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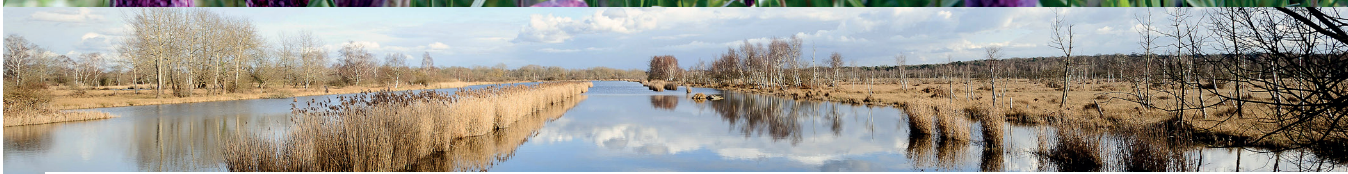
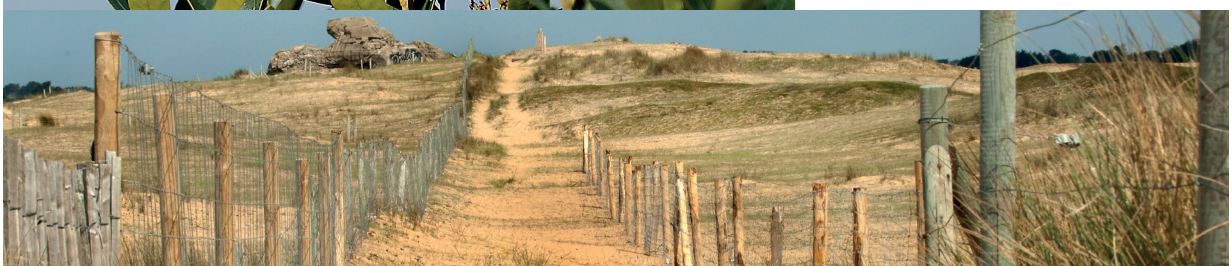
REPORT



INTERNATIONAL ENVIRONMENT RANKINGS

How Does France Perform?



February 2022

Abstract (French)

Pour interpeler les décideurs ou pour communiquer vers le grand public sur les performances environnementales d'un pays ou d'une région, des scores simples intégrant plusieurs critères environnementaux sont de plus en plus couramment diffusés. Ces indices dits « composites » agrègent ainsi des indicateurs individuels portant sur des thématiques différentes comme le changement climatique, la qualité de l'air et de l'eau, ou la politique de protection de la biodiversité.

Dans une logique de développement durable, d'autres indices combinant les aspects environnementaux et les aspects sociaux (bien-être, bonne santé) se développent également. Ces indices s'inspirent souvent des objectifs de développement durable (ODD), qui offrent un cadre reconnu internationalement.

Ce rapport vise à faire un point de situation des principaux indices utilisés à des fins de classements internationaux. Une première partie présente de façon synthétique 10 indices (cinq portant sur l'environnement et cinq sur le développement durable), parmi les plus reconnus au niveau international. Elle précise les indicateurs sous-jacents mobilisés par chacun d'eux, les métriques retenues et les modes de pondération et agrégation adoptés, en mettant l'accent sur leurs particularités. Les principaux résultats issus des classements obtenus sont également présentés, incluant le classement de la France. La seconde partie du rapport détaille chacun de ces indicateurs, sous forme de fiches dédiées, qui peuvent être consultées de manière indépendante. Le résultat obtenu par la France y est décrit de manière plus détaillée, en identifiant quels critères lui sont ou non favorables.

Au-delà de leur grande diversité dans les objectifs et choix méthodologiques, de nombreux indices utilisent des principes similaires (moyenne arithmétique des scores individuels pondérés ou non, scores compris entre 0 et 100), la priorité étant donnée à la simplicité et à la lisibilité. Mis à jour pour la plupart tous les ans ou tous les deux ans, les indices donnent lieu à des classements des pays. Les pays d'Europe et en particulier la France obtiennent souvent de bons résultats. La France a ainsi de très bons classements sur le *green future index* (4e), *l'environmental performance index* (5e), le SDG-index basé sur les ODD (8e) et l'IDH-P (8e) qui intègre à la fois le développement humain et l'environnement. Néanmoins, divers axes de progrès peuvent être identifiés sur le domaine environnemental : vie sous-marine et pratiques de pêche, énergies renouvelables, niveaux d'émissions de gaz à effet de serre par habitant, état de la biodiversité, ce dernier étant à distinguer de la politique de protection de la biodiversité.

Acknowledgements

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Abstract (in English)

To call on decision-makers or to raise awareness with the public about a country or region's environmental performance, simple scores which include several environmental criteria are being increasingly developed. These so-called 'composite' indexes bring together individual indicators on different themes such as climate change, air and water quality, and biodiversity protection policy.

Following the principles of sustainable development, other indexes combining environmental and social aspects – wellbeing and good health – are also being created. These indexes are often based on SDGs (Sustainable Development Goals), which provide an internationally recognised framework.

This report aims to provide an overview of the main indexes used for international rankings. The first part summarises ten indexes (five about the environment and five about sustainable development), all of which have an international standing. It describes the underlying indicators used by each of them, the metrics used, and the methods of weighting and aggregation adopted, with an emphasis on their particularities. The main results from the rankings are also presented, including France's positions. The second part of the report explains each of these indexes in detail, in the form of dedicated factsheets, which can be consulted independently. France's result is described in more detail and favourable criteria are identified.

Despite their great diversity in objectives and methodological choices, many indexes use similar principles (arithmetic mean of weighted/unweighted individual scores, scores between 0 and 100), with an emphasis on simplicity and readability. Most of the indexes are updated annually or every two years, resulting in country rankings. European countries, and France in particular, generally perform well. France has very good rankings on the Green Future Index (4th), the Environmental Performance Index (5th), the SDG Index (8th) and the IDH-P (8th) which integrates both human development and environmental factors. Nevertheless, various areas of progress can be identified in the environmental field: underwater life and fishing practices, renewable energy, emission of greenhouse gases per capita, and state of biodiversity. The latter should be distinguished from policies to protect biodiversity.

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Introduction

When aggregating several underlying 'indicators', scores or indexes provide an overview of a complex subject. They are being used more often to raise awareness among decision-makers or to communicate with the public. They are generally updated every year or every two years and can be used to evaluate changes over time or to compare territories, such as countries, regions, towns, and more.

There are several types of environmental indexes. Some of them are about a specific theme (e.g., climate change). Other 'composite' indexes aggregate criteria related to different types of topics, such as air and water quality, biodiversity, climate and more. Lastly, other indexes are based on sustainable development, combining environmental and social factors (wellbeing and good health, and fair economic development). The latter category is an extension of the work carried out by the Commission on the Measurement of Economic Performance and Social Progress, which is also known as the Stiglitz Commission. Most often, these indexes use indicators that have been collected within the internationally recognised framework of SDGs.

Indexes can be based on three or four underlying indicators only, or on several dozen indicators. Although some indexes have been brought in by international organisations, such as the United Nations (UN) and the Organisation for Economic Co-Operation and Development (OECD), or are in partnership with them, others have been developed by universities or private foundations, and have become references in their field. These indexes produce rankings between countries, which are easy to report on.

Without aiming for completeness, the objective of this document is to present 10 indexes that have been chosen for their environmental relevance but also their reputation and transparency. It will provide information about the methodologies and data used to create these indexes. Following this, it will analyse France's results and will identify the main areas of improvement for each of them.

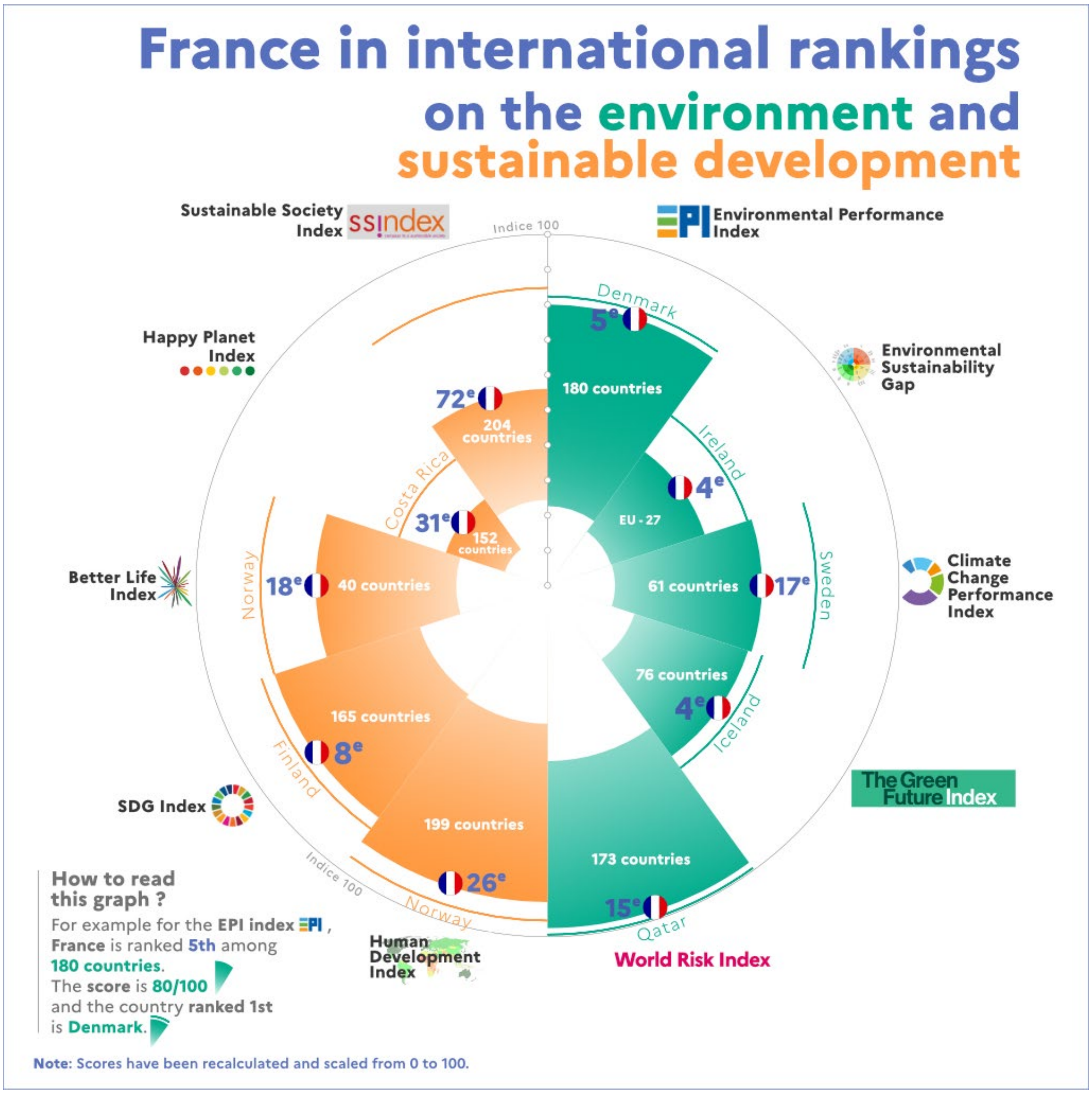
The five specifically environmental indexes are:

- The Environmental Performance Index (EPI), by Yale University
- The Environmental Sustainability GAP (ESGAP), by the French Development Agency
- The Climate Change Performance Index (CCPI), by Germanwatch e.V.
- The Green Future Index (GFI), by MIT Technology Review
- The World Risk Index (WRI), by the Institute for International Law of Peace and Armed Conflict (IFHV) at Ruhr-University Bochum, in collaboration with Bündnis Entwicklung Hilft. The Joint Research Centre of the European Commission (JRC) developed the very similar INFORM Risk Index, which is also analysed in this report.

The five indexes about sustainable development are:

- The Human Development Index (HDI) and the Planetary pressures-adjusted Human Development Index (PHDI), by the United Nations Development Programme
- The SDG Index, based on SDGs, by the UN-SDSN (Sustainable Development Solutions Network) and the Bertelsmann Foundation (it should be noted that similar indexes have been developed by the OECD and Eurostat)
- The Better Life Index (BLI), by the OECD
- The Happy Planet Index (HPI), by the New Economics Foundation
- The Sustainable Society Index (SSI), by the Sustainable Society Foundation.

The first part of this document will provide an overview of these 10 indexes. It will explain the underlying indicators used for each of them, as well as the metrics, weightings and aggregation methods used, with a focus on their specifics. The main results of these rankings are also discussed. The second part of the document explores each of these indexes in detail, in the form of dedicated factsheets, which can be referred to in a contained way.



Part 1

10 Environmental Performance and Sustainable Development Indexes: Presentation, Methods, and Results

I. Summary of the 10 Indexes

Among the 10 indexes, 5 of them are for the most part focused on environmental issues, whereas the other 5 include sustainable development-related social criteria. Their main characteristics are described below and are summarised in *Table 1*. These indexes are based on different individual indicators, which are often put together in categories. Although most indexes include between 7 and 32 indicators, the HDI and HPI only have 3. The SDG Index, however, includes 121 indicators. Some indexes add a dashboard showing each country's detailed performance in addition to their final score.

Environmental Performance Index (EPI)

The Environmental Performance Index, or EPI, is a composite index created in 2006 by Yale University (Connecticut, United States), and is published every two years. The ranking that was published on 6 June 2020 analyses 180 countries. This comprehensive index covers a wide range of topics and is well known and frequently referred to worldwide. It currently aggregates 32 indicators which are divided into 11 categories: air quality, water resources, waste management, heavy metals, agriculture, pollution emissions, climate change, sanitation and drinking water, fisheries, biodiversity and ecosystem services. One aspect of this index is that the individual indicators are constantly changing. In 2006, the EPI was only based on 16 indicators which were divided into 6 categories. The 'climate change' category did not exist at the time, whereas it now accounts for 24% of the final score.

The EPI focuses on a country's environmental awareness – or efforts – rather than on the environment's actual status. Other than pressure and status indicators, it includes trend indicators (e.g., increases/decreases in emissions) and response indicators, which reflect implemented public policies. For example, the proportion of protected areas accounts for 80% of the biodiversity score. This weighting favours developed countries.

Environmental Sustainability GAP (ESGAP)

The ESGAP assesses a country's environmental sustainability. This concept was defined by University College London (UCL) in 2003 as the maintenance over time of environmental functions that are necessary for the correct functioning of the biosphere, by integrating the concept of critical natural capital to be preserved. For each environmental function studied and each underlying indicator, an objective to be reached has been set. Recent developments have been made at the request of the French Development Agency (AFD), which wanted a tool to assess whether funded projects in a country would contribute to sustainable development. After a testing phase in 2019 and 2020 in several territories, including New Caledonia (*Levrel, 2020*), Vietnam and Kenya (*Fairbrass and Ekins, 2020*), this index was calculated for all European Union countries in 2021. The AFD would like to promote this index on a global scale.

The ESGAP includes 21 individual indicators which have been used to develop two synoptic indexes. One of these assesses current statuses in comparison to environmental objectives, while the other evaluates the trend, or progress, towards these objectives. The result is a dashboard showing the scores for each indicator, both in terms of level and trend.

Climate Change Performance Index (CCPI)

The Climate Change Performance Index (CCPI) has been published since 2005 by the independent Germanwatch organisation, with the support of the Climate Action Network. It scores and ranks 61 countries according to 14 criteria related to climate change, divided into 4 categories: greenhouse gas emissions (GHG), renewable energy, energy consumption and climate policy. Regarding the latter, it namely includes expert opinions on policies undertaken in these countries. These opinions are the reason why rankings can vary from one year to another. Another aspect of this index is that it compares a country's current context as well as its 2030 goal, with a target trajectory as set out in the Paris Agreement.

Green Future Index (GFI)

The Green Future Index (GFI) is also about climate change and focuses on decarbonising society. It was created by MIT Technology Review and was published for the first time in 2021. It made waves in France because the country came fourth in the ranking. It assesses 76 countries and ranks them based on their progress and efforts to reduce emissions, and their trend towards a low-carbon future. Based on 18 indicators divided into 5 pillars, it assesses the share of renewable energy, changes in emissions and the climate policies in each country, and it also looks at decarbonisation more comprehensively by including green innovation and meat consumption.

World Risk Index (WRI)

The World Risk Index (WRI) assesses risk levels in 173 countries, for 5 natural risks: earthquakes, cyclones, flooding, droughts, and rising sea levels. It was designed to be a guide for decision-makers. It is calculated by the Institute for International Law of Peace and Armed Conflict (IFHV) at Ruhr-University Bochum. The concept was developed in 2011, in collaboration with the Institute for Environment and Human Security at the United Nations University (UNU-EHS). The World Risk Index was revised in 2017 and is now based on 28 indicators. In addition to the 5 technical indicators that describe the 5 types of natural risks, which come under the 'exposure' umbrella, the 23 other indicators are part of the societal dimension. This is about the country's vulnerability to extreme events (human victims or economic consequences) and the country's capacity to adapt and cope in the event of a crisis. This capacity, which is generally higher in developed countries, is assessed using criteria such as healthcare, investments, education and research, but also ecosystems and forest management protection, which are also preventive means against risks.

Human Development Index (HDI)

The Human Development Index (HDI) was developed by the United Nations Development Programme (UNDP) via the Human Development Report, to provide another measurement other than GDP. It was published for the first time in 1990 and has been updated regularly since then. The last reports give an HDI for 199 countries. It is a composite, but simple index, because it is only based on four underlying indicators related to three different fields: education, standards of living and life expectancy.

This choice makes it readable and applicable to many countries. However, it reduces an ambitious concept like 'a decent standard of living' to a single measure: income per capita, which are data that are easily collected on a global scale. It would have been more accurate to estimate how much money is available after paying for basic needs. The PHDI or Planetary pressures-adjusted HDI was put forward in 2020. It comes from multiplying the HDI by a 'planetary' adjustment factor, which is intended to include an environmental aspect. In practice, this factor is calculated using two underlying indicators: carbon dioxide emission levels and material consumption.

SDG Index Score

The SDG Index Score was published for the first time in 2015 by the UN-SDSN (Sustainable Development Solutions Network), in collaboration with the Bertelsmann Foundation and Cambridge University Press. It measures a country's overall performance regarding Sustainable Development Goals (SDG). These SDGs were adopted in 2015 by the 193 countries in the UN as part of the 2030 Agenda. They describe an ideal future for 2030, divided into 17 goals, promoting the links between social justice, economic growth, peace and solidarity, and ecosystem preservation. The SDG Index includes 121 underlying indicators, but only 91 for non-OECD countries.

Although the SDGs were initially designed to be a set of different types of goals, the SDG Index provides extra information by giving an overall score. It also has a dashboard for each country with their performance according to each SDG and an assessment of its trends regarding the 2030 goal. The performance and trends for each of the 121 (or 91) underlying indicators can be seen in each country's dedicated factsheet. Other methods have been suggested to measure overall SDG performance, namely by the OECD and Eurostat.

Better Life Index (BLI)

The Better Life Index (BLI) was created in 2011 by the OECD and is used to assess and compare living standards in each country. It uses 24 indicators, divided into 11 categories: housing, income, jobs, health, knowledge and skills, environment, life satisfaction, safety, work-life balance, community and civic engagement. The last three categories show that this index emphasises social interaction as something that contributes to high living standards. It was designed to be an alternative to GDP and is aimed at the public. This is why it is published in the form of an innovative interactive website (www.oecdbetterlifeindex.org). Firstly, it shows the results for all countries, with each country being represented by a flower with 11 petals. The size of each petal depends on its score. Secondly, the user can choose their own weightings between the 11 categories; in this case, the tool will show a score and will rank according to these weightings.

Happy Planet Index (HPI)

The Happy Planet Index (HPI) is an economic index that was designed to be an alternative to GDP and the HDI. It was created by the New Economics Foundation (NEF), a British think tank, and is now produced by the Wellbeing Economy Alliance. The HPI is calculated by multiplying three indicators: life expectancy, population wellbeing (according to the Gallup World Poll) and ecological footprint (in global hectares, according to the Global Footprint Network). The 2016 calculation added population inequality for the life expectancy and wellbeing criteria, in the form of a fourth dedicated indicator. Nevertheless, the last edition, dating from October 2021, does not use this option, focusing more on the result's readability.

Sustainable Society Index (SSI)

The Sustainable Society Index (SSI) was developed by the Sustainable Society Foundation to provide the public and authorities with a simple tool to measure society's sustainability. It is based on the Brundtland report's definition, which puts forward the concept of sustainable development. It gives a score and ranks based on three dimensions: human (or social) wellbeing, economic wellbeing and environmental wellbeing. It includes 21 indicators, of which 9 are for the human wellbeing dimension. This covers basic needs (food, clean drinking water, etc.), personal development (health and education) and social factors (governance and income inequality). Two indicators are based on other sub-indicators. The SSI has been produced and developed by the Technische Hochschule in Cologne since 2018. Data from the 2019 edition were put online in mid-2021. One aspect of this index is that it does not have an overall ranking that includes the three dimensions. On the other hand, it provides a visual image of the results for each country in the form of a radar diagram which can be easily used to see how each country compares (*Figure 6*).

Table 1: Index Summary and France's results

Index	Full Name, Author	Main Characteristics	Number of Indicators	France's Ranking	Country in 1st Position
Environmental Indexes					
EPI	Environmental Performance Index (EPI), Yale University	Complete indicator, focuses on a country's environmental efforts	32	5th out of 180 (2nd in 2020)	Denmark
ESGAP	Environmental Sustainability GAP, French Development Agency and UCL (London)	Environmental sustainability, via the maintenance over time of four environmental functions	21	4th in Europe	Ireland
CCPI	Climate Change Performance Index, Germanwatch e.V.	Focused on climate change. It includes past and future emission changes, as well as energy and climate policies	14	17th out of 61	Denmark
GFI	Green Future Index, published by MIT Technology Review for the first time in 2021	Dedicated to decarbonising society. It assesses a country's share of renewable energy, emissions and climate policies.	18	4th out of 76	Iceland
WRI	World Risk Index, UNU-EHS	Assesses the risk related to five extreme weather events, focusing on how society adapts	28	15th out of 173 (rankings by least at risk)	Qatar
Sustainable Development Indexes					
HDI and PHDI	(Planetary) Human Development Index, UNDP	Designed to be an alternative to GDP, to measure human development	4 (6 for PHDI)	26th out of 199 (or 8th for PHDI)	Norway (or Ireland for PHDI)
SDG Index	SDG Index, UNU-SDSN and Bertelsmann Foundation	Assesses a country's performance regarding the 17 SDGs as well as their likelihood of meeting 2030 objectives.	121 (91 for non-OECD countries)	8th out of 165 (4th in 2020)	Finland
BLI	Better Life Index, OECD	Assesses the quality of life, based on 11 categories, including community life	24	18th out of 40	Norway (South Africa 40th)
HPI	Happy Planet Index (New Economics Foundation, 2016)	Simple design like the HDI. It includes the environment with an ecological footprint dimension.	3	31st out of 152	Costa Rica
SSI	Sustainable Society Index, Sustainable Society Foundation	This index looks at three dimensions: human (or social) wellbeing, economic wellbeing and environmental wellbeing	9 + 5 + 7	17th out of 204 (human), 67th (economic) and 110th (environment)	–

II. Methods and Indicators

The diversity of objectives for each index and data availability limitations causes real diversity among methodological choices, depending on the number of underlying indicators, the metrics used to assess them, aggregation techniques, how the results are presented, etc. Despite this, certain methodological choices are common to many of the indexes. The information described in this chapter is summarised in *Table 2*.

II.1. Common Features in the Aggregation Methods

1. Scores are normalised, in certain cases compared to objectives

The indexes analysed in this report give a score between 0 and 100 (or sometimes 0 and 10) to each of their underlying indicators. This is called normalisation, which can be used to compare, then aggregate, indicators that are about different subjects, and thus, different metrics. The inclusion of a parameter that is only scored on three or four classes, or of a measure of the change of a parameter over time, is also possible. In most cases, the scale used for each indicator is linear, which means that the relationship between the 0-100 score and the underlying indicator is linear.

For half of these, 0 and 100 refer to the weakest and strongest performances, respectively, for the countries in question. The score is relative and therefore rankings between countries gain even more importance. For the other half of these indexes, 100 represents a goal to be reached. This is the case for the EPI and ESGAP for the environmental indexes, as well as the HDI, SDG Index and HPI for sustainable development indexes. This goal is either directly set at an international level (this is the case for 12% of SDGs in the SDG Index), or has a scientific basis, such as maximum metal deposits for good ecosystem health, or CO_2 emissions that meet the +2 °C threshold.

2. Arithmetic or Geometric Mean

Most indexes calculate an **arithmetic mean** of individual indicator scores, which has the advantage of being simple and easy to read. In this case, there are two possible strategies. The first strategy involves choosing equal weightings (e.g., the SDG Index and the BLI), on the basis that if one criterion has been deemed relevant, there is no reason for it to be significantly more or less important than another, especially as the criteria are very different. The second strategy involves weighing the indicators, with factors that reflect the authors' choice to give more importance to a criterion. For the CCPI, some indicators have a 5% factor while others have a 10% factor. For the EPI, this is much more varied, since several indicators each account for 1.5% of the final score, while three others each weigh 10 to 12%.

It should be noted that when there is a high number of underlying indicators, they are most often brought together in families or categories. In this case, integration, with or without weighting, is generally carried out within indicators of the same category, which gives an intermediary index. These categories are then aggregated in a second stage. This two-stage aggregation prevents a category from being over-represented in the results because it has more individual indicators – and sometimes there are more indicators simply because there are more data available. For example, for the SSI, human wellbeing represents 9 out of 21 indicators, and for the SDG Index, one of the SDGs includes 17 indicators whereas another only has 3. This second aggregation is most often carried out in an equally weighted way, but in a few cases, certain categories are intentionally overweighed, such as climate policy for the GFI, and biodiversity, air quality and climate change for EPI. On the other hand, for the BLI, weightings are up to the user.

Some indexes have chosen to use a **geometric mean**, which means multiplying scores instead of adding them. This includes the ESGAP, the WRI, the HDI since 2011 and the HPI. This technique is known to limit the offsetting effects of a poor score by other scores, i.e., low scores will have more of an impact on the result. Thus, for example, with two scores of 10 and 90 (out of 100), although their arithmetic mean is 50, their geometric mean is only $30 = (10 \times 90)^{1/2}$. This aggregation technique is useful for composite indexes. Indeed, it is even recommended by the OECD-JRC 2008 handbook, which is a reference on the subject. However, in practice, it is not used very often, as the influence a parameter can have on a result is less clear, which can affect readability.

The ESGAP uses this choice because it wants to be a variation of the concept of strong sustainability, according to which it is important to preserve each of the environment's components. Other indexes which use a geometric mean at one stage of the process (or multiplication), often use an arithmetic mean at another stage. For example, the WRI carries out an arithmetic mean for several indicators in the 'vulnerability' section, before multiplying the result with the 'exposure' section.

3. Specific Aspects in Methodological Choices

Several indexes change from one edition to another, either by modifying or adding indicators. This is namely the case for the EPI and SDG Index. Others have seen more drastic changes to their method. Such is the case for the WRI and the CCPI, which were modified in 2017, and the HDI in 2011 (geometric mean), then in 2020 (creation of the PHDI). This allows the indexes to adapt to newly identified challenges, scientific progress and new data that have been made available. Nevertheless, it is important to be careful before comparing results from one year to another.

In the SDG Index's presentation report, an additional dashboard was created with a very different aggregation rule to the one used to calculate the index; within each of the 17 SDGs, it takes the average score of the two worst performing underlying indicators, which highlights each county's worst scores. This is intended to encourage countries to improve in these areas. Although France is 8th in the index's rankings, 3 of its SDGs are in the red in this dashboard.

The ESGAP separately assesses each country's level and trend for each of the 21 underlying indicators. The aggregation method used is similar to the index about levels, and the index about trends.

Indicators always use a linear scale, except for a few special cases. Within the HDI, income is assessed on a logarithmic scale since each additional dollar is assumed to have less of an effect on wellbeing than the previous dollar (decreasing marginal utility). Furthermore, the maximum value is set at 75,000 dollars, assuming that beyond this amount, the benefit to wellbeing and human development is near zero. For similar reasons, the WRI uses a logarithmic scale for 3 out of its 28 indicators: life expectancy, public health spending and private health spending. The EPI also uses a logarithmic conversion for certain indicators (e.g., fine particle pollution, also known as PM2.5) to better differentiate between countries with middling rankings and close scores.

The 2016 version of the HPI included population inequality for two indicators – life expectancy and perceived wellbeing – in the form of an additional indicator dedicated to these inequalities. Inequality is estimated using a ratio between the geometric mean and the arithmetic mean, for the indicator of interest and for the population.

Symbolically, the authors of the CCPI have chosen to leave the first three positions in the rankings empty as they deem none of the countries to have performed well enough to be worthy of being on the podium (France, being ranked 17th, only has 13 countries ahead of it).

Table 2: Overview of Methods Uses in Different Indexes and Types of Related Indicators

Name	Aggregation method	Data transformation	Methodology specifics	Changes to the methodology	Number of indicators/categories	Past [or future] trend indicators	Response indicators	Data other than quantitative statistics
EPI	Arithmetic mean, weighted	0 to 100 (100 = objective to be reached)	There are response and trend indicators	Can change with each edition	32 for 11 categories	11 (emissions, soil cover)	3 (protected areas and species)	–
ESGAP	Geometric means	5 to 100 (100 = objective to reach)	European-context objectives	Recent index	21 for 4 functions	A separate index is calculated for changes in the 21 indicators	–	–
CCPI	Arithmetic mean, weighted	0 to 100 (100 = best performance)	Climate policy assessment	Criteria added in 2017	14 for 4 categories	3 [and 3 for changes to come]	3 (2030 objectives) + 2 (climate policies)	2 (assessment of climate policy)
GFI	Arithmetic mean, weighted	0 to 10 (10 = best performance)	Climate policy assessment	Recent index	18 for 5 pillars	5 (emissions, renewable energy)	4 (implemented policies)	4 (policy assessments)
WRI	Weighted arithmetic mean, then multiplied	0 to 100 (100 = best performance)	Several coping indicators	Revised in 2017	27 for 4 components	5 (disasters happening)	–	Corruption Perception Index
HDI and PHDI	Geometric mean	0 to 100 (100 = objective to be reached)	Few indicators	Modified in 2011 (geometric mean) then in 2020 (PHDI)	4 for 3 themes (6 for PHDI, for 4 themes)	–	1 (years of schooling desired)	–
SDG Index	Arithmetic mean	0 to 100 (100 = objective to be reached)	Dashboard with a different aggregation	Changes little from year to year	91 (121 for OECD countries) across 17 SDGs	–	–	8 qualitative indicators: wellbeing, safety, access to justice, freedom of the press, etc.
BLI	Arithmetic mean, weighted by the user	0 to 10 (10 = best performance)	Final weightings are chosen by the user	–	24 for 11 categories	–	–	Wellbeing, safety, health, water quality satisfaction, community links
HPI	Multiplication approach	0 to 100 (100 = objective to be reached)	The 2016 version included inequality calculations	2016, 2021	3 (4 in 2016)	–	–	Subjective wellbeing
SSI	Arithmetic mean, not weighted	0 to 10 (10 = best performance)	3 sub-indicators	2017	21 for 3 categories	–	–	Subjective wellbeing, good governance

II.2. Indicators Used

1. Status, Pressure and Response Indicators

Most indexes include between 7 and 32 indicators. The HDI and HPI, however, only have 3, whereas the SDG Index includes 121 indicators.

In many situations, indicators are either **pressure indicators** (for example an emission level, which is included in many environmental indexes; fisheries pressure is also noteworthy), or **status indicators**:

- ecosystems: examples of this are the chemical status of waterways, forest cover, or an assessment of habitat quality
- environmental health: the indicators that are used most often are related to drinking water, and at times, bathing waters and atmospheric pollution, the latter of which is most often assessed via particle concentration, or the share of the population that is exposed to this particle pollution
- wellbeing and health: income, life expectancy and subjective wellbeing are measured, in addition to indicators such as infant mortality or education levels.

Response indicators are also sometimes included and focus on policies implemented by countries and are partially decorrelated from impact assessments. This is namely the case for the surface area of protected areas, which are included in the WRI, the SDG Index, the SSI and the EPI. For the latter of these, since 2020, 80% of the 'biodiversity' score has been based on response indicators (protected areas and species) and only 20% is based on an assessment of habitat quality. These choices favour certain countries, including France.

Another example of response indicators is assessments of a country's climate policy, using expert opinion, for the two indexes dedicated to climate change, CCPI and GFI.

For the social aspects, there is a response indicator about education; other than the mean number of years of schooling, which is often lower in developing countries, the HDI also includes the number of expected or desired years of schooling, which reflects a country's wish to develop it for its young people.

Status indicators are supplemented with **indicators of evolution, or trends**. For example, the EPI analyses the change in a country's tree cover since 2000 and wetland loss since 1992. Four criteria related to atmospheric emissions assess trends since 2008, not the current level of emissions (which favours developed countries). The GFI and CCPI are similar in terms of emissions analysis.

Future trends are also sometimes explored. For each indicator, the SDG Index and ESGAP ask: is the country on the right track to meet the goal set for 2030? It is not simply a matter of assessing past increases or decreases, but of comparing the observed annual rate of change with the annual rate of change required in that country to meet the target. Nevertheless, this analysis is not included in the quantified index. It is either an additional index (as is the case for the ESGAP) or is presented as an additional dashboard (as is the case for the SDG Index).

The CCPI, which is about climate change, also contains indicators about future trajectories. The latter of these is response indicators since they compare the goal set by the country for 2030 with their desired trajectory (such as the result of the Paris Agreement to limit global warming to less than +2 °C).

This information can be seen in *Table 2* above.

2. Fields Covered

We will now look at the main fields covered by the different indexes, starting first with the environment, and then sustainable development. A summary of this is available in *Table 3*.

a) The Most Represented Environmental Indicators

Each index has its own specificities and focuses on a particular theme. Despite this, certain environmental assessment themes regularly occur. The following themes have been included in at least four indexes:

- climate: greenhouse gas emissions, renewable energy
- air quality
- water: water quality, water resources
- biodiversity: protected areas, tree cover
- waste (focus on waste production, only one index includes a recycling rate)
- footprint per capita: raw material consumption for the PHDI, ecological footprint for the HPI and SSI. Footprint calculation is more specifically explained in this report in *Appendix 1*. Additionally, the SDG Index includes several imported impacts (paragraph d)).

To a lesser extent, several indexes also include marine life or fisheries and ecosystem status (biodiversity index).

b) The Case of Climate Change

Climate change can be analysed using only one or two indicators, that is, greenhouse gas emissions and/or energy consumption (EPI and the ESGAP). Other indexes include a country's share of renewable energy (SDG Index and SSI). Lastly, the CCPI and GFI are dedicated to this theme and are more developed, including expert opinion assessments of climate policy. For each of the emission subjects – energy consumption and renewable energy – the CCPI assesses the changes to come and the country's objectives. The GFI looks at decarbonisation more comprehensively by including green innovation and meat consumption.

The more specific theme of greenhouse gas emissions is the most used for the 10 indexes studied in this report. The EPI is a special case, in that it places more importance on climate change with, in its last edition, eight indicators that account for 24% of the final score, even if this only relates to emissions. Among these emissions, it is one of the few indexes to explicitly include elements other than CO_2, such as methane, nitrous oxide and black carbon.

These emissions are generally measured by mass per capita. The CCPI and EPI are different in that they use emissions per GDP. This choice favours developed countries for emission level indicators but less so when the focus is on trend indicators (changes to emissions).

c) The Case of Biodiversity

Assessing an ecosystem's status is complex, as it involves estimating the quality of habitats and biological diversity, both in its different levels of organisation and in its evolution. At a local level, assessing species richness and abundance, using the Shannon Index, for example, is an approach that has full support. It is, however, difficult to aggregate this information on a country-wide level. Therefore, many indexes have given up trying to assess biodiversity, in favour of simpler and more readable indicators, such as

- protected areas (as is the case for the EPI), even if it is well-known that this is a response indicator and that protection, *a priori*, is decorrelated from the actual ecosystem statuses
- tree cover or changes to it (the GFI, for example)

  Note: the WRI, SDG Index and SSI merge these two types of indicators.
- the proportion of land habitats that are in a well-preserved state, from a regulatory point of view (this is the case for the ESGAP).

Nevertheless, some tools can be used to assess biodiversity status at a local level, which may allow for wide-scale aggregation. Notable examples are the MSA (Mean Species Abundance) and the BII (Biodiversity Intactness Index), which are both based on solid scientific knowledge. They use a similar concept, which involves:

- estimating, for a given ecosystem, the abundance of species present (meaning the population), using a model that uses anthropic pressures as input data (e.g., land use, distance from a road, fragmentation, climate change, etc.)
- comparing this abundance to that of a reference population, in an undisturbed habitat. To do this, a certain number of example ecosystems have been outlined (FRB, 2020). This can be seen in *Appendix 2*.

These indexes reflect a possible, estimated, biodiversity status, not an actual status. Additionally, they are not regularly updated. A preliminary version of the ESGAP was going to include the BII, but in the end, the proportion of well-preserved habitats according to the Habitat's directive was used instead in the recent European study.

The EPI included the Biodiversity Habitat Index (BHI) and the Species Habitat Index (SHI) in 2020, which focus on the degradation and fragmentation of habitats. The weight of these two indicators is less than that for indicators about protected areas. For illustrative purposes, we can say that France got the maximum score of 100 for indicators related to protected areas but is only 65th in the SHI rankings and 152nd in the BHI rankings.

d) Innovative Environmental Indicators

Many indexes change over time and include new underlying indicators, namely in the environmental field. By taking advantage of progress and available data, they include certain innovative themes. Here are a few examples of this.

Within the SDG Index, seven out of the 121 indicators evaluate 'imported impacts', which means impacts that are seen in countries from which consumed goods are imported: (fatal) work accidents (SDG 8), scarce water consumption (SDG 6), threats to marine life (SDG 14), threats to aquatic/land species (SDG 15), SO_2 and reactive nitrogen (SDG 12), and CO_2 emissions (SDG 13). Values are per the country's population. Most data come from a 2020 scientific article.

One aspect of the ESGAP is that it includes the recreational and heritage aspects of nature, through the criteria about the preservation of natural world heritage sites, which is examined by the International Union for Conservation of Nature (IUCN). Even if this is only one criterion out of 21, the ESGAP does include the concept of ecosystem services and heritage value, in line with its purpose, which is to raise awareness about the maintenance over time of environmental functions that are necessary to both the correct functioning of the biosphere and human wellbeing.

'Ecosystem services' have also been taken into consideration by the EPI since 2020, but only through tree cover. In fact, tree cover was already present in previous editions of the index; however, it was part of the biodiversity category. Today, only the SSI looks at natural capital, according to the methods described in the following paragraph.

As soon as the data are available, certain indexes include healthy life expectancy, which is deemed to be more accurate than just life expectancy (SSI) or loss of healthy life expectancy due to a given pollutant (EPI).

e) 'Green' Monetary Indicators

Different indexes and indicators have come about in the fight against the omnipresence of the GDP indicator, which measures economic growth while ignoring what this does to the planet's natural capital, in addition to also showing biases. For example, an increase in cancer, and therefore the use of chemotherapy, increases GDP.

As a result, various initiatives have emerged under the umbrella of a 'green GDP', adding monetary equivalents of human capital and natural capital, including environmental damage, assuming that they are substitutable with economic capital.

Among them, adjusted net savings is one of the most used indicators. This is published every year by the World Bank and is included in the SSI, as part of the 'economic wellbeing' dimension, next to GDP. It is derived from a country's gross savings, by adding education spending to it, which contributes to increasing human capital, then by subtracting:

- energy, mineral, and forest depletion: these resources are evaluated using their trade value or their operation cost
- and environmental damage caused by CO_2: they are indirectly assessed, for example, using the price of a tonne of emitted CO_2. This method has its limits on a theoretical level and leads to low influence being allocated to this damage for the final result.

The result is written in the percentage of national gross income, and it can be negative (*Appendix 3*). For the latest values, which were published in 2019, the average for adjusted net savings for less developed countries is nearly double the average for all countries (18% versus 10%). France is 77th with 9.2% and presents a stable natural capital, while the average for European countries is 11.5%.

f) Socioeconomic Indicators

Regarding socioeconomic indicators related to sustainable development, life expectancy (or healthy life expectancy, as is the case for the SSI) and education (or illiteracy) are the most common themes, followed by subjective wellbeing, income (or income distribution) and governance (including corruption).

For all indexes we studied in this report, the level of subjective or perceived wellbeing is evaluated using the Gallup World Poll survey, which will be described in further detail in *paragraph II.3*.

The theme of governance is included in different ways. For example, the SS uses the World Bank index, which is itself the sum of six sub-indicators, including political stability and corruption. The BLI includes an indicator about the stakeholder participation in regulation development: consultation methods, transparency, feedback mechanisms, etc. It is based on a question submitted to government representatives according to the methodology proposed by the International Ranking Expert Group (iREG), which was developed by the OECD in collaboration with the European Union. Two other indexes (the WRI and SDG Index) include the Corruption Perception Index, which has been published by Transparency International since 1995, using surveys and expert opinion.

Some indexes also use GDP, indicators about community links and health indicators. The latter may use subjective or perceived health status, health system quality, frequency of certain diseases, infant mortality, etc.

Table 3: Summary of Indexes and the Main Themes They Include (non-exhaustive overview of themes)

Main themes addressed in these indexes → *Index name ↓*	Greenhouse gas emissions	Renewable energy	Air quality or exposed population	Water quality	Water resources	Drinking or sanitary water	Fishing or marine life	Protected areas	Changes to tree cover	Ecosystem statuses or biodiversity index	Waste	Footprint calculation or imported impacts	GDP or Debt	Income or income distribution	Community	Education, schooling and illiteracy	Health and health system	Life expectancy	Subjective wellbeing	Governance (including corruption)	Other themes *[highlighting those that are part of the relevant index's specificity]*
Environmental Indexes																					
EPI	x		x	x		x	x	x	x	x	x										x
ESGAP	x		x	x	x	x	x			x	x										x *[developments]*
CCPI	x	x																			x *[climate policy]*
GFI	x	x							x		x										x *[climate policy]*
WRI					x	x		x	x				x	x	x	x	x			x	x *[natural risks]*
Sustainable Development Indexes																					
HDI [and PHDI]	[x]											[x]		x		x		x			
SDG Index	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x *[peace, famine, poverty]*
BLI			x	x											x	x	x	x	x	x	x *[leisure, community]*
HPI												x						x	x		
SSI	x	x			x			x	x			x	x	x		x		x		x	x

II.3. Underlying Data

Most individual indicators are based on **quantified and objective data**. In the environmental field, this can be changes to tree cover, emission levels for pollutants or greenhouse gases, the share of renewable energy, the size of protected areas, etc. For more socioeconomic criteria, this can be income per capita, average schooling age, homicide and unemployment rates.

Underlying data that score each chosen individual indicator are varied. However, the strategy to choose them is rather consistent. When possible, indexes use official figures from national or international statistics organisations, which have the advantage of being nationally approved, or centralised data from the World Bank, the World Health Organization (WHO), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Children's Fund (UNICEF), the International Energy Agency (IEA), the European Space Agency (ESA), etc.

Data from these organisations tend to be raw data, but can also include calculations (e.g., weighting per wealth) and in certain special cases they are themselves indexes that result from the aggregation of several indicators (e.g.: raw material consumption calculated by the United Nations Environment Programme (UNEP) or the World Bank index about governance). Sometimes, certain composite indexes use an existing index as a data source. For example, the WRI uses the score given by the EPI for ecosystem protection, which includes several indicators.

Some databases related to recurring themes are used by many indexes, such as the level of pollutant emissions, quality of drinking water, tree cover, subjective wellbeing evaluation, life expectancy, etc.

To include a maximum number of countries while also ensuring standardised assessment, other data may be used, whether this is scientific publications or reference studies, from when they cover several countries. For example, the Biodiversity Intactness Index publication which assesses globally, or even NGO data from Oxfam and Global Forest Watch. Indexes can also draw on satellite data since they can be used to carry out standardised evaluations on a global scale (as is the case for tree cover or changes to land use).

Qualitative data, however, are also used. The most obvious case is wellbeing, which is evaluated using the Gallup World Poll opinion survey, within three indexes: the SDG Index, the BLI and the HPI. This survey, which is carried out every four years (2012, 2016 and 2020), assesses subjective population wellbeing in each country. It also has more specific questions, still focusing on people's feelings, for example, feelings of safety (a criterion that is also used by the SDG Index and BLI).

There are other qualitative criteria used in several indexes, from corruption perception in the SDG Index and the WRI to the assessment of climate policy by expert opinion in the CCPI and GFI. This is further explained in *Table 2* below.

Two indexes stand out based on their use of results from perception surveys: i) the SDG Index with 8 indicators, out of 121 in total, which are subjective (questionnaire basis), or qualitative, ii) the BLI with 5 indicators, out of 24, based on perception surveys. Among these subjective indicators, the community links category is noteworthy, with one of the specificities of the BLI being to take into consideration social life, by also including work-life balance and civic engagement. Additionally, water quality is addressed based on the satisfaction of people that have been surveyed (Gallup World Poll), instead of using a quantitative criterion. Moreover, it should be remembered that the BLI also has an iREG indicator regarding governance, which is developed by the OECD using a survey.

III. Results Analysis

III.1. Analysing the Results of Different Countries

1. Rankings: European Domination

European countries lead in sustainable development rankings, such as the HDI, the BLI, the SSI and the SDG Index by a wide margin, as well as environmental rankings, such as the EPI (the first 11 countries are European), the CCPI, the GFI and even the WRI. They are at less of a disadvantage compared to other OECD countries by a resource and energy consumer lifestyle, or by petrol and coal development. Conversely, Gulf countries, and to a lesser extent, the United States, rarely rank highly. Additionally, European countries have good levels of education and limit inequalities. They are also lucky enough to have diversified habitats and to suffer less from extreme weather events compared to other regions around the world.

In particular, Scandinavian countries often top rankings, namely for the three environmental indexes (the EPI, CCPI and GFI) and most sustainable development indexes (HDI, SDG Index, BLI and SSI), even if they rank low in terms of ecological footprint or raw material consumption, as we will see later.

The ESGAP, during its study based on European Union countries in 2021, shows that performances regarding human health and wellbeing, including development, are generally good in Europe. This is also the case for soil erosion, the use of water resources and bathing waters. On the other hand, they rank lower regarding the environmental status of waterways and habitat conservation and, most of all, absorption of pollution by ecosystems: this pollution is mainly France's CO_2 emissions, but also nitrogen and phosphorus emissions (eutrophication risk), and emission of ozone precursors.

2. Scores and Objectives to be Reached

When 100 represents an objective to be reached, a country's score has meaning and can be used to see how far the country is away from reaching the target. *Table 4* shows France's scores as well as the best-ranked country for these indexes, except the HPI. For the latter, the final score is not expressed on the same scale, given that an indicator, ecological footprint, appears in the calculation's denominator.

Table 4: Scores for Four Indexes that Assess Countries According to an Objective to be Reached (100)

	Environmental Indexes		Sustainable Development Indexes	
	EPI	**ESGAP**	**HDI**	**SDG Index**
Maximum Score	82.5 (Denmark)	60 (Finland)	95.7 (Norway)	85.9 (Finland)
France's Score	80	47	90.1	81.7

Sources: *2020 EPI report, Usabiaga-Liaño 2021 (ESGAP); Human Development Report 2020 (HDI); Sustainable Development Report 2021 (SDG Index)*

For the EPI and SDG Index, scores for those in the top position are similar, at around 80 or 85. For the HDI, the best scores are noticeably closer to 100, since reasonable objectives were set for each of the three indicators. For example, the age of 85 for life expectancy (nearly reached by Japan and Hong Kong), 15 years for the length of schooling and 75,000 dollars for gross income per capita, which is a sum derived from a scientific study that shows that wellbeing barely increases beyond this value. Conversely, for the ESGAP, scores are further from 100 since the goals are demanding: for example, good ecological status for all locations in the country, or a level of emissions that is compatible with global warming, i.e., limited to 1.5 °C (for this criterion, all European countries scored 0). Additionally, the ESGAP's final calculation carries out a geometric mean of indicators, which is more disadvantageous than the arithmetic mean.

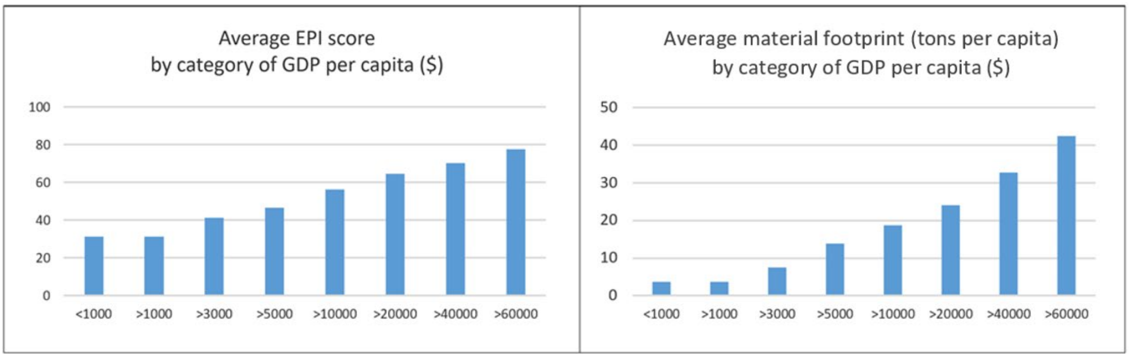
The 2020 edition of the report that presents the SDG Index assessed the work needed to be done for a given country to reach 100 for each indicator, which is also known as the 'SDG Gap'. By calculating the sum for a given SDG, one can calculate the cumulative 'SDG Gap' for all countries, and then the share of each country in this cumulative amount. We can therefore see that in 2020, the G20 accounts for the greatest share of work that needs to be done for environmental SDGs 12 to 15. More specifically, China, Europe and the United States each account for around 15% of the work that needs to be done globally to reach SDGs 12 (sustainable consumption and production) and 13 (climate).

3. Developed Countries: Should We Be Looking at Efforts or Impacts?

Developed countries have, unsurprisingly, good scores for economic and societal axes. Additionally, for the environment, they have both the political stability and wealth required to develop their practices, undertake regulatory work and protect different environments. This starts with the areas that are likely to have a direct impact on our health (air quality, drinking water quality and water quality in general), but also, more generally, it concerns the protection of ecosystems and biodiversity, as well as mitigating global warming.

The EPI (illustrated below) and the GFI, which both focus on the efforts carried out by each country through its national policies, via the size of protected areas for biodiversity or the reduction in atmospheric emissions, further solidify the top position of the most developed countries (*Figure 1, on the left*), even if it is these countries that have the biggest impact. The more economically developed a country is, the larger its footprint, in terms of land use, CO_2 emissions (carbon footprint) and material consumption (*Figure 1, on the right*).

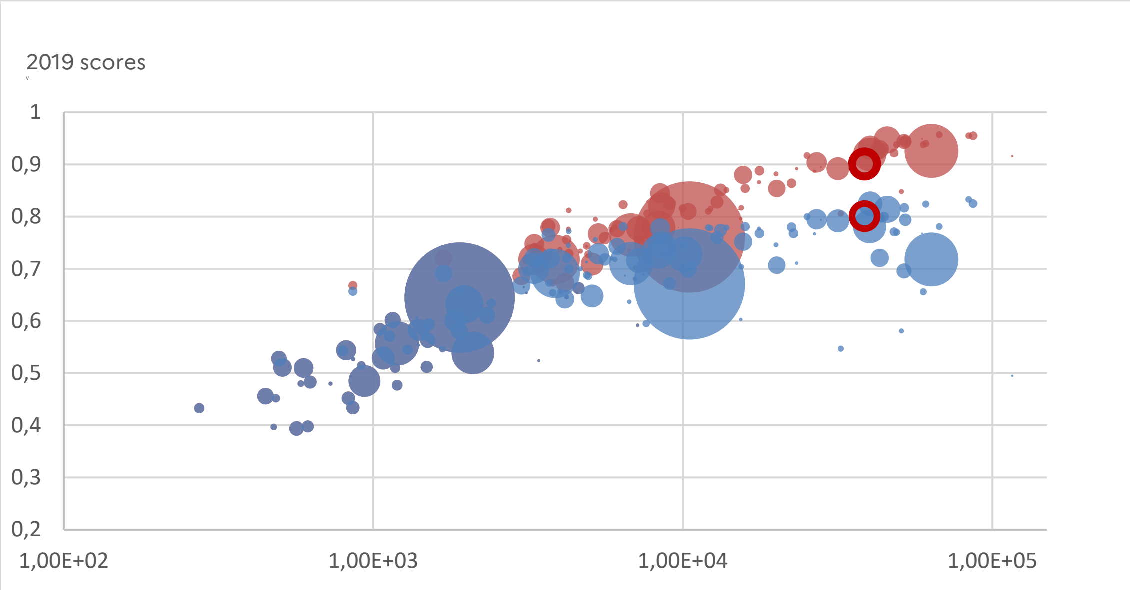
Figure 1: EPI and Raw Material Consumption by Country



Sources: *EPI Report 2020, UNEP-IRP; World Bank, SDES calculations*

The HDI, which is based on life expectancy, level of education and living standards, positively correlates to economic development[1]. To include the impact of this development, the United Nations Development Programme (UNDP) created a new index, the PHDI or Planetary pressures-adjusted Human Development Index, by adding two environmental criteria: raw material consumption and greenhouse gas emissions throughout a country's territory. Quite logically, for these two criteria the scores are lower for the most developed countries (with the highest HDI).

Figure 2: Comparing the HDI and PHDI



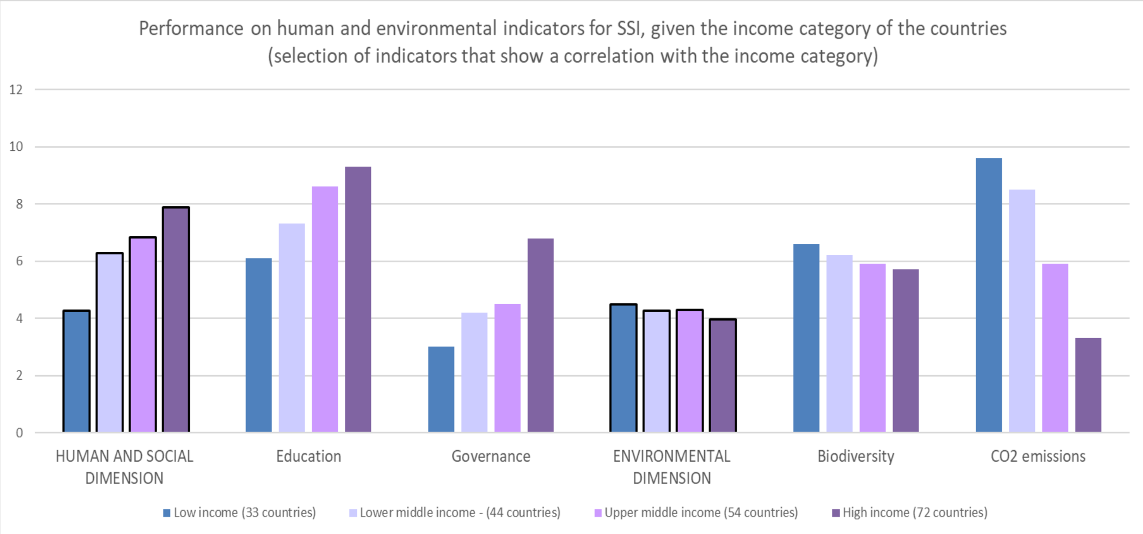
Note: HDI indexes in orange and PHDI in blue, 2019 value (y-axis), according to the GDP/per capita ($) (x-axis). The size of each dot is proportional to the country's population. By construction, HDI> PHDI. France's dots are circled in red.
Source: *SDES calculations, based on the Human Development Report 2020 (UNDP 2020)*

Consequently, the correlation between results from the new PHDI and economic development is not as clear. *Figure 2* shows that for countries with a high GDP per capita, the PHDI stops increasing with GDP and moves further from the HDI, whereas for countries with a lower GDP, the HDI and PHDI dot clouds are very similar. For indicative purposes, we can look at Scandinavian countries (Norway, Finland and Iceland), which fall almost 20 spots between the HDI's rankings and that of the PHDI. The United States and Canada fall almost 40 spots, while many Middle Eastern countries and Luxembourg fall around 80 spots, if not lower. Conversely, France, which is 23rd in the HDI, moves up to the 8th spot for the PHDI. The reason it moves up in the rankings is that the scores of other developed countries decrease more than France's score.

The SSI, which makes the difference between three sub-indexes according to the three sustainable development dimensions, can be used to make a similar observation. As seen in *Figure 3* (the three bar charts to the left), wellbeing in the human and social dimension is more easily reached in countries with a higher income (according to the World Bank's classification). Regarding the environmental dimension, the trend is reversed, with the best results being for countries with lower incomes, namely for certain indicators, such as CO_2 emissions (the three bar charts to the right). The authors of the SSI note that these trends are less clear for European and Central Asian countries.

[1] We can see a similar correlation for the Better Life Index for OECD countries.

Figure 3: Performance of a Selection of Human and Environmental Indicators from the SSI, According to a Country's Income Levels



Note: for each indicator, country averages according to the World Bank's four categories, based on income level (2020).
***Source:** SDES calculations using SSI 2019 data (published in 2021)*

Regarding SDGs, the SDG Index shows that several OECD countries have considerable progress margins for the three 'planetary' SDGs, no. 12 to14: responsible consumption, climate action and life below water.

III.2. Analysing France's Results

1. Some Very Good Results and a Few Areas of Improvement

In general, France performs very well regarding the environment, with the GFI (4th), the EPI (5th) and the ESGAP (4th in Europe), and sustainable development, with the SDG Index (8th) and the HDI, especially for the PHDI version, which includes the environment, where it finishes 8th. France has very good scores in many fields, including biodiversity protection, drinking water and air quality for those related to the environment, and for more societal aspects, health (including the health system), wellbeing, life expectancy, safety, leisure, poverty and sustainable cities.

According to the indexes and metrics used, France's results are more ambiguous regarding energy (consumption and renewable energy subthemes), climate policy, resource consumption and education. Some disappointing scores can be used to identify areas for improvement, namely, for environmental axes: life below water and fishing practices, renewable energy, emissions levels, biodiversity status – even if for the latter domain, France has had excellent biodiversity protection policy scores for the past two years, namely because its protected areas have been expanded.

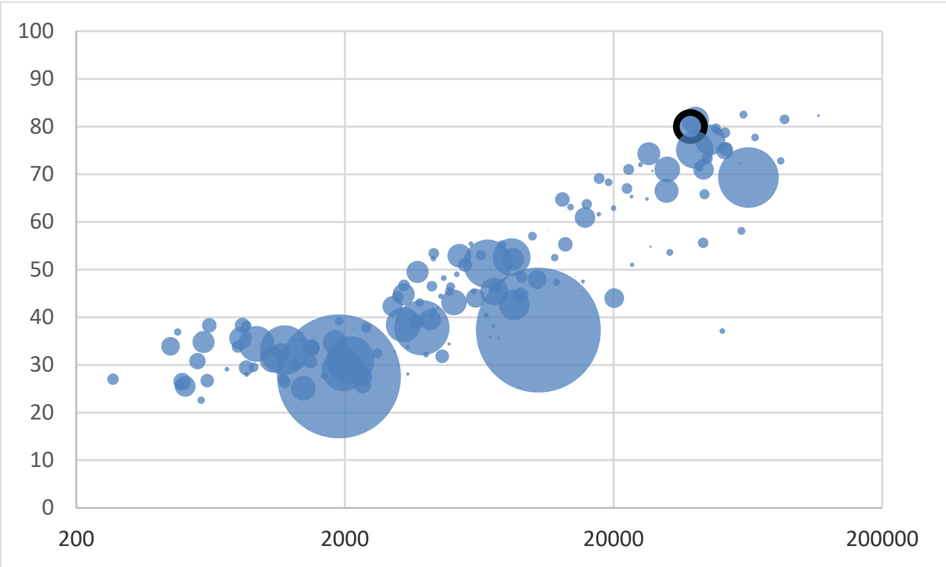
Regarding socioeconomic axes, it is mainly France's debt that is the issue, and its result is weaker than other developed countries concerning gender parity.

2. Results for Environmental Indexes

For the EPI, which is a world-renowned and often referenced ranking, France is 5th globally, after having reached 2nd place in 2018. *Figure 4*, which compares the EPI to GDP, shows that its score is noticeably better than other developed countries. France is in the process of positive momentum since it was only 27th in 2014 and 10th in 2016. This positive change is both thanks to the progress undertaken (e.g., listing new protected areas and decreasing atmospheric emissions) and to changes to the calculation method used for the EPI, particularly due to the choice of indicators used for biodiversity. In the 2020 edition, priority was given to protection criteria (size of marine and land areas, and representativeness of protected species) compared to evaluation of habitat conservation status.

Figure 4: EPI Scores

GDP per capita ($)



Note: (x-axis) GDP values per capita for each country, in dollars, logarithmic scale; (y-axis) EPI score. The size of each dot is proportional to the country's population. France's dot (score: 80.9) is highlighted.
Sources: *EPI Report 2020, World Bank*

France, therefore, has, with its recent major marine protected areas, the maximum score of 100 (joint first place). It also has a score of 100 for two indicators related to health (housing standards and solid fuel pollution) and for four atmospheric emission criteria. The latter is evaluated by favouring trends (changes) over absolute values, which is advantageous for developed countries (nevertheless, for greenhouse gas emissions per capita, France is only 117th). The most disadvantageous indicators for France are the three indicators related to fishing and tree cover loss, which is, since 2020, in the 'ecosystem services' category. It should be noted, however, that this assessment of tree cover is based on satellite observations and contains interpretation errors, with the effects of Storm Klaus on forests in the Landes being interpreted to be deforestation.

An ESGAP study for the whole of the European Union shows that France performs rather well for each of the four functions that make up the index, coming in 4th out of the 28 countries of Europe for the overall score. It should be remembered that since the index is based on a geometric mean, countries with homogeneous scores are favoured. France has very good results for its use of forest resources, eutrophication and acidification, and drinking water. Its scores are weaker than many other European countries regarding groundwater resources, bathing waters and soil erosion. For greenhouse gases, level 0 was set at 2.5t/capita, which is deemed incompatible with a trajectory of +2 °C. Due to this, all European countries have a score of 0.

France also has excellent results for the GFI (4th out of 76 countries), which is an index that was recently created by MIT Technology Review, dedicated to climate change and decarbonising society. Results are good for most indicators, except those dedicated to renewable energy. France is highly ranked for the 'climate policy' pillar (3rd), which is based on expert opinion and accounts for 40% of the index's final score. It scores well for sustainable agriculture and its policies supporting hydrogen as part of the recovery plan. In general, European countries are favoured for CO_2 emissions, for which the focus is more on evolution between 2013 and 2018, with a diminution in Europe, than on the current level of emissions. This differs from the ESGAP described above, where all European countries have a score of zero for this criterion because of their current level of CO_2 emissions.

Regarding the CCPI, which is also specifically about climate change, France is 17th out of 61 countries, which is a weaker result compared to the GFI. For many years now, it has been ranked between 15th and 23rd place, with its score mainly changing based on the assessment of its climate policy. Before moving from 23rd to 17th place in 2022, its rank fell in 2021 because experts considered that France was lacking in concrete measures in the transport and construction sectors, which is a different assessment from that of the GFI. A more significant point is that France's index is dragged down due to the renewable energy category (for which it agrees with the GFI), with a relatively poor score, even if the share of this type of energy has increased over the past five years.

For the WRI, which is about risks related to extreme natural events, France is 15th (starting from the bottom, because the countries in the top positions are those that are most at risk). Yet, it is not on the list of the least exposed countries (it is only 40th for this criterion), nor the least 'susceptible': it is 36th for the susceptibility criteria, which means that human or economic consequences are possible following an extreme weather event. It is, however, much better regarding its coping capacities in the event of a crisis (13th) and for the societal adaptation criteria (13th). This includes risk prevention and education levels, in addition to protecting ecosystems (which play a role in prevention). It should be noted that for this indicator about ecosystem protection, the WRI uses the scores given by the EPI, which are advantageous for France.

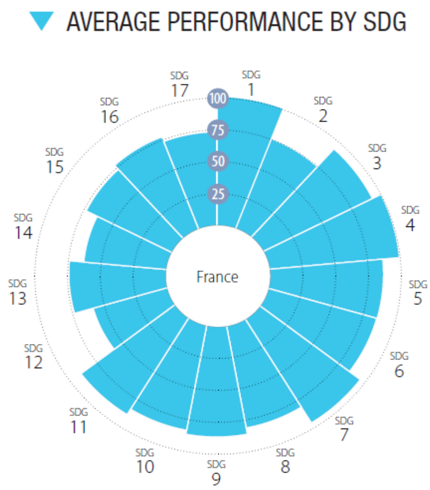
Regarding footprints, which form indexes of another type (*Appendix 1*), France has the 45th largest ecological footprint per capita (4.7 global hectares in 2017, according to the Global Footprint Network) and 34th largest raw material consumption per capita (see details in *Appendix 2*). This means that if we were to create an overall ranking of countries with the least impact, it would, for both cases, be around the 120th position, with a slightly larger footprint than the European average. Regarding its carbon footprint, France has the 36th largest footprint per capita, according to OECD calculations. The latter does not consider CO_2, but rather only for fuel in the energy sector; they are only published for 66 countries.

3. Results for Sustainable Development Indexes

Regarding the SDG Index, which covers all SDGs, France is 8th in the rankings, after having reached 4th place in 2020. In fact, its score increased between 2020 and 2021 but it got a lower ranking because other countries at the top of the rankings increased their score even further. France has a nearly perfect score for SDGs 1 'no poverty', 4 'education' and 7 'clean energy', like most developed countries. Aside from the rankings, it is on the right path to meeting its 2030 objectives for three SDGs and its score, for the most part, improved over the past two years for all SDGs, except SDG 14 wherein the indicator about fish released after being caught, which was added this year, penalises it.

There is room for improvement for France regarding electronic waste generation and imported impacts (CO_2 emissions, but also SO_2 and nitrogen compounds) within SDG 12. The index's additional dashboard shows that, like many OECD countries, France is 'in the red' for SDGs 12 to 14, the three environmental ('planetary') goals.

Figure 5: Illustration of France's Scores for the SDG Index



Note: this radar diagram represents country scores for each of the 17 SDGs, with each score being between 0 and 100 (levels 25, 50, 75 and 100 are shown in SDG 1).
***Source:** Sustainable Development Report 2021*

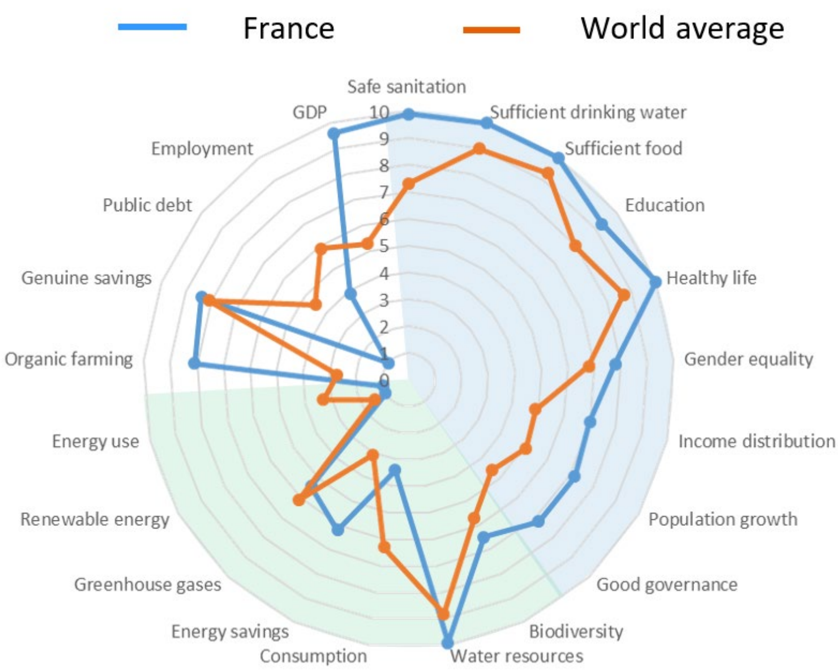
France is 26th in the HDI and increased its score between 1990 and 2018. Unlike the previous index, this one is based on only three indicators: life expectancy, living standards and education. For the (planetary) PHDI that was created in late 2020 by adding two environmental indicators – atmospheric emissions and raw material consumption –, France moved up to 8th place. This is because it received good scores for both indicators, or at least, better scores than other countries at the top of the HDI. Let us recall that it is less developed countries, thus those that have a lower HDI, that have the best scores for environmental criteria.

For the HPI, which follows a similar conception to the HDI with a small number of indicators, France is 31st out of 152 and is the 5th country in Europe (2019 results). Its scores are good regarding life expectancy and wellbeing, but it scored poorly for its ecological footprint, like all developed countries, even if 2020 assessments show that the ecological footprint of these countries may reduce by nearly 15% (e.g., CO_2 emissions) following the health crisis.

The BLI is based on more detailed indicators. France is 18th out of 40 countries (mainly OECD countries). Its best scores are related to work-life balance, and health and safety. Its weakest scores are related to income, civic engagement and the quality of its environment. France has moved up regarding 'work-life balance' but has fallen when it comes to education and community. Regarding health, life expectancy at birth is around 82 years in France, which is nearly two years more than the OECD average of 80 years. In contrast, self-rated health assessments are slightly below the OECD average.

The SSI looks at three dimensions (using 21 indicators) without putting together an overall score, but by producing an easy-to-read radar diagram, which can allow each country to compare itself to a global average. France is 82nd for economic wellbeing, 136th for environmental wellbeing and 28th for human wellbeing (regarding this latter criterion, French Polynesia is 9th, with the rankings being topped by Bermuda, Andorra and Greenland). For France, scores are weak for public debt, energy use and its share of renewable energy. Between 2020 and 2021, France's rankings have dropped slightly.

Figure 6: Illustration of France's Results for the SSI



Note: France's SSI scores, compared to the global average, based on population size. On a blue background: human wellbeing, on a green background: environmental wellbeing and on a white background: economic wellbeing.
Source: *SSI 2020, TH Cologne's website, 2021*

IV. Main Findings

Composite indexes, which use a simple score but reflect a complex reality by including several underlying domains, are a more commonly used method of calling on decision-makers to act or raising awareness among citizens. This is the case for the environment and sustainable development. Indexes can be used to assess national efforts over time and to compare countries.

Despite the variety of methods used and the intrinsic complexity of some of them, the organisations that produced these composite indexes have generally prioritised a simple and easy-to-read result, namely an index score and rankings. They can be supplemented by dashboards and radar diagrams, to not lose sight of specific performances for each of the topics in question and to identify areas for improvement.

Initiatives to better bring together impacts and efforts in the same index should be highlighted. Some indexes combine pressure or status indicators (e.g., level of emissions per capita or tree cover) with trend indicators on the same subject (e.g., decrease in emissions and changes to tree cover). Other methods include a footprint calculation or evaluate 'imported' impacts, such as CO_2 emissions, water consumption and deforestation.

In general, the most developed countries have a larger impact or 'footprint' on the planet. Conversely, it is generally these countries that implement the most ambitious policies to protect the environment, decrease emissions or fight climate change, especially in Europe. This may seem paradoxical, and a specific difficulty for indexes is including these two trends, using suitable criteria. It is important to understand the choices made and the biases that they may have in interpreting results.

European countries rank highly, with the 11 top countries in Yale University's Environmental Performance Index being European countries. Countries in Europe also top the two indexes dedicated to climate change (the CCPI and the GFI) and those about sustainable development.

France is involved in this dynamic with overall very good rankings and with scores that range from good to very good for biodiversity and climate policy, as well as for water and air quality. For more societal themes, France's results are good for health and wellbeing, security and leisure. Scores are weaker in some environmental fields, which are areas for improvement, such as life below water and fishing practices, renewable energy, emissions levels and biodiversity status.

Developing and regularly updating indexes is part of a larger context of increasingly robust data being made available for a growing number of countries, by international organisations, NGOs and think tanks. New themes are gradually being added, which are being inspired by evolution in the state-of-the-art. This is the case for footprint calculations as well as ecosystem services, such as including the recreational and heritage aspects of nature.

New indexes are emerging, such as the ESGAP, a French initiative, which was applied for the first time for a country in 2020 and the Green Future Index by MIT Technology Review, which was published in early 2021. A new version of the Human Development Index (HDI) included an environmental section, to make a 'planetary' HDI, or PHDI, in late 2020. The Happy Planet Index, which had not been updated for three years, was published in October 2021. These changes benefit from the internationally recognised SDG framework and strong commitments such as the Paris Agreement.

Due to the crisis caused by the pandemic, when using indexes based on data collected in 2020, certain environmental scores should improve, such as those related to greenhouse gas emissions, footprints and air quality, especially in the most developed countries. The aim will be to see if this improvement can continue beyond 2020, or at least, partially continue. For societal aspects and sustainable development indexes, it is not as easy to forecast. The health crisis sped up awareness and should strengthen a trend that we have already observed according to which composite indexes are evolving to include the green economy (or recovery measures), imported impacts and wellbeing indicators.

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To complete this bibliography, more specific references for each of the indexes will be referenced in the following chapters.

Part 2

Detailed Factsheets Per Index

Factsheet 1
EPI - Environmental Performance Index - 2020 edition – Yale University

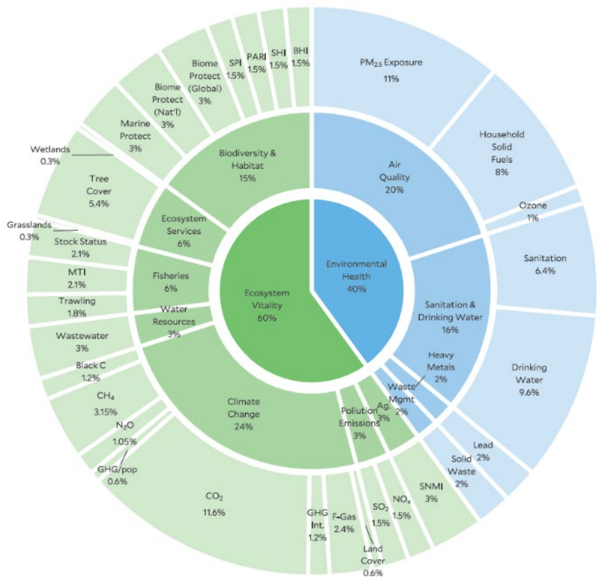
1. Indicator and Methodology

1.1. Presentation

The Environmental Performance Index, or EPI, is a composite index created in 2006 by Yale University (Connecticut) and is now jointly produced with the Earth Institute at Columbia University in New York. It aggregates several indicators, which represent different environmental fields and is a reference in this field. It is comprehensive, based on the number of themes it looks at, is world-renowned and is often referenced. Lastly, its solid methodology is strengthened by regular expert assessments led by third parties (e.g., the JRC). The indicators used as part of the EPI change with each edition. It does not only use environmental status indicators but also trend indicators (e.g., increase or decrease in emissions) and indicators that evaluate a country's response (e.g., protected areas). It is therefore a synoptic tool that can be used to evaluate the effectiveness of measures taken, or even a country's 'effort', rather than just evaluating the 'sustainability' of its economy. Thus, France's excellent result (5th in the 2020 rankings and 2nd in 2018) is not synonymous with no impact on the environment.

The EPI is a composite index, which is the result of aggregating individual indicators that are deemed to reflect the diversity of public environmental initiatives and are divided into several categories: air quality, biodiversity, water resources, agriculture, etc. It has a good reputation internationally and has been published every two years since 2006. The 2020 rankings, which were published on 6 June, cover 180 countries, like in 2018 and 2016.

Figure 7: Presentation of the 32 EPI Indicators, Divided Into 11 Families



Source: EPI 2020

1.2. Methodology and Specificities

One specificity of the EPI is that its indicators are constantly changing; although it now has 32 indicators, divided into 11 categories, in 2006 it used only 16 categories, divided into 6 categories. For example, the 'climate change' category, which now accounts for 24% of the final score, did not exist in 2006. This increase in the number of indicators is particularly clear for the past few years because there were 20 in 2016 and 24 in 2018. For the first time, in 2020 the EPI included waste management and the contribution of changes to land use regarding CO_2 emissions.

Indicators and categories are brought together with two major objectives: health (the complete name is 'environmental health') which is dominated by water and air quality, and ecosystems ('ecosystem vitality') which includes biodiversity and climate change. Although each objective weighed 50% in 2016 and 2018, in 2020, health accounts for 40% (in blue in *Figure 7*) and ecosystems for 60% (in green in *Figure 7*).

For each of the 32 individual indicators, a country's score is measured in terms of how far it is from a long-term target. Several sections refer to Sustainable Development Goals. The authors explain that these target values were developed using international agreements, objectives set by international organisations, and even consensus in the scientific community. They also mention that countries with good scores are those that have committed for many years to protection and prevention policies. Indeed, another specificity of the EPI is that it does not only have indicators that assess environmental status but also has several indicators that measure a country's efforts, through changes to a parameter over 10 or 15 years (e.g., atmospheric emissions and tree cover loss). A positive change over one or two years would not be enough to get a good score.

As with each edition of the EPI, new indicators have been suggested and many pre-existing indicators have been modified, with the whole representing a different weighting. Some indicators stay the same, but their metrics may have changed. They are still relevant and meet recognised criteria for this type of process (simplicity, measurability, completeness, transparency, etc.). The advantage of these changes is that they can be used to adapt to recently identified concerns and scientific progress, while underlying data adapt to newly available data. All raw data, calculations and weightings can be downloaded, which means that the process is fully transparent. However, these permanent changes to the method complicate detailed analysis for non-experts. It is also these methodological changes that cause relatively significant modifications to a given country's score from one year to another. Consequently, it is the country's ranking that is highlighted.

As part of the 'environmental health' objective, individual indicators are status indicators (e.g., exposure to atmospheric pollutants, access to drinking water), which is perfectly legitimate even if one may note that it is the most developed countries that have the best score. Conversely, in the second objective, 'ecosystems', several indicators are trend indicators ('loss' or 'growth rate'), not status indicators, which is another particular aspect of the EPI. Thus, a country going from 80% to 70% of tree cover would receive a lower score than another going from 5% to 6%, because it is the trend that is assessed. It is, therefore, necessary to qualify the statement made by the authors that present the EPI as a way of measuring 'sustainability statuses'. The EPI is also a measurement of the work carried out by a country, or its progress.

As seen in *paragraph 1.3*, for greenhouse gas emissions, the indicators that measure emissions changes are adjusted by a complex calculation, to avoid penalising a country that has already decarbonised its economy, and thus would have more difficulties in continuing to decrease emissions. It should be noted that this choice, once again, tends to favour developed countries.

In addition to status and trend indicators, the EPI also has response indicators, which are related to implemented public policies. This is typically about the proportion of protected areas. While they reflect 'the distance from targets set out for environmental policies' (according to the authors of the EPI) or the probability of improvement in the future, it can be argued that such indicators may be uncorrelated with actual environmental status. In the 'biodiversity' category, 80% of the score is based on response indicators (protected areas and species), with only 20% being based on an assessment of habitat quality. This choice favours France in particular (details in *paragraph 2.1* below).

Despite having added several indicators, the authors note that the EPI does not consider the 'imported' impacts of a country, i.e., the impacts related to importing products that cause CO_2 emissions or deforestation in another country. As the EPI adapts to the knowledge and data available, it is possible to imagine that a later version will include these indirect, or imported, impacts, which are a recent concern.

Similarly, it is conceivable that ecosystem services, an innovative subject for which there are now increasingly well-recognised benchmarks, could be integrated in the future in a more precise and comprehensive manner (at this stage, they are based mainly on tree cover loss).

Regarding the metrics used to evaluate an indicator, for the most part, the authors prefer data that are homogeneous on a global scale, rather than official statistical data. This could be criticised if we only wanted to analyse the most developed countries, which have proven data and validation procedures. However, it is a reasonable process if the aim is to look at 180 very diverse countries. In practice, it tends to be satellite observations, which are becoming ever more available, or scientific publications, which, however, do not guarantee a follow-up over time.

1.3. Presentation of Individual Indicators

To make the indicators comparable, each one is converted into a value that is relative to the target, with a scale between 0 and 100, sometimes after log transformation, which is, to our knowledge, an original methodological aspect. The objective of this is to better differentiate countries that rank in the middle and have close scores. 100 represents a desired long-term goal (for certain criteria, some countries have reached this maximum score). Scores are then aggregated using a weighting system. The three most influential indicators are CO_2 emissions, exposure to fine particles (PM2.5) and access to drinking water (they weigh between 10% and 12% each), whereas 15 of the 32 indicators weigh less than 1.5% each.

The 'ecosystem services' category, which accounts for 6% of the total EPI, is new for the 2020 edition. Its main indicator (90% of the category) is tree cover loss, which was in previous versions of the EPI, with the same weight, in the 'biodiversity' category. Two indicators about grassland loss and wetland loss have been added to this, which is a significant step forward for the EPI's methodology, in that it recognises the interest and services provided by these different ecosystems. It is nevertheless feeble in practice since they only account for 5% of the category each, which comes to only 0.3% of the total EPI. One aspect is that these three indicators only look at trend changes, with tree cover loss since 2000 (source: Global Forest Watch) and wetland or grassland loss since 1992 (source: ESA).

Within the 'climate change' category, the indicator about CO_2 emissions accounts for 55% of the category (it is also the most influential indicator for the EPI as a whole). It is supplemented with seven other indicators with smaller weightings, including those about methane, nitrous oxide, black carbon and fluorinated gas emissions. It is mainly based on emissions trends between 2008 and 2017. However, they have been adapted to take the country's GDP and history regarding emission reduction into consideration; behind the synoptic titles of these indicators (e.g.: CO_2 intensity trend or methane intensity trend) are complex calculations, in which the aim is to avoid penalising countries that have largely decarbonised their economies. Among the countries that scored better than France for this indicator are some European countries, as well as African and Asian countries with much lower GDPs.

We can point to the calculation of the Disability-adjusted life years (DALY), in the health category, which was introduced in 2018 for lead exposure. Its use became more widespread in the 2020 edition for other indicators [2]: exposure to ozone and PM2.5, insalubrity and sanitation, and indoor air pollution.

1.4. Underlying Metrics

The EPI developers have chosen to favour data that are available for all countries that can be homogeneously collected on a global scale, with a validation level that is the same from one country to another, even if it means ignoring official statistical data. Nevertheless, Eurostat and the UNSD are both used for wastewater and waste management. They use technical and scientific publications[3] or data from satellite observations. The latter can be used to cancel out any biases linked to national measures, however they cannot always account for the heterogeneity of situations in the field if not readjusted with *in situ* observations.

2. Results

2.1. France's Ranking: A Very Good Score

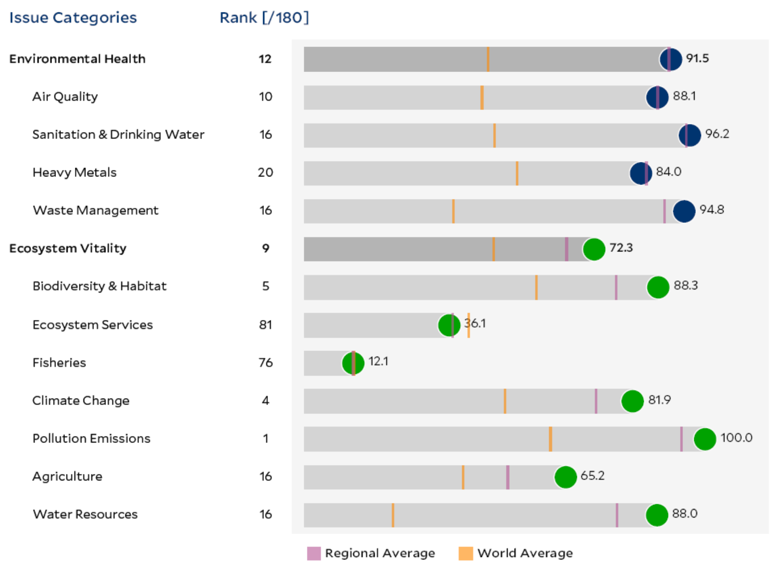
In the 2020 edition of the EPI, France is 5th globally with a score of 80. It is on an upward trajectory from 27th in 2014, to 10th in 2016, and up to 2nd in 2018. This trend is thanks to both progress that has been made (e.g., protected areas and atmospheric emissions) and to certain changes for indicators used in the EPI. The 2020 rankings are led by Denmark, Luxembourg, Switzerland and the United Kingdom. The 11 top countries are European, with Japan and Australia coming in 12th and 13th respectively. Germany came in 10th, Canada 20th, the United States 24th (a slight increase), with China coming in at 120th (its result did not change compared to the 2018 edition).

Having scored well for most criteria, France is 12th for the 'Environmental Health' objective (40% of the total EPI) and 9th for the second objective, 'Ecosystem Vitality' (60% of the total EPI). Yet, it is 5th in the overall rankings, therefore even better ranked, which shows that most countries that have an excellent score for at least one of the two objectives (Environmental Health or Ecosystem Vitality) do not have such success with the other objective.

For 10 of the 32 individual indicators, France got the maximum score of 100 and therefore comes in joint first. These are i) two indicators related to health, insalubrity and solid fuel pollution, ii) four criteria among the seven in the 'biodiversity and habitat' category, which are all related to protection policy, the size of protected marine and land areas, and the representativeness of protected species, iii) and lastly, four criteria related to atmospheric emissions, which are evaluated by change trends, not an absolute value: SO_2 and NO_x emissions for pollution, and methane and black carbon[4] for the greenhouse effect.

[2] By using calculations from the Institute for Health Metrics and Evaluation.
[3] Examples of sources: Commonwealth Scientific and Industrial Research Organisation, Global Forest Watch, European Space Agency, Sea Around Us and the Potsdam Institute for Climate Impact Research.
[4] Regarding black carbon, its effect on climate change has only been agreed upon since around 2013. This shows the utility of the EPI's progressive methodology, even if this progressive aspect may also complicate the interpretation when comparing throughout the years.

Figure 8: Illustration of France's Results for the EPI



Source: EPI 2020

As the EPI contains indicators that measure a country's response (e.g., protected areas) and trend indicators (e.g.: decrease in emissions), it evaluates a country's 'efforts': France's excellent overall result, and more general for European countries, does not mean that our economies do not have an impact on the environment. Furthermore, the most developed countries generally have the best scores, as *Figure 4* in the previous chapter shows.

2.2. Detailed Assessment of Indicators and Identifying Which Are the Most Penalising

Regarding the first objective, Environmental Health, France has an excellent score of 91.5. The only penalising indicator is the one about ozone (score: 58, rank: 45th). For many years, and particularly in 2018, ozone pollution peaks were recorded in France, due to both primary pollutant emissions (including some that are of natural origin) and extreme heat events, because ozone forms due to sun rays.

For the second objective, Ecosystem Vitality, the overall score is weaker (71.3), and individual scores are more disparate. Considering the weightings of the criteria, this is where we find the most penalising elements for France's final EPI ranking (much more penalising than ozone mentioned above). This relates to tree cover loss, the three criteria related to fisheries (fish stock status, share of trawler catches and marine trophic index[5]) and, to a lesser extent, the Biodiversity Habitat Index.

Tree cover loss is the main criterion that weakens France's ranking, especially since it probably plays an indirect role in CO_2 emissions due to land-use change, even though the weight of this criterion is low. During a previous memo about the subject, the SDES highlighted this indicator's inadequacy, considering the national reality. Indeed, while official forest statistics

[5] This index is in fact an analysis of the changes in how much fish, crustaceans, molluscs, and sea urchins are caught compared to stocks (source: Sea Around Us, University of British Columbia, Australia), which combines observed and reconstituted data.

(FAO) show tree cover growth of 3.9% for France between 2000 and 2014, the EPI shows a negative trend, using satellite data. This is likely due to Storm Klaus in 2009[6].

Overall, out of the 11 categories of indicators in the EPI, France has very good scores for the following three categories: Pollution Emissions, Climate Change and Biodiversity & Habitat. On the other hand, France could improve in two categories for which its performance is middling: Ecosystem Services (in practice, changes to tree cover) and Fisheries.

It is interesting to further analyse the indicators within two notable categories. Regarding the Climate Change category, France has a very good overall score, since the predominant criteria are the four emissions criteria based on trend changes (CO_2, methane, etc.), for which it ranks well. Nevertheless, the 2020 EPI added a greenhouse gas emissions per capita criterion, for which France is only 117th, as well as a criterion evaluating CO_2 emissions due to changes in land use, for which France is only 59th. At this stage, these two criteria only weakly influence the overall EPI as they account for 0.6% of the score each. In 2018, a criterion that specifically looked at CO_2 intensity in the energy sector was part of this category. France was 12th thanks to its nuclear energy, but this criterion is not part of the 2020 edition.

For the Biodiversity category, nearly all the criteria have either been changed since the 2018 edition. This is one of the themes for which France ranks well, thanks to the maximum score of 100 for indicators that measure protected land areas, where 100 means 17% protection, and protected marine areas, where 100 means 10% protection. Despite this, France received mediocre scores for the two criteria related to habitat quality; France is 65th for the Species Habitat Index, which evaluates habitat size loss since 2001 and 152nd (its worst ranking) for the Biodiversity Habitat Index, which evaluates habitat deterioration (including, for example, fragmentation). As these two status indicators only represent 20% of the category, against 80% for the five indicators related to protected areas and species, it can be inferred that France is artificially advantaged for this theme and that its current excellent ranking could be in question for future editions of the EPI.

France did not perform as well in 2020 (5th) as it did in 2018 (it was 2nd with a score of 83.9, behind Switzerland). Changes to EPI indicators lowered the scores of most countries that topped the rankings between 2018 and 2020, including France. For France, this fall is mainly due to the addition of the 'Fish caught by trawling' criteria within the 'Fisheries' category, the addition of the 'Ozone exposure' category in the 'Air quality' category and a weaker score in the 'Protected Areas Representativeness' index, even if the score for protected land and marine areas continues to be 100.

[6] There is matter for discussion, because the authors of the EPI indicate that countries should not be penalised for a situation that does not come under the scope of its management. In this situation, France suffered tree cover loss due to a weather event. It should be remembered that Storm Klaus caused the loss of nearly 45 million m^3 of cover, which is more than four years of growth.

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Factsheet 2
ESGAP – Environmental Sustainability GAP French Development Agency and University College London

1. Indicator and Methodology

1.1. Presentation

The ESGAP, or Environmental Sustainability GAP, can be used to assess a country's 'environmental sustainability' (*Ekins et al., 2019*). This concept is defined as the maintenance over time of environmental functions that are necessary to the correct functioning of the biosphere, by integrating the concept of critical natural capital to be preserved. This is also explored in work about planetary boundaries (*Steffen et al., 2015*), for example. Thus, for each environmental function studied and each underlying indicator, it sets an objective to be reached. It was designed by Paul Ekins' team at University College London (UCL) in 2003.

In 2018, the French Development Agency (AFD) asked this same team to develop a tool to open dialogue with countries based on the question of 'Are we shifting towards more sustainable development in this territory?'. Concretely, the first objective is to assess the context of funded projects, but a second objective is to also provide an 'environmental sustainability' tool on a global scale, by adopting a 'strong sustainability' approach, which assumes that it is important to preserve each of the environment's components[7].

The ESGAP includes 21 individual indicators that are used to create two synthetic indexes: the Strong Environmental Sustainability (SES) index, which assesses the current status concerning set environmental objectives, and the Strong Environmental Sustainability Progress (SESP) index, which assesses trends, or progress towards these objectives.

The result is a dashboard showing the scores for each indicator, both in terms of level and trend. The index is based on a solid methodological basis and looks at all environments and ecosystems, such as continental waters, marine, air, soil and forest environments, land ecosystems and biodiversity. The aggregation technique used (*paragraph 1.2*) emphasises territories with homogeneous scores for all criteria.

This index is in its testing phase and has been tried in different territories in 2019 and 2020, such as New Caledonia, Vietnam and Kenya. An assessment for all countries in the European Union was conducted and published in 2021 (*Usabiaga, 2021*).

[7] The 'weak sustainability' hypothesis assumes that taking from certain natural and finite resources can be offset, either by improving other environmental aspects or by investing in human or economic capital.

1.2. Methodology and Specificities

Representativeness and the Conceptual Framework

The SES index is the first to include the concept of biophysical limits on a national level. The methodological framework was established by the team at UCL in the 2000s and this work was recognised, even though there was not enough reliable data available at the time to develop the index. Consequently, although it is currently being tested in different countries, including those in Europe (*Usabiaga, 2021*), the ESGAP is already quite visible in the world arena (publications and UNEP working groups).

21 individual indicators were chosen, to represent the 4 'functions' as planned for in the initial conceptual framework. The first three functions are environmental, with the fourth looking at human wellbeing:

- 'Source' function: maintaining nature's capacity to provide resources: space, soil, water, fish stock, etc. [8]
- 'Sink' function: maintaining the capacity to neutralise pollution (waste, pollutant and greenhouse gas emissions), without being subjected to changes or ecosystem damage
- 'Life-Support' function: maintaining the health and functioning of ecosystems, including biodiversity, habitat quality and runoff regulation
- 'Human Health and Welfare' function: maintaining human health and fostering human wellbeing, directly or indirectly. This relates to both our health, which namely depends on air and drinking water quality, and a recreational aspect, though swimming and preserving high-quality natural sites.

Although it is, for the most part, based on environmental and ecosystem criteria, the purpose of the ESGAP is to look at the relationship between humans and their environment, in a sustainable context. Thus, in addition to a fourth function dedicated to human health and wellbeing, the 'Source' function includes human use of resources, and the 'Sink' function looks at our emissions through nature. This also confirms that the ESGAP is strongly linked to the concept of 'nature's contribution to people', which was developed by UCL; in addition to their intrinsic ecological value, ecosystems have a utility value via the services that they provide to humans (the concept of ecosystem services), as well as a heritage value[9].

Aggregation Technique

Each of the 21 individual indicators is scored from 0 to 100, which makes it easier to understand and implicitly normalises the indicators. In practice, as a geometric mean is calculated afterwards, a score of zero must be avoided; scores are therefore calculated from 5 to 100.

The index is based on equal weighting of the indicators. This is a common and recognised practice; the authors have not identified a scientific or ethical reason for overweighing one over another. In practice, equal weighting aggregation is calculated for each category or function. In the second stage, the four functions are then equally weighted. If there was only one aggregation stage for the 21 criteria, the 'Sink' function, which uses 7 of the 21 indicators, would dominate, compared to, for example, the 'Life-Support' function, which only has 3 indicators.

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[8] This function includes the concept of human use, including fish and woody biomass consumption. In the long run, the framework does not exclude that the use of fossil resources be included in this function.

[9] Certain experts, including the *Chaire de Comptabilité écologique* [Chair of ecological accounting] at AgroParisTech, are considering developments to shift towards a more 'monetary' index, including, for example, the unpaid ecological costs of human activity or by estimating the necessary cost for a country to preserve or rebuild its natural capital (by comparing it to its GDP). As of now, these initiatives are not part of the ESGAP.

At each of the two stages, aggregation is carried out using a geometric mean. Compared to an arithmetic mean, weaker scores have more of an impact on the final score. For illustrative purposes, let us consider two scores of 10 and 90. Their geometric mean is $30 = (10 \times 90)^{1/2}$, whereas the arithmetic mean would be 50. The geometric mean stops poor scores from being offset by a very good score. Thus, to have a good overall ranking on the Strong Environmental Sustainability (SES) index, a country must have good scores all around. This is a pragmatic way of expressing the concept of 'strong' environmental sustainability.

There is also a progress index, called the Strong Environmental Sustainability Progress (SESP) index. Its calculation uses Eurostat's method to measure progress towards SDGs (Eurostat 2019). It firstly calculates an annual growth rate made up of a compound annual growth rate (CAGR) for each of the indicators: i, based on y results seen in years t_1 and t_0.

$$\boldsymbol{CAGR_a = (\frac{y_{t_1}}{y_{t_0}})^{\frac{1}{t_1 - t_0}} - 1}$$

This rate is then compared with the rate of change that is theoretically necessary to reach this set objective. This provides a progress indicator. The result may be negative if the country is moving further from the objective, but in this case, a score of 0 is allocated. It may also be above 100% if it has progressed in such a way as to reach the objective before the set date. In this case, a score of 100 is allocated. Lastly, a geometric mean is carried out between the different progress indicators.

1.3. Presentation of Individual Indicators

Table 5: List of Individual Indicators

Function	Topic	Subtopic	ESGAP indicator	Data source
Source	Biomass	Forest resources	Forest use rate (fellings/increment)	EEA (2017)
		Fish resources	Fish stocks within safe biological limits	EEA (2018, 2019)
	Freshwater	Surface water resources	Water consumption: freshwater bodies not under water stress	EEA (2018)
		Groundwater resources	Groundwater bodies in good quantitative status	EEA (2018)
	Soil	Soil erosion	Area with tolerable soil erosion	Panagos et al. (2020)
Sink	Earth system	Greenhouse gases	Per capita GHG emissions/annual allowance	Eurostat (2019), IPPC (2018)
		Ozone depleting substances	Consumption of substances	Ozone secretariat UNEP (2019)
	Terrestrial ecosystems	Ozone pollution	Cropland and forest area exposed to safe ozone levels (critical levels)	ETC-ACM/EEA, Horálek et al. (2020)
		Acidification	No exceedance of critical loads of eutrophication and acidification for ecosystems (N and S deposition)	UN-ECE 2017, Tsyro et al (2020))
	Freshwater ecosystems	Surface water pollution	Surface water bodies in good chemical status	EEA (2018)

		Groundwater pollution	Groundwater bodies in good chemical status	EEA (2018)
	Marine ecosystems	Marine pollution	Coastal water bodies in good chemical status	EEA (2018)
Life support	Terrestrial ecosystems	Functional diversity	Terrestrial habitats in favourable conservation status [%]	EEA 2020 (State of Nature)
	Freshwater ecosystems	Ecological status	Surface water bodies in good ecological status	EEA (2018)
	Marine ecosystems	Ecological status	Coastal water bodies in good ecological status	EEA (2018)
Human health and welfare	Human health	Outdoor air pollution	Population exposed to safe levels of $PM_{2.5}$	ETC-ACM/EEA, Horálek et al. (2020)
		Indoor air pollution	Population using clean fuels and technologies for cooking	WHO (2020)
		Drinking water pollution	Samples that meet the drinking water criteria	EC (2016)
	Amenity	Bathing waters	Recreational water bodies in excellent status	EEA (2019)
		Recreation	Population with nearby green areas [%]	Poelman (2018)
		Natural and mixed world heritage sites	Natural and mixed world heritage sites in good conservation outlook (based on 3 criteria)	IUCN World heritage, Osipova et al. (2020)

Source: *Usubiaga-Liano, 2021*

Specificities

One aspect of this index is that it includes the recreational and heritage aspects of nature, such as the preservation status of world natural heritage sites, assessed by the IUCN. Additionally, communities that live near to green areas are included in the 'Human Health and Welfare' function, in the same way as the quality of bathing waters (last lines in *Table 5*). The ESGAP therefore fully includes the notion of ecosystem services and heritage value.

The 'Amenity' theme, with three indicators, weighs as much as the 'Health' theme, which also has three indicators: water pollution, outdoor air (fine particles) and indoor air.

The presence of the soil erosion criteria in the 'Source' function should be noted because this matter is not often prioritised in this type of exercise. Nevertheless, the use of mineral resources (metals and fossil fuels) is not included in this function.

Soil is also included in the 'Life Support' function through critical loads for acidification and eutrophication being merged into one indicator. The concept of critical loads, which is a well-known tool in Europe, was defined in the pan-European UNECE 'Air' convention, to fight long-range air pollution, primarily 'acid rain'. This is the maximum deposition value of a pollutant above which significant undesirable effects are observed on soil and the ecosystem at a given location, and it, therefore, depends on the type of ecosystem at that location.

Air appears as a source, or vector, of our pollution. In practice, other than the critical loads mentioned above (impacts on different environments), the ESGAP includes ozone (cultivation and tree exposure) and exposure to fine particles (human health). Indicators about greenhouse gas emissions and substance emissions that damage the ozone layer are added to this.

Water appears as a 'target' environment, in that it is a victim of water withdrawals and the final repository of pollution. Water in the ESGAP is analysed via seven criteria with two of them being related to water withdrawals, three about the good chemical status of water (surface, ground and marine), and the last two being about good environmental status (surface waters and marine environments). In addition, there are two criteria related to human health: the quality of drinking water and bathing waters.

Lastly, the ESGAP includes biodiversity simply and pragmatically, via an assessment of land habitats with good conservation status, according to the Habitat directive, and thus specific to the EU[10].

These indicators are not based on the notion of footprints, which would consider any imported impacts of consumption in a territory.

Defining Objectives

For each indicator, the value of 100 corresponds to an objective or a threshold that should not be exceeded. Wherever possible, the method uses 'environmental standards' or target values, which are the result of political choices. For example, the good ecological status of waterways in Europe or a level of emissions that is compatible with global warming, i.e., limited to 1.5 °C or 0.5t/capita. Regarding this same emissions criterion, level 0 was set at 2.5t/capital, which was deemed incompatible with this objective. The authors specify that these thresholds often include a margin of uncertainty, are thus more restrictive, and are therefore more suitable than 'environmental limits' based on scientific knowledge alone, which are usually linked to a significant change in the relevant ecosystem[11].

One aspect of the ESGAP is that it analyses several criteria that have been outlined by European directives, with concepts such as 'good chemical status' and 'good environmental status' of water masses (Water Framework Directive) or 'good conservation status' of habitats (Habitats Directive). This has the advantage of ensuring that data are always available and regularly updated and can be easily understood by the public and decision-makers. However, it should be noted that for the 'good environmental status' of a water mass or the 'good conservation status' of a habitat, countries have a margin of freedom for the criteria's assessment method. The ESGAP was developed in a way that makes it particularly suited to Europe, but this has not stopped it from being applied to other areas, such as Kenya and Vietnam, by adapting criteria.

Most indicators are based on a quantification with a threshold effect, respecting or not a limit: the percentage of a water mass that has a good environmental status, the percentage of freshwater masses that are not subject to excessive withdrawals, the percentage of land surface area that is not subject to excessive soil erosion, the percentage of lands that are not subjected to critical ozone levels[12], etc. While these pragmatic choices ensure that the index stays consistent and can be easily understood, it should be remembered that each score is not necessarily proportional to the actual severity of the impact.

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[10] A previous version of the index considered the Biodiversity Intactness Index (BII), which assesses species loss on a site due to the impact of human activity, with the aid of modelling that uses input data about land use, human population density and distance from a road. This scientific work, combining richness (number of species present) and abundance (population within a species), has the advantage of proposing results at a global level (*Steffen et al., 2015; Newbold et al., 2016*). However, it is not regularly updated, and they are not observations, but rather modelling.

[11] Conversely, *a priori*, the authors specify that the thresholds or objectives set by SDGs can be too political and too lacking in scientific basis. This can be because they are the result of negotiations between several countries in various contexts.

[12] AOT40, which calculates accumulated plant exposure over a year. The threshold chosen for AOT40 is that which leads to a 5% cultivation (wheat, forest) production loss.

1.4. Underlying Metrics

As presented in *paragraph 1.3*, some data come from global sources such as the IUCN and the UNEP, but almost half of the indicators have been developed by taking a consolidated European database as a model. This is notably the case for critical loads, which assess atmospheric pollution within the pan-European UNECE framework, or for water, with lots of data having been collected by the European Environment Agency (EEA): water that is not subjected to stress due to excessive withdrawal, water with a good environmental or chemical status and quality of bathing waters.

Nevertheless, it is possible to find equivalent, or proxy, data for non-European countries. *A. Fairbrass 2020* studied the feasibility of extending the ESGAP to all countries. For example, it is possible to replace forest stock assessment (growth or felling) with a measurement of a clear increase in tree cover that can be seen by satellite, as is done by other international composite indexes. If the ESGAP were to be applied to several countries for comparative reasons, it would be possible to only use some of the 21 indicators. Their underlying metrics would be adapted if necessary, and a procedure would be implemented to make up for missing data.

The index was applied to different territories in 2019 and 2020, such as New Caledonia, Kenya and Vietnam. This was an opportunity to confirm the methodology while also refining certain indicators. The adaptability of the method to the territory was one of the index's principles from the start. For New Caledonia, the index was adapted by removing criteria (indicators) that were not relevant, or for which data would not be available (e.g., o groundwater bodies). Conversely, an indicator was added to the 'Source' function to assess the destruction rate of forests by wildfire, which is a particularly relevant issue for this territory.

2. Results

Figure 9 comes from the ESGAP 2021 study dashboard for all European Union countries. The colours show each country's performance, these countries being ranked according to their overall result regarding the Strong Environmental Sustainability (SES) index, which assesses current statuses compared to set environmental objectives.

Figure 9: ESGAP Scores for the European Union

Country	FI	IE	GB	FR	EE	HR	CY	SE	PT	SK	GR	ES	LT	DK	IT	SI	RO	LV	AT	CZ	PL	BG	HU	NL	DE	LU	MT	BE
SES index	60	59	50	47	43	43	43	43	43	41	41	39	38	37	37	36	35	35	33	33	31	30	30	28	28	28	26	19
Source	78	73	63	62	75	64	34	65	49	61	40	41	77	76	43	62	58	79	55	55	63	56	62	72	65	40	11	32
Sink	45	44	41	32	22	28	28	22	27	22	28	28	22	30	28	14	31	22	16	19	28	25	21	21	15	13	14	12
Ecosystems	38	43	35	40	24	55	66	25	45	43	66	37	15	10	31	59	27	10	29	20	15	18	11	7	10	14	51	9
Human health	98	91	72	61	88	35	53	96	55	50	36	57	83	89	52	35	32	88	46	58	34	33	57	57	60	86	57	38

Source: Usabiaga-Liaño, 2021

European scores for environmental functions are unbalanced; the weakest scores (orange and red squares) are for the 'Life Support' function, and especially the 'Sink' function (pollution absorption), with scores below 50, especially due to CO_2[13] emissions. Human health and welfare scores, including amenities, are for the most part good and are led by Northern countries such as Scandinavia, the Baltic states, Ireland, and the United Kingdom. France is 11th for this function. Results are also good in Europe for soil erosion, water resource use and

[13] For this criterion, level 0 was set at 2.5t/capita, which is deemed incompatible with a trajectory of +2 °C. For this reason, all European countries have a score of 0 (increased to 5 for final aggregation).

bathing waters. On the other hand, we can see weaker scores for the environmental status of waterways and habitat conservation and, most of all, ecosystem pollutant absorption. This is mainly due to CO_2, but also nitrogen and phosphorus (eutrophication risk) and ozone precursors.

France performs quite well for each of the four functions and is 4th overall in Europe. It should be remembered that since the index is based on a geometric mean, countries with a homogeneous score are favoured. France has very good scores for its use of forest resources, eutrophication and acidification, and drinking water. Its scores are weaker than many other European countries for groundwater resources, bathing waters and soil erosion.

The top three countries are Finland, Ireland and the United Kingdom. Belgium comes last in this ranking because it received poor scores for several criteria, such as the quality of its ecosystems and waters, eutrophication and forest resources. For some criteria, all European countries have the same score. This includes fish stock and CO_2 emissions, with a null score for all countries. Regarding substances that weaken the ozone layer, all countries received the maximum score.

If we look at the Strong Environmental Sustainability Progress (SESP) index, which assesses progress, France once again performs well (5th). It should be noted that the Czech Republic, Ireland (again) and Denmark show the best progress.

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Factsheet 3
CCPI - Climate Change Performance Index – Germanwatch

The Climate Change Performance Index (CCPI) has been published since 2005 by Germanwatch, an independent organisation, with the support of the Climate Action Network. It scores and ranks 61 countries according to 14 criteria related to climate change. It includes future trends and expert opinions about each country's policies.

1. Indicator and Methodology

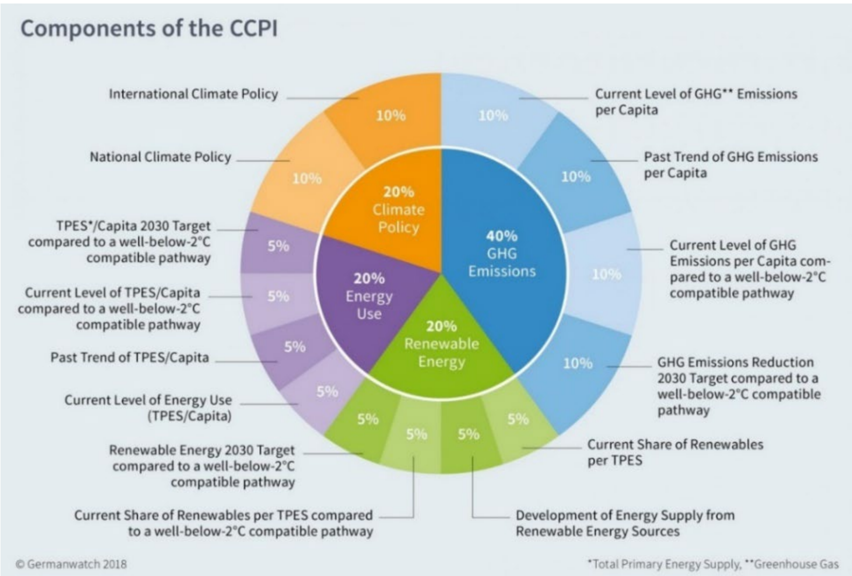
1.1. Methodology and Specificities

The CCPI carefully analyses the work carried out by a country for the environment, using 14 individual indicators spread across 4 categories:

- GHG emissions: 40% of the total, with 4 indicators weighing 10% each
- Renewable energy: 20% of the total, with 4 indicators each weighing 5%
- Energy consumption: 20% of the total, with 4 indicators each weighing 5%
- Climate policy: 20% of the total, with 2 indicators each weighing 10% (national policy and international policy). For these criteria, the index is based on expert opinion[14], which is another particular aspect of this index.

Another aspect of this index is that in addition to current and past emissions, it includes future trajectories. Several indicators compare the country's context with its desired trajectory based on the Paris Agreement, which is a point of reference in international climate negotiations.

Figure 10: 14 CCPI Indicators, Divided Into 4 Categories



Source: *Germanwatch 2020*

[14] More than 200 experts, according to the authors.

Each indicator is scored between 0 and 100, via a normalised calculation: 0 represents the worst result scored by a country, and 100 represents the best. Indicator aggregation takes place after this using a sum of weighted scores: 6 of them each weigh 10% of the total amount, and the 8 others each weigh 5%.

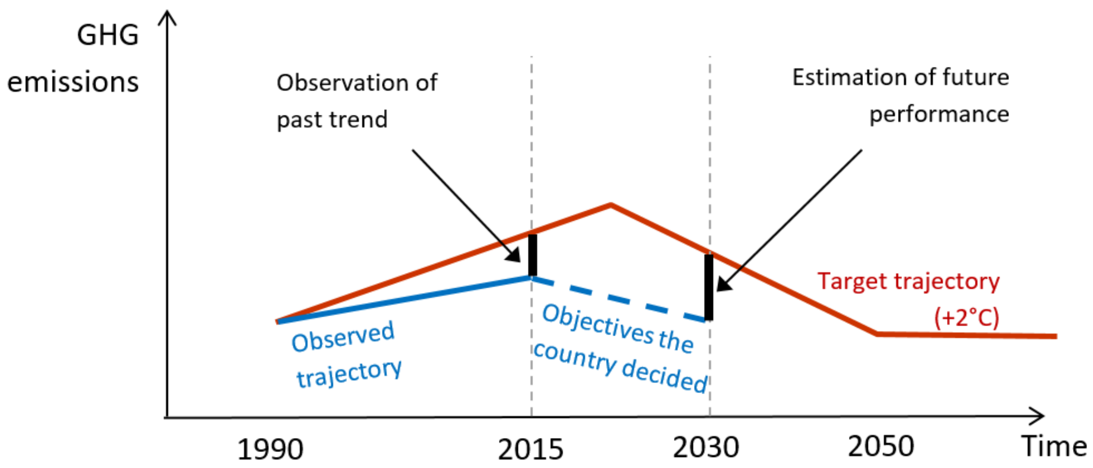
Among environmental indexes, climate change is often only analysed using only one or two indicators (greenhouse gas emissions, for example). The advantage of this approach is that it is very detailed and looks to the future while including energy policy.

1.2. Presentation of Individual Indicators, Metrics and Sources

The three emissions categories, the share of renewable energy and energy consumption follow a similar pattern, with four quantitative indicators:

- an indicator about the current level
- an indicator about past change (increase or decrease)
- and two criteria were added in 2017, after the Paris Agreement was signed, which involve comparing the country's situation to the country's desired trajectory to limit global warming to less than + 2 °C (*red line in Figure 11*)[15]. The current level of emissions is compared to the 2015 dot for this trajectory in *Figure 11*, this is a 'past performance' measure. The last indicator compares the 2030 dot on this same trajectory to the objective which was set by the country for 2030, this is a 'future performance' measure.

Figure 11: Calculation Method For 2015 and 2030 Indicators Related to the Country's Trajectory Based on the Paris Agreements



Source: SDES, according to Germanwatch 2020

[15] This trajectory began in 2010 for renewable energy, starting in 1990 for emissions and energy consumption. Additionally, for developing countries, the trajectory may include a period of increase in emissions before decreasing. This is the case shown in *Figure 11.*

The fourth category, an assessment of climate policy, seems to be the reason rankings can significantly vary from one year to another[16]. For example, the EU is ranked as a country by the CCPI. Yet, it moved up 6 places (from 21st to 16th) between 2020 and 2021, thanks to the Green Deal, which is still in its beginning stages. Even if this is not reflected in facts, experts believe that the objectives shown are ambitious and are a positive signal, with, for example, the possibility of increasing the objectives for emissions reduction in 2030.

2. Results

2.1. France's Ranking

The index is calculated for the 61 countries that account for more than 90% of greenhouse gas emissions. In the 2021 rankings, the top countries are Sweden, the United Kingdom and Denmark. Among the non-European countries, Morocco, Chile and India perform well. The last five countries are the USA, Saudi Arabia, Iran, Canada and Taiwan. China is placed in the middle of the rankings.

The worst countries for the climate policy criteria are the USA, Australia, Turkey, Algeria and Russia.

Symbolically, the authors chose to leave the first three positions in these rankings empty as they deem none of the countries to have a performance that is worthy of being on the podium.

For the past four years, France has placed between 15th and 23rd place, with changes to its score and rank being mainly due to changes to climate policy. It placed 17th in the 2022 rankings, which were published in late 2021, and therefore is the 14th country since the first three positions are empty. Its score is 61, which is an improvement compared to previous years. This score has moved France into the 'good scores' category, which is for results over 60.

2.2. Detailed Assessment of Indicators and Identifying Which Are the Most Penalising

France's index is lowered by the renewable energy category, for which its score is relatively poor. Despite an increase in the share of renewable energy over the past five years, the country's 2030 objective regarding renewable energy does not correspond to a trajectory that is below 2 °C.

Before moving up in 2022, France's position dropped in 2021 (23rd), due to a significant degradation in expert opinion about its national climate policy. Although France continued to be well-regarded for its commitments and initiatives on an international level, such as the One Planet Summit, experts noted a lack of concrete measures nationally and in the transport and construction sectors.

This lack of action in these two sectors is also reflected in the country's middling position in the GHG emissions and energy consumption categories.

According to this expert opinion, the unprecedented process of consultation with the creation of a Citizen's Convention on Climate was considered in the 2021 edition, but paradoxically, does not seem to favour France in that the promise to take all suggestions on board, unfiltered, was not kept. In the 2020 edition of the CCPI, experts noted that the *Gilets jaunes* [Yellow Vests Movement] contributed to a lack of ambition in French climate policy.

[16] We can see high variability from one year to another, even if the indicators and their weightings have not changed (unlike other indexes, which add criteria or change weightings from year to year).

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Factsheet 4
Green Future Index – MIT Technology Review

1. Indicator and Methodology

1.1. Presentation

The Green Future Index focuses on decarbonising society. It was created by MIT Technology Review, in partnership with Salesforce and Citrix (Morgan Stanley), and was published for the first time in 2021. It assesses 76 countries and ranks them based on their progress and efforts to reduce emissions and trend towards a low-carbon future.

Based on 18 indicators divided into 5 pillars, it assesses the share of renewable energy, changes in emissions and the climate policies in each country.

1.2. Methodology and Specificities

18 individual indicators are spread across 5 categories, or 'pillars': carbon emissions, energy transition, green society, clean innovation and climate policy. Each indicator is scored between 0 and 10, with a score of 10 being given to the best performance among assessed countries. The index then carries out a weighted sum of these scores.

An arithmetic mean of the indicators is calculated within each pillar, with equal weighting. Following this, the five categories are aggregated with more weight being given to the fifth category: 40% against 15% for each of the other categories. This is specific to this index, as the last pillar includes a 'qualitative' assessment of each country's climate policy, by MIT Technology Review experts.

1.3. Individual Indicators and Underlying Metrics

The first pillar is dedicated to CO_2 emissions. Other than an indicator that measures the current level of emissions, it includes four other indicators which measure overall changes to these emissions between 2013 and 2018: total emissions, transport emissions, industrial emissions and emissions from agriculture. These methodological choices are probably advantageous to developed countries:

- as these 5 indicators are equally weighted, *in fine*, the actual level of emissions weighs four times less than emission changes
- each of these 5 indicators is relative to GDP, not population size, as is generally the case for environmental indexes. For the score about emissions, this is advantageous to developed countries while it is not advantageous to them for scores about changes in emissions.

The Energy transition pillar measures the share of the latter in the country's final energy consumption in 2017 (40% of the pillar, source: IEA), but also measures changes to the share of renewable energy in production, between 2014 and 2019 (60% of the pillar, source: IRENA).

The Green society pillar looks at decarbonisation more comprehensively in addition to measuring environmental preservation and adopted sustainable practices. The indicators in this pillar include the relative number of green buildings, the proportion of recycled waste, changes to tree cover and lastly, meat and dairy consumption per capita.

The Clean innovation pillar analyses clean innovation (number of patents relative to GDP), the number of start-ups in food tech and investments in green energy (the latter weighs 50%, which is as much as the previous two combined).

Lastly, the fifth pillar, which is about climate policy, accounts for 40% of the final index. It is made up of four indicators based on expert opinion, with a focus on climate action, through an assessment of the effectiveness of implemented policies concerning the objectives of the Paris Agreement. It also includes an assessment of the implementation of carbon taxes, an evaluation of the implementation of sustainable agriculture policy, including private-sector investment in agriculture, and an appraisal of investment in decarbonisation through recovery plans following the Covid-19 pandemic.

The data sources are mainly the FAO, the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), the World Bank, the UN and the World Intellectual Property Organization (WIPO). The private BloombergNEF website is also used for information about financial investments.

2. Results

2.1. Country Rankings, Including France

The top of the ranking is dominated by European countries, which make up 15 of the top 20. The top three are Scandinavian countries: Iceland, which is aiming to be carbon-neutral by 2040 and can use geothermal energy and hydroelectricity, Denmark and Norway. France follows in 4th place, thanks to its assertive policy and investment in the hydrogen sector, for which it was given an excellent score for the Climate policy pillar, and which accounts for a considerable amount of the final score[17].

Costa Rica's (7th) and New Zealand's (8th) presence should be noted, for each of them has made progress in terms of renewable energy and decarbonising of their industrial and agricultural sectors. Canada comes in 14th while the USA is only 40th.

At the bottom of the ranking are low-income countries (Bangladesh and Ghana) and petrol-producing countries such as Russia, Saudi Arabia, Iran, Algeria and Qatar. In general, the chosen criteria and weighting seem to favour developed countries, focusing on work that has been carried out (decrease in emissions, changes to tree cover, number of clean innovation patents, etc.). It is nevertheless difficult to be sure about this because, at this stage, the index only takes 76 countries into account, of which there are a limited number of least developed countries.

2.2. Detailed Assessment of Indicators and Identifying Which Are the Most Penalising

Developed countries, and in particular, European countries, seem to be favoured (mentioned above) for the emissions pillar. France is 13th.

France also ranks well for the Clean innovation pillar (9th), which is led by diverse countries: Singapore, Finland, Chile, Luxembourg, and Morocco, among others.

France received an excellent score regarding 'Climate policy', which is based on MIT Technology Review expert opinion and comes in 3rd, behind New Zealand and Denmark.

[17] The authors also provided an alternative ranking, where each of the pillar is equally weighted. In this case, France is 10th, not 4th (Costa Rica and New Zealand also move down, whereas the countries at the top do not move).

Scores are excellent for three out of the four indicators in this pillar: carbon taxing and sustainable agriculture. For these two indicators, several countries hold joint first place, including France. Regarding the post-Covid recovery plan, France is 3rd, thanks to its hydrogen policy[18].

On the other hand, France is only 60th out of 76 countries for the Energy transition pillar, which equally measures the current situation, the share of renewable energy and changes between 2013 and 2018 (energy production). The seven best-performing countries for this pillar are in Africa (Ethiopia, Angola, Uganda, etc.), followed by Iceland in 8th place.

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futura-sciences article.

[18] The authors explain that Covid caused an overall decrease in global GDP of 4.4% and a CO_2 decrease of 8.8% for the first six months of 2020, compared to 2019.

Factsheet 5
World Risk Index

1. Indicator and Methodology

1.1. Presentation

Created in 2011, the World Risk Index (WRI) assess the level of risk in 173 countries, for 5 natural risks: earthquakes, cyclones, flooding, droughts and rising sea levels. It identifies spheres of action to reduce disaster risks and was designed to be a guide for decision-makers. It is calculated by the Institute for International Law of Peace and Armed Conflict (IFHV) at Ruhr-University Bochum, in collaboration with Bündnis Entwicklung Hilft. The modular concept and structure were designed alongside the Institute for Environment and Human Security at United Nations University (ONU-EHS). The World Risk Index was revised in 2017 and now uses 23 indicators. Even if other similar indexes were created at the same time, such as the INFORM Risk Index, which will be described at the end of this factsheet, the World Risk Index has been commented on and reused by various authors.

1.2. Methodology and Specificities

The concept of the WRI is about understanding risk. Within the natural and industrial risk community, disaster risk is defined as being the consequence of the interaction with a physical hazard (e.g., rising sea levels), with:

- the probability of it happening – the combination of the intensity of the danger and its probability is the exposure in the WRI
- the territory's vulnerability – if a country is not vulnerable, a dangerous natural event can take place without it being a disaster.

In practice, the index is made up of four categories, or dimensions, bringing together several sub-indicators:

1. each country's exposure is assessed using five technical indicators, with each of them being related to one of the types of natural risks being studied.

Vulnerability is assessed using a thorough set of most socioeconomic criteria, divided into three dimensions:

2. susceptibility (potential human victims and economic damage)
3. coping capacity (effectiveness of crisis management methods) A society with readily available healthcare, insured goods and a suitable response capacity is less vulnerable
4. adaptive capacities or adaptation (a society's long-term capacity to adapt).

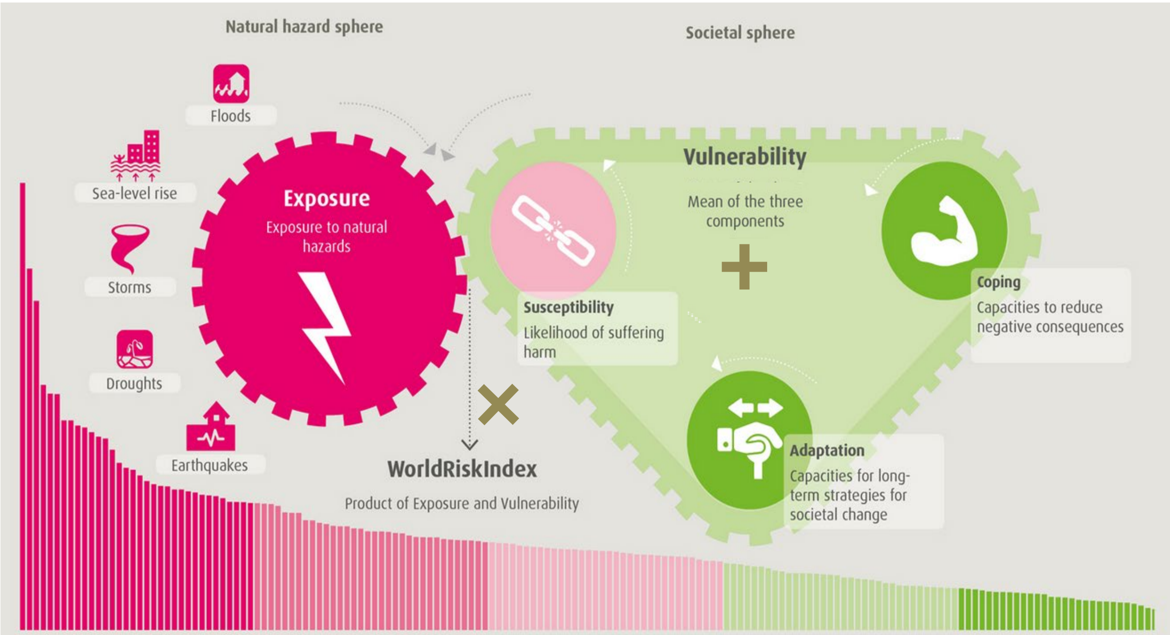
All indicators are converted into a non-dimension score between 0 and 100, as well as the final WRI score. Within each of the components (1) to (4), an arithmetic mean is carried out, with underlying indicators being weighted. The three vulnerability components (2) to (4) are then merged using an equal weighting average. Lastly, this vulnerability is multiplied by exposure (1).

In short :

Vulnerability = 1/3 × (Susceptibility + (1 – Coping) + (1 – Adaptation))

WRI = Exposure x Vulnerability

Figure 12: Overview of the WRI's Methodology



***Source:** World Risk Report 2021*

<u>Explaining Vulnerability</u>

With its unique sea-level situation, the Netherlands is the 16th most exposed country, but, conversely, is among the most well-equipped countries to handle this, among the 16 least vulnerable countries. *In fine,* it is 65th out of 181 countries.

Haiti and New Zealand have similar earthquake exposure levels. However, Haiti is twice as vulnerable, with its vulnerability being assessed at 70 whereas New Zealand's score is 29. Not only is the number of deaths higher, but economic losses are devastating since they exceed the country's gross national income, with only 2.5% of losses being insured. In the final result, Haiti is 22nd out of 181 in the 2020 WRI whereas New Zealand is 114th.

Other than the annual report, an online tool can be used to see the overall index for all the countries on a map.

Large countries, such as Brazil, China and India have different regions with various levels of risk. The index's modular structure means that analysis can be carried out locally and regionally.

1.3. Presentation of Individual Indicators and Underlying Metrics

The 23 individual indicators are shown below.

Table 6: List of Indicators in the World Risk Index, in Four Categories, or Dimensions

	Society vulnerability		
(1) Population Exposure	(2) Susceptibility	(3) Crisis management capacity	(4) Long-term adaptation capacity
A) Earthquakes B) Cyclones C) Flooding D) Droughts E) Rising sea levels	Public Infrastructure: A) People without Access to Basic Sanitation Services B) People without Access to Basic Drinking Water Services Housing Conditions: *data unavailable* Nutrition: C) Prevalence of Undernourishment Poverty & Dependency: D) Ratio of persons younger than 15 years or older than 65 to persons aged 16 to 64. E) Extreme Poverty (Share of a population living on less than $USD 1.25 per day) Economic Productivity F) Gross Domestic Product per capita (Purchasing power parity) G) Gini Index	Government & Authorities A) Corruption Perception Index B) Fragile States Index Disaster Preparation: *data unavailable* Medical Services: C) Number of Physicians per 10,000 persons D) Number of Hospital Beds per 10,000 persons Community: *data unavailable* Economic Coverage E) Insurance (except life insurance)	Education: A) Adult Literacy B) Gross Education Enrolment Gender Equality: C) Gender parity in education D) Share of women in the national Parliament Ecosystem Status & Environmental Protection: E) Water Resources F) Biodiversity and Habitat Protection G) Forest Management H) Agriculture Management Adaptation Strategies: *data unavailable* Investment: I) Life Expectancy at Birth J) Private Health Expenditure K) Public Health Expenditure

Source: *World Risk Report 2021*

Exposure

The chosen measurement tool is based on exposed populations, via past events. This includes a probability component (frequency of events) and a geolocalised assessment of the population living in the area affected by these events. Between 1980 and 2010, the most common and most devastating natural hazards were floods, storms, earthquakes and droughts, accounting for 81% of all events and 83% of reported deaths[19].

The rising sea levels indicator was added in 2018 because the authors believe that it will have more of an impact in the future. It measures the proportion of the population that is currently living in an area that would be affected if the sea were to rise 1 metre in the future. Therefore, there is no probability component, unlike the four other dangers, which is why this indicator was weighted 0.5. This same weighting (0.5) was applied to the population that is exposed to droughts because the authors believe that current data may overestimate the number of exposed people. Consequently, these two risks account for 12.5% of the exposure score each, with the other three weighing 25% each.

Vulnerability

In practice, vulnerability is made up of 23 societal indicators. They are not separate from one another but are relevant and have an impact on the result. They are divided into three main components which are equally weighted (susceptibility, management capacity and long-term adaptation capacity), but within each of these components, underlying indicators are weighted; their impact on vulnerability varies between 6% and 22.5%. Several other indicators were initially identified in the methodology but did not end up being used, due to data not being available at the time or because collection would have been too expensive. This concerns housing conditions and a country's preparedness for a disaster, for example.

Component (2), Susceptibility, has seven indicators (weighted sum), divided into four sub-categories: public infrastructure, nutrition, poverty and economic productivity. This looks at population vulnerability in a broader sense (risk of undernourishment, difficulty in accessing sanitation, GDP per capita, etc.), not the specific vulnerability to a specific hazard.

Component (3), Coping capacities, is assessed via five indicators: medical services and material protection (insurance) on the one hand, and aspects that might have an impact on action, such as corruption and poor government, on the other hand.

Component (4), Adaptive capacity, uses 11 indicators and is an overall assessment of how society functions through 4 themes: education, gender equality, health investment and lastly ecosystem status and environmental protection. Through a risk adaptation lens, the last component in the WRI includes traditional criteria found in environmental or human wellbeing indexes.

More specifically, it is believed that protecting the environment prevents risks (flooding, droughts and even the fight against climate change) and that ecosystems in good health provide a better guarantee that society can adapt to extreme conditions, with better access to resources.

The assessed criteria are:

- water resources (water quality as well as water withdrawal and use)
- forest management with changes to tree cover
- biodiversity protection policy.

These environmental indicators are for the most part taken from Yale University's Environmental Performance Index (EPI).

Lastly, it can be noted that three societal indicators use a logarithmic scale: public and private health expenditure, and life expectancy.

[19] The calculation of exposed populations is different from the number of deaths due to these past events; the number of deaths depends on the vulnerability of the exposed population, which is evaluated here separately.

Underlying Metrics

The main sources of information are renowned international organisations, such as the UNESCO Institute for Statistics, WHO (for example, the Joint Monitoring Programme by WHO-UNICEF and the World Bank. Other indexes and global reports are also used, including the Human Development Report by the UNDP (poverty and dependency ratio) and Yale's EPI (environmental indicators).

Regarding the analysis of past events and their geographic extension, the primary support is the PREVIEW Global Risk Data Platform (GRID), led by the UNEP (in collaboration with UNESCO and the World Meteorological Organization, but also other organisations such as the European Space Agency and the United States Geological Survey). To assess exposure, this information is cross-referenced with spatial demographic data from the Center for International Earth Science Information Network (CIESIN). Consequently, it is a question of modelling and calculation results. Regarding rising sea levels, this uses scenario predictions by the Center for Remote Sensing of Ice Sheets at the University of Kansas (CreSIS).

2. Results

2.1. Rankings of Different Countries

Exposure has more of an impact on the final index than vulnerability because its variability is high, with scores that are closer to zero for less exposed countries (exposure scores vary between 0.3 and 64). Global warming and the changing climate that results from it increases the intensity and frequency of natural disasters, therefore exposure. Nevertheless, as the reference period is long, exposure varies little over time and it is, above all, vulnerability criteria that change a country's ranking from one year to another.

The importance of economic and societal factors causes the WRI's results to be generally advantageous for developed countries. The economic impacts of disasters increase with development levels, but these are not included in the WRI. In addition, these countries are often insured. In less developed countries, economic consequences are more minor, but these countries are less well-insured. The consequences are most felt in terms of dead, injured or homeless people.

Disaster risk hot spots are in Oceania and South-East Asia, with island states being susceptible to storms and rising sea levels, but also in Central America, and Central and Western Africa. There is a 'double penalty' phenomenon in countries where exposure is highest (20th percentile) because the average vulnerability value is also the highest.

Countries like Vanuatu, Tonga, the Solomon Islands, the Philippines and Guatemala are facing threats that combine earthquakes, hurricanes and flooding, with a significant share of the population being exposed (up to 86% for Vanuatu). They top these rankings, with the biggest risk indexes (above 20 for the top 10, with Vanuatu scoring 50). The chosen multiplication strategy (**Exposure x Vulnerability**) results in significantly high values for the top of the ranking, while the bottom of the ranking is 'packed', with minor differences.

At the bottom of the rankings are countries that are less at risk, such as Qatar, Saudi Arabia, Malta, Scandinavian countries, and more generally, European countries.

2.2. France's Ranking and a Detailed Assessment of the Indicators

In the 2020 rankings, France is 167th out of 181 with a score of 2.5. Countries that top these rankings are those that are most at risk. France is therefore 15th (starting from the bottom) and 8th among European countries. Yet, it is not on the list of the least exposed countries (it is only 40th for this criterion with a score near 10), nor on the list of least 'susceptible' countries, which means that human or economic consequences are possible in case of an extreme weather event. It is, however, much better regarding its coping capacities in the event of a crisis and for the societal adaptation criteria. This includes risk prevention and education levels, in addition to protecting ecosystems. It should be noted that for this latter indicator, the WRI uses the scores given by the EPI, which are advantageous for France.

2.3. Comparison with the INFORM Risk Index

The INFORM Risk Index, which was published for the first time in 2012, is a joint initiative led by the European Commission's Joint Research Centre (JRC) and the Inter-Agency Standing Committee (IASC) Task Team on Preparedness and Resilience, in partnership with UN agencies, private partners and NGOs. It is a platform that provides an objective basis for risk analysis for countries, development agencies or risk mitigation players.

It includes a risk index between 0 and 10 which is based on the main areas of risk (hazard and exposure, vulnerability and lack of coping capacity):

$$INFORM\text{-}r\ \textbf{score} = (Exposure \times Vulnerability \times Lack\ of coping\ capacity)^{1/3}$$

The concept is therefore similar to the WRI, based on the concept of risk and on many societal indicators. A fundamental difference is that it includes conflict risk in addition to natural risks, with equivalent weightings. A specific index, the Global Conflict Risk Index, is also produced.

Five categories of natural risk are analysed, of which four are the same as in the WRI; the rising sea levels category is not included, but tsunamis are. There are three other notable differences with the WRI:

- INFORM Risk includes more underlying indicators, with 54 in total. For example, different vulnerable population categories are included in the vulnerability criteria. Child mortality is analysed, in addition to malnutrition, FAO indexes about diets and price volatility, the prevalence of different diseases (AIDS, tuberculosis and malaria) and the number of refugees or uprooted people. A communication component was also added, with four criteria including access to electricity and internet users
- INFORM Risk analyses the Coping capacity component differently from the WRI in that it is included in the vulnerability dimension. As a result, it includes this component in the multiplication formula used for the index's final calculation, which is a geometric mean between exposure, vulnerability and capacity.

A geometric mean is also calculated for the exposure dimension. Therefore, a high score for the events category gives a relatively high final exposure score, even if the scores for other events are lower[20].

An online tool can be used to view an assessment of each country, to view the overall index or view each of the exposure, vulnerability and coping capacity dimensions, mapped for all

[20] In practice, it is a geometric mean for reversed exposure scores (10 – score). Calculating a geometric mean is a technique that causes weaker scores to have more of an impact on the result. However, in this case, the calculation is intended to have the opposite effect – high exposure scores have more of an impact (in other words, to limit the offsetting effect of high exposure for one type of event by low exposure to other types of events).
Additionally, this inclusion takes place in two stages: first with a geometric mean of the five types of natural events and then a geometric mean between natural risks and conflict risks.
Note: additionally, within the different sub-categories in the vulnerability dimension, the authors chose complex aggregations, combining arithmetic and geometric means.

countries. For exposure, the user can choose to view only exposure to natural hazards or exposure to conflict risks. However, there is no complete index calculation just for natural risks.

For the calculation using 2019 data, France received a score of 2.4 (out of 10) and came in 145th (46th starting from the bottom) which is a slightly weaker result compared to the WRI. The least advantageous dimension for France is vulnerability (it falls 50 spots compared to the WRI), due to a mediocre score regarding migrants and uprooted people. The most significant natural risk for France is related to flooding, followed by tsunamis. It should be noted that the conflict indicator (0.6 out of 10) is not in France's favour – among the 45 countries with a better score than France, 41 have a conflict score below 0.1.

For many other countries, the addition of conflict risks, which weighs as much as natural risks in exposure for each country, causes the rankings to be very different to the WRI. The most at-risk countries are no longer island states in Oceania, but rather Somalia, South Sudan, Yemen and Chad. Vanuatu, which took the top spot in the WRI, is 69th, with a score of zero for conflicts. On the other hand, the Philippines and Guatemala, which are at the top of the WRI's rankings, are around 30th place here, because they have both natural and conflict risks. Countries with the lowest risk index are Singapore, Liechtenstein, Estonia, Luxembourg and three Scandinavian countries, Denmark, Norway and Finland.

INFORM Risk data are sourced from organisations such as the IMF's Climate Change Dashboard, which only looks at the risks caused by climate change, and thus uses a different calculation (https://climatedata.imf.org/pages/access-data). A coming change to the index is including the risks of epidemics. This idea put forward by the authors in 2018 is likely to become a reality following the Covid-19 pandemic. A prototype of this – the result of a collaboration between the JRC and the WHO – is already available online.

The authors note that other types of risks could be included, but are not as of yet, due to a lack of data or reliable methodology. This is the case for technological risks which, with conflicts, could be an 'anthropogenic risks' category.

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INFORM Risk by the European Commission's Joint Research Centre

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Factsheet 6
Human Development Index (HDI) and Planetary pressures-adjusted Human Development Index (PHDI)

1. Indicator and Methodology

1.1. Presentation

The Human Development Index (HDI) was developed by the United Nations Development Programme using the Human Development Report. It was published for the first time in 1990 and has been updated regularly since (the last edition was in 2019). The idea was to give meaning to 'human development', progress towards greater wellbeing, with a more comprehensive view than just economic development, which is usually estimated via GDP.

It is a composite, but rather simple index, because it is only based on four underlying indicators related to three different fields: education, standards of living and life expectancy. The last reports give an HDI for 199 countries or territories.

Several additional indexes have been developed based on the HDI. The most used is without a doubt the IHDI, which takes inequality levels into account. Additionally, the latest UNDP report (2020 report) presented a new index, the PHDI. It is slightly different in that because it includes planetary pressures using two extra indicators.

1.2. Methodology and Specificities

1.2.1. HDI

For the HDI, three fields are analysed:

- a decent standard of living, based on income per capita
- a long and healthy life, based on life expectancy
- knowledge, based on two indicators (mean years of schooling and expected years of schooling).

Indicators have been normalised on a scale of 0 to 100. Each indicator has a minimum value which corresponds to a score of 0, and a maximum score, which corresponds to a score of 100. The maximum value corresponds to a reasonable objective, based on observations from the past 30 years. For example, 15 for the mean years of schooling and 85 years for life expectancy (the highest values in 2019 were 84.7 years in Hong Kong and 84.5 years in Japan).

The final HDI is calculated using a geometric mean of the three indicators:

$$\mathbf{HDI = (I_{\text{standard of living}} \times I_{\text{healthy life}} \times I_{\text{knowledge}})^{1/3}}$$

It has been acknowledged that this type of aggregation can less easily allow a poor score for one criterion to be offset by a good score for another. It was adopted in 2010, with arithmetic means being used before this:

$$\mathbf{HDI = 1/3 \times (I_{\text{standard of living}} + I_{\text{healthy life}} + I_{\text{knowledge}})}$$

The advantage of this index is that it is simple since it is made up of very few underlying indicators which are well-recognised and easy to calculate. The authors made a pragmatic choice with indicators that are available for many different countries. A limit to this approach is that an ambitious concept, such as 'decent standard of life' is, in practice, reduced to a sole indicator: income per capita[21].

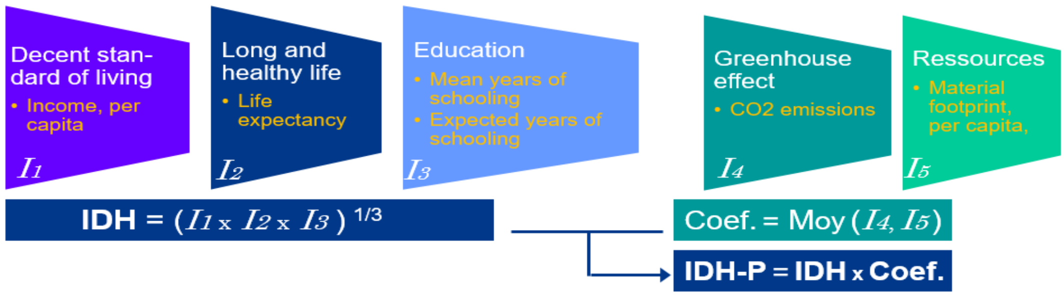
The HDI made waves in France after the Commission on the Measurement of Economic Performance and Social Progress (the Stiglitz Commission) submitted a report in 2009 that recommended improving quality of life measurements. Thus, since 2011, a slightly different but similarly based index, the HDI-2, has been used for French regions, primarily as a pedagogical tool, but also to compare regions. For knowledge, the IDH-2 looks at the graduate population, and instead of income, looks at 'living standards', which is income while also considering household makeup (still using a logarithmic scale). Final aggregation uses an arithmetic mean, not a geometric mean like the HDI.

1.2.2. IHDI and PHDI

Several additional indexes were developed using the same basis, such as the IHDI which looks at inequality among populations. For this, each of the three dimensions ($I_{\text{healthy life}}$, $I_{\text{knowledge}}$, $I_{\text{living standard}}$) is weighted by a level of inequality, which is assessed via a specific calculation using additional data. For any country, its IHDI is always lower than its HDI, with the latter representing a 'maximum', which could only be reached if no inequality existed.

The planetary PHDI adds two environmental dimensions to the three initial dimensions in the HDI, by multiplying the HDI by a planetary pressures-adjusted factor. It was proposed for the first time in 2020, considering that the concept of human development must always be updated and adapted to the challenges of the time[22]. Driven both by the Covid-led crisis and by an increase in man-made pressures and "unprecedented challenges in the emerging Anthropocene", the UNDP believes that the challenge today is to continue human development all while reducing the pressures on the planet. In the interest of staying consistent with the HDI, the UNDP considers the PHDI to reflect an intergenerational inequality within the HDI.

Figure 13: Overview of the Methodologies in the HDI and PHDI



Source: SDES

[21] By limiting it to income per capita, the index does not consider certain aspects such as the quality of goods or services, which tends to underestimate the score of more developed countries. Additionally, *Hastings 2007* noted that income per capita cannot be representative of actual conditions in a country, for example in petrol-rich African countries wherein income rarely reaches the pockets of its residents.

[22] It should be noted that the PHDI, based on its objectives and the limited number of indicators it analyses, is very similar to the Happy Planet Index (HPI), which also includes an ecological footprint.

The Planetary pressures-adjusted factor considers two indicators: carbon dioxide emissions per capita and material footprint per capita, per country. An average of the two gives an adjustment factor, to which the HDI is multiplied.

1.3. Presentation of Individual Indicators, Metrics and Sources

Regarding standards of living, it is gross national income (GNI) per capita that is used, after Purchasing power parity (PPP) adjustment, i.e. GNI converted at an exchange rate that allows for differences in the cost of living between two countries.

Furthermore, the maximum value is set at 75,000 dollars, because a 2010 publication[23] showed that beyond this amount, the wellbeing and human development benefit is near zero. Effectively, a few countries have a sum that is above it and they, therefore, have a score capped at 100 for this criterion (Brunei, Liechtenstein, Qatar and Singapore). Additionally, unlike others, this criterion is not linear, because each extra dollar is assumed to have less of an effect on wellbeing than the previous dollar; a natural logarithm is applied.

This choice has two consequences. Firstly, it discriminates more against countries with lower average incomes and smoothens the difference between countries with high average incomes. Secondly, scores are pulled upwards. An income of around half of the maximum value gives a score of 90, which contributes to pulling up the HDI overall.

Some authors believe that instead of income per capita, it would have been more accurate to assess disposable income per capita after paying for essentials, such as housing, food, clothing, education and healthcare (pocket money). This, however, would make assessing all countries in a uniform way more difficult.

The concept of a 'long and healthy life' is assessed using life expectancy. An assessment of good health life expectancy would have been more accurate. In its 2020 report, the UNDP explained this choice in that good health life expectancy is strongly correlated to life expectancy (0.997 linear correlation factor) and that this data is more easily accessible.

For knowledge, having two indicators makes sense since many developing countries have a low level of schooling within their adult population (indicator: mean years of schooling), but show a desire to improve schooling among young people (indicator: expected or desired years of schooling). A simple arithmetic mean gives the $\mathbf{I}_{\mathbf{knowledge}}$ indicator. Missing data are estimated, by using the scores from neighbouring or similar countries. Thus, the expected years of schooling are estimated for nine countries, and for three other countries, it is the actual number of years of schooling that is estimated[24].

For the two additional indicators about planetary pressures, which are used for the PHDI. Each of the indicators is interpolated in a linear way between 0 and 100.

[23] Kahneman and Deaton, published in 2010, in the prestigious Proceedings of the National Academy of Sciences (PNAS).

[24] It should be noted that until 2010, the schooling criteria were measured differently, since the HDI also considered illiteracy.

2. Results

2.1. Overall Rankings

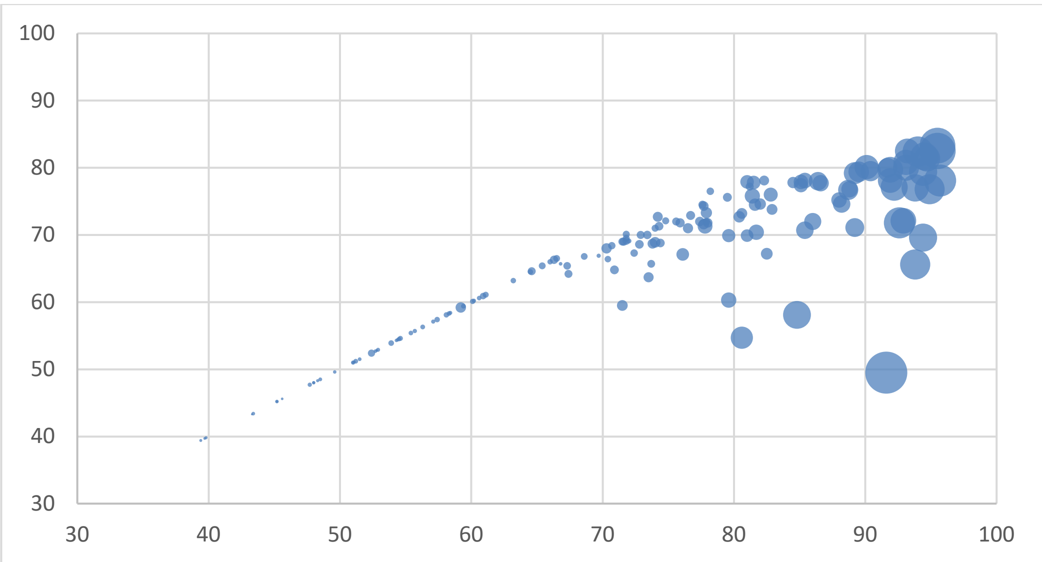
Regarding the HDI, since 2014, countries have been divided into four categories by using a formula based on the quartiles for each indicator (for all countries over 10 years): 'low', for a score below 0.55, 'medium' up to 0.7, 'high' up to 0.8 and 'very high' above this. Most developed countries are in the latter category, with 'very high' scores. These countries have stable governments and powerful economies. The top 10 countries are led by Norway with a score of 0.953. Seven of the countries are European and three are Asian (Hong Kong, Australia and Singapore). Canada is 13th and the USA is 15th[25].

Unsurprisingly, developing countries often have scores that fall in the 'low' category. In addition to poverty, low life expectancy and a lower number of years of schooling, which are reflected in the HDI, these countries generally face difficulty in accessing healthcare and have high birth rates.

Regarding the PHDI, the 2020 calculation is based on the same indicators as the 2019 HDI. The rankings are led by Ireland, Switzerland (which are 2nd and 3rd for the HDI), Denmark and the United Kingdom. In comparison to the HDI, Norway, which took the top spot, falls 15 places, with the USA falling 45 spots and several Middle Eastern countries falling by around 80 spots. Luxembourg is most likely penalised by non-resident consumption, and falls 128 spots, coming in at the end of the rankings. Conversely, countries such as Costa Rica, Moldova and Belarus move up between 33 and 37 spots.

We can see that the planetary adjustment only has a small impact on countries at the bottom of the HDI. For countries with high and very high human development, the impact tends to become stronger, as can be seen in *Figure 14*.

Figure 14: Comparison Between the HDI and the PHDI, Multiplied by 100



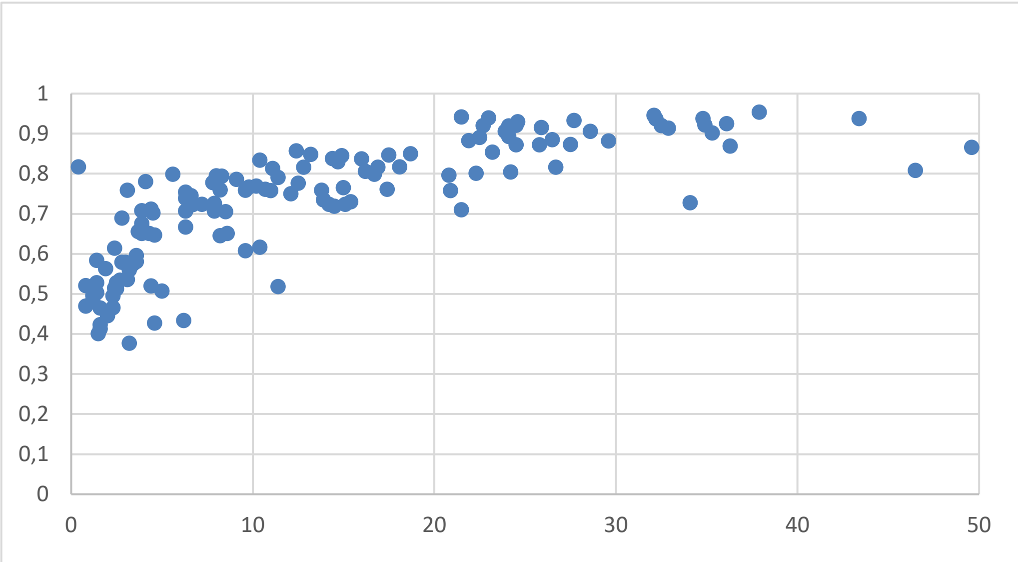
Note: a comparison between the HDI on the x-axis and PHDI on the y-axis. The size of the dot is proportional to GDP per capita By construction, PHDI <HDI
Source: *Human Development Report 2020*

[25] *https://worldpopulationreview.com/country-rankings/hdi-by-country.*

This shows that human development (positive) and the (negative) impact on the planet can grow together. Although they are not perfectly correlated, both have the economic development of the country as a common explanatory factor. This is confirmed by *Figure 15*, which compares material footprints and the 2019 HDI. Nevertheless, it should not be concluded that there is an inherent conflict between the environment and human or economic development, since in other indexes, such as Yale University's EPI, countries with a high level of development get good rankings.

Figure 15: Comparison Between the HDI (y-axis) and Material Footprints

Per capita



Note: Comparison between the HDI (y-axis) and material footprint.
Source: *HDI Report 2019 and IRP data 2017*

2.2. France's Ranking

France is 26th in the HDI, following Spain (24th) and the Czech Republic (25th), and just ahead of Malta (27th) and Italy (28th). France increased its score by 0.48 between 1990 and 2018, against 0.72 on average for the other 199 countries assessed.

For the planetary PHDI, France moved up to 8th place, which is a better result than the HDI. This is because it received very good scores for the two planetary indicators when compared to other developed countries. As explained above, it is less developed countries – those with a low to medium HDI – that have the best scores for planetary criteria. France has a score of 0.93 for the emissions indicator, which is slightly higher than the European average (0.89). Switzerland, Sweden, Latvia, Montenegro and Liechtenstein, on the other hand, have scores nearer to 0.95.

France received a score of 0.85 for the material footprint indicator. Towards the top of the HDI rankings, only Italy and Ireland are better. For this criterion, most countries with a very low HDI received scores close to 1.

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Factsheet 7
SDG Index – SDSN – Other Similar Indexes

Focus on SDGs

Adopted by all 193 United Nations Member States in 2015 as part of the 2030 Agenda, the 17 Sustainable Development Goals (SDGs) describe an ideal future for 2030 by reasserting the links between different development dimensions, such as social justice, economic growth, peace and solidarity and preserving ecosystems. The 17 SDGs are divided into 169 more specific indicator-targets, which are monitored by national statistics agencies and international organisations.

Environmental challenges appear for the most part in SDGs dedicated to clean water and sanitation (SDG 6), responsible consumption and production (SDG 12), climate action (SDG 13), life below water (SDG 14) and life on land (SDG 15). Environmental challenges are also explored in SDGs dedicated to clean energy (SDG 7) and sustainable cities (SDG 11), and indirectly for certain targets about agriculture, wellbeing and growth.

Several methodologies have been developed to measure the overall performance of countries compared to SDGs. The main one is the SDG Index Score which is published by the UN-SDSN (Sustainable Development Solutions Network, in collaboration with the Bertelsmann Foundation and Cambridge University Press). It was published for the first time in 2015. Also worth mentioning is the OECD's 2019 study, 'Measuring Distance to the SDG Targets' and Eurostat reports.

1. Indicator and Methodology

1.1. Presentation of the Index and its Methodology

The SDG Index's calculation gives an overall score per country and therefore ranks countries exclusively on SDGs. In 2021, 165 countries were assessed. This process needs to tackle several challenges since SDGs were not designed to be used to make a synoptic indicator, but rather as a full panorama of different types of targets. Additionally, they are, above all, targets that have been chosen politically, and are not always scientific criteria that can easily be converted into universally accepted 'scores'. The SDG Index is therefore not an official monitoring tool, but rather a supplement that can be used to see the overall change for a set of countries regarding objectives set for 2030.

Out of the 169 indicator-targets within the SDGs, only 91 were used. Others were not used, either because they have not been consensually converted into measurable indicators, or because there were not enough countries with available data. Nevertheless, the SDG Index adds 30 extra indicators for OECD countries, bringing it to 121 indicators in total.

Each parameter received a normalised score between 0 and 100. The result for each indicator is intended to be simple and easy to read. A country with a score of 50 is halfway to the maximum score of 100, which is the objective to be reached. This target is either directly described in the SDG (this is true in only 12% of cases), is based on a scientific definition (e.g., CO_2 emissions to meet +2 °C) or is determined by an average of the five best countries for this parameter. This average of the five best countries is used when it is difficult to set a target, but it is also sometimes used when several countries have exceeded the SDG target (e.g., infant mortality). In some cases, a country may receive a score above 100 if it has gone beyond the objective. The score of zero is set by the 2.5 percentile (according to recommendations in the OECD-JRC 2008 report, which is a reference in this field).

Within each of the 17 SDGs, a simple arithmetic mean between the different indicators was calculated with equal weighting. Between the different SDGs, an arithmetic mean without weighting was used, to increase readability. It has been shown that the rankings would not have greatly changed had a geometric mean been used[26].

The SDG Index result (a score between 0 and 100) creates a ranking of countries.

1.2. Underlying Indicators

The index is based on 121 indicators for OECD countries but only 91 for other countries. They are unevenly redistributed between SDGs. SDG 1 (no poverty) and SDG 10 (reduced inequalities) only have 3 indicators, whereas SDG 3 (good health and wellbeing) has 17.

In the version that was published in May 2021 by the SDSN, six indicators were added for 2020, and five were modified to improve the relevance of the indicators and to take data that had been made available into account. Between 2019 and 2020, five indicators were added and 11 were modified. Without changing the methodology, the authors explain that caution is required when comparing scores or rankings for a country from one year to another.

It is worth noting that the addition of the SDG dedicated to the export of pesticides that are dangerous to health, as part of SDG 2 (zero hunger), includes the idea of sustainable agriculture, for which France has an average score. France scored poorly on the addition of an indicator on fish that is caught but rejected (SDG 14). Furthermore, France benefits from the replacement of the effective carbon rate indicator with an indicator relating to the price of carbon emissions in SDG 13.

We can see that seven indicators assess the impacts seen in countries from which we import, otherwise known as imported impacts: (fatal) work accidents (SDG 8), scarce water consumption (SDG 6), threats to marine life (SDG 14), threats to aquatic and land species (SDG 15), SO_2 and reactive nitrogen (SDG 12) and CO_2 emissions (SDG 13). The majority come from assessments made by an Australian multidisciplinary team in several scientific publications (in particular, *Lenzen et al., 2020*), using calculations based on input-output data between countries.

1.3. Dashboard and Additional Calculations

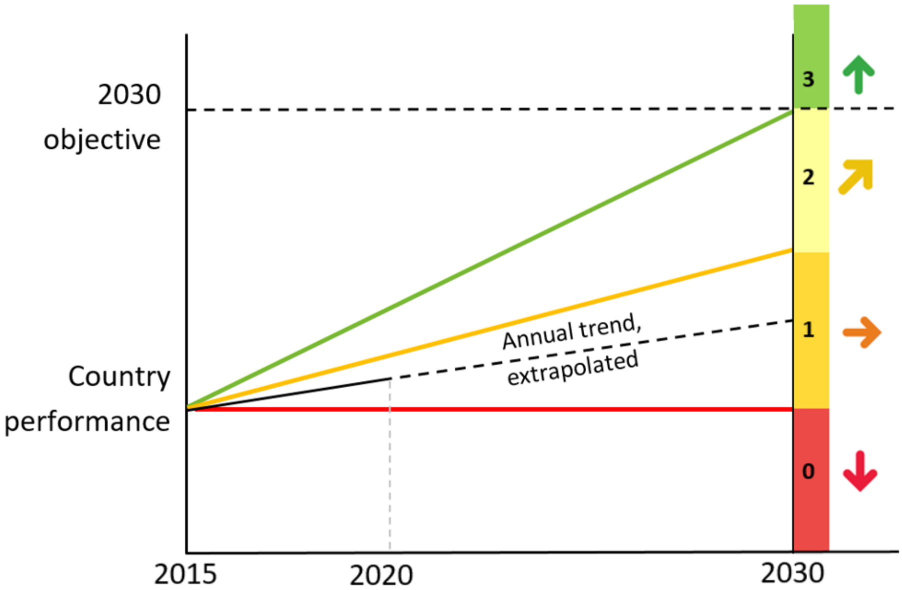
The main index is supplemented by other calculations, which enrich the methodology and make it quite specific:

1) Trend Assessments

For each indicator, the overall score is supplemented by a trend assessment. By extrapolating the change in the parameter since 2015 (dotted line), it is possible to assess the possibility of reaching the set goal by 2030 (green trajectory), which is inherent to the SDG process. This gives a score between 0 and 3 and a coloured arrow, as shown below.

[26] Use of the geometric mean is recommended by the OECD-JRC report (2008) to not support 'offsetting' weak scores by higher scores in other criteria. In this case, the possible 'offsetting' effect is handled differently, via the dashboard which will be presented below.

Figure 16: Methodology to Understand Trends



Source: *SDES, using the Sustainable Development Report 2021*

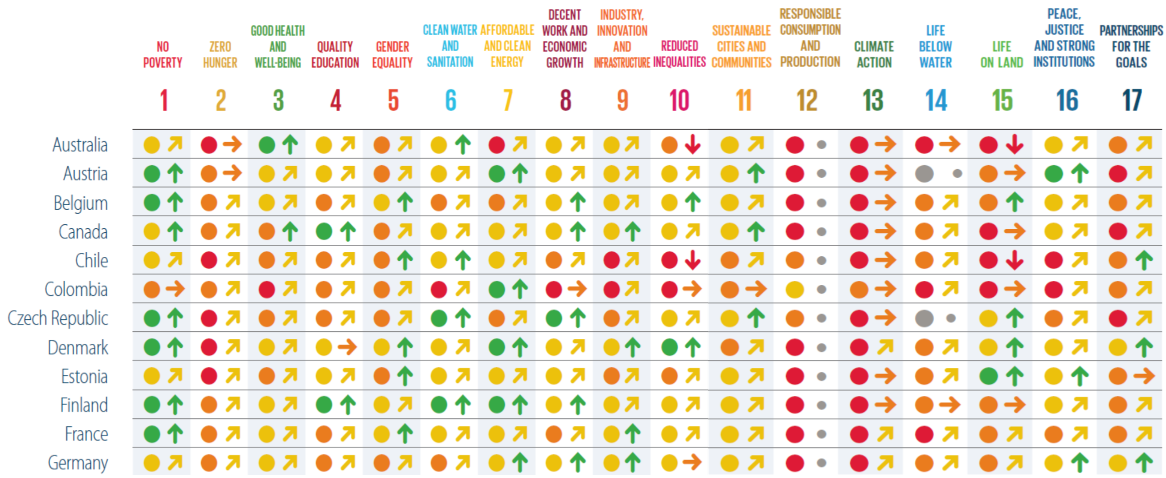
These trends are then aggregated for each SDG which has between 3 and 17 individual indicators with a simple calculation rule: an average of trend scores for individual indicators.

2) A dashboard that shows the areas of improvement more visibly

It shows the 17 SDGs visually, using a colour code. It is important to note that this dashboard was developed with a very different aggregation rule to the one used for the SDG Index. Within a given SDG, it takes the average of the scores for the two worst performing parameters (whether there are 3 or 10 parameters). This determines the colour of this SDG. This calculation is similar to the 'one out, all out' calculation, by taking the worst-performing score. It highlights the worst scores for each country, to encourage countries, even those with very good scores, to improve. Thus, in 2021, France was red for SDGs 12 to 14 (planetary SDGs), much like other OECD countries.
For each country, the dashboard shows both the result (coloured dots) and an arrow showing the trend[27]. *Figure* 17 shows an example for OECD countries.

[27] This visual overview has the benefit of being able to show the results of nearly 200 countries in a synoptic way. For example, Eurostat shows a less synoptic, but more specific, visual for each European country, with two areas of focus: one showing the score for each SDG and the other, its trend.

Figure 17: Extract From The Dashboard for the Top OECD Countries



Source: *Sustainable Development Report 2021*

Among OECD countries, it is noted that SDGs 1 (no poverty), 7 (clean energy) and 16 (peace and institutions) have more green dots. A green dot means that all indicators for the relevant SDG are green. On the other hand, SDG 2 (zero hunger) and environmental SDGs (12 to 15) get more red dots. It should be remembered that due to a different aggregation technique used in the SDG Index, it is possible to have a red dot, even if the average actual score for this SDG is acceptable or even good.

1.4. Data Used

When possible, official SDG indicators were used, such as those approved by the UN Statistical Commission. However, to improve quality and representativeness, other data could be used. In this case, it could be official or unofficial data, but remains data that has been produced on an international level and covers at least 80% of UN countries. The authors highlight the fact that the data used may differ from nationally approved statistical data. Firstly, these data may be modified to ensure international coherence and comparability. Secondly, more recent national data may exist without them having been approved internationally because this process takes time.

Thus, most data are provided by international organisations (World Bank, OECD, WHO, FAO, UNICEF mainly) whereas others come from household surveys (Gallup World Poll), civil society (Oxfam and the Tax Justice Network) and peer-reviewed publications. For the 2021 edition, around 11% of indicators have data for 2020. The impact of the Covid-19 crisis on SDGs, even though it is already reflected in an overall decrease in scores for some countries, it has not been fully input into the index or in dashboards.

When data is missing for a country, the average for a country in the same group or same area is used. In this case, the calculated score is only used to calculate the SDG Index, not for the dashboard or for more detailed analyses.

2. Results

2.1. General Overview

The 2020 report noted slight progress by most countries over the past ten years, most notably in South-East Asia and Sub-Saharan Africa, and more generally, in middle-income countries. Nevertheless, there has been little progress for more environmental SDGs (6, 13, 14 and 15)[28].

In 2021, there is a reverse global trend, with the average for countries having declined from the previous year, largely due to the increase in poverty and unemployment rates because of the Covid-19 pandemic. However, scores for countries at the top of the rankings continued to increase.

Results are presented by area, which brings together similar countries, which, according to the authors, allows each country to better compare, both in terms of results and for the type of policies implemented. These seven areas are OECD countries, South-East Asia, Eastern Europe and Central Asia, the Middle East and North Africa, Latin America and the Caribbean, Sub-Saharan Africa and Oceania. There are plans for other versions of the SDG Index to be developed in the future. This could be a city-level variation like a *US Cities Sustainable Development Report*.

For many years, the rankings have been dominated by Finland (1st in 2021), Sweden (1st in 2020) and Denmark (2nd in 2021). For the most part, European countries top the rankings, with the first non-European countries being Japan (18th), Canada (20th) and New Zealand (23rd). However, they all have at least one red SDG on the dashboard. Moreover, these countries struggle to progress in areas such as 'responsible consumption and production', 'climate action' and 'biodiversity' (especially marine life). The USA is only 32nd in the rankings, having been penalised by the most environmental SDGs (12 to 15), but also by SDG 10 (reduced inequalities).

Results in Terms of the SDG Gap and Spillover[29]

As each criterion is scored between 0 and 100, and 100 is an objective to be met, for each indicator, it is possible to evaluate the progress that is left to be made for a given country, i.e., the SDG gap.

By summing them up for a given SDG, one can calculate the cumulative 'SDG Gap' for all countries, then the share of each country in this cumulative amount. We can therefore see that in 2020, the G20 accounts for the greatest share of work that needs to be done for environmental SDGs 12 to 15. More specifically, China, Europe and the United States each account for 15% of the work that needs to be done globally to reach SDGs 12 and 13, whereas for SDGs 6 and 7, it is China and India that have the largest share of work that needs to be done for this gap with around 20% each.

This method is also complemented by the calculation of a spillover effect on other countries, which could prevent them from meeting the SDGs themselves. These spillovers are analysed for finance (corruption, banking secrecy, etc.), peace (arms exports, which incidentally penalise France, or organised crime), and the environment (water use, natural resources use, sales of pesticides and illegal trade of wild animals). As expected, developed countries perform worst.

[28] Improvement was most clear for SDG 1 (no poverty) and SDG 9 (industry, innovation, and infrastructure). There has been little to no progress for SDG 2 (zero hunger), SDG 16 (peace, justice, and strong institutions) and more environmental SDGs (6, 13, 14 and 15).

[29] Gaps and spillovers are two calculations that have been explained in the 2020 report but were not used in such a detailed way in the 2021 report.

2.2 France's Ranking

In the SDG Index Score rankings that were published in May 2021 by the SDSN, France was 8th with a score of 81.7. Compared to 2020, its score increased from 81.1 to 81.7, but it still fell four spots, having been 4th in 2020. This is because countries at the top of the list improved even more. For example, Finland was 3rd in 2020 but 1st in 2021, with its score going from 83.8 to 85.9.

France has a close to perfect score for SDG 1 (no poverty), 4 (quality education) and 7 (clean energy) and has a very good score for 3 (good health and wellbeing) and 11 (sustainable cities and communities)[30]. France's score has improved overall over the past two years, but its score has regressed for SDG 14 (life underwater), due to the choices made for this SDG. This is most likely why its position dropped between 2020 and 2021. France's results are shown in *Figure 5* which can be found in *chapter III.2*.

In the dashboard, France is in the red for 3 environmental SDGs (12 to 14), much like many other OECD countries. More specifically:

- France's worst score is for SDG 12 (responsible consumption and production). Several indicators are red for this goal, whether it is due to electronic waste generation or imported impacts (emissions of SO_2 and nitrogen compounds, including nitrogen oxides). It is worth noting that the score for non-recycled household waste improved in 2020 and 2021 compared to 2019 (the data used dated from 2018 and were the same as used in 2021: 0.8 kg/capita/day).
- France's score for SDG 13 varies from one year to another. It dropped between 2019 and 2021 because the criterion about the human impact of climate-related disasters was removed. It moved up in 2021 when the 'effective carbon rate' indicator was replaced with an indicator about the price of carbon emissions. It should be noted that imported CO_2 emissions (red for France) and exported CO_2 emissions via petrol products (green for France) are in SDG 13.
- France has room for improvement for SDG 14 (life below water). The drop in its scores is both due to i) the indicator added in 2021 about fish that are discarded after being caught, for which France has a rate of 16%, compared to 0.2% for Finland, which tops the rankings and ii) a score of 49.1 given by the Ocean Health Index, which measures chemical and nutrient contamination (Finland has a score of 70).

Other SDGs with weaker scores are:

- SDG 17 (partnerships), with a lower score for development aid. For SDG 16 (peace), France is in the red for an indicator (arms exports), but the impact of this is limited because this SDG has 9 other indicators.
- SDG 2 (zero hunger) and sustainable agriculture. In this case, it is the parameter about 'trophic levels', which was penalising, i.e., meat consumption which needs energy for its production. It is therefore for these indicators that there is the biggest room for improvement for France.

[30] It should be noted that according to Eurostat calculations for SDG 1 (no poverty) and 6 (clean water), France received the best scores. However, it was not the same underlying indicators that were used.

Figure 18: France's Dashboard

Source: *Sustainable Development Report 2021*

It should be noted that for trends, France has progressed for all SDGs, and is on target to reach 2030 goals for SDGs 1, 5 and 9.

Other Similar Indexes About SDGs

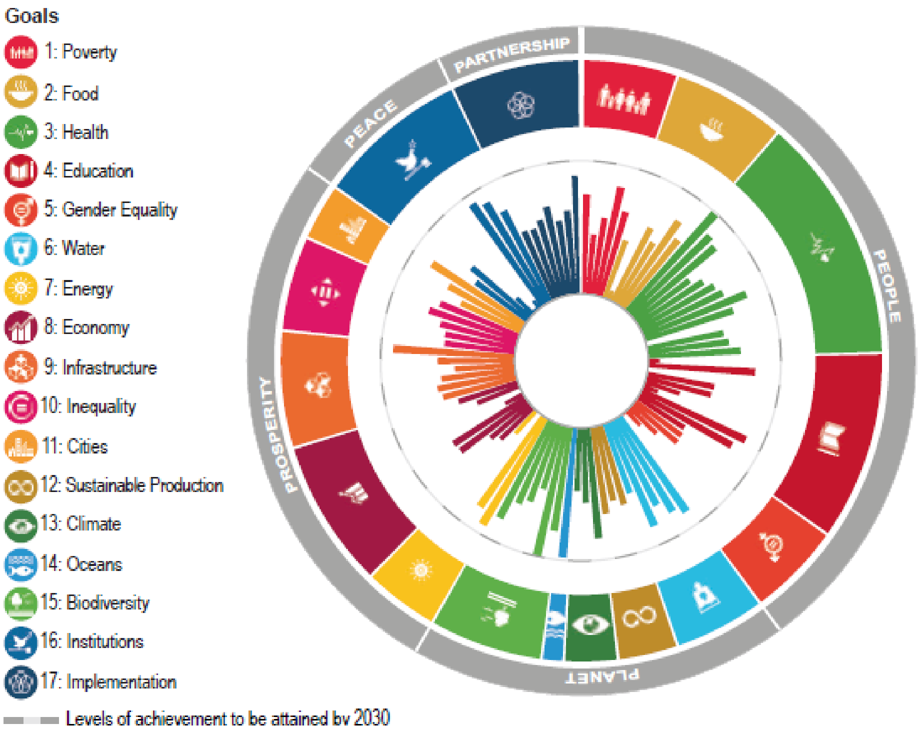
Other institutions have led similar studies, including the OECD and Eurostat. Their calculations follow a globally similar methodology to the SDG Index developed by SDSN with an arithmetic mean of normalised scores between 0 and 100. However, within a given SDG, individual indicators differ compared to those used in the SDG Index. This depends both on available data, with more data being available for OECD countries, but also in that, an indicator may be relevant depending on if we are looking at Europe, the OECD or globally.

An OECD study (OECD report, 2019: Measuring Wellbeing and Progress) analysed 105 indicators based on SDGs. For each one, the target (100) is either directly described in the SDG (12% of cases), defined with the help of an OECD expert opinion or determined by the average of the three best OECD countries for this target (remember that the SDG Index considers, in this case, the average of the five best countries in the world). The score for an indicator cannot go above 100, whereas this is possible for the SDG Index.

The OECD does not analyse trends related to reaching 2030 goals. The authors identified a limitation, which also applies to the SDG Index, in that these targets are set uniformly, in line with the 2030 Agenda or best performance, without considering the intrinsic characteristics of countries. For example, in desert countries like Yemen, Egypt and Mauritania, indicators about biodiversity and forests will never be as high as in countries such as Gabon, Finland and Japan, where more than two-thirds of the total surface area is covered by forests.

The OECD study does not publish a score nor a ranking of countries. It carries out a calculation for OECD countries only, and then carries out an average for all countries, by weighing each country by population (*Figure 19*).

Figure 19: Overview of Results for the Average OECD Country



Source: OECD 2019

When each result is analysed for each SDG, OECD countries are, on average, rather close to reaching the five goals related to the planet (France: 6: water, 12: sustainable production, 13: climate, 14: life below water and 15: biodiversity), as well as others such as cities (SDG 11). Regarding the five planetary SDGs, most OECD countries have improved their score over time, in a similar way to SDGs about health (SDG 3) and gender equality (SDG 5). However, for gender equality, countries remain, on average, far from the goal, in the same way as for food (SDG 2) and peace and institutions (SDG 16).

Eurostat is responsible for implementing SDGs at a European level and for guiding EU countries in their national implementation of the SDGs. In its annual monitoring report[31], Eurostat carries out a deep analysis of SDG indicators for each country, by analysing the trends of each, and by presenting detailed dashboards. In practice, Eurostat places as much or more emphasis on trend analysis as on the intrinsic value of the SDGs. Methodologically, Eurostat extrapolates a trend over the last few years and compares it to the baseline trajectory for achieving the target, just like the SDG Index, but with slightly different scoring criteria. Another small difference is that Eurostat assumes a geometric progression of the indicator between now and 2030, not a linear progression. For indicators that do not have a quantified target, Eurostat takes an annual increase of 1% as the reference trajectory.

The 2020 Eurostat report shows that Europe is making progress for most SDGs, except for SDG 5 (gender equality) and SDG 13 (climate) which are not, or not sufficiently, on target. In general, environmental SDGs (12 to 15) show little progress over past years. This also applies to

[31] Eurostat, sustainable development in the European union –Monitoring report on progress towards the SDGs in an EU context, 2020 and 2021 editions.

SDG 7 (clean energy). Europe, however, has made progress for SDGs 16, 1 and 3. Due to a lack of available data, trends cannot be analysed for SDG 14 (life underwater). By way of illustration, for the latter, it is worth noting an increase in good quality bathing sites, but, on the other hand, ocean acidification continues to progress. Ecosystems and biodiversity (SDG 15) continue to be under the pressure of human activity.

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Factsheet 8
Better Life Index – OECD

1. Indicator and Methodology

1.1. Presentation

The Better Life Index was created in 2011 by the OECD and is used to assess and compare the quality of life in different countries. It was designed to be an alternative to GDP and is aimed at the public. It is published in the form of an innovative interactive website.

1.2. Methodology and Specificities

The index is made up of 24 indicators, divided into 11 categories: housing, income and heritage, jobs, health, education (knowledge), environment, life satisfaction (subjective wellbeing), safety, work-life balance, community and civic engagement.

One aspect of this index is that it includes social life as a contributing factor to life quality with categories about work-life balance, social support network and civic engagement. The index is calculated by the OECD and its partner countries, i.e., 40 countries. There is no publication with an overall score and rankings, but rather, there is a dedicated website. It presents the scores for each country with a flower with 11 coloured petals, with the size of each petal being proportional to the score. It can be used to see the results for all countries. Moreover, the user can choose their own weightings between the 11 categories. The tool will show the result for the aggregation and will rank based on this weighting. Lastly, visitors to the website are invited to indicate, among these 11 categories, which of the categories is most important to them. For French visitors, health is often the most important. For the 100,000 visitors that have answered, wellbeing, health and education are the three most important categories.

Within each of the 11 categories, the individual indicators are equally weighted (between 1 and 4 per category, 2 the most often). It is worth noting that the environmental category is related to human health (air quality and tap water quality), which is coherent with the index's objective.

Depending on data availability, future versions of the index may present a more detailed scale in time, such as on a regional level to compare areas within a country, or even compare various social groups (men/women, elderly/young, etc.).

1.3. Presentation of Individual Indicators

One aspect of this index is that 5 of the 24 indicators are based on perception surveys and are therefore qualitative criteria. This is also the case for the assessment of wellbeing and one of the safety criteria (feeling safe when walking alone at night). For health, although the first criterion is life expectancy, the second is also based on a perception survey about self-assessing one's health. More unexpectedly, this subjective process is also used for an environmental criterion: water quality. This is measured by the rate of positive answers to this question: "In the city or area where you live, are you satisfied or dissatisfied with the quality of water?"[32]. The BLI has a qualitative indicator about social network support in the event of problems.

The Better Life Index is supplemented by regular OECD publications (every two or three years), in the form of "How's Life?" reports. These consider and analyse criteria other than those in the index. For example, regarding civic engagement, the proportion of elected women is analysed, as is participation in electoral and regulatory processes (indicator described below).

One aspect of these additional reports is that they consider equity indicators and give a better score for a given criterion when inequality[33] is lower in the country. In general, for each indicator for which socioeconomic distribution is available, the OECD looks at the gap between high socioeconomic levels (last income quintile, or 80%) and low socioeconomic levels (first income quintile, or 20%).

For income, data were corrected with purchasing power parities (PPP), to take the differences in the cost of living between countries into account for a comparable basket of goods and services. In the OECD's recent analyses, a socioeconomic vision is proposed, which considers that the main indicators used can be divided into four dimensions: economic capital, human capital, social capital and natural capital.

1.4. Metrics and Sources Used

Data are for the most part taken from official sources such as the OECD, United Nations statistics and national statistics offices. Nevertheless, as explained above, several individual indicators are based on opinion surveys, and more particularly, the Gallup World Poll. The Gallup organisation regularly carries out opinion surveys in more than 140 countries around the world, to learn more about population lifestyles and subjective assessments, whether it is assessments about wellbeing, one's health, social interactions, hobbies, and more.

An interesting case that is worth pointing out is the indicator about stakeholder participation in regulation development. This indicator measures elements such as consultation methods, transparency and retroactive mechanisms, according to an iREG methodology developed by the OECD. This method is based on a questionnaire given to government representatives (2014 and 2017) and collaboration on European Union's Better Regulation Practice work. A score between 0 and 4 is calculated using this, which is then normalised and integrated into the Better Life Index's calculation.

[32] This question is intentionally open, but we can consider that many people answering this question are doing so about the quality of their tap water, not the quality of waterways or water tables. This environmental criterion is more a criterion about human health or wellbeing.

[33] Previous versions of the index looked at criteria such as the gender wage gap, number of hours of work and the feeling of safety, and even the gap in life expectancy depending on one's education level.

2. Results

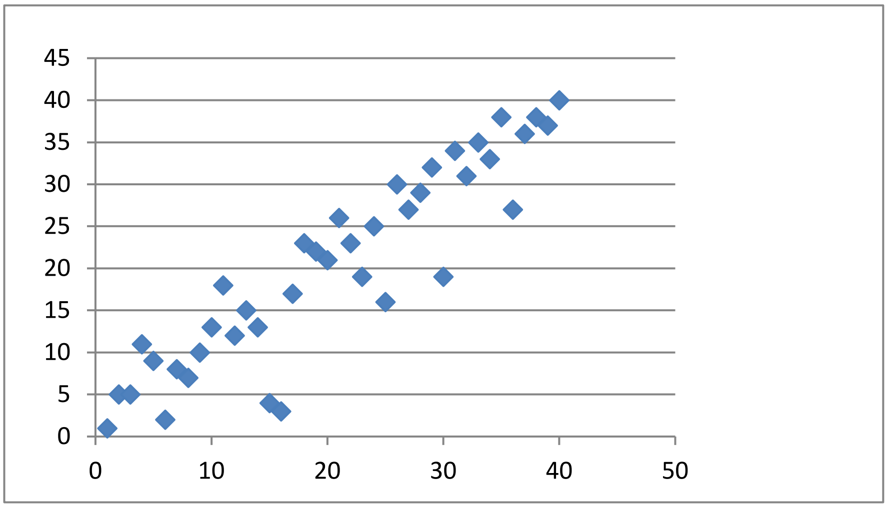
2.1. General Overview

For all 40 countries in question, individual wellbeing has improved since 2010, but only slightly. This is more prominent in countries where wellbeing was initially weaker, especially in Eastern Europe, where progress is most significant. Inequality continues to depend on one's sex, age and level of education. The situation even tends to regress in certain categories, such as the links between individuals and their relationship with public authorities. For criteria such as housing, poverty and social connections, there are as many countries that have improved as there are that have regressed.

By choosing to equally weigh the 11 categories on the website, we can see that the rankings are led by Norway, Australia, Iceland, Canada and Denmark (which have a score close to 8/10). Mexico, Colombia and, above all, South Africa, have the weakest scores. The worst performing European country is Greece (36th), which only has good scores for health and work-life balance.

Additionally, it can be noted that for OECD countries, BLI rankings strongly correlate with the HDI, as can be seen in *Figure 20*.

Figure 20: Comparison of the BLI and HDI

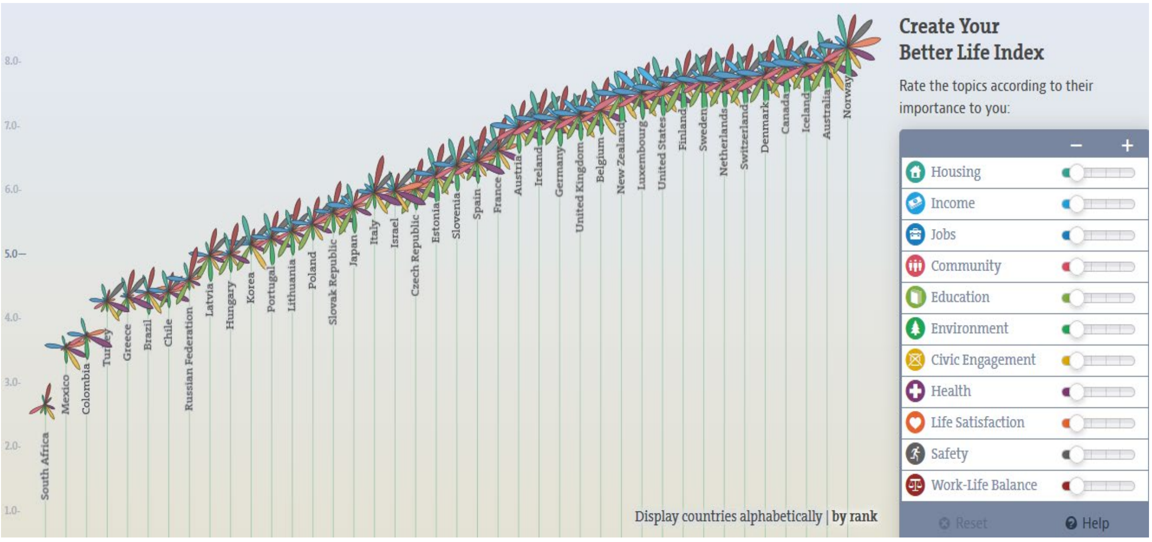


Note: BLI on the x-axis and HDI on the y-axis.
Source: *website for the OECD's BLI 2021, Human Development Report 2021*

2.2. France's Ranking

France is 18th out of 40 (with a score of around 6.7). Its best scores are related to work-life balance, health and safety. France has weaker scores for income, civic engagement and environmental quality. Nevertheless, for these criteria, France has a middling rank, since other countries also do not have good scores.

Figure 21: Visual of BLI Results for All Countries – Equally Weighted



Source: OECD website, 2021

In general, the most penalising criteria between countries are income, social ties, the environment and satisfaction (or subjective wellbeing). Safety, education, health and housing are less penalising, except for a few poorly performing countries, like South Africa and Latin American countries.

2.3. Detailed Assessment of Indicators and Identifying Which Are the Most Penalising

Compared to other countries, France falls in the rankings related to education and social ties[34]. Regarding social ties, in France, 90% of people surveyed think they know someone who they can contact if they need help, which is similar to the OECD average, which comes in at 89%. However, in France (and in Hungary), a relatively limited share of the population sees friends each week.

France is particularly well-placed for the work-life balance criterion. In France, nearly 8% of employees work very long hours, which is lower than the 11% observed in the OECD. Employment rates for women between the ages of 25 and 54 are also above the average for member countries. Italy and France are the two countries where the most time is spent on hobbies and one's self, on average.

Regarding health, life expectancy at birth is around 82 years old in France, which is nearly two years more than the OECD average of 80 years. In contrast, self-rated health assessments are slightly below the OECD average. In its "How's Life?" reports, the OECD notes the work done in France to improve health services and conditions in hospitals with lower waiting times in A&E, but also the creation of the popular rent-a-bike system (Vélib) in Paris. It is considered to have improved health, while also limiting environmental damage caused by vehicles.

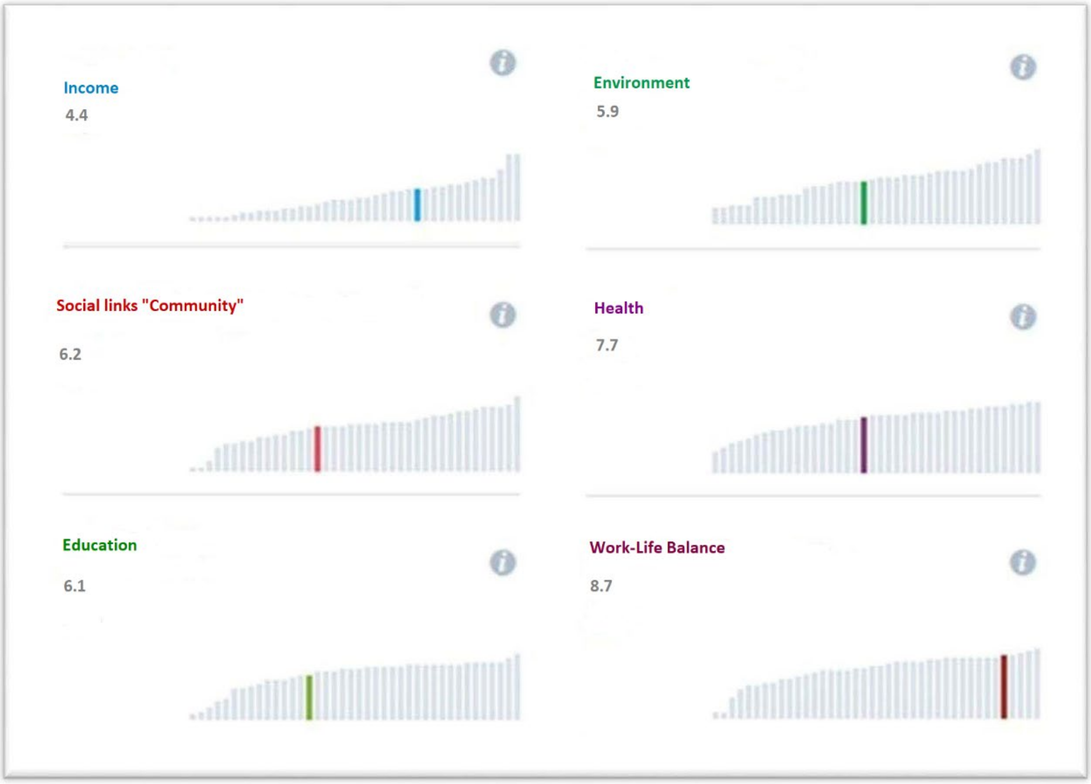
For the environment, France is 22nd for air quality (exposure to fine particles) and 25th for water quality (subjective assessment of water quality). The OECD also notes that policies have

[34] Results per country are available on https://stats.oecd.org/Index.aspx?DataSetCode=BLI&lang=fr.

been implemented to improve air quality in French cities and transport, especially in the Île-de-France and with the Ecophyto II plan.

Certainly, France performs worst concerning education. The Programme for International Student Assessment (PISA) is used to assess learned knowledge, and France is only 27th, even though it has a score above the OECD average. Additionally, the French can hope to spend 16.5 years in education between the ages of 5 and 39, which is less than the OECD average (17.2 years). 78.4% of adults between the ages of 25 and 64 have received a secondary education, which is similar to the average of 78% in OECD countries.

Figure 22: Illustration of the Results and Rankings for France for 6 of the 11 Criteria Categories



Source: OECD BLI website 2021

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Factsheet 9
Happy Planet Index – New Economics Foundation

1. Indicator and Methodology

1.1. Presentation

The Happy Planet Index (HPI) is an economic index that was designed to be an alternative to gross domestic product (GDP) and the Human Development Index (HDI). Like the HDI, it is a simple index, with only three indicators, but includes the environment in the form of an ecological footprint. It is a way to measure the environmental efficiency of wellbeing support in each country. It was created by the New Economics Foundation, a British think tank, and is now produced by the Wellbeing Economy Alliance.

1.2. Methodology and Specificities

The HPI is calculated by multiplying three indicators: life expectancy, subjective life satisfaction (according to the Gallup World Poll) and ecological footprint (in global hectares, according to the Global Footprint Network – Appendix 1). In practice, the ecological footprint indicator is a division, not a multiplication.

Indicators have been normalised on a scale of 0 to 100. A maximum value is attributed to each indicator, which corresponds to a score of 100. This was chosen by the authors as being an 'excellent performance'.

An intermediary step was added, which involves adjusting scores so that each of their variance factors is equivalent, ensuring that each of the indicators has the same proportion of impact on the final score. In practice, this is done by including a constant within each indicator, before multiplying scores:

$HPI = an \times [S_{life\ expectancy} \times (S_{wellbeing} + b) - c]/[S_{ecological\ footprint} + d]$
– where $S_{indicator}$ represents the score

The 2018 version of the HPI (2016 data) was unusual in that it included population inequality for two indicators, life expectancy and perceived wellbeing, in the form of an additional indicator dedicated to these inequalities[35]. Inequality was estimated using a ratio between the geometric mean and the arithmetic mean, for the population and relevant indicator. Nevertheless, the last edition, dating from October 2021, does not use this option, focusing more on the result's readability.

1.3. Presentation of Individual Indicators

The three indicators used are well-known and use renowned sources.

The Gallup World Poll is used to assess subjective wellbeing. This survey, which is carried out every four years (2012, 2016 and 2020), assesses subjective population wellbeing in each country. In the wellbeing field, such surveys are useful and relevant indicators, albeit involving

[35] The authors said: "Imagine Country A where everyone dies at 60, and Country B where 60 is the average age, but half of the population dies at 40 and the other at 80. If you are an unborn foetus, you do not know in which half of the population you will be born into. Most people would prefer Country A, where there is less uncertainty, because there is less inequality.

subjective individual judgements, if they are established using rigorous procedures. This is, for example, what the Stiglitz report of 2009 said.

To evaluate the environmental dimension, the HPI chose to use an ecological footprint. Its advantage is that it is a synoptic indicator, including different impacts, and was made popular with the public by the Global Footprint Network, even if it is subject to some criticism by the scientific community regarding its theoretical basis. It emphasises the impacts (not the work done by countries to mitigate them) and thus penalises developed countries, unlike other environmental indexes.

1.4. Underlying Metrics

The HPI was updated in October 2021, using 2019 data. The previous edition was based on 2016 data.

For the October 2021 version, the authors chose to collect as much 2020 data as possible (in practice, for 88 countries), to measure the effects of the pandemic. To do this, they either used other, more partial, sources (for example, for life expectancy, using national websites or Eurostat) or created 2020 data by adjusting 2019 data. For example, for life expectancy, they used a scientific article that evaluated life expectancy alongside Covid-19 related deaths based on a mortality rate. For the ecological footprint, they used the change in CO_2 emissions between 2019 and 2020, based on the fact that these emissions play a major role in ecological footprints.

2. Results

2.1. France's Ranking

France is 31st out of 152 countries and is the 5th country in Europe (2019 results). Its scores are good for life expectancy (12th) and wellbeing (25th), but it scored poorly for its ecological footprint, like all developed countries, even if 2020 evaluations show that the ecological footprint may reduce by nearly 15% (e.g., CO_2 emissions) following the health crisis.

2.2. Possible Changes Due to the Health Crisis

According to a first assessment in the Global Footprint Network's report for Earth Overshoot Day 2021, the global ecological footprint dropped by 6.5% between 2019 and 2020, due to the pandemic. Data are, however, not available for all countries. As mentioned above, by using CO_2 emissions, the authors of the HPI assessed that for most high-income countries, the decrease would be closer to 15%, which is significant. Nevertheless, it is still impossible to know if this will have an impact on the rankings.

Additionally, they believe that following the pandemic, HPI indexes should increase overall in 2020. If the first significant effect is the drop in life expectancy by 1 year, this only accounts for 1% to 2% of a country's score, compared to the 6% mentioned above for its footprint. Moreover, in countries with strong social safety nets, welfare did not deteriorate significantly, and people even benefited from the slower pace of life brought about by lockdown. In other countries, social ties have even been strengthened, which contributes to wellbeing.

Factsheet 10
Sustainable Society Index

1. Indicator and Methodology

1.1. Presentation

The Sustainable Society Index (SSI) has been calculated every two years since 2006. It was developed by the Sustainable Society Foundation, and has, since 2018, been produced and published by the Technische Hochschule in Cologne (TH Köln). It is currently calculated for 154 countries. Based on 21 indicators, it aims to evaluate sustainability levels in each country, by proposing an index for each of the three sustainable development dimensions. It is referenced on an EC website and was the subject of an assessment by the European Union's Joint Research Centre (JRC) in 2012, which confirmed its solid methodology and coherence in the choice of indicators. It has also been analysed in scientific literature.

1.2. Methodology and Specificities

The SSI aims to be a transparent and easy-to-use tool to measure the sustainability of a society. It follows the definition in the Bruntland report which put forward the three pillars of sustainability, or rather wellbeing: human wellbeing (essential needs, education, governance, inequality, etc.), economic wellbeing (income, employment, etc.), and environmental wellbeing. The latter is divided into two categories: energy and climate, and natural resources. One specific aspect of this index is that it does not have an overall ranking that includes the three dimensions. It is currently calculated for 204 countries and territories.

The SSI's dedicated website has a visual of the results for each country in the form of a radar diagram, allowing each country to easily assess its ranking. Additionally, a factsheet describes each indicator and underlying metrics.

Each indicator is scored between 0 and 10. 0 and 10 account for the worst and best performance, respectively, among the countries in question, except for certain indexes that use calculations carried out by others, such as the Worldwide Governance Indicators by the World Bank, the FAO's Global Water Information System (that compares water consumption to water renewable resources), and the Global Footprint Network's ecological footprint. An arithmetic mean (not weighted) is calculated for each pillar.

As well as increasing the publication frequency (from every two years to annually), TH Köln intends to supplement the index with other individual indicators, e.g., linked to resilience or companies' commitment to sustainability, taking care, however, not to multiply these indicators and not to undermine the clear focus and usability of the index.

1.3. Presentation of Individual Indicators

The 21 indicators are divided into 7 categories and 3 dimensions:

Human Wellbeing	Basic Needs	Sufficient Food
		Sufficient Drinking Water
		Safe Sanitation
	Personal Development & Health	Education
		Healthy Life
		Gender Equality
	Well-balance Society	Income Distribution
		Population Growth
		Good Governance
Environmental Wellbeing	Natural Resources	Biodiversity: tree cover, protected areas
		Renewable Water Resources: water withdrawal compared to the renewable resource
		Consumption: material footprint
	Climate & Energy	Energy Use
		Energy Savings
		Greenhouse Gases
		Renewable energy
Economic Wellbeing	Transition	Organic Farming
		Genuine Savings
	Economy	GDP
		Employment
		Public Debt

The 'human wellbeing' dimension is comprehensive and brings together 9 of the SSI's 21 indicators. The 'environmental wellbeing' dimension is made up of two categories: climate & energy, and natural resources. The 'climate & energy' category weighs more since it includes four out of seven indicators. The natural resources category includes three indicators about various aspects: material footprint, water resources and biodiversity.

The biodiversity indicator is special since it is a synthesis of two scores, with one being about the variation in tree cover and another being about the surface area of protected areas. It is worth noting that this category prioritises pressure on the environment, not the work done by a country. Most environmental indicators are pressure indicators (energy consumption, CO_2 emissions, water withdrawals compared to renewable resources, material footprint, etc.), although two parameters are about the country's response: surface area of protected areas (which contributes to half of one indicator) and energy savings between 2013 and 2017.

Other Aspects of Note

Within the 'environmental wellbeing' category, the SSI has inserted a specific indicator called 'consumption', which is derived from the ecological footprint (Global Footprint Network data), by removing the share related to carbon footprints. CO_2 emissions are already accounted for in another indicator (IEA data).

Until 2020, the 'healthy life' indicator was not about life expectancy, but rather 'health-adjusted life expectancy' (HALE), which is published by the WHO and deemed more relevant.

It estimates life expectancy, minus the estimated number of years in poor health. This has changed in 2020, as life expectancy data are more regularly updated for all countries.

The SSI is one of the few indexes to include genuine savings, a monetary indicator published annually by the World Bank that includes natural capital. Using an economy's savings rate, this indicator adds investment in human capital (education spending) and then subtracts the depreciation of natural capital, i.e., natural resources consumption (energy, minerals and forests) and pollution damage (CO_2 and particulate emissions). This assumes that economic capital, human capital and natural capital can be substituted.

The governance indicator is based on the World Bank indicators, which are evaluated using six sub-indicators (public participation, corruption, etc.), which are mostly assessed with responses to questionnaires.

1.4. Underlying Metrics

Like many other indexes, the SSI relies on databases provided by international organisations, such as WHO (health expectancy), IEA (four energy indicators), FAO and the World Bank. It draws heavily on FAO indicators (water resources, forest cover, food, drinking water and sanitation) and those of the World Bank:

- several monetary indicators: GDP, public debt, genuine savings, income distribution
- population growth
- schooling and employment rates
- for governance, it uses a dedicated World Bank indicator, which itself is a sum of six sub-indicators, including political stability and corruption.

For the ecological footprint, data come from the Global Footprint Network.

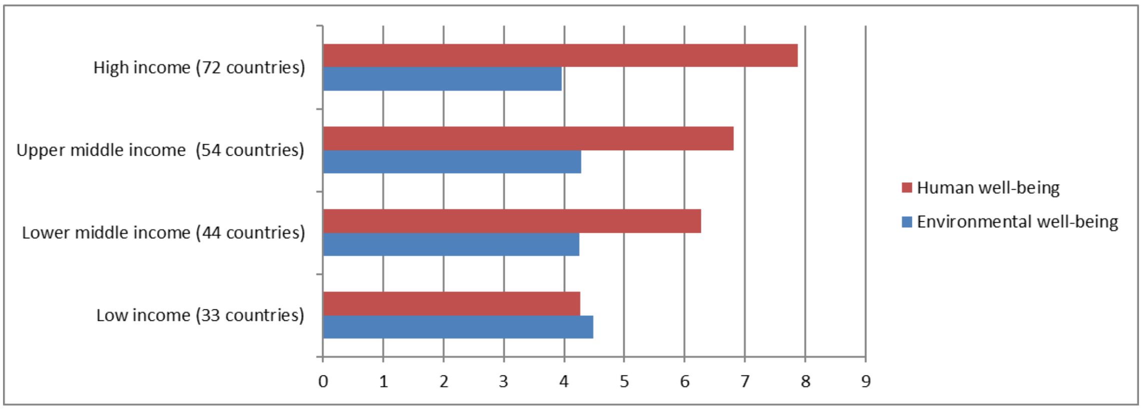
2. Results

2.1. Overall Country Performance and Analysis by Income Level

During the 2006–2020 reference period, only the human wellbeing dimension showed a continuous improvement globally. On a sustainability scale from 1 (the lowest) to 10 (the highest), the social dimension receives the highest scores. For the environmental dimension, progress has been made for two of the three natural resources indicators, whereas results for the climate & energy category are mixed and more negative.

Overall, European countries top the rankings, especially Scandinavian countries, even if it is less clear for environmental wellbeing. 2018 and 2020's results confirm that economic and social sustainability is difficult to balance with environmental sustainability. Human wellbeing is more easily reached in high-income countries (according to the World Bank's classifications), as can be seen in *Figure 23* (red bars).

Figure 23: Results Average for All Countries, by Income Classification



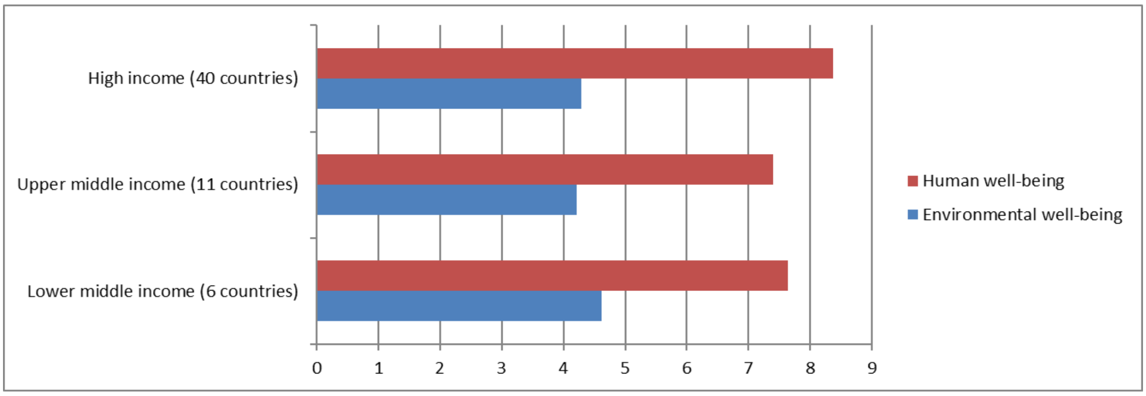
Note: the four income classifications are defined by the World Bank.
***Source:** SSI 2020, SDES calculations*

Regarding what the SSI calls 'environmental wellbeing', the trend is neutral or even reversed (blue bars) with poorer countries ranking higher in this respect, while dynamic and/or resource-rich countries are at the bottom of the list. This is mainly due to the four indicators for climate & energy, in that, a country's economic level does not influence performance in the other three indicators about the protection of natural areas.

The negative link between income and the environment is strongest in the United States and Africa.

Nevertheless, these trends are less clear for European and Central Asian countries. These countries received acceptable scores for environmental sustainability despite belonging to the highest-income groups.

Figure 24: Results Average For European and Central Asian Countries, by Income Classification



***Source:** SSI 2020, SDES calculations*

2.2. France's Ranking

The SSI looks at three dimensions (using 21 indicators) without putting together an overall score, but by producing an easy-to-read radar diagram (*Figure 6*), which can allow each country to compare itself to a global average. France is 82nd for economic wellbeing, 136th for environmental wellbeing and 28th for human wellbeing (for this latter criterion, French Polynesia is 9th, with the rankings being topped by Bermuda, Andorra and Greenland).

By going beyond the authors' calculation and averaging the three dimensions, the ranking is dominated by Liechtenstein with a score of 8.5, but this result is questionable, as only 10 of its indicators are available. The top country for which all 21 have been assessed is Denmark, which comes in 6th with a score of 7.1. Switzerland is just ahead with a score of 7.3 and 20 of the 21 indicators being available. France is 72nd with a score of 5.6.

2.3. Detailed Assessment of Indicators and Identifying Which Are the Most Penalising

For France, scores are poor for public debt, energy consumption and the share of renewable energy, with the latter having slightly regressed in 2021.

Conversely, it has excellent scores (close to 10) for GDP, water resource use and several social indicators, whether it is basic needs (food, water and sanitation) or personal development (education and life expectancy). To a lesser extent, France has good scores (close to 9) for organic farming and genuine savings.

Between 2020 and 2021, France's rankings have dropped slightly. It should be noted that scores have changed for two indicators, but this is due to a change in underlying data:

- an upward trend for health: while in 2020 the SSI looked at healthy life expectancy (2018 WHO data), in 2021 life expectancy data were used (2019 World Bank data), which, in practice, favours all countries,
- a downward trend for biodiversity: in 2021 FAO data were used instead of World Bank data, which seems to disadvantage France in terms of tree cover change, as it does for the average of wealthier countries (the trend is the opposite for lower-income countries).

Between 2016 and 2018 there were also changes to the underlying data, but this had little impact on the final result, according to the authors. In the future, TH Köln plans to update (or back-calculate) indexes from previous years with the selected underlying indicators and databases in 2020.

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APPENDIX

Appendix 1: Calculating Footprints

Environmental consumption footprint indicators aim to measure the impacts of economic activity on a global scale. They can be calculated for a produced good, an activity, or a country. In this case, they account for the environmental consequences of consuming goods and services, both in the country and in the countries concerned by the imported goods. For example, material and water footprints look at all the resources taken to satisfy the country's final demand. Carbon footprints measure greenhouse gas emissions linked to the production of goods or to the country's final demand, by including both those emitted on the national territory and those linked to imported goods and products.

Ecological Footprint

The notion of footprints applied to the pressures of human activity on the environment is inspired by the ecological footprint (*Boutaud and Gondran, 2018*). Based on a concept born in 1995 and updated since 2003 by the *Global Footprint Network think tank*, this indicator is published every two years by the WWF.

It reflects the environmental pressures associated with a population's consumption of goods and services by estimating the biologically productive areas needed to regenerate the natural resources used (food, wood, fish, etc.) and to assimilate the waste generated to produce these goods and services (typically, to absorb greenhouse gas emissions). These areas are measured in global hectares (gha). The use of this single unit is a way of aggregating very different types of impact. The total can be compared to the available biological capacity (biocapacity) of the studied country or region, which reflects its capacity to produce resources and absorb waste.

Ecological footprints are not used by French statistical authorities and have been the subject of methodological criticism, which the Global Footprint Network summarises on its website; it neglects non-renewable resource depletion, as well as the harmful impact of dangerous chemical emissions. It also does not consider ecosystem degradation or, conversely, their possible resilience. In practice, for most developed countries, greenhouse gases contribute to more than half of the ecological footprint[36]. Nevertheless, it raises awareness about the consequences of our lifestyle with a simple result, hence its political and public success. It also shows how dependent a given territory is on others that are often poorer, highlighting inequalities between countries.

The global ecological footprint has exceeded the Earth's biocapacity since the 1970s, which means that we are overexploiting our environment. This available biological capacity is 1.7 gha per person on average, while the global average ecological footprint.

[36] This is one of the main conclusions of the 2010 CGDD/SDES report, which helped to bring the carbon footprint to the forefront of public policy monitoring in France, to the detriment of the ecological footprint. This report has shown that calculating an ecological footprint can be reproduced and is generally transparent, despite some shortcomings and limitations that are inherent in the underlying data. It also noted that changes in the ecological footprint are correlated with changes in GDP, and therefore with the economic context. Furthermore, the Stiglitz Report, which recommends supplementing economic indicators such as GDP with other indicators, suggests footprints that are less comprehensive than the ecological footprint, but more clearly linked to physical measures, and gives the example of the carbon footprint.

in 2017 was 2.8 gha per person. It would therefore take about 1.7 planets to cover humanity's needs. A French person's footprint is 4.7 gha, so if all humans consumed as much as a French person, 2.8 planets would be needed. France has the 45th largest footprint per capita, which corresponds to 123rd place in the reverse ranking (considering countries with the least impact), or 19th among EU countries. If all humans consumed like an American, it would take about five planets; the USA and Gulf countries have the largest footprints (*2017 data, Global Footprint Network*)

When ecological footprints are compared to each country's biocapacity, the largest deficits are for the Middle East and Luxembourg, but also Reunion and Martinique (*Global Footprint Network data published in 2021*); conversely, French Guiana is the territory with the highest biocapacity compared to its footprint.

Unlike many other environmental indexes or indicators, four Scandinavian countries score poorly here, at around 6 gha per person, behind France. However, for Norway, Sweden and Finland, this footprint does not exceed the country's biocapacity, given their low population density.

Ecological footprints are used by several composite indexes, including the SSI and the HPI.

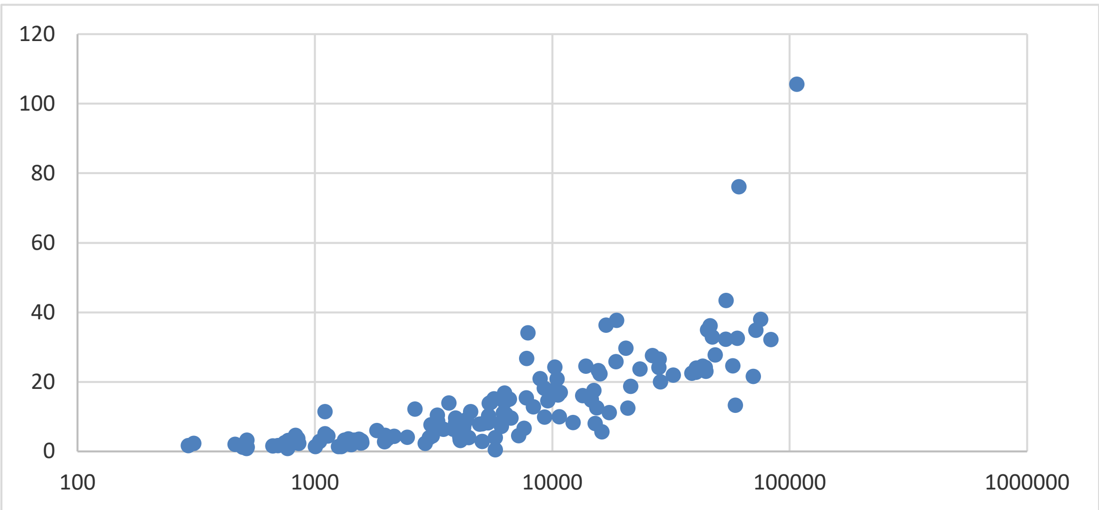
Raw Material Consumption

Raw Material Consumption (RMC) reflects all the raw materials used to meet a country's final consumption. In addition to domestic extraction, plus imports and minus exports of materials, it includes the resources used abroad to produce and transport imported products. It is written in 'raw material equivalents', combining the mass of non-metallic minerals (mainly construction materials), biomass, fossil fuels and metallic minerals.

France's material consumption, estimated at 13.9 t/capita in 2018, is higher than its apparent domestic consumption, as is the case for other countries that import more raw materials that are integrated into imported processed products than they export (European Union, the United States, etc.). This generally reflects the use of extractive and industrial activities in emerging and/or developing countries. For France, non-metallic minerals constitute the main share (over 40%), followed by biomass and fossil fuels, with metallic minerals contributing about 10%. Metallic minerals and fossil fuels are mainly imported (CGDD/SDES, 2021).

Figure 25: Raw Material Consumption

Per capita (t) as a function of GDP per capita ($) 2017 value



Source: *IRP (2017 data) based on GDP (2017 data, World Bank), SDES calculations*

The International Resource Panel (IRP, connected to the UNEP) publishes estimates for most countries. For France, the estimate (22.5 t/capita) is higher than France's national calculation, due to different calculation hypotheses. According to the IRP, France has the 34th highest consumption per capita, which corresponds to 115th place in the reverse ranking (considering countries with the least impact), or 17th of the EU countries, the average of the European countries being slightly higher than France's footprint. Luxembourg has the highest consumption with more than 100 t/capita, followed by Singapore and the United Arab Emirates[37]. Japan, which is highly dependent on imports, has a material consumption that is more than twice the level of its apparent consumption. As with their ecological footprint, Scandinavian countries perform worse than France, with between 32 and 36 t/capita for Norway, Sweden and Finland.

For raw materials exporting countries (e.g., Australia, Russia, China, Chile), the situation is reversed, and material consumption is lower than the apparent consumption. The smallest consumptions calculated by the IRP are around 1 tonne/capita (Ethiopia, Madagascar, Malawi, Afghanistan, etc., but also Belarus).

Material consumption is used by several composite indexes, notably the PHDI.

Carbon Footprint

Carbon footprint is a way to measure the quantity of greenhouse gases (GHG) that have been emitted by a country to meet all its needs (infrastructure, and consumption of goods and services), due to its energy consumption, both nationally and via imports (i.e., imported goods or goods that are made using imported raw material). This corresponds to emissions caused by internal final demand. Carbon dioxide emissions (CO_2) make up the largest part of the carbon footprint, but the latter also includes other GHGs that have been aggregated in CO_2 equivalent (CO_2 eq)[38].

The methods used to calculate carbon footprints have not been standardised internationally. Most statistics organisations use a macroeconomic model of imports and exports, by category of goods, but data sources and calculation model hypotheses vary. Internationally, we have:

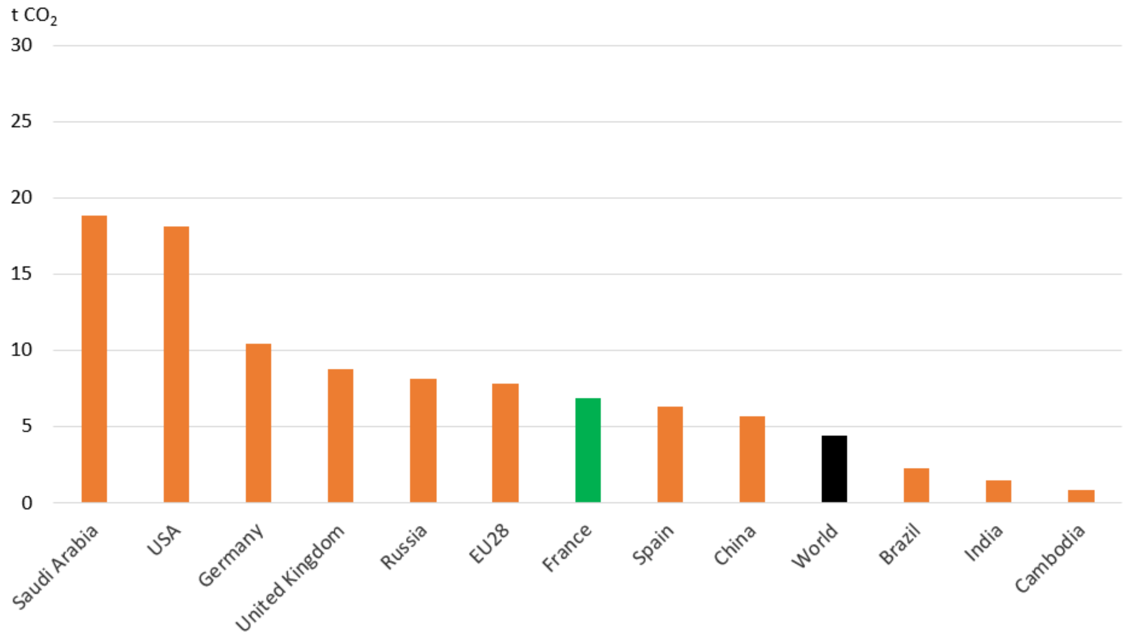
- the Exiobase model, which looks at all GHGs. It is a set of economic and environmental statistics developed by international research units,
- OECD calculations, which are more limited in scope: they consider CO_2 only, in the energy sector only.

These two calculations are only available for a limited number of countries (73 countries for Exiobase and 66 for the OECD), which are essentially those that produce the highest amount of emissions and have the biggest footprint. A per capita footprint is used as a basis for comparison. According to OECD assessments, France had the 36th largest carbon footprint in 2018 (6.7 tonnes/capita, for energy CO_2 only). Compared to Europe, it performed well, coming in 22nd out of 28 European countries, which have a higher average (7.8 tonnes/capita). The average for the 66 countries comes to 4.4 tonnes/capita. The countries with the largest footprints are Luxembourg, Brunei, the United States, Australia, Saudi Arabia and Singapore, with results close to or exceeding 16 tonnes/capita. Cambodia and Myanmar have the smallest footprint, with around 1 tonne/capita.

There is a difference between the results published on a global scale by the International Resource Panel (UNEP) and the calculations resulting from the Eurostat method: material footprint officially estimated at 13.9 t/capita in France in 2018 (*source SDES*). Standardisation of existing calculation methods is underway between international bodies, including the OECD.

[38] The carbon component in the ecological footprint goes beyond this definition by incorporating this quantity in required surface area of forest to sequester these carbon dioxide emissions.

Figure 26: International Comparison of CO_2 Footprints in 2015 (OECD)



Field: energy-sector CO_2 emissions only
***Source:** OECD 2021. Processing: SDES, 2021*

In France, carbon footprints are used to support public policy, notably for the National Low-Carbon Strategy. It is calculated by the Data and Statistical Studies Department (SDES) in the Ministry of Ecology Transition. It covers CO_2, CH_4 and N_2O, which, together, represent 96% (in CO_2 equivalent) of the seven GHGs in the Kyoto Protocol. In 2019, France's carbon footprint was around 600 MtCO_2 eq, i.e., 9 tCO_2 eq per person. This is like the Exiobase model, which evaluated France's carbon footprint to be 9.6 tonnes of CO_2 eq/capita in 2016 for all GHGs, which is around 5% higher. It is also similar to the OECD's calculation, which gives a slightly lower result but includes fewer emissions.

Import-related emissions account for half of the footprint (49%). CO_2 accounts for 76% of the footprint, CH_4 for 16% and NO_2 for 8%. After staying at just over 11 tCO_2 eq per capita between 1995 and 2005, France's carbon footprint started to decrease by around 25%. A provisional assessment for 2020 gives an additional decrease of 9% due to the health crisis, to 8.2 tCO_2 eq.

Like many developed countries, France's footprint (600 MtCO_2 eq in 2019) is noticeably higher than GHG emissions on its territory. The national GHG inventory is estimated to be 436 MtCO_2 eq in 2019, of which 74.5% are CO_2 (331 Mt). This is a 20% decrease since 1990. This figure does not take land use, land-use change, and forestry (LULUCF according to the emissions inventory) into account. Net annual carbon sequestration in France's forest biomass is evaluated to be 49.5 MtCO_2 eq.

Water Footprint

Similarly, water footprints assess the actual consumption of water in the different stages of production of a product by the consumer or the producer.

There is:

- blue water: has been sourced from lakes, rivers or underground aquifers for domestic and agricultural uses,
- green water: rainwater that has been taken in by plants, stored in soil or evaporated, and is particularly relevant for agricultural areas,
- grey or polluted water: in the methodology, grey water is the amount of blue water needed to assimilate or dilute pollutants to be available for use elsewhere.

These definitions were designed in 2002 at UNESCO-IHE, developed by the University of Twente (The Netherlands), and are currently published by the Water Footprint Network. It can also be processed into 'virtual water', which is related to the production of goods or products.

France's water footprint is 4,900 litres/day, of which 53% is internal and 47% is external. It is the same in Norway and Finland. In Luxembourg, it amounts to 6,900 litres/day. In the United States, it is 7,800 litres/day, of which 80% is internal (source: Water Footprint Network).

A similar calculation to the water footprint is used by the SDG Index, which assesses imported water.

Land Footprint

Land footprints, which are used less often, aim to depict the surface area of land used, nationally and internationally, to meet a population's needs in food, housing, clothing, transport and other goods and services. Unlike ecological footprints, land footprints are written in a surface area unit (km^2 or ha) and do not take a country's bioprocessing capacity into account.

According to the most recent and thorough international study (*Wood et al., 2018*), France's land footprint is 100 million hectares (Mha), or 1.6 hectares per capita. A little more than a third of this footprint serves to feed the French, and a quarter of it to house them. The rest is used to produce goods and services that are consumed by the French population. Nearly half of France's footprint is due to imports.

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Appendix 2: Biodiversity and Habitat Indexes

Assessing an ecosystem's status implies evaluating the quality of habitats and biological diversity, both in its different levels of organisation and in its evolution, using a method that can be transposed to different types of environments. The main parameters used for analysis are species richness (number of species present) and abundance (number of individual animals) within each species, which is generally assessed by equitability, i.e., the relative abundance of the different species (low equitability means that certain species dominate).

Following *in situ* observation of an ecosystem and counting the number of animals, two statistical descriptors are usually used: Simpson's Diversity Index and the Shannon Diversity Index, or their variants. The term index is used here as a 'statistical index', not a 'composite index' like the Environmental Performance Index (EPI). Both provide a representation of richness and equitability, with the Shannon Diversity Index giving more weight to rare species.

However, there are not enough detailed *in situ* observations at a significant number of locations in many countries. Therefore, many of the composite indexes that have been analysed in this report do not give an actual assessment of biodiversity, preferring to use simpler indicators, such as:

a) endangered species, using the Red List Index, which is, for example, included in the SDG Index. By monitoring over time, via in situ observations, it gives a score between 0 and 1 for the risk of extinction. Nevertheless, it only focuses on certain species,

b) protected areas (e.g., like the EPI) but it is known that protection is *a priori* decorrelated from the actual status of ecosystems,

c) tree cover or changes to it (in the Green Future Index (GFI), for example)

   please note that the WRI, SDG Index and SSI merge these two types of indicators: (b) and (c).

d) the proportion of land habitats that are in a well-preserved state, from a regulatory point of view (this is the case for the ESGAP)[39].

However, some tools can be used to evaluate richness or abundance based on models, requiring in situ observations of only a small number of reference ecosystems. This means that biodiversity status can be assessed not only at a local level, but also over a large geographical area (e.g., an ecoregion), or even aggregated at a country level. Among the most used indexes, there are the Biodiversity Intactness Index (BII), the Mean Species Abundance (MSA) and the Potential Disappeared Fraction of species (PDF), which all have solid scientific bases (FRB, 2020).

Biodiversity Intactness Index (BII)

The BII was developed in 2005 (*Scholes, 2005*), and then applied on a global scale in 2016 (*Newbold et al., 2016*). It is not guaranteed to be regularly updated. It is also used by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) to monitor Aichi Biodiversity Targets (target 12: prevent the extinction of endangered species and target 14: preserve ecosystem services).

Its concept involves assessing, for a given ecosystem, <u>abundance</u> (i.e., population) within each group of species, then comparing it to a reference population, which lives in an undisturbed habitat. For this, a certain number of reference ecosystems are set out and brought together in biomes. Abundance calculations for a location are done using a model (e.g.: PREDICTS,

[39] This criterion is pragmatic and can be used for monitoring over time. However, it should be remembered that criteria are not strictly identical from one country to another, as countries have a margin of freedom in their assessment and this data is only available in Europe.

which uses input data such as land use, human population, distance from the closest road, etc.). For a given area, each type of ecosystem is analysed, after which an average is calculated by weighting each of them by their surface area. The BII also includes richness, i.e., the number of species present (*Newbold et al., 2016*).

Although not unanimously supported, scientists have since proposed two thresholds of acceptability, which can determine whether an ecosystem has a good status: less than 10% loss for abundance and less than 20% loss for species richness. On this basis (*Newbold 2016*) concludes that 58% (in surface area) of land ecosystems are biologically jeopardised, according to the BII.

Mean Species Abundance (MSA)

Mean Species Abundance (MSA) assesses biodiversity integrity, by comparing species abundance, which is, for example, evaluated by the GLOBIO model, with mean original species abundance living in an undisturbed habitat. MSA calculates abundance for each species, while the BII does it for groups of species. Additionally, the BII gives more weight to areas that are rich in species and analyses more types of ecosystems than the MSA (*FRB, 2020*).

Potential Disappeared Fraction of Species (PDF)

The Potential Disappeared Fraction of Species (PDF) considers the potential loss in the year to come by looking at land use, also using models (e.g.: ReCiPe or LC-IMPACT).

Although they have the undeniable advantage of being able to be used over large areas, these three indicators only reflect an estimated ecosystem status, and not the actual status, except at a limited number of reference locations. Additionally, they are not regularly updated.

Species Habitat Index (SHI)

The SHI measures the loss of suitable habitats for species within protected areas. It is written in surface area, which acts as a "proxy" for population decline for these species (*Powers and Jetz, 2019*). Habitat destruction in terms of area (ha or km^2) and fragmentation is modelled each year using satellite observations. It is then cross-referenced with the presumed presence of the different species in each location. Endemic species are overweighted.

Biodiversity Habitat Index (BHI)

The BHI focuses on habitat deterioration and fragmentation without being limited to just protected areas like the SHI and translates this information into potential biodiversity loss. It was designed to monitor target 5 of the Aichi Biodiversity Targets. It uses satellite observations and underlying data in the PREDICTS model, like the BII (Geobon).

The BHI and SHI are part of monitoring for the Aichi Biodiversity Targets. In 2020, they were included in Yale's EPI. France is 65th for the SHI and 152nd for the BHI. Nevertheless, for the EPI, the weight of these two indicators within the biodiversity category is much less than the indicator about protected areas.

Many tools that assess the impact of human activity, such as a firm, on biodiversity are based on the MSA, the PDF or the BII (*Fondation pour la recherche sur la biodiversité, 2020*).

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Appendix 3: Sustainable Development Monetary Indicators

Green GDP

GDP, a tool used to measure economic activity, was developed in the 1930s in the United States following the crash. Not only is it not designed to measure our wellbeing, but it is also biased. For example, an increase in cancer, and therefore in the use of chemotherapy, increases GDP. John Fitzgerald Kennedy said in 1968 that "our GDP counts air pollution and cigarette advertising, and ambulances to clear our highways of carnage". Additionally, economic development is often done to the detriment of the planet's natural capital, which is not infinite. Therefore, several initiatives that come under the umbrella of 'Green GDP' have emerged. They involve providing an indicator of economic flows with a way to measure the depreciation of natural resources or environmental damage.

Adjusted Net Savings

Adjusted net savings, or genuine savings, reflects capital or heritage variation. It is an indicator that has been recommended by economists (*Insee, 2009*). It is published by the World Bank annually, and is, for example, included in the SSI as part of the 'economic wellbeing' dimension. It is derived from gross savings, which measures a country's available resources, minus consumption of fixed capital, plus education spending that contributes to human capital and minus depreciation of natural capital, such as reduction in energy, mineral and forest stocks and the environmental damage caused by CO_2 emissions [40]. The result is written in the percentage of national gross income. It can be negative, which is indicative of unsustainability.

Adjusted net savings components should be understood as stock variations of different capitals. With sustainability in mind, it integrates human and natural capital together with economic capital. However, this assumes that these three types of capital are expressed through a common unit and are substitutable. For example, drawing on certain exhaustible natural resources can be offset by investment in economic or human capital, or by improving other environmental aspects. This corresponds to the weak sustainability hypothesis (while strong sustainability requires the protection of each of the environment's components).

The increase in human capital is assessed in this indicator using education expenditure. In other economic indicators, human capital is represented by an individual's productivity throughout their life. Even if this productivity is itself dependent on their life expectancy, health and level of education, it is, above all, an economic view, not a way to measure wellbeing[41].

For the environment, extracted resources are usually estimated using their market value or operating cost, while environmental damage is estimated using a theoretical model, based for example on the pricing of a tonne of emitted CO_2, which is more controversial. For example, the 2009 Stiglitz report states that "all the indirect methods of valuation will depend to some extent on 'what if' scenarios", and further specifies that "under the current state of the art, the prices used to value carbon emissions are not able to give it any significant role". In practice, educational expenditure and environmental damage in developed countries vary much less than savings from one year to another[42].

The latest published values (2019), the average for adjusted net savings for all countries was around 10%, with greater performance for the least developed countries, at 18% on average.

[40] The World Bank also publishes a version that also includes the damage caused by particle emissions. In practice, its result is very similar. *See https://data.worldbank.org/indicator.*

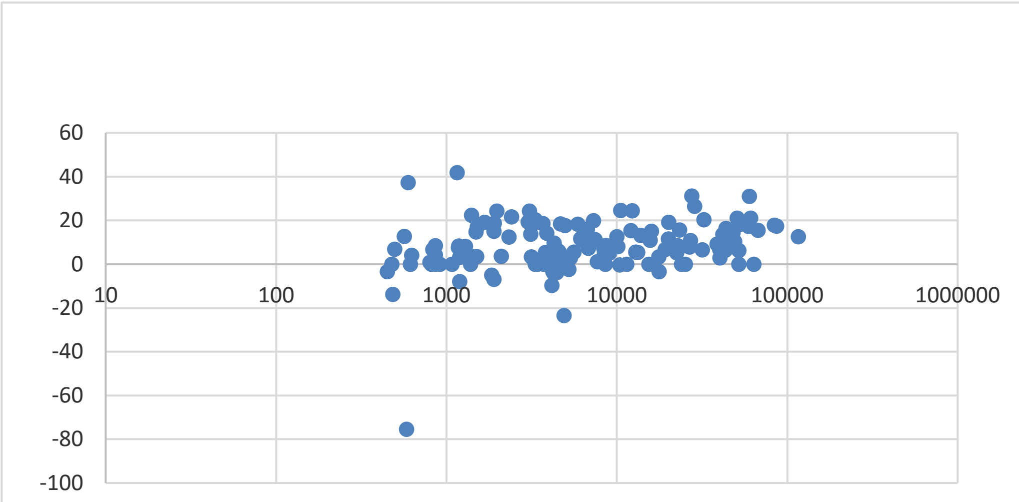
[41] Breaking with the logic of a monetary or capital indicator, composite indexes are a way of addressing wellbeing. The HDI, the HPI and the SSI are analysed in this report. These indexes also look at education, for example, but as a physical indicator (level of education), not as an economic variable.

[42] Moreover, while adjusted net savings can in principle be used to evaluate 'sustainability' by integrating variations in resources (natural capital), it cannot be used to assess the extent to which these resources are being depleted, which is not possible with approaches such as footprints or planetary boundaries.

Nepal tops the rankings. Countries whose economy is highly dependent on natural resources like petrol resources, for example, the Middle East or the United States, generally have a lower score. However, high-growth countries have good adjusted net savings (e.g., 25% for China), because their economic performance increases gross savings, despite their high natural resource consumption. The OECD average is 7.8%, which is below average, with a slightly better result in Europe with 11.5%. France is 77th with 9.2%.

Figure 27: Comparison of Adjusted Net Savings and GDP

In % of gross national income based on GDP ($ per capita)



Source: 2019 World Bank data, SDES calculations

Other Economic Indicators

The UN (UNEP) created the Inclusive Wealth Index (IWI) in 2012 and published it again in 2014 and 2018. It is based on a hypothesis that measuring wellbeing drivers over the long term, i.e., flow, is equivalent to measuring wellbeing which can be incorporated into stock. It includes 18 variables for economic capital, human capital (including education, employment, etc.) and natural capital. The latter includes the production of petrol and mineral resources, agricultural production, fisheries, forestries, ecosystem services provided by forests and damage due to CO_2 emissions. The index shows an upward trend for about 60% of countries, especially for developing countries, which could, according to the authors, be considered a sustainable trajectory. Despite this, the share of natural capital has been decreasing since 1990 and now represents about 20% of total capital, in favour of economic wealth and human capital. The latter represents about 60%. In France, natural capital is stable.

In the 2000s, Canadian economists put forward the Index of Economic Wellbeing (IEWB), which looks at actual consumption flow per capita including unpaid work, which is not included in GDP, changes in productive resources (natural resources, international debt, etc.), human capital, inequality of income distribution and economic security. The authors suggested that the IEWB could be used instead of GDP within a more aggregated index such as the HDI. However, it has not been widely adopted.

The World Bank launched a Human Capital Index (HCI) between 0 and 1 in 2018 as part of its Human Capital project. It approximates the average productivity of a newborn in each country using a mathematical function, assuming its nominal productivity (equal to 1) is adjusted by three factors, multiplied by each other, which are five-year mortality, health status and education level. Five underlying variables are needed to estimate each of these three factors.

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ACRONYMS AND ABBREVIATIONS

Acronyms and Abbreviations

AFD	French Development Agency
BLI	Better Life Index
CAGR	compound annual growth rate
UNECE	United Nations Economic Commission for Europe
CCPI	Climate Change Performance Index
CCR	Centre commun de recherches de la Commission européenne (en anglais, JCR)
CGDD	General Commission for Sustainable Development
CO_2	Carbon dioxide
DALY	Disability-adjusted life years
EEA	European Environment Agency
EPI	Environmental Performance Index by Yale University
ESA	European Space Agency
ESGAP	Environmental Sustainability GAP
FAO	Food and Agriculture Organization of the United Nations
GFI	Green Future Index
GHG	Greenhouse gases
GRID	Global Risk Data Platform (UNEP)
HALE	Health adjusted life expectancy
HPI	Happy Planet Index
IASC	Inter-agency Standing Committee Task Team for Preparedness and Resilience
HDI	Human Development Index
PHDI	Planetary pressures-adjusted Human Development Index
IEA	International Energy Agency
IFHV	Institute for International Law of Peace and Armed Conflict at Ruhr-University Bochum (Germany)
IFEN	Institut français de l'environnement
IFHV	Institute for International Law of Peace and Armed Conflict at Ruhr-University Bochum
iREG	International Ranking Expert Group
IRENA	International Renewable Energy Agency
JRC	Joint Research Centre of the European Commission (en français, CCR)
MIT	Massachusetts Institute of Technology
CO_2	Carbon dioxide
NO_x	Nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
ODD	Objectifs de développement durable

OMS	Organisation mondiale de la santé
UN	United Nations
ONU-EHS	Institute for Environment and Human Security at United Nations University
PISA	Programme for International Student Assessment
PM2.5	Fine particles (diameter that is less than 2.5 micrometres)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
SDG	Sustainable Development Goals
SDSN	Sustainable Development Solutions Network
SES	Strong Environmental Sustainability, ESGAP score
SESP	Strong Environmental Sustainability Progress, ESGAP score
SO_2	Sulphur dioxide
SSI	Sustainable Society Index
TH	Technische Hochschule
UCL	University College London
UNICEF	United Nations Children’s Fund
LULUCF	Land use, land-use change, and forestry
WHO	World Health Organisation
WIPO	World Intellectual Property Organization
WRI	World Risk Index

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