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Measuring the progress towards a resource-efficient European Union under the Europe 2020 strategy

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ABSTRACT

Resource efficiency is an essential priority of the Europe 2020 Strategy, which under the Flagship Initiative for a resource efficient Europe calls for a shift towards a resource-efficient economy. In this context, indicators and composite indexes could be useful in order to evaluate the progress of the European Union towards the objectives of the Roadmap to a Resource Efficient Europe.

This paper benchmarks the 28 European members based on a composite index, namely the Resource-Efficiency Capacity Index. The index is based on the calculations of 29 indicators, which are grouped in three dimensions. The first dimension benchmarks EU-28 members according to the promotion of waste recycling, to the support of research and innovation in resource efficiency and to the implementation of environmental taxation. The second dimension benchmarks EU members according to energy efficiency in residential buildings and the third dimension according to the development of more sustainable transport modes. The three dimensions are aggregated for a final ranking.

The results indicate that Denmark received the highest ranking with a composite index value of 3.35, followed by Sweden (3.22) and Finland (3.13) in 2013. The establishment of more effective policies is necessary in the member states with the lowest scores in the Resource-Efficiency Capacity Index: Slovakia (1.8), Malta (1.92) and Poland (1.93). Although the European Union has made considerable progress in this issue in the last decade, many actions should still be faced to increase resource efficiency to inform more about the concept of life-cycle thinking to increase waste recycling, to make more attractive the system of public passenger transport, or to increase the energy efficiency of residential buildings, among others.

1. Introduction

Resource efficiency is about using the Earth's resources (metals, minerals, fuels, water, land, timber, fertile soil, clean air and water) in a sustainable manner to supply society needs (i.e. energy and transport), producing more value with fewer resources, lessening our impact on the environment and consuming in a more intelligent fashion (European Commission, 2014). Resource efficiency involves (i) moving from a linear economic model (where products become waste after use) to a circular economy (where the value of resources is maintained, products are re-used or recycled and materials are fed back into production), (ii) increasing technological innovation or eco-innovation to produce more value with fewer resource and (iii) consuming and producing in a more intelligent and more environmentally friendly way, among others.

Unsustainable consumption and production patterns put our resources under pressure and threaten the supply security (Yu et al., 2017), so improving resource efficiency would significantly help limit emissions, save money and boost economic growth. A more efficient use of resources would be essential in making progress to combat climate change and to achieve the EU's targets on greenhouse gas emissions (Tanning and Tanning, 2015). In this context, The European Commission put forward a Flagship Initiative for a Resource Efficient Europe (European Commission, 2011a) as part of its 'Europe 2020 Strategy' (European Commission, 2010a,b) to shift towards a resource-efficient, low-carbon

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economy. The Roadmap to a Resource Efficient Europe (European Commission, 2011b) is one of the main building blocks of the flagship initiative. The Roadmap to a Resource Efficient Europe sets a vision, for 2050, based on the importance of a sustainable management of all resources from raw materials to energy, water, land, air and soil. Policies based on increasing resource productivity and decoupling economic growth from resource use and its environmental impact are the basis of this regulation. More specifically, "making technological improvements, a significant transition in energy, industrial, agricultural and transport systems as well as changing producers' and consumers' behaviors" are the recommendations to achieve a resource-efficient Europe (European Commission, 2011b).

In that sense, (i) *to transform the economy* by reducing the health and environmental impacts of waste, decreasing the generation of waste and promoting recycling, supporting resource-efficiency research and innovation and protecting the environment through the application of right prices, such as energy and environmental taxation; (ii) *to improve buildings* by increasing both energy efficiency of residential buildings and energy-efficient household appliances; and (iii) *to ensure efficient mobility* by moving towards more energy-efficient and environmentally friendly modes of passengers and goods defined by the OCDE (1997) as transportation that does not endanger public health or ecosystems, are some of the main challenges established in the Roadmap to a Resource Efficient Europe.

In this context, the European Commission noted the need for indicators to measure progress towards the objectives proposed by the Roadmap to a resource efficient Europe. After a process to discuss and agree on indicators,[1] the European Commission presented the Resource Efficiency Scoreboard (European Commission, 2014),[2] which includes 30 indicators for assessing the use of natural resources in the EU and for monitoring the progress towards a resource-efficient Europe.

Specifically, the scoreboard includes a set of 20 indicators that show progress in shifting the economy onto a more resource-efficient path (waste generation and treatment, research and innovation in environmentally related fields and environmental taxation) and with regard to the pressure on nature and ecosystems and developments in key areas of basic needs with a high impact on the environment (nutrition, housing and mobility). The rest of the indicators of the Resource Efficiency Scoreboard shows progress in reducing the pressure on biological resources (such as sources of minerals, metals and energy as well as stocks of fish, timber, water, fertile soils, clean air, biomass and biodiversity) and ensuring a smarter use of these resources for the future.

Although there are an ample number of indicators, composite indexes would be useful tools for policymakers to provide relevant information about the progress regarding the Roadmap to a Resource Efficient Europe. They are essential to summarize, focus and condense the great complexity of the environment to a manageable information amount (Godfrey and Todd, 2001). Thus, a composite index could be useful for benchmarking the performance of EU-28 countries across aspects that relate to resource-efficiency policies. However, it is frequently argued that composite indicators can be too subjective, due to the mechanism used to include or exclude indicators in the aggregated index, the scheme of normalization and the selection of the scheme of normalization, algorithm of imputation, weights and system of aggregation (Singh et al., 2007).

Despite the research developed on resource efficiency (Section 2 presents a literature review), there is not any exhaustive index-based approach that allows for assessing the resource efficiency in the framework of the Roadmap to a Resource Efficient Europe. In fact, at the EU level, the Sustainable Development of Energy, Water and Environment Systems (SDEWES) City Sustainability Index proposed by Kilkış (2015, 2016) includes some indicators related to sustainable transport, recycling or energy consumption. However, these analyses allow for the benchmarking of the performance of cities (22 Mediterranean port cities and 12 Southeast European cities) but not EU- 28 countries. The objective of our paper is to obtain a composite index (namely, the Resource-Efficiency Capacity Index) for the benchmarking of the performance of EU-28 countries across aspects that relate to resource-efficiency policies in the framework of the Roadmap to a Resource Efficient Europe.

For this index, specific policies of the EU related to waste recycling, resource-efficiency research and innovation, energy and environmental taxation, energy efficiency of residential buildings and sustainable transport have been considered.

Research presenting policy recommendations on resource efficiency has been mainly centred on these issues. The change in consumption and production patterns in society is essential for eliminating waste before it is produced and thus for reducing its quantity and toxicity (Singh and Ordoñez, 2016). Therefore, prevention should be the primary aim, followed by its reuse and recycling, which are also key activities to make the environment cleaner. These activities require suitable policies that promote this environmentally friendly behaviour in society (Urbaniec et al., 2016). Moreover, support of research and innovation on environmentally friendly, economically feasible and socially acceptable technological and non-technological solutions are essential in the field of resource efficiency (Kang and Lee, 2016). Another essential concept is the establishment of economic incentives to set a price for environmental damage as the tendency for people to over-exploit resources of common property. Therefore, charges and subsidies can be established in order to internalize environmental costs (Hatfield-Dodds et al., 2017). In this context, there are two main types of economic instruments to provide an incentive to use resources sustainably: right-based measures and price-based measures (Beder, 2001). Right-based measures include tradable pollution rights (emission trading). However, price-based measures use subsidies and charges to internalize environmental costs and benefits. Subsidies are payments from the government to the producer whose aim is to reduce good or service prices and, in this way, to encourage their sale. Examples of subsidies have been the development of grants for environmental technology, grants for particular environmental projects or some tax-deductible activities for money spent on soil conservation or recycling schemes. However, charges makes reference to a 'price' that is paid for polluting the environment. It includes product charges, for example, charges on packaging whose aim is to discourage disposal or encourage recycling. Regarding energy efficiency of residential buildings, it is another relevant concept, as buildings are responsible for a large share of energy consumption and greenhouse gas emissions, which require reinforcing legislation in order to promote sustainable energy consumption in society (Labanca et al., 2015). Finally, more environmentally sustainable transport modes are essential to reduce energy consumption, which requires promoting the use of eco-friendly transport modes, as well as to support innovative

[1] The process involved all key stakeholders, to discuss and agree on indicators and targets by the end of 2013. Moreover, the selection of the indicators was also based on experts' consultations. For example, Mudgal et al. (2012) identified and assessed indicators related to resource use and their environmental impacts and presented recommendations for the implementation of indicators and targets in the EU policy context.

[2] The Resource Efficiency Scoreboard was published the first time by the statistical office of the European Union (Eurostat) on 6 December 2013 (Scoreboard, 2013), and the first full analytical report was published in November 2014 (European Commission, 2014).