Green Finance

Green Finance, 3(1): 28–45.
DOI: 10.3934/GF.2021003
Received: 17 December 2020
Accepted: 20 February 2021
Published: 23 February 2021

http://www.aimspress.com/journal/GF

Research article

Responsible consumption and production in the European Union. A partial order analysis of Eurostat SDG 12 data

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Abstract: The UN Sustainable Development Goal 12, responsible consumption and production, is a key element in a sustainable development of our planet as it is closely linked to the exploitation of renewable and non-renewable resources. The present study focuses on five main indicators selected by Eurostat as key factors for the development of the SDG 12, i.e., 1: resource productivity, 2: average CO_2 emissions from new passenger cars, 3: circular material use rate, 4: generation of waste excluding major mineral wastes and 5: consumption of toxic chemicals for the 27 member states of the European Union, the data being analyzed applying partial ordering methodology that constitutes an advantageous decision support tool. Based on the first 4 indicators the 27 EU member states have been mutually ranked finding France, Italy, and Malta as the best and Bulgaria and Estonia as the worst among the 27 countries in complying with the SDG 12 targets. Studying the temporal development, a slightly positive tendency was observed. The most important indicator, looking at the whole EU appears to be the generation of waste, whereas, e.g., the CO_2 emission apparently is the key issue for France and Bulgaria, whereas the circular material use rate is the most important in the case of Greece. The temporal development of the consumption of toxic chemicals was separately analyzed disclosing that the amount of non-toxic waste has increased whereas a decrease in chemicals hazardous to human health and to the environment was noted. The results constitute important for authorities and regulator in their effort to select actions in order better to comply with the SDG 12 targets.

Keywords: sustainability; SDG 12; consumption; production; EU; partial ordering; ranking; indicator importance

JEL Codes: C3, C6, C8

1. Introduction

The latest compilation of the progress in sustainable development in Europe is found in the 2020 Eurostat report "Sustainable development in the European Union. Monitoring report on progress towards the SDGs in an EU context" (Eurostat, 2020a) where the overall goal is by 2030 to *achieve the sustainable management and efficient use of natural resources* (UNDP, 2020). Sustainability comprises three main pillars, i.e., economically viable decisions, environmentally sound decisions, and socially equitable decisions. The present study applies Eurostat data for five out of six main indicators discussed in the report for SDG 12 (Eurostat, 2020a) for the period 2007 to 2017 (Eurostat, 2020b, c, d, e, f). The 6th main indicator, i.e., "Gross value added in the environmental goods and services sector" (Eurostat, 2020g) will not be treated here due to lacking data for several of the year coved. Hence, the 5 main indicators included in this study are:

- Consumption of toxic chemicals (Eurostat, 2020b)
- Resource productivity (Eurostat, 2020c)
- Average CO_2 emissions from new passenger cars (Eurostat, 2020d)
- Circular material use rate (Eurostat, 2020e)
- Generation of waste excluding major mineral wastes (Eurostat, 2020f)

It is noted that these indicators virtually focus on the environmental part of sustainability and only indirectly with the economic part through the resource productivity, which is defined as the gross domestic product divided by domestic material consumption. Obviously, the financial aspects should not be neglected. Thus, Tseng et al. has studied financial aspects of sustainable supply chain (Tseng et al, 2018, 2019).

The selection of these main indicators for SDG 12 is nevertheless obvious. Hence, production of toxic chemicals, as well as the average CO_2 emissions from new passenger cars appear as important indicators in relation both to sustainable production and consumption. Further, the general production of waste parallel to an increase resource productivity and circular material use rate obviously work towards a higher degree of sustainability both in relation to production and to consumption. The interlink with other SDGs should be emphasized. SDG 13, Climate action, is obvious (CO_2) emission and SDG 11, Sustainable cities, and communities (Waste) and SDG 3, Good Health and Well-being (toxic chemicals) may here serve as illustrative examples.

In the Eurostat report (Eurostat, 2020a) the development in the single indicators is treated separately. However, to obtain a more comprehensive picture of the sustainable production and consumption the group of indicators (here 5) should be taken into account simultaneously. To do so, often an aggregation of the single indicators into one overall indicator is done. However, although this leads to a complete linear ordering of the studied objects, as here, e.g., the EU member states, valuable information concerning the influence of the single indicators may be lost due to compensation effects (Munda, 2008). As such partial order methodology constitutes an advantageous decision support tool for authorities and regulators in their attempt to select focus areas and allocate resources as well as to avoid pitfalls in their work to improve the situation in order better to comply with the SDG 12 target.

The paper is structured by a methodology section followed by a result and discussion section that further is subdivided in two: a) an overall analysis to what extent the 27 EU member states (cf. Table 1) comply with the SDG 12 taken the 4 indicators Resource productivity, Average CO_2 emissions from new passenger cars, Circular material use rate and Generation of waste excluding

major mineral wastes simultaneous into account for the years 2010, 2014 and 2017, respectively and b) an analysis of the consumption of toxic chemical for the years 2004 to 2019 at a European Union scale (excluding United Kingdom); the paper finalizes with some conclusions and outlook.

Table 1. Country codes.

Country	Codes	Country	Codes	Country	Codes
Austria	AUT	France	FRA	Malta	MLT
Belgium	BEL	Germany	DEU	Netherlands	NLD
Bulgaria	BGR	Greece	GRC	Poland	POL
Croatia	HRV	Hungary	HUN	Portugal	PRT
Cyprus	CYP	Ireland	IRL	Romania	ROU
Czechia	CZE	Italy	ITA	Slovakia	SVK
Denmark	DNK	Latvia	LVA	Slovenia	SVN
Estonia	EST	Lithuania	LTU	Spain	ESP
Finland	FIN	Luxembourg	LUX	Sweden	SWE

2. Methods

2.1. Indicators and Data

The indicators being included in the study is summarized and described in Table 2. The CCH indicator has 2 subcategories: non-Hazardous waste (nonHaz) and Hazardous waste (Haz), the latter further being subdivided in wastes hazardous to the human health (HazHea) and to the environment (HazEnv), respectively. In Table 3 the data for the 27 EU member states are given for the 4 indicators RPR, CO_2, CMUR and WAS, respectively for the years 2010, 2014 and 2017, respectively (Eurostat, 2020c, d, e, f). It should be noted that for the indicators CO_2 and WAS negatives are given, thus securing an identical orientation of the indicators, i.e., the higher the better, i.e., contribution positively to the sustainable production and consumption.

Table 4 shows the four indicator values for the European Union and for Greece (GRC) for the years 2010 to 2017 (Eurostat, 2020c, d, e, f). Again, the indicators CO_2 and WAS are given as negatives to obtain an identical orientation of the indicators, i.e., the higher the better. In Table 5 the applied data for the hazardous waste analyses is given. It should be emphasized that all data are given with as negatives as higher values reflect less sustainability. Thus, this will correspondingly be visualized in the Hasse diagram where the least sustainable years will appear in the lower part of the diagrams. The nonHaz has been calculated by subtracting the Haz from the total Haz + nonHaz. It should be noted that HazHea and Hazenv to some extent overlap and as such the sum does not equal Haz (Eurostat, 2020b).

It should be noted that the data applied in the present study provided by Eurostat do not look at specific products but summarizes overall figures for the European Union as such as well as for the single member states.

It should further be emphasized that in all cases the data are taken as reported by Eurostat (2020b, c, d, e, f), i.e., the data are accepted as true values. In other word any, not reported, possible data uncertainty nor data noise has not been taken into account in the calculations.