



COMPARING EUROPEAN INNOVATION SYSTEMS: THE GREEN HORIZONS SCOREBOARD

Providing accessible data on innovation systems for sustainability

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Key messages

- I Developing innovation policy for sustainable development increasingly requires the analysis of large data flows on environmental, economic and social indicators in order to identify the most efficient and sustainable innovation instruments. While data now become increasingly available, presenting these data in an accessible and meaningful way to policy makers and other stakeholders still is a challenge;
- II Over the past years, several scoreboard and data sets have been developed, each of which presents relevant sustainability data in a different way. The RECREATE Green Horizons scoreboard offers the unique feature of comparing in an integrated way progress in technological innovation systems that are relevant for sustainable development;
- III The Scoreboard looks in detail at 11 technological innovation systems and their progress over time in 34 ERA (European Research Area) countries through a framework of six aspects, for each of which multiple indicators are provided. It also allows comparison of progress between each of these countries as well as more detailed single country assessments. The 'one-stop shop' function of the Scoreboard is highly appreciated by policy makers, which tested the first version of the Scoreboard;
- IV Further collection, updating, integration and meaningful presentation of essential sustainability policy-relevant data is needed for policy- and decision-making in this field in the future. Technological innovation system approaches as applied by the RECREATE Green Horizons Scoreboard can provide an important contribution in this respect.



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RECREATE is a 5-year project running from 2013 to 2018, funded by the European Commission. It is carried out by a consortium consisting of 16 key partners from European research and industry and is led by the Joint Institute for Innovation Policy (JIIP). The overall objective of the project is to support the development of the European Union's research and innovation funding programme Horizon 2020, with a specific focus on the part Societal Challenge 5: Climate Action, Resource Efficiency and Raw Materials.

<http://www.recreate-net.eu/dweb/>

Introduction

Sustainable development aims to achieve three goals: economic development, environmental protection and social equity. Innovation is a powerful tool to advance all three goals². However, measuring the results of innovation is a challenge. For resources and raw materials for instance, more and better economic, environmental and social data are needed across the whole value chain in order to make meaningful comparisons between value chains. Moreover, also the presentation and analysis of data needs attention in order to make the large amounts of data that become available also accessible for

analysis and interpretation by the relevant policy- and business decision-makers. “A new generation of indicators” is therefore needed “which can measure innovative performance and other related output of a knowledge-based economy”.³

With this aim, in the past years several scoreboards and data sets were developed that each have access to different underlying data and present these in different ways. Examples are the European Raw Materials Information System⁴ as well as the Eco-innovation Scoreboard and Eco-innovation index.⁵



The European Raw Materials Information System (RMIS)

The RMIS is the European Commission’s reference webbased knowledge platform on non-fuel, non-agricultural raw materials from primary and secondary sources. The overarching goal of the RMIS is to facilitate the availability, coherence and quality of knowledge required for EU raw materials policies and access to key raw materials information from knowledge bases within and beyond Europe. The underlying aim is to secure undistorted access to (critical) raw materials for a European Industrial Renaissance and in the context of the European Strategy Implementation Plan on Security and Defence.



The Eco-innovation Scoreboard and the Eco-innovation index

The Eco-Innovation Scoreboard (Eco-IS) and the Eco-Innovation Index illustrate eco-innovation performance across the EU Member States. They aim at capturing the different aspects of eco-innovation by applying 16 indicators grouped into five dimensions: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency and socio-economic outcomes. The Eco-Innovation Index 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 Eco-IS and the Eco-Innovation Index complements other measurement approaches of innovativeness of EU countries and aims to promote a holistic view on economic, environmental and social performance.

The RECREATE Green Horizons Scoreboard

Innovation literature defines technological innovation systems (TIS) as 'the networks of organizations and institutions in the public and private sectors whose activities and interactions initiate, import and diffuse new technologies'⁶. It is important to measure performance of TIS, as these are key drivers behind progress towards sustainable development within and between countries.

Comparing technological innovation systems is a unique feature of the RECREATE scoreboard vis-à-vis existing scoreboards. The RECREATE Green Horizons Scoreboard (green-horizons.eu) provides time series indicators on eleven TIS that are relevant for innovations for sustainable development (Figure 1).

Figure 1: Technological Innovation Systems in the Green Horizons Scoreboard



The Scoreboard enables policy-makers, researchers, businesses and industry, and the general public to quickly find sets of relevant indicators related to each TIS, compare performance over time and

across countries, and analyse relations between different indicators for the countries in the European Research Area.



The European Research Area (ERA)

The European Research Area (ERA) was launched by the European Commission in 2000, with the idea of developing attractive opportunities for researchers within Europe. ERA is at the heart of the EU 2020 Strategy and of the Innovation Union (IU), where it can help contribute to growth and jobs⁷.

Its aim is to create “a unified research area open to the world based on the Internal Market, in which researchers, scientific knowledge and technology circulate freely and through which the Union and its Member States strengthen their scientific and technological bases, their competitiveness and their capacity to collectively address grand challenges”⁸.

Currently, all EU-28 Member States plus 13 associated countries (Albania, Bosnia and Herzegovina, Faroe Islands, Former Yugoslav Republic of Macedonia, Iceland, Israel, Moldova, Montenegro, Norway, Serbia, Switzerland, Turkey, Ukraine) are participating in the European Research Area.

Approach and design of the Scoreboard

For each TIS, the RECREATE Green Horizons Scoreboard analyses several functions or ‘aspects’ of technological innovation systems that all need to be stimulated for successful innovation. This is based

on ‘aspects’ that together determine the success of technological innovation systems⁹. The aspects in turn are represented by several indicators in the Scoreboard.

The RECREATE Green Horizons Scoreboard adopts six functions of innovation systems that all need to be ‘performed’ or ‘stimulated’ for successful innovation. These are:

1. Entrepreneurial experimentation
2. Knowledge development and diffusion
3. Influence on the direction of search
4. Market formation
5. Resource mobilisation
6. Legitimation of technologies

The argumentation behind the selection of these crucial aspects of successful TISs is that first of all, the presence of active entrepreneurs is a prime indication of the performance of a technological innovation system (aspect 1). Mechanisms of learning and diffusion are also at the heart of any innovation process (aspect 2). Government, industry and markets together determine the selection of successful

innovations by guiding directions of search (aspect 3). Further, preconditions for markets in which the innovations can develop have to be set, in particular by governments (aspect 4). Financial and human capital have to be mobilised to make innovations flourish (aspect 5). Finally, the technologies in a TIS have to be generally supported by the public in order to be successful (aspect 6)¹⁰.

The type and number of available indicators differ per technological innovation system and per aspect considered. An example of indicators available for the TIS Waste and Recycling are listed in Table 1.

Table 1: Available indicators for the Waste and Recycling technological innovation system in the Green Horizons Scoreboard

Knowledge development and diffusion	Influence on the direction of search	Market formation	Legitimation of technologies	Resource mobilisation
<ul style="list-style-type: none"> - Patents in Waste management (total, per 1,000 researchers, per 1 million inhabitants); - Scientific publications (total, per 1,000 researchers, per 1 million inhabitants) 	<ul style="list-style-type: none"> - GHG emissions per capita, landfill sector; Waste to landfill 	<ul style="list-style-type: none"> - Prices of glass, paper, plastic waste 	<ul style="list-style-type: none"> - Eurobarometer survey - Environmental concern 	<ul style="list-style-type: none"> - BERD Sewerage, waste management, remediation; - Private R&D expenditure; - Early and late stage investment Waste & Recycling; - Environmental protection expenditure on waste management; Public R&D spending - Environment sector (PPS per capita, share of GBAORD)

Why use the scoreboard? Examples of analyses that the Scoreboard offers

The Scoreboard offers three main routes of analysis:

- 1 Technological innovation system analysis;
- 2 Country comparison; and
- 3 Single country assessment.

Technological innovation system analyses with the Green Horizons Scoreboard

Technological innovation system analyses are useful for policy makers and analysts that are not so much interested in singular indicators, but rather in the development of these indicators in relation to oth-

er indicators in the same TIS. For instance, waste policy makers, or policy-makers and analysts more generally interested in analysing the performance of a country in a Circular Economy, could look into the data provided for the Circular Economy-related innovation system 'Waste and Recycling' (Figure 2).

Figure 2: Analysis of the 'Waste and Recycling' TIS with the Green Horizons Scoreboard

← WASTE AND RECYCLING

Waste treatment and recycling have an important role in building a resource-efficient circular economy. Recycling protects the environments, supports security of supply of **raw materials** and can provide more cost-effective inputs to industry. In a circular economy, waste is eliminated by closing reuse and recycling loops.¹ A resource-efficient system of production and consumption benefits economically through the use of residuals, by-products, and waste as inputs to production processes. With the given state of technology, **governance** processes are often more important for increasing recycling rates or reducing waste than actual technological innovations.^{2 3 4} The success of the innovation system for waste and recycling critically depends on developments in product design, consumer behaviour, waste infrastructures, and the business case for waste utilization. All these factors are ultimately strongly shaped by government regulations and policies.



1. Ellen MacArthur Foundation. 2012. 'Towards a Circular Economy Economic and Business Rationale for an Accelerated Transition'.
2. Bulkeley, Harriet, Matt Watson, and Ray Hudson. 2007. 'Modes of Governing Municipal Waste'. *Environment and Planning A* 39 (11): 2733–53. doi:10.1068/a38269.
3. Manhart, Andreas. 2011. 'International Cooperation for Metal Recycling from Waste Electrical and Electronic Equipment'. *Journal of Industrial Ecology* 15 (1): 13–30.
4. Saner, Dominik, Yann B. Blumer, Daniel J. Lang, and Annette Koehler. 2011. 'Scenarios for the Implementation of EU Waste Legislation at National Level and Their Consequences for Emissions from Municipal Waste Incineration'. *Resources, Conservation and Recycling* 57: 67–77.

KNOWLEDGE DEVELOPMENT AND DIFFUSION ⓘ

Patents in Waste management

Patents can help protect and realize innovations within waste management.

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For each TIS, the Scoreboard provides a brief introduction of the system's relevance for sustainable development. All available indicators for the TIS are grouped per innovation aspect (Knowledge Development and Diffusion, Entrepreneurial Experimentation, ...). Per available indicator it is explained why it has been included. For instance, the indicators patents and scientific publications included in the 'Waste and Recycling' technological innovation system, it is explained that patents 'can help protect and realize innovations within waste management' and scientific publications 'serve as proxy for research and knowledge diffusion activity'¹¹. The number of available indicators differs per innovation aspect considered. Each of the individual indicators is 'clickable'. Doing so will provide for the indicator in question a short description, the meta data and the original data that are the basis for the indicator. Each indicator

can be shown as a map, box plot, line chart and bar chart.

Country comparisons with the Green Horizons Scoreboard

For policy makers and analysts interested in 'best case countries' or in finding out about their own country's performance compared to other countries, the scoreboard allows comparing indicators from a specific technological innovation system across countries. By choosing this option on the landing page of the Scoreboard, one can select the type of analysis one would like for a chosen TIS. Two routes are possible here: comparison of countries on a single indicator, or on several indicators at a time. Choosing 'analyse one indicator and compare countries' will allow the user to compare one specific indicator across countries. Figure 3 shows a multi-indicator comparison between countries. Here,

the indicators ‘share of renewables in the electricity sector’ and ‘employment in the renewable energy sector’ for a number of countries in the ERA region are compared. By moving the mouse over any of the

dots, information is provided about the indicator values for the country in question, like for Sweden as an example in Figure 3.

“Comparisons on how different countries perform that can be made with the Green Horizons Scoreboard are all important for my job.” (Spanish policy maker)

Figure 3: Information provided by the Scoreboard on the relation between share of electricity from renewables and employment in the renewable energy sector in a number of ERA countries in 2013



Single country assessments with the Green Horizons Scoreboard

A user interested in an overview of TIS indicators in one country only can use the ‘get a country overview’ tab on the introductory page of the Scoreboard. This gives information on indicators in each TIS in a chart, including which country has the min-

imum and maximum value for the indicator as well as the average value. For example, selecting a number of indicators for the critical raw materials TIS for France will show the consumption of critical raw materials by France, and how it performs vis-à-vis the minimum, maximum and average consumption values in Europe (Figure 4).

Figure 4: Status quo of key indicators on critical Raw Materials in France in 2013 as shown in the Green Horizons Scoreboard



Overall added value of the Green Horizons Scoreboard

The added value of the Green Horizons Scoreboard compared to existing scoreboard approaches was tested by ten policy makers active in the sustainability area in various positions in six different EU countries (Belgium, Netherlands, Germany, Den-

mark, Spain, Slovakia). Next to helping to improve the Scoreboard on many detailed points, the policy makers also commented on its user-value to them. In summary, they appreciated in particular its 'one-stop shop' character, compiling information from different sources in an innovative and attractive way.

“I can use the Green Horizons Scoreboard as a one-stop shop” (Slovak policy maker)

Main added value of the Scoreboard according to the test-users was:

- ✓ Its unique approach of grouping indicators according to the technological innovation systems.
- ✓ Its scope, which includes information not covered by other databases such as Eurostat (e.g. on climate change adaptation).
- ✓ Its flexibility compared to, for example, the Eco-innovation scoreboard, as it allows the user to create comparisons as needed, for example of different countries. This was seen as very interesting and practical for potential users.
- ✓ The possibility it offers to integrate different information sources in nexus areas and link different policy areas.
- ✓ Its function as a “one-stop shop” as a lot of relevant information is compiled from different sources, the sources themselves are available, too, as well as raw data. It thus can help guide interested users to undertake further searches for information and data on a national level for those countries they are most interested in.

Conclusions and recommendations

By providing information on technological innovation systems, the Green Horizons Scoreboard adds to policy relevant information on progress in innovation for sustainable development. In this way, it can help policy makers and business decision makers to take informed decisions about stimulating innovation for the future.

By providing the information in an accessible and attractive way, the scoreboard can also be of interest to anyone that wants to get quickly informed about research and innovation progress in the ERA area in general.

Whereas the Green Horizons Scoreboard takes a new step towards measuring innovation for sustainability, it is certainly not the last step in this area that needs to be taken. More, equally accessible data for policy analysis and decision-making will still be needed in the future. Main policy recommendations in this respect are:

1. Further examine remaining data gaps with respect to sustainable innovation policy needed to guide policy and decision-makers (European Commission, national R&I policy makers);
2. Provide support to regularly update and add relevant indicators to the Scoreboard to provide latest,

up-to-date information for policy making (e.g. via calls for research projects that maintain the scoreboard);

3. Enable taking user feedback on the user friendliness and usefulness of the Scoreboard regularly into account, with the aim to improve these aspects (e.g. via calls for research projects that maintain the scoreboard);

4. Stimulate the further use of integral technological innovation systems approaches as a promising way to compare essential sustainability data within as well as between ERA countries (European Commission);

5. Further integrate relevant information for decision-making, for instance by making links to all main data relevant for policy making on innovation for sustainability accessible on a single data portal (European Commission).

Implementing these steps will contribute to exploiting the full potential of innovation for sustainability in the future. And it is clear that such innovation, and its implementation, is needed - as there is still quite a road ahead towards achieving the Sustainability Development Goals until 2030.

References used

- 1 Whereas the authors are responsible for the final draft of this policy brief, the text has greatly benefitted from the expert contributions.
- 2 Advocated by for example UN (2013), Science, technology and innovation for sustainable development, CDP Background Paper No. 16, Available at: <https://www.un.org/development/desa/dpad/wpcontent/uploads/sites/45/publication/CDP-bp-2013-16.pdf>; UNDP (2017), Innovation for the Sustainable Development Goals, Available at http://www.undp.org/content/undp/en/home/librarypage/development-impact/spark-_-scale-_-sustain---2016-year-in-review.html
- 3 OECD, What indicators for science, technology and innovation policies in the 21st century? Available at: <http://www.oecd.org/science/inno/37082579.pdf>
- 4 The European Raw Materials Information System, Available at: <http://rmis.jrc.ec.europa.eu/>
- 5 The Eco-Innovation Scoreboard and the Eco-innovation Index, Available at: https://ec.europa.eu/environment/ecoap/indicators/index_en
- 6 Freeman, C., 1987. Technology Policy and Economic Performance – Lessons from Japan. Pinter
- 7 European Research Area, Available at: <https://www.mariecuriealumni.eu/newsletter/all-you-need-know-europeanresearch-area-era>
- 8 Ibid.
- 9 Hekkert, M.P., Suurs, R.A.A., Negro, S.O., Kuhlmann, S., Smits, R. E. H. M., 2007. Functions of innovation systems: A new approach for analysing technological change. Technological Forecasting and Social Change 74, 413-432
- 10 Hekkert, M and Simona Negro (2011) Understanding technological Change, Utrecht University, November 2011
- 11 Ibid.

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Co-creation in sustainability science – Challenges and potential ways forward in implementing co-creation in European research and innovation funding

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