

EU Eco-Innovation Index: 2017 version

Technical note

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Introduction

This short technical note provides brief information on the overall structure of the Eco-Innovation Index in its 2017 version, its indicators and the underlying calculation method. In addition, we provide information on some methodological tests which have been carried out, in order to test the robustness of the current approach to calculate the composite index.

In the Annex of this technical note, short meta-data tables are included for each index indicator.

What is the Eco-Innovation Index?

The Eco-Innovation Index is a tool to assess and illustrate eco-innovation performance across the 28 EU Member States. The index aims at capturing the different aspects of eco-innovation by applying 16 indicators grouped into five thematic areas:

1. Eco-innovation inputs
2. Eco-innovation activities
3. Eco-innovation outputs
4. Resource efficiency outcomes
5. Socio-economic outcomes

It thereby shows how well individual Member States perform in different dimensions of eco-innovation compared to the EU average and presents their strengths and weaknesses. The index complements other measurement approaches of innovativeness of EU countries and aims to promote a holistic view on economic, environmental and social performance.

Which indicators are included in the 2017 version?

The 2017 version of the index consists of 16 indicators from 8 different data sources, which were the same indicators used as in the previous versions. In this version, all 16 indicators were updated, with most of them having their latest data for 2016 or 2017. Table 1 on the next page provides an overview over the indicators used in the 2017 version of the Eco-Innovation Index.

It is important to note that the Eco-Innovation Index is not a static tool, but continuously adapted and improved, as more recent data becomes available and new data sources are being tested. If evaluated as better-suited, new data sources replace the ones used in previous index versions. For example, in a former (2015) update of the index, data from the “Orbis” company information database replaced data from the previously used “Thomson One” database, as “Orbis” has a significantly higher coverage of companies and thus provides a more solid basis for the calculation of two indicators in the pillar of “socio-economic outcomes” (see indicators 5.2 and 5.3 in Table 1). However, replacements of underlying data sources also lead to changes in the country scores for the respective indicators, and thus, to some extent limit the direct comparability of the index results over time.

Table 1: List of indicators in the 2017 version of the Eco-Innovation Index

Name of indicator	Source	Year	Updated for 2017 version
1. Eco-innovation inputs			
1.1. Governments environmental and energy R&D appropriations and outlays (% of GDP)	EUROSTAT	2016	Yes
1.2. Total R&D personnel and researchers (% of total employment)	EUROSTAT	2016	Yes
1.3. Total value of green early stage investments (USD/capita)	Cleantech	2014-2017	Yes
2. Eco-innovation activities			
2.1. Enterprises that introduced an innovation with environmental benefits obtained within the enterprise (% of total firms)	EUROSTAT / CIS questionnaire	2014	NO
2.2. Enterprises that introduced an innovation with environmental benefits obtained by the end user (% of total firms)	EUROSTAT / CIS questionnaire	2014	NO
2.3. ISO 14001 registered organisations (per mln population)	ISO Survey of Certifications	2016	Yes
3. Eco-innovation outputs			
3.1. Eco-innovation related patents (per mln population)	Patstat	2014	Yes
3.2. Eco-innovation related academic publications (per mln population)	Scopus	2016	Yes
3.3. Eco-innovation related media coverage (per numbers of electronic media)	Meltwater	2017	Yes
4. Resource efficiency outcomes			
4.1. Material productivity (GDP/Domestic Material Consumption)	EUROSTAT	2015	Yes
4.2. Water productivity (GDP/total fresh water abstraction)	EUROSTAT	2011	Yes
4.3. Energy productivity (GDP/gross inland energy consumption)	EUROSTAT	2015	Yes
4.4. GHG emissions intensity (CO ₂ e/GDP)	EEA	2015	Yes
5. Socio-economic outcomes			
5.1. Exports of products from eco-industries (% of total exports)	EUROSTAT	2016	Yes
5.2. Employment in eco-industries and circular economy (% of total employment across all companies)	Orbis	2016	Yes
5.3. Revenue in eco-industries and circular economy (% of total revenue across all companies)	Orbis	2016	Yes

Note: Data on early stage investments were kindly provided by Cleantech Group (<http://www.cleantech.com>)

How is the Eco-Innovation Index calculated?

Country specific figures of the single indicators are weighted with the share of population in order to calculate an EU average that corrects the bias of smaller Member States. Thus the EU average of a sub-indicator displays the weighted mean of all country specific data of the EU-28 Member States.

The EU average of indicators that displays absolute numbers (e.g. Domestic Material Consumption [DMC] and GDP to calculate the material productivity indicator) is built directly by summing up the underlying data.

In order to exclude statistical outliers, a lower and upper threshold is introduced which is defined as [25%-Quantile - 1.5 * Interquartile Range] and [75%-Quantile + 1.5 * Interquartile Range], respectively. Values above or below these thresholds are replaced by the corresponding threshold value. The EU average is then calculated with the data corrected by the threshold. This ensures that even if the original data differs in several orders of magnitude between countries, it does not distort the resulting country scores. For example, data on “green investments per capita” (indicator 1.3) show a large spectrum across the EU-28 countries and fluctuate highly between years, depending on when a certain investment deal is stroke. By adjusting outliers, influence on the overall composite score is limited.

In order to normalize the dataset we use the Min-Max Normalization, scaling all values into a range from 0 to 1. This allows summing up the indices into the composite index. The overall index score of each EU-28 Member State is calculated by the unweighted mean of the 16 sub-indicators in order to avoid a bias between the thematic areas of the index.

However, in order to provide an index which is easy to understand and to communicate, we scale the composite index to a reference value, setting the EU average at a value of 100. Countries with higher figures than the EU average obtain a higher score than 100 and countries with lower figures achieve less, depending on the deviation from the EU average.

Missing data are not replaced by estimations; thus, countries without available data do not get a result for the respective indicator.

The score of the sub-index in each of the five areas is calculated by the unweighted mean of the underlying indicators. Consequently, each indicator has the same weighting in the five areas. Furthermore, each of the sub-indices is re-scaled to [EU average = 100].

Which variations to construct the index have been tested?

In order to test the robustness of the applied assumptions with regard to (a) the methods to identify and exclude data outliers, (b) the method for normalizing the data and (c) the aggregation approach, we tested several variations and combinations thereof and analysed the impact on the overall result of the index, in particular the ranking of countries.

The following variations were tested:

1. Identifying outliers: using the '5%/95%-Quantiles' to identify outliers and set a threshold.
2. Normalisation: applying the 'z-score' method and the 'distance-to-reference' method to normalise the data.
3. Aggregation: aggregating the five areas with equal weight instead of each indicator with equal weight.

Together with the main methodologies applied for the index (see above), a total of 12 variations for the overall index numbers and country rankings were obtained and analysed.

In general, the impacts of the various changes on the overall country rankings were small. In 14% of all variations, the country ranking stayed exactly the same. In further 45% of the cases, the ranking of single countries changed only by 1 position up or down, in 22% of the cases, the change effected 2 positions. Changes of 3, 4 or 5+ positions of single countries in the overall ranking occurred with a frequency of 8%, 2% and 8%.

The results of the testing indicate that the country ranking achieved with the current standard calculation procedure is relatively robust against variations in the underlying methodology to set up the composite indicator.

Annex: Eco-Innovation Index 2017

- Documentation of indicators -

The following list of tables provides a documentation of each indicator in the eco-innovation index, with a description of the below listed characteristics:

- Name of the indicator
- Short description
- Unit of measurement
- Original data
- Data provider
- Link to original data
- Most recent year available
- Frequency of updates
- Geographical coverage
- Update in Index 2017

Indicator group: Eco-innovation inputs

Name of the indicator	Governments environmental and energy R&D appropriations and outlays
Short description	The relative priority given by governments to investing in research and development in the areas of energy, including renewables, and environment
Unit of measurement	Percentage (of GDP)
Original data	Mln Eur
Data provider	EUROSTAT
Link to original data	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=gba_nabsfin07&lang=en
Most recent year available	2016
Frequency of updates	Annually
Geographical coverage	100%
Update in Index 2017	Updated to 2016

Name of the indicator	Total R&D personnel and researchers
Short description	Indicator of the knowledge and research capabilities of a country. Since the data for R&D personnel involved in eco-innovation or environmental or cleantech research is not available, the generic indicator is used
Unit of measurement	Percentage (of total employment)
Original data	Share of total employment
Data provider	EUROSTAT
Link to original data	http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsc00025
Most recent year available	2016
Frequency of updates	Annually
Geographical coverage	100%
Update in Index 2017	Updated to 2016

Name of the indicator	Total value of green early stage investments
Short description	The value of early stage investments in cleantech industries
Unit of measurement	USD/capita
Original data	USD per country
Data provider	Cleantech
Link to original data	www.cleantech.com, however access to data is available only upon subscription. In case of the Eco-IS, the data was provided directly by Cleantech.
Most recent year available	2017
Frequency of updates	Quarterly & annually
Geographical coverage	100%
Update in Index 2017	Updated to 2017, based on a cumulative indicator for 2014-2017

Indicator group: Eco-innovation activities

Name of the indicator	Enterprises that introduced an innovation with environmental benefits obtained within the enterprise
Short description	Based on the EUROSTAT's Community Innovation Survey (CIS), 2014 version
Unit of measurement	Percentage (of total firms)
Original data	N of companies per country
Data provider	EUROSTAT / Community Innovation Survey (CIS)
Link to original data	http://ec.europa.eu/eurostat/web/microdata/community-innovation-survey
Most recent year available	2014
Frequency of updates	Not systematic. The indicator was covered only in the 2008 and 2014 surveys.
Geographical coverage	79%
Update in Index 2017	Data for 2014 (no update)

Name of the indicator	Enterprises that introduced an innovation with environmental benefits obtained by the end user
Short description	Based on the EUROSTAT's Community Innovation Survey (CIS), 2014 version
Unit of measurement	Percentage (of total firms)
Original data	N of companies per country
Data provider	EUROSTAT / Community Innovation Survey (CIS)
Link to original data	http://ec.europa.eu/eurostat/web/microdata/community-innovation-survey
Most recent year available	2014
Frequency of updates	Not systematic. The indicator was covered only in the 2008 and 2014 surveys.
Geographical coverage	79%
Update in Index 2017	Data for 2014 (no update)

Name of the indicator	ISO 14001 registered organisations
Short description	The importance of observing environmental management requirements for business. Can be seen as a proxy indicator for the level of environmental awareness and management capability of business.
Unit of measurement	Number per mln population
Original data	N of organisations per country
Data provider	ISO Survey of Certifications
Link to original data	http://www.iso.org/iso/home/standards/certification/iso-survey.htm
Most recent year available	2016
Frequency of updates	Annually
Geographical coverage	100%
Update in Index 2017	Updated to 2016

Indicator group: Eco-innovation outputs

Name of the indicator	Eco-innovation related patents
Short description	According to OECD's scoping of patents in environmentally-related technologies: Energy generation from renewable and non-fossil sources PLUS Combustion technologies with mitigation potential PLUS Emissions abatement and fuel efficiency in transportation PLUS Energy efficiency in buildings and lighting PLUS Complementary Patstat queries conducted by EIO team
Unit of measurement	Number per mln population
Original data	N of patent per country
Data provider	Patstat database of European Patent Office (EPO)
Link to original data	No links available as Patstat database used for extracting data is offline (on CD)
Most recent year available	2014 (the data for later years is available but incomplete)
Frequency of updates	Bi-annual
Geographical coverage	100%
Update in Index 2017	Updated to 2014

Name of the indicator	Eco-innovation related academic publications
Short description	Institutions being involved in publications with the following list of English key-words in title and/or abstract: eco-innovation, energy efficient/efficiency, material efficient/efficiency, resource efficient/efficiency, energy productivity, material productivity, resource productivity
Unit of measurement	Number per mln population
Original data	N of publications
Data provider	Scopus
Link to original data	www.scopus.com (access is available upon subscription)
Most recent year available	2016
Frequency of updates	Daily
Geographical coverage	100%
Update in Index 2017	Updated to 2016

Name of the indicator	Eco-innovation related media coverage
Short description	Number of hits in all electronic media covered by "Meltwater News" with key-word "Eco-innovation" (translated in all EU-28 languages)
Unit of measurement	Number per mln population
Original data	Annual hits Number of electronic media sources
Data provider	Online media monitoring
Link to original data	www.meltwater.com (access is available upon subscription)
Most recent year available	2017
Frequency of updates	Daily
Geographical coverage	100%
Update in Index 2017	Updated to 2017

Indicator group: Resource efficiency outcomes

Name of the indicator	Material productivity
Short description	Illustrates the GDP generated by material consumption of a country
Unit of measurement	GDP/Domestic Material Consumption
Original data	Domestic Material Consumption (DMC)
Data provider	EUROSTAT
Link to original data	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_a_c_mfa&lang=en
Most recent year available	2016
Frequency of updates	Annually
Geographical coverage	100%
Update in Index 2017	Updated to 2015

Name of the indicator	Water productivity
Short description	Illustrates the GDP generated by domestic water consumption
Unit of measurement	GDP/total fresh water abstraction
Original data	Total fresh water abstraction
Data provider	EUROSTAT
Link to original data	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wat_abs&lang=en
Most recent year available	2015
Frequency of updates	Annually
Geographical coverage	79%
Update in Index 2017	Updated to 2011

Name of the indicator	Energy productivity
Short description	Illustrates the GDP generated by domestic energy use
Unit of measurement	GDP/gross inland energy consumption
Original data	Primary energy consumption
Data provider	EUROSTAT
Link to original data	http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tsdcc120
Most recent year available	2016
Frequency of updates	Annually
Geographical coverage	100%
Update in Index 2017	Updated to 2015

Name of the indicator	Greenhouse gas (GHG) emission intensity
Short description	Illustrates the amounts of GHG emissions generated per unit of GDP
Unit of measurement	CO2e/GDP
Original data	GHG emissions
Data provider	EEA
Link to original data	http://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer
Most recent year available	2015
Frequency of updates	Annually
Geographical coverage	100%
Update in Index 2017	Updated to 2015

Indicator group: Socio-economic outcomes

Name of the indicator	Exports of products from eco-industries
Short description	Based on selected list of trade codes referring to "environmental goods and services" (Source: Ecorys)
Unit of measurement	Percentage (of total exports)
Original data	Eurostat COMEXT
Data provider	EUROSTAT
Link to original data	http://epp.eurostat.ec.europa.eu/newxtweb/
Most recent year available	2016
Frequency of updates	Annually
Geographical coverage	100%
Update in Index 2017	Updated to 2016

Name of the indicator	Employment in eco-industries and circular economy
Short description	<p>Indicates the share of employment in eco-industry and circular economy in total employment. Total employment is an aggregate employment in all companies across sectors in a specific country. Data have been sourced from the Orbis database.</p> <p>Eco-industry company population was selected based on NAICS codes for eco-industries, including waste treatment, water sector, environmental technologies, recycling, reuse and recovery. The selection excludes companies engaged in energy generation and storage. The scope has been defined specifically for the Eco-IS. Annex I provides the full list of NAICS codes selected for data extraction. Annex II provides additional information on how this indicator was calculated.</p> <p>If company data was not reported for the most recent year, is was taken for the previous or penultimate one.</p>
Unit of measurement	Percentage (of total employment of all companies in Orbis database)
Original data	Number of employees in companies in eco-industry sector in a specific country (aggregation of micro level data).
Data provider	Orbis database
Link to original data	https://orbis.bvdinfo.com (access to data is available only upon subscription)
Most recent year available	2016
Frequency of updates	Annually
Geographical coverage	100%
Update in Index 2017	Updated to 2016

Name of the indicator	Revenue in eco-industries and circular economy
Short description	<p>Indicates the share of revenue from eco-industry in total revenue across sectors in a specific country. Total revenue is aggregate revenue in all companies across sectors in a specific country. Data have been sourced from the Orbis database.</p> <p>Eco-industry company population was selected based on NAICS codes for eco-industries, including waste treatment, water sector, environmental technologies, recycling, reuse and recovery. The selection excludes companies engaged in energy generation and storage. The scope has been defined specifically for the EcoIS. Annex I provides the full list of NAICS codes selected for data extraction. Annex II provides additional information on how this indicator was calculated.</p> <p>If company data was not reported for the most recent year, is was taken for the previous or penultimate one.</p>
Unit of measurement	Percentage (of total revenue of all companies in Orbis database)
Original data	Annual revenue of companies in eco-industry sector in specific country (aggregation of micro level data)
Data provider	Orbis database
Link to original data	https://orbis.bvdinfo.com (access to data is available only upon subscription)
Most recent year available	2016
Frequency of updates	Annually
Geographical coverage	100%
Update in Index 2017	Updated to 2016

Annex I. NAICS codes selection for eco-industry and circular economy

NAICS codes used for employment and revenue of eco-industry and circular economy (indicators 5.2 and 5.3)

NAICS	Description of relevant NAICS codes
221320	Sewage Treatment Facilities
325991	Custom Compounding of Purchased Resins
326212	Tire Retreading
331314	Secondary Smelting and Alloying of Aluminium
331420	Copper Rolling, Drawing, Extruding, and Alloying
331492	Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except Copper and Aluminium)
334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use
423140	Motor Vehicle Parts (Used) Merchant Wholesalers
423930	Recyclable Material Merchant Wholesalers
453310	Used Merchandise Stores
532210	Consumer Electronics and Appliances Rental
532220	Formal Wear and Costume Rental
532230	Video Tape and Disc Rental
532292	Recreational Goods Rental
532299	All Other Consumer Goods Rental
532310	General Rental Centers
532411	Commercial Air, Rail, and Water Transportation Equipment Rental and Leasing
532412	Construction, Mining, and Forestry Machinery and Equipment Rental and Leasing
532420	Office Machinery and Equipment Rental and Leasing
532490	Other Commercial and Industrial Machinery and Equipment Rental and Leasing
541620	Environmental Consulting Services
562111	Solid Waste Collection
562112	Hazardous Waste Collection
562119	Other Waste Collection
562211	Hazardous Waste Treatment and Disposal
562219	Other Non-hazardous Waste Treatment and Disposal
562910	Remediation Services
562920	Materials Recovery Facilities
562998	All Other Miscellaneous Waste Management Services
712190	Nature Parks and Other Similar Institutions
811111	General Automotive Repair
811112	Automotive Exhaust System Repair
811113	Automotive Transmission Repair
811118	Other Automotive Mechanical and Electrical Repair and maintenance
811121	Automotive Body, Paint, and Interior Repair and Maintenance
811122	Automotive Glass Replacement Shops
811198	All Other Automotive Repair and Maintenance
811211	Consumer Electronics Repair and Maintenance
811212	Computer and Office Machine Repair and Maintenance
811213	Communication Equipment Repair and Maintenance
811219	Other Electronic and Precision Equipment Repair and Maintenance

811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance
811411	Home and Garden Equipment Repair and Maintenance
811412	Appliance Repair and Maintenance
811420	Reupholstery and Furniture Repair
811430	Footwear and Leather Goods Repair
811490	Other Personal and Household Goods Repair and Maintenance
813312	Environment, Conservation and Wildlife Organizations
924110	Administration of Air and Water Resource and Solid Waste Management Programs
924120	Administration of Conservation Programs

Annex II: Additional explanation on Orbis-based eco-industry employment and turnover data

(Indicator group: Socio-economic outcomes)

The Orbis database is one of the largest proprietary databases of companies with worldwide coverage. It contains information on over 275 million companies worldwide, of which more than 99% are private companies. In Europe, more than 100 million companies are covered.

The database contains micro data on company income, turnover, deals, as well as historical information, address and contact details. The database is updated continuously based on the most recent financial reports of the companies. Data can be aggregated on a country, region or sectoral level (using SIC, NAICS and NACE classifications).

The following specifications were applied when downloading and analysing the Orbis data:

- The Orbis version which was used for obtaining data has the following specifications: Update number: 16902; Software version: 129.
- Companies in Orbis were selected according to the 50 NAICS (2012) codes, see Annex I above. As many larger companies have a diverse operational structure and therefore more than one NAICS code, only the primary one for each company was used for the selection. This also ensured that companies in the retrieved list were mainly active in the relevant sectors.
- All companies with either a value for the annual revenues or a value for the number of employees were selected and downloaded. The variables are termed “Operating revenue (Turnover)” and “Number of employees” in Orbis.
- Orbis data was arranged in descending order, once by revenues and once by number of employees, in order to ensure the inclusion of all companies with at least one value.
- In order to retrieve total per-country revenues and employment, the segmentation analysis tool in Orbis was used.
- During the compilation of the 2017 version of the index, some data for the Czech Republic was found to be inconsistent, wherefore some data adjustment was foretaken by neglecting the respective values. The issue were several thousand companies reported with the exact same revenue, despite a volume of several million USD. Therefore a statistical test for identifying outliers was applied to the count of each specific volume of revenue, resulting in a selection of respective revenue values to be omitted.