and interactive experience for users. Moreover, given the importance of raising awareness among all social agents on environmental matters, even without prior knowledge of the environment or the economy, the description of each indicator will be provided in a dropdown format, so as not to hinder visualisation.

Being a European initiative and given our context within the EU, the evolution of the indicators will be shown for both Spain and the average of the European Union (EU-27) to provide a point of comparison for national results, wherever possible.

Finally, result tables will be accessible for all users for each indicator and will always be accompanied by a metadata sheet with all the information related to the sources used and the calculation of these. Annex II includes an example of the format the metadata will have.

Data updates will be in line with the annual publication of environmental indicator data. On the other hand, there should be other updates with new indicators, if any, in subsequent national action plans on the circular economy, climate change, and biodiversity. Additionally, after the pertinent research, those indicators that are in the experimental phase and initially presented as Proxy indicators should be updated once the final indicators are found.

5.1 Dissemination schedule

Starting in 2024, quarterly updates of the indicators are proposed, considering the different times of the year when the data on which they are based are updated.

6 Implementation schedule

6.1 First phase

In this initial phase, the proposal contains 39 indicators: 12 for climate change, 12 for the circular economy, 7 for energy, 8 for biodiversity. The list of these indicators is found in Annex I. Some of them align with Sustainable Development Goals indicators, already validated at the national level. Others are part of the European Commission's proposal for the monitoring framework of the 8th EAP, which defines the European Green Deal indicators.

The publication of this experimental statistic with all the indicators mentioned in this document is initially planned for the end of 2023, providing annual information for most indicators from 2008 onwards.

As mentioned in section 5, Dissemination of Information, the indicators will be accompanied by their corresponding metadata, indicating the correspondence of each indicator with the European Green Deal and SDG indicators (see Annex II).

From this first publication, the data for each year will be disseminated, with necessary updates throughout the year as data sources or calculation methodologies improve.

A dissemination schedule will be established to update the series of indicators, depending on data availability.

6.2 Second phase

In addition to these 39 indicators, there are other indicators under study for which robust sources or calculation methods are not yet available. Part of the experimental process of the project will involve publishing these indicators for user monitoring. Different calculation methods and information sources are being investigated for their incorporation in a second phase.

Indicators under Study

In relation to *Climate Change*, research will be conducted on indicators to measure the carbon footprint, energy demand and consumption by economic sectors, green bonds, subsidies for green projects or the impact of natural disasters on the population, infrastructure and economy.

Carbon Footprint: An indicator that measures the total volume of greenhouse gases (GHG) produced by human economic and daily activities.

The Zero Emission Vehicles (ZEV) Indicator is a measure of the proportion of ZEVs in a vehicle fleet. ZEVs are vehicles that produce no exhaust emissions, such as battery electric vehicles (BEV) and fuel cell electric vehicles (FCEV).

Surface Temperature Anomalies (land and marine). 'Average surface temperature anomaly' measures how much the Earth's surface temperature has deviated from its long-term average. 'Temperature record' is the highest or lowest temperature ever recorded in a specific location. 'Cold nights' and 'hot days' refer to nights and days where temperatures fall below or rise above a certain threshold. 'Average sea surface temperature anomaly' measures how much the sea surface temperature has deviated from its long-term average.

For the *Circular Economy area*, we will study the rate of circular material, jobs related to the circular economy by gender, indicators related to the reuse and purification of water, or indicators related to agri-food activity.

Circular Material Rate: Measures the proportion of recycled material fed back into the economy, thereby saving the extraction of primary raw materials in the general use of materials. The use of circular materials, also known as the circularity index, is defined as the ratio between the circular use of materials and the general use of materials.

Circular Economy-Related Jobs by Gender: Jobs are expressed in terms of the number of people employed. Jobs corresponding to the Circular Economy in NACE codes 33, 38, 45, 46, 47, and 48 are considered, differentiating between men and women.

For the *Energy area*, new sources of data will be sought to achieve greater disaggregation in the aforementioned indicators, and other indicators related to the energy balance, energy footprint or the relationship between energy consumption and greenhouse gases.

Energy Footprint: The energy footprint is a measure of the environmental impact of an individual, organisation, or activity in terms of energy consumption. It is calculated by measuring the amount of primary energy consumed, considering the energy source and its environmental impact. The energy footprint can be used to assess the environmental impact of various activities, such as transportation, industry, agriculture, and domestic consumption. It can also be used to compare the environmental impact of different products and services.

To expand the *Biodiversity* indicators, new data sources will be sought to measure forest connectivity, bird indices, and progress towards sustainable forest management.

Common Birds Index: This indicator integrates the abundance and diversity of a selection of common bird species associated with specific habitats.

Forest Connectivity: This indicator measures the degree of connectivity of forest ecosystems to create and integrate ecological corridors and increase resilience to climate change.

The decline in the number and variety of pollinators, as well as the contribution of pollinators to crop provisioning services.

6.3 Future of the operation

As mentioned in section 3.4, to address new environmental information needs and as the methodology and information sources become established, new indicators, action areas, or study fields may be added to improve the monitoring of the European Green Deal actions.

The expansion of the experimental statistics with new indicators in subsequent phases will align with the continuous development and dissemination of the 2030 Agenda for Sustainable Development indicators.

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8 Annex I. Indicators by area of study

8.1 Climate Change

- Greenhouse gas emissions per capita
- Greenhouse gas emissions per GDP
- Proportion of fossil fuels in the total energy supply
- Climate related economic losses
- Annual mean levels of fine particulate matter PM10 in cities (population weighted)
- Premature deaths due to exposure to fine particles (PM2.5)
- Shares of environmental taxes in total tax revenues
- Passenger ground transport by type of transport
- R&D Expenditure Intensity
- Domestic expenditure in environmental protection by institutional sector and percentage of GDP
- Gross value added in environmental goods and services sector (% of GDP)
- Employment in the sector of environmental goods and services (% of total economy)

8.2 Circular Economy

- Domestic materials consumption per GDP
- Domestic materials consumption per capita
- Physical trade balance
- Municipal waste generation per capita
- Waste generation (excluding major mineral wastes) with respect to the GDP
- Food waste generation per capita
- Waste recycling rate, excluding mineral waste
- Recycling rate of packaging waste
- Recycling rate of electrical appliances and electronic goods
- Trade in recyclable raw materials
- Gross investment in tangible goods
- Number of employees in the circular economy

8.3 Energy

- Primary energy consumption
- Household final consumption per capita
- Energy intensity measured as a function of net domestic energy use per unit of GDP
- Energy efficiency in the construction of Nearly Zero-Energy Buildings

- Energy imports dependency of fossil fuels
- Energy mix in electricity generation
- Renewable energy share in the gross final energy consumption

8.4 Biodiversity

- Forest area in proportion to total area
- Average marine acidity (pH)
- Red List Index
- Proportion of land that is degraded over total land area
- Number of vulnerable marine ecosystem areas
- Marine protected area
- Proportion of large sites for terrestrial and freshwater biodiversity which are part of protected areas, by type of ecosystem
- Proportion of agricultural surface area where ecological agriculture is carried out

9 Annex II. Metadata format: example

Below is an example of the metadata format for each environmental indicator. The image shows the details of one of the proposed indicators, Material Consumption (tonnes per capita).

Index	Consumption of materials per capita
Action line	Circular Economy / Production and Consumption
Type of indicator (Global, European, National)	Global European
Correlation with other sets of indicators	SDG: 12.2.2.1/8.4.2.1 Green Deal: 1
Description	National material consumption (CNM) measures the annual quantity of solid, liquid and gaseous materials (excluding air and water) used directly by the economy CNM is calculated as the sum of national material extraction (ENM) and material imports (IM) minus material exports (EM).
Calculation method	$CNM = ENM + IM - EM$ Material Consumption per capita in year t • $\frac{CNM_t}{Pt}$ Where CNM_t is the national material consumption in year t and Pt is the population on 1 July in year t.
Units	Tonnes per inhabitant
Data Source	Office for National Statistics
Periodicity	Annual
Disaggregations (Gender, Types of material, Others)	Types of material
Derived from the National Statistical Plan (YES/NO)	Yes (8465)
Statistical Operations	Material Flow Accounts
Responsible body	Office for National Statistics
Link to Eurostat metadata	https://ec.europa.eu/eurostat/cache/metadata/en/sdq_12_20_esmsip2.htm
Date of last metadata update	13/05/2022
Notes	The indicator can be divided into five large types of products: <ul style="list-style-type: none"> - Biomass and biomass products - Minerals and metal ores - Non-metallic minerals - Fossil fuels - Other products • Waste for final treatment and disposal The last two do not present values for national material extraction.