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Analyzing the environmental and resource pressures from European energy activity: A comparative study of EU member states

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ABSTRACT

Sustainable development and environmental protection are key concepts in the European energy policy. The Europe 2020 Strategy establishes the necessity of reducing environmental pressure and resource consumption to increase sustainable development in the EU. In this context, the aim of this paper is to develop an Environmental and Resource Pressure Aggregated Index that considers these two dimensions. This index provides information about the achievement of the targets in the member states as well as the achieved effects of the environmental policies on energy policy and sustainable development. Therefore, it would help policy-makers to plan future policy actions.

The results show that, among EU countries, Portugal, Latvia, Italy, Austria and France have low environmental and resource pressure. Recommendations are made for member states with the worst results (Estonia, Poland, Cyprus, Czech Republic and Luxembourg) in order to improve their actions in climate change and energy policy.

1. Introduction

A great pressure on the environment and natural resources costs has been taking place because of the increasing demand and competition for resources. As economic growth can involve an excessive demand for natural resources with the consequent environmental degradation [1], one of the main objectives of the European environmental policy is to decouple this concept from environmental degradation and resource consumption.

In this context, the European Community Treaty considers the promotion of SD (sustainable development) and the EP (environmental protection) as key issues in the European Union. Moreover, EP requirements have to be integrated into the implementation of the other European policies and activities to promote SD [2,3].

Comprehensive environmental protection legislation has been developed in the European Union by means of the introduction of command and control, financial as well as technical instruments. The 1st EAP (Environmental Action Programme) (1973–1976) is the European reaction to increasing ecological damages, in which issues related to detect those damages as well as to develop a technological progress according to ecological necessities are emphasized. The establishment of directives and regulations for different pollution sources is set in the 2nd EAP (1977–1981).

Later, the 3rd EAP (1982–1986) develops prevention policies of the environmental damages to control and reduce the pollution and the 4th EAP (1987–1992) shows the importance of integrating the environmental policies with the other community policies.

The main objective of the 5th EAP (1993–2000) is to promote SD by means of integration of the environmental dimension into all main policy areas as well as providing new policy instruments (regulatory, financial and horizontal instruments as well as financial support mechanisms). Subsequently, the 6th EAP (2001–2010) involves the implementation of the European Union's Sustainable Development Strategy and considers five strategic actions: to improve the establishment of existing legislation, to consider environmental concerns into other European policies, to work closer with the market, to empower people as private citizens and to promote a behavior change and consider the environment in land-use planning and management decisions.

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The 7th EAP is the present guide of European environmental policy until 2020 [4]. It establishes three main objectives: to protect, conserve and enhance the Union's natural capital, to turn the Union into a resource-efficient, green, and competitive low-carbon economy and to safeguard the Union's citizens from environment-related pressures and risks to health and wellbeing.

This legislation seeks that all EU's policies contribute to environmental sustainability. The aim is that the EU stays globally competitive by means of a sustainable economic growth focused on the integration of resource efficiency across different policy areas. Therefore, the present European environmental policy considers additional topics, in which climate change and energy are emphasized.

The 2030 framework for climate and energy policy seeks to make the European Union's economy and energy system more competitive, secure and sustainable. For it, this framework establishes targets related to a reduction of the domestic 2030 GHG (greenhouse gas) emissions of at least 40% compared to 1990, increase the share of renewable energies (RES-E) and energy efficiency to at least 27% in 2030 [5].

In this context, SD indicators and composite indexes are an important tool to provide information on countries related to environment, economy, society or technological development [6]. These indicators allow policy making to summarize and focus information of the high complexity and dynamism of the environment. Besides, these "indicators arise from values (we measure what we care about), and they create values (we care about what we measure)" [7]. As a consequence of these characteristics, the development of new indicators and indexes that involves improvements in SD actions and strategies is still necessary [8].

Acting on that concern, and in the present context of scarce empirical research about methods to elaborate SD indexes [9,10], the objective of this paper is to propose a set of indicators related to sustainable EP in energy policy in the EU-28 for the year 2012 in order to obtain the ERPAI (Environmental and Resource Pressure Aggregated Index).

With this aim, the paper is structured as follows: firstly, we analyze the EP sustainability indexes developed in the literature. Then, we study the EP and SD in the energy policy of the EU and we propose indicators to calculate the aggregated index. In the next section, we present our methodology to calculate ERPAI and we analyze the main results. Finally, we discuss and conclude about the necessity of introducing improvements in the environmental policy in the EU that facilitates member states to get the aims related to SD and climate change and energy.

2. Environmental protection: a survey of sustainability indexes

Different proposals of EP indicators and/or indexes have been developed in the literature. Wackernagel and Rees [11] develop the ecological footprint concept which measures the total land area that is essential to maintain the food, water, energy and waste-disposal demands per person, per product or per city. It allows policy makers to obtain data of environmental sustainability at national and global level. The Pressure-State-Response approach is developed by the OECD -Organization for Economic Cooperation and Development Environment Directorate [12,13]. It establishes the impact of human activities ('pressure') on the environment and results in change in the quality and the quantity of environmental conditions ('state'). Society acts as a feedback and responds to these changes by means of environmental, economic and sectored policies ('response'). World Business Council for Sustainable Development (WBCSD) [14] establishes an eco-efficiency framework based on the identification of indicators, which allows companies to assess their performance related to economic and environmental sustainability.

Likewise, different eco-system indices have been developed. Krotscheck and Narodoslawsky [15] develop the Sustainability Performance Index with the aim of measuring the sustainability in process industry. It calculates the area required to embed a process into the biosphere. The Living Planet Index [16] measures the global biodiversity by means of the analysis of trends of vertebrate species in freshwater, seawater and terrestrial ecosystems. Chambers and Lewis [17] develop the Eco-Index which by means of the use of both bottom-up and top-down approaches and entire life cycle data allows policy makers to perform the ecological footprint.

Regarding environmental indices, the Environmental Quality Index is one of the pioneers. It analyses the environmental impacts of different alternatives by means of the analytic hierarchy process methodology. Each environmental indicator is evaluated according to linear utility functions and its global value is established as the weighted sum of all environmental indicators. Parker [18] develops the Index of Concern of Environmental Problems with the aim of measuring the public concern related to environmental problems. It considers 11 indicators classified in three groups: air problems, water problems and landscape-related problems. Puolamaa et al. [19] develops the Index of Environmental Friendliness that is calculated from the aggregation of direct and indirect data related to global and local environmental problems, such as greenhouse effect, biodiversity and noise.

WEF (World Economic Forum) develops the Environmental Sustainability Index [20] as a measure of overall progress towards environmental sustainability in 122 countries. It considers 67 variables that are grouped into 22 sub-indicators. Later, the 2002 Environmental Sustainability Index involves twenty one core indicators which are applied to 142 countries, in which the value of every country is aggregated in function of the average value of core indicators [21,22].

The South Pacific Applied Geoscience Commission develops the Environmental Vulnerability Index with the aim of analyzing the potential damaged related to environmental issues. It establishes 50 indicators classified in hazards, resistance and damage categories which have equal weights and are aggregated by an arithmetic mean [23]. However, the Environmental Performance Index [24] seeks to measure the effects of six environmental policies in promoting ecosystem vitality and natural resource management by means of principal component analysis methodology.

However, the development of an exhaustive methodological approach based on the elaboration of EP index related to SD and energy policy is still weak [9,10]. Different international organisms show the importance of analyzing the concepts of energy policy, SD and EP together and identify indicators related to CO_2 emissions [25], clean production technologies, resources and energy efficiency [26,27] as the most relevant.

3. Material and methods

3.1. Environmental protection and sustainable development in the European energy policy: analysis and proposal of indicators

Climate change is one of the main concerns of both policy-makers and the general public. The development of GHG emissions, as a consequence of human activities (in which burning of fossil fuels is emphasized), has involved increases in the average temperature of the Earth over the last 250 years. Panel on Climate Change establishes that environment, the economy and human society itself could have important negative consequences (such as, loss of biodiversity, changes in agricultural yields and other changes in ecosystems, water and food shortages) if an increase in the

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