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Assessment of Sustainable Economic Development in the EU Countries with Reference to the SDGs and Environmental Footprint Indices

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Abstract: The article analyses sustainable economic development of EU countries according to the sustainable development goals (SDGs), by using indices of integrated sustainable development and environmental footprint. Sustainable economic initiatives can be driven by economic, environmental and social aspects, applying principles of innovation and knowledge. However, development requires skills, human and financial resources; in turn, it increases productivity, efficiency, competitiveness, profit, and promotes a better working environment. In general, sustainable business initiatives contribute to SDGs and reduce the environmental footprint. The scientific problem is how to develop a sustainable economy while ensuring the achievement of SDGs and at the same time reducing the environmental footprint. The object of the scientific research is the evaluation of sustainable economic development through the analysis of integrated sustainable development indicators. The aim of the research is, upon the evaluation of SDGs and environmental footprint indices as well as the analysis of the integrated sustainable development indicator, to identify the opportunities for sustainable economic development in the EU countries. The research has been carried out by analysing the scientific literature, and applying SDGs and environmental footprint methodology to calculate individual and integrated sustainable development indices. The results have shown that despite the disparity of SDG indices, the overall value of the integrated sustainable development indicator is distributed quite evenly among the EU countries. The impacts from each of the SDG indices range from 11% to 31% but the environmental footprint index has the greatest impact on the sustainable development of a country—up to 31%.

Keywords: sustainable development; SDG; environmental footprint; renewable energy

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1. Introduction

Sustainable development (SD) is defined as "... the paradigm for integrating environment and development policies to meet the needs of the present and allow the future generations to enjoy a decent standard of living" [1]. Accordingly, it is necessary to concentrate efforts to protect and save the environment without neglecting economic and social aspects. So far, national development activities have been evaluated mainly by using economic and GDP-based indicators. To measure sustainable economic development, there is a need to involve not only SDG indices but also the group of environmental footprint indices. The group of SDG indices usually reflect economic, social and ecological aspects. However, environmental footprint indicators must be added as well because they can measure the circularity of materials and energy in the region. Scientists [2,3] already in 1999 and others [4–9] a decade later have stated that economic development has to become sustainable, moving from linear growth to the circular economy. Some researchers [10] named this period the third industrial revolution, and well-being without growth [6] or the development of green assets [11]. Their criticisms can be related to the issues of prosperity, economic welfare and sustainability [12].

Prosperity includes a broader concept than the material standard of living. It covers a full range of economic, social and environmental elements that influence the overall well-being of societies [13]. Welfare could be created by using inventive management methods where the driving force would be smart people with smart leadership, smart government with smart infrastructure and smart industry [14]. Still, to harmonize SD there is a need to develop self-management, culture and knowledge [15]. There is a need for a shift from the concept of sustainable development toward a knowledge economy that is using innovations; consequently, the concept of sustainable development should be supplemented by basic dimensions of knowledge and communication [16]. Among the main challenges nowadays there are the environmental problems caused by human activities, and changes in people's behaviour are needed to solve them [16]. Economic development is associated with significant use of raw materials, consumption of natural resources and economic changes; hence, this can cause serious environmental and social impacts, and indeed, will increase the need for green materials and approaches in order to achieve overall sustainable development [17]. Human activities can degrade ecosystems, diminish ecosystem services of value to society, and cause serious environmental problems such as persistent toxicity, and pollution [18]. Therefore, the use of green and environmentally safe materials can protect the ecosystem and achieve the related SDGs.

Today, as never before, information about the environment and its problems is easily available but the approach to ecology and environmental processes is superficial and unsupported by fundamental knowledge. People are obliged to have a basic knowledge of environmental concepts and processes [19], but if they will attempt to maximize the goals of just one system, this will not achieve sustainability because the impacts on other systems are ignored [20]. The UN agenda emphasises that the interlinkages of the SDGs are important to ensure the realization of sustainable development [21]. To achieve progress in human well-being, countries will therefore need to commit to a broad agenda of sustainable development that acknowledges and exploits the links between different goals and targets [22]. The implementation of the SDGs in the face of climate change, social exclusion and increasing inequalities is a priority for governments around the world. Simultaneously, the effective achievement of SDGs requires an effective and integrated environmental approach [23]. Resources alone, of course, are not sufficient to achieve SDGs. They must be accompanied by appropriate policies, incentives and institutional frameworks [24]. For this reason, SDG-specific policy conversations are recommended, both within national governments and across international partner organisations [24]. Therefore, a wide range of tools and studies are needed to analyse the complexity of SDGs and to achieve the goals in the remaining years until 2030 [17]. SDG tools are designed to define, quantify and monitor SD parameters while gathering instrumental data to help politicians make informed decisions and create the right policy instruments that will lead to sectoral paradigm shifts [25]. The main objectives of the 17 SDGs are to reduce poverty, protect the environment and improve well-being.

Other tools such as life cycle analysis and ecological footprint (EF) are also used to assess sustainability [26]. The ecological footprint is used for the evaluation of human demand according to a finite area of biologically productive space [27]. The concept of EF is based on the evaluation of the physical area which is needed to sustain a certain process, whether it is an economic, industrial or farming one. The area is the underlying dimension of the EF method and, thus, the more area a process needs to fulfil a service, the more it costs from a sustainability point of view. The EF index is used to compare human demands against the biosphere's ability to renew [27]. One of the EF index methods in the EF family is called the Sustainable Process Index (SPI) which can be used for assessing ecological hotspots and finding alternate environment-friendly solutions in the life cycle of a process [28].

Even though there have been many attempts to develop a common single indicator for the evaluation of sustainable development, one single indicator is still lacking. In practice, a complex indicator called Integrated Sustainable Development Indicator is usually used for the evaluation of regional sustainable development [29]. The purpose of this article is the evaluation of SDG and environmental footprint indices as well as the analysis of the integrated sustainable development indicator, to identify the opportunities for sustainable economic development in the EU countries. The object of the paper is the evaluation of sustainable economic development through the analysis of integrated sustainable development indicators. The scientific question: how to develop a sustainable economy while ensuring the achievement of SDGs and at the same time reducing the environmental footprint? Research methods: scientific analysis of SDG and environmental footprint indices as well as the analysis of possibilities for sustainable economic development proposed by scientists and international organisations. The analysis of integrated sustainable development indicators is performed by using the approaches of the SDGs and environmental footprint and employing the Eurostat and Global Footprint Network databases.

2. The Assessment of Sustainable Economic Development

2.1. Limits to Growth

A limits to growth concept had been defined by D. Medouz in the report to the Club of Rome in 1972 and has set the background to the concept of sustainable development and opened the way for greater use of renewable resources. The types of renewable resources differ by their source, structure, availability, price and other aspects. Their classification is important for the assessment of the implementation of corresponding economic measures. An important shortcoming is that renewable resources are valued in the short term. Economic and financial measures are usually adopted, respectively, without applying long-term forecasts. As a result, only some types of renewable energy sources (RES), such as biofuels, wind and solar power generation, gain an advantage and dominant position in the sustainable regional energy economy. From a macroeconomic point of view, different forms of support mechanisms for the development of renewable resources have their specific purposes and objectives. However, their main direction is continuing development of a society which does not have to confront problems of quality of life and continuously maintains self-regulated mechanisms. Environmental problems are caused by human activities; thus, changes in people's behaviour are needed to solve them [16]. Consequently, the previously rather theoretical interpretation of the concept of sustainable development has switched to the practical implementation of different measures, such as the reduction of the use of fossil resources, development of RES, bio and circular economy, implementation of measures for pollution reduction, application of new technologies, etc. However, such measures have revealed environmental, social and economic shortcomings. One of them is the territorial dimension, which has become the most important criterion for sustainable development. Inhabitants and territorial suitability are the main parameters determining the suitability of a sustainable living model [30].

The sun is a major source of energy for the ecosystem, but the anthroposphere is lacking one element—the decomposer which breaks down useful components and closes the material cycle creating a waste-free system [31]. A new concept of economic development is associated with the interaction of the ecosphere and the anthroposphere. Economist Tim Jackson in his book "Prosperity without Growth" argues that well-being and prosperity are possible in the community which creates social capital. Nowadays, sustainable development has become a challenge in all sectors of economic activities. Particularly important are the problems of resource and energy supply, energy efficiency, and the protection of nature.

To achieve sustainability, a circularity of products and energy is needed. Therefore, a systematic approach is important in order to manage and control the resource flows and distribution, reduce waste and create useful materials from waste. The circular economy is designed following the cradle-to-cradle principle emphasizing effectiveness rather than efficiency [32]. In March 2020, the European Commission adopted a new Circular Economy Action Plan that defines initiatives for the life cycle of products. This plan describes the circular design measures of products and prioritises the reduction and reusing of materials before recycling [33] to ensure waste prevention measures, promote a circular economy and encourage sustainable consumption [34].

The first strategy of the circular economy includes the use of renewable and recyclable materials as resource inputs. Business entities adopt cut-waste technologies and increase efficiency by phasing out the use of scarce resources [35]. The second strategy describes the recovery of resources. It emphasises innovative recycling and upscaling techniques to increase the value at the end of a product life cycle and to promote return flows. The various resources have different return flows which depend on recycling methods [35]. The third strategy describes the method of product life extension. The lifecycle of a product can be extended using repairing, upgrading, remanufacturing or remarketing. The fourth strategy promotes the sharing principle, which increases the use of products, and facilitates utilisation, productivity and user value creation [35]. The fifth strategy—product as a service—constitutes an alternative model of buying and owning a product. It describes the principle of maintaining the ownership of the product while allowing one or more customers to lease it [35].

2.2. The Green Deal Is a Flagship of the EU Sustainable Development

The life cycle approach, used for the evaluation of the environmental impacts of a product or service throughout the value chain, is important. Upcoming legislation and legislative proposals, such as the EU Bauhaus, the EU Circular Economy and the EU Environmental Footprint, are increasing the pressure on all economic sectors. In 2019, the EU came up with one of the biggest challenges in environmental policy development by adopting The European Green Deal. This is an ambitious document promoting efforts to reach long-term sustainability and climate neutrality [36]. This deal has multiple strategies, policy instruments and targets (for example, the new Circular Economy Action Plan and the 2030 Biodiversity Strategy). It promotes eco-innovative, sustainable and digital technologies. Moreover, other policy documents such as the Zero Pollution Action Plan adopted in May 2021 and the Fit for 55 Package launched in mid-July 2021 are the main tools for the EU and its Member States to help cut emissions by at least 55% by 2030. The Green Deal covers many sectors and themes but the most important are the following: industry, especially energy and resource-intense sectors, circular economy, mobility, agriculture, forestry, ecosystem, blue economy, research and development, financial and bilateral cooperation.

The reason for the appearance of the Green Deal is the lack of sufficient real initiatives for SD. The annual global extraction of materials has tripled from 1970 to 2017; it contributes to about half of total greenhouse gas (GHG) emissions and more than 90% of biodiversity loss. As well as the resource extraction and processing of materials, fuels and food have increased the contamination of water. The EU's industry still accounts for 20% of the EU's GHG, because it remains too "linear" and only 12% of the materials it uses come from recycling. Therefore, now the industry is shifting to a circular economy through expanding sustainable and job-intensive economic activities. The circular economy has a significant potential for low-emission technologies, sustainable products and services. It offers great potential for new activities and jobs in energy and resource-intensive industries, such as steel, chemicals, cement, textiles, construction, electronics and plastics. Measures of extracting embodied materials, such as the use of micro and biodegradable plastics, acquire great importance. New forms of collaboration in industry gain importance for the development of supply chains. Digital technologies are critical enablers for attaining the SDGs in all sectors. The EU has committed itself to implementing the SDGs as outlined in the Green Deal and to increasing resource productivity, decoupling economic growth and reducing environmental impacts using the life cycle approach [37].

Construction and building sectors need a lot of energy and mineral resources. The building sector consumes about 40% of total energy use; therefore, there is a need for the enforcement of legislation related to the energy performance of buildings. A sustainable product and energy policy has the potential to reduce the use of resources and waste and ensure the supply of sustainable raw materials. The circular economy plan also provides many alternatives to consumers to choose durable and repairable products; however, reliable, comparable and verifiable information is needed to make more sustainable decisions and reduce the risk of "greenwashing".

The transport sector emits a quarter (25%) of the EU's GHG emissions; therefore, according to the Green Deal document, a 90% reduction in transport emissions is needed by 2050. To achieve this goal, multimodal transport needs a strong boost, in the development of production and deployment of sustainable alternative transport fuels. Transport should become less polluting, especially in cities as well. There is a need to mobilise research on new technologies, sustainable solutions and disruptive innovations. A full range of instruments is available under the Horizon Europe programme, and information is a core element for data-driven innovation.

The European food sector is well developed and famous for being safe, according to the EU Green Deal document. High quality nutrition will, however, require a global sustainability standard in the food value chain. The Farm to Fork Strategy can contribute to achieving circular economy targets by stimulating sustainable food consumption and promoting affordable and healthy food. This document contributes to sustainable development as well, because the consumers can get information from the farmers about their products, and evaluate the nutritional value and the environmental footprint.

A sustainable "blue economy" plays a central role in the Green Deal policy. The main goals are to achieve zero pollution and a toxicity-free environment, prevent pollution from being generated and restore the natural functions of ground and surface water.

The financial sector has ambitious goals as well. At least 30% of the EU Investment Fund has to contribute to fighting climate change. The European Commission proposed the Just Transition Mechanism, including the Just Transition Fund, Greening national budgets of the EU countries and well-designed tax reforms.

Last but not least, the EU has to become a global leader in cooperation to achieve SD. After the Paris Agreement, the EU can provide continuing leadership for tackling climate change. Consequently, bilateral engagement with partner countries is necessary to develop international carbon markets, and to support trade policy and the EU's ecological transition mechanism.

3. The Evaluation of Indices for Sustainable Economic Development

3.1. The Evaluation of SDG Indices

Sustainable development objectives have been at the heart of European policy-making for a long time and they are supporting the implementation of key projects, sectoral policies and initiatives [33]. The Sustainable Development Agenda 2030 and its 17 Sustainable Development Goals (SDGs) give the impulse for achieving sustainable development [33]. In 2015, the United Nations (UN) adopted 17 SDGs which are divided into 169 targets; the 232 indicators are used to follow the realization of the 17 SDGs and their targets [37]. In 2001, the European Council adopted the first European Union SD strategy. It has 155 indices and they are divided into 10 groups. The earlier Lisbon Strategy devised in 2000 had 14 structural indices. At country level, the Lithuanian SD strategy, for example, has 84 indices. The traditional function of indicators is either external evaluation or internal steering of government or corporate actions [37]. SDGs are the major agenda for sustainable development by 2030 and the main embodiment of sustainable development [38]. All SDGs cover the main aspects of the sustainable development triangle—the natural, economic and social environment. Additional components of other indices can be added as well.

All SDGs have been investigated as useful indices for assessing the sustainability of economic activities. The differences in SDG indicators between the EU countries lie mainly in the economic and social dimensions, especially in GDP and GDI per capita, and this divides the EU into two groups of countries—"rich" and "poor" countries [39]. The developed countries provide better well-being but have greater environmental and material footprints. They need to reduce their environmental footprint substantially to achieve SDG 12 (responsible consumption and production). However, the top trade-off pair of SDG 3 (good health and well-being) and SDG 12 is the most widespread across 121 countries [40].

SDG 8 emphasises economic growth while improving resource use efficiency by reduction of material footprints; however, nowadays 77% of countries have an unbalanced sustainable development situation regarding the reduction of the environmental footprint (EF) [40]. All aspects of SD are important in the evaluation and analysis of SDGs and their policy documents but social and economic aspects do not allow us to create groups of EU countries with similar environmental and energy profiles [39].

According to their structure, SD indices can be divided into two types: simple and complex. Simple indices are used to measure one activity, i.e., economic activity is measured by using the GNP or FDI index; environmental activity—by using the values of GHG or CO_2; social activity—by using the rate of disease or job skills. Complex indices combine two or more individual indicators or "sub-indicators" into one number. Composites have the advantage of expressing complex information within a single index and allowing companies or countries to be ranked in terms of their general sustainability [26]. The overall sustainable development indicator is obtained by combining the values of the sectoral sustainability indicators [26].

3.2. Additional Indicator—The Environmental Footprint Index

Stakeholders and researchers recognise the need for further development of all indicators to track sustainability. The European Commission has developed indicators on efficiency and productivity in the use of natural resources and academic researchers have supported and continue to support the development of national Ecological Footprint accounts [41]. A "footprint" is a quantitative measurement describing the appropriation of natural resources by humans and describes how human activities can impose different types of burdens and impacts on global sustainability [26]. Ecological footprint and its categories are always defined in units of area; however, footprints other than these, are not usually defined (only) in area units [26]. The main strength of the ecological footprint concept is that it is attractive and intuitive and it helps in understanding the complex relationships between the many environmental problems [26]. However, it should be noted that it measures only one major aspect of sustainability and not all environmental concerns, so the ecological footprint excludes economic or social indicators [26]. One of the complex indicators which have been pointing in the same direction as other SDGs is the environmental footprint indicator. However, only the material footprint is an official SDG indicator, while other footprints have spread over different SDG targets [42]. The European Commission, DG Environment defines environmental footprint methods as the environmental performance of products (both goods and services) and organizations (companies, public administrative entities and other bodies) across their whole lifecycle relying on scientifically sound assessment methods agreed upon as international standards to enable reducing the environmental impacts [43]. Other scientific references, for example, Sphera—one of the leaders in the practical application of EF methodology, defines EF and ecological footprint as a method to evaluate the supply and demand of goods and services for the planet and assumes that the entire population follows a certain lifestyle characterized by a known person or a group of people. The Cambridge dictionary defines environmental footprint as the effect a person, company, activity, etc. has on the environment, for example, the number of natural resources that they use and the harmful gases that they produce.

The European Commission created a recommendation (2013/179/EU) on the use of common methods to measure the performance of products and organisations along with the Product Environmental Footprint (PEF) and the Organizational Environment Footprint (OEF) Guide in April 2013. This document aims to provide comprehensive technical guidance on how to conduct an assessment of the environmental footprint and reduce environmental impacts [43]. PEF and OEF enable measurement of environmental performance by providing reliable environmental information. The new European Commission recommendation on the use of the PEF and OEF methods (C/2021/ 9332 final) adopted on 16 December 2021, concluded that Environmental Footprint methods (EU Environmental Footprint) can support the communication of environmental impacts based on the EU

Environmental Footprint pilot phase during the period 2013–2018 and can be used in policy development at EU level [44]. It was noted that the EU Environmental Footprint method has the potential for various product policy tools and can be the framework for sustainable products, consequently, the use of EU Environmental Footprint methods is already foreseen in the context of EU policies and legislation such as the Taxonomy Regulation, the Sustainable Batteries Initiative and the Green Consumption Pledge [44]. It should help companies to calculate their environmental performance based on reliable, verifiable and comparable information, and for other actors (public administrations, NGOs and business partners) to have access to such information and should also enhance the development of an EU Environmental Footprint database [44].

The environmental footprint methodology calculates the overall environmental impacts of economic activities, products, production or services. The materiality principle is the core element of the EU Environmental Footprint and it focuses on the processes, impacts and lifecycle stages that are most relevant from an environmental perspective. The EU Environmental Footprint is a complex evaluation method based on the Life Cycle Assessment (LCA) approach and involves thousands of processes. However, about 10–20 of those processes are responsible for about 80% of the impacts. The natural cycles, ecosystems and natural resources are being degraded and altered by human impact, and the environmental problems are grave [32]. The EU Environmental Footprint method is used as a standard for a final LCA of products and allows us to understand whether a product is better or worse than the average, including the evaluation of packaging, electricity, transport and other processes. The EU Environmental Footprint method proved a useful tool for emerging policies such as sustainable finance (taxonomy) because it can define environmentally sustainable (taxonomy) activities and evaluate the CO_2 index. The EU Environmental Footprint helps to assess the processes of production or service and to reveal the problem areas from the viewpoint of environmental degradation [45]. It reveals the choices to reduce the impacts on the environment and can be used in the preparation of strategic action plans by business entities or the whole sector of the economy. The EU Environmental Footprint is a good informational tool for consumers because it provides clear and understandable information about sustainable and green products. One of the main aims of the EU Environmental Footprint method is to promote sustainable goods to consumers. The forerunners in the area of communicating lifecycle environmental performance to consumers are Austria, France and Germany [46]. The application of product-specific calculation rules is called Product Environmental Footprint Category Rules (PEFCRs) which can be applied by business entities and the economic sector. These are the most comprehensive tools for the EU Environmental Footprint evaluation and they have been developed to avoid 28 different systems to measure the lifecycle environmental performance. Italy is the first country in the EU that has created a voluntary initiative called "Made Green in Italy" relying on PEF.

The evaluation of sustainable development of economic activities is carried out using SDG and EU Environmental Footprint methodology. SDG is based on SD principles, while the EU Environmental Footprint uses the life cycle methodology that can assess the environmental impacts of economic activities. Impacts on the environment as pollution of air, water and soil, consumption of renewable and fossil resources, and generation of waste are also evaluated. Activities which do not harm the natural environment are called sustainable as they do not exceed the bio-productive capacity of the environment.

4. Data and Methods

All indicators of these SDGs are expressed in fractions (number fraction, volume fraction, value fraction) and expressed in per cent. Social aspects are reflected in the group SDG 2 (Zero hunger), SDG 3 (Good health and well-being) and SDG 12 (Responsible consumption and production). The environmental aspects are reflected in the group SDG 11 (Sustainable cities and communities), SDG 13 (Climate action) and SDG 7 (Affordable and clean energy). The values here are expressed in percentages or quantities. The aspects of knowledge are reflected in the group SDG 4 (Quality education) and SDG 17 (Partnership for goals). The values here are expressed in percentage. Some SDGs (SDG 7, SDG 12 and SDG 17) can be used to define all aspects of sustainability. The share of RES in gross final energy consumption can be attributed to environmental and economic indicators. The development of RES decreases the environmental pressure through the reduction of the use of fossil resources but it also increases economic development. Consequently, in the present research, this indicator (SDG 7_40—share of RES) has been assigned to the environmental group of SDG indicators. SDG indicators and EU policy targets that are the most relevant to sustainable business development are presented in Table 1 below. The abbreviations in Table 1 are as follows: ECON—economic indicators; SOC—social indicators; ENV—environmental indicators; KNOW—knowledge indicators.

Table 1. SDG indicators in relation to EU policy targets.

SD Group	SDG Indicator	SDG Group. Definition. Targets Defined by Policy Documents	Unit; Policy Reference
ECON	SDG 9_10—Gross domestic expenditure on R&D by sector	SDG 9—Industry, innovation and infrastructure. This indicator measures gross domestic expenditure on R&D as a value fraction of the gross domestic product (GDP). Increasing combined public and private investment in R&D to 3% of GDP. The objective for this indicator is a value of 3.7	Number, value fraction expressed in per cent; European Research Area
ECON	SDG 17_10—Official development assistance as a share of gross national income	SDG 17—Partnership for the goals. This indicator measures the financial support (grants, loans), expressed as a share of the Gross National Income (GNI) of a country, provided to developing (recipient) countries. Provide 0.7% GNI as official development assistance within the timeframe of the 2030 Agenda	Number, value fraction; The new European Consensus on Development
ECON	SDG 7_30—Energy productivity or economic output to produce a unit of gross available energy	SDG 7—Affordable and clean energy. The indicator measures the economic output that is produced per gross available energy. 32.5% increase in energy efficiency by 2030	Number, fraction of energy productivity; EUR/MJ, Directive (EU) 2018/2002
SOC	SDG 2_40—Area under organic farming	SDG 2—Zero hunger. The indicator measures the share of total utilised agricultural area (UAA) occupied by organic farming (existing organically-farmed areas and areas in process of conversion). At least 25% of the EU's agricultural land should be under organic farming by 2030	Number, area fraction; Farm to Fork strategy
SOC	SDG 3 and SDG 11_40—Road traffic deaths by type of roads	SDG 3—Good health and well-being. SDG 11—Sustainable cities and communities. The indicator measures the number of fatalities caused by road accidents, including drivers and passengers of motorised vehicles and pedal cycles as well as pedestrians. Halving the overall number of road deaths in the EU by 2020 starting from 2010	Number, fraction of deaths per 100,000 population Towards a European road safety area
SOC	SDG 12_30—Average CO_2 emissions per distance from new passenger cars	SDG 12—Responsible consumption and production. The indicator is defined as the average carbon dioxide (CO_2) emissions per distance travelled by cars in a given year. Reduce CO_2 emissions from new passenger cars to 95 g of CO_2 per km in 2020	Number, mass of emissions per distance travelled, (g/km). Regulation (EU) 2019/631

Table 1. *Cont.*

SD Group	SDG Indicator	SDG Group. Definition. Targets Defined by Policy Documents	Unit; Policy Reference
ENV	SDG 11_60—Recycling rate of municipal waste	SDG 11—Sustainable cities and communities. The indicator measures the mass fraction of recycled municipal waste divided by the total municipal waste arising. Increase the preparation for re-use and recycling of municipal waste to a minimum of 60% by weight by 2030	Number, mass fraction of recycled municipal waste.Directive (EU) 2018/851
ENV	SDG 13_10—Greenhouse gas emissions	SDG 13—Climate action. The indicator measures total national emissions of greenhouse gases (GHG), including CO_2, CH_4, N_2O, F-gases (NF_3), SF_6 from all sectors of the GHG emission inventories. Reduce net greenhouse gas emissions by 55% by 2030 compared to 1990	Number, mass flow rate of Greenhouse Gas Emissions per capita, (kg/per year). European Climate Law
ENV	SDG 7_40—Share of RES in gross final energy consumption	SDG 7—Affordable and clean energy. The indicator measures the share of renewable energy consumption in gross final energy consumption according to the Renewable Energy Directive. Increase the share of RES in gross final energy consumption by at least 32% by 2030	Number, energy fraction of RES (%). Directive (EU) 2018/2001
KNOW	SDG 4_20—Tertiary educational attainment	SDG 4—Quality education. The indicator measures the share of the population aged 25–34 who have completed tertiary studies (e.g., at a university or a higher technical institution). The share of 25–34 year-olds with tertiary educational attainment at least 45% by 2030	Number, fraction of population. European Education Area
KNOW	SDG 4_70—Share of individuals with at least basic digital skills	SDG 4—Quality education. This indicator measures the share of people aged 16 to 74 having at least basic digital skills. By 2025, 230 million adults should have at least basic digital skills (this is around 70% of the adult population in the EU)	Number, fraction of population. European Education Area
KNOW	SDG 17_60– Share of households with high-speed internet connection	SDG 17—Partnership for goals. The indicator measures the share of households with fixed very high capacity network connections. By 2030, all European households should be covered by a Gigabit network	Number, fraction of the population. 2030 Digital Compass

The values of these indicators have been obtained from Eurostat databases regarding the type of SDG. An additional environmental footprint indicator has been used to better assess environmental performance. The modified version has been applied by additionally adding these indices. The environmental footprint approach has been investigated and the method developed by Wackernagel and Rees [2,5] and their research team [47]. Consequently, three indicators have been used to evaluate the environmental footprint index: human development index (HDI), environmental footprint and biocapacity index. The values of HDI have been retrieved from the Human Development Reports published by the United Nations Development Programme (UNDP).

The integrated sustainable development index (I_{SD}) covers three main aspects of sustainable development (economic, social and environmental). The I_{SD} approach was developed by R. Čiegis [48,49] and is used in this research. Calculation of I_{SD} can be expressed by the following Formula [48]:

$$I_{SD} = \sum_i a_i I_i \tag{1}$$

where: I_i—indices of individual aspects of sustainable development; a_i—weights of indices of individual aspects of sustainable development (under the condition $\sum_i a_i = 1$).

However, additional indices such as knowledge, innovation and environmental footprint have been added, thus I_{SD} can be calculated by using the modified Formula:

$$I_{SD} = a_1 I_{Econ} + a_2 I_{Soc} + a_3 I_{Env} + a_4 I_{Know} + a_5 I_{EF} \tag{2}$$

where: I_{Econ}, I_{Soc}, I_{Env}, I_{Know}, I_{EF} are economic, social, environmental, knowledge indices and environmental footprint index, respectively; a_1, a_2, a_3, a_4, a_5 represent weight or importance of indices (under the condition: $a_1 + a_2 + a_3 + a_4 + a_5 = 1$).

Each of the SD indices (I_{Econ}, I_{Soc}, I_{Env}, I_{Know}, I_{EF}) consists of a series of indicators and the Formula can be expressed thus:

$$I_m = \sum_i \mathrm{a}_i R_i \tag{3}$$

where: I_m is the indicator comprising the relevant index; a_i—the weight of the indicator comprising the relevant index (under the condition: $\sum_i a_i = 1$); R_i—relevant index [48,49].

The reliability of applied discounting principles in the long term will increase the sustainable development index I_{SD} which is calculated using the following Formula [46]:

$$I_{SD} = \frac{I_{SD}}{(1+r)^t} \tag{4}$$

where: t—time index, years; I_{SD}—integrated sustainable development index (t in years), and r— discount rate.

In order for the data to be compared across indicators, each variable has been rescaled from 0 to 100. Rescaling is usually very sensitive to the choice of limits and extreme values (outliers) at both ends of the distribution. Consequently, the choice of the upper and lower bounds can affect the relative ranking of countries in the index. In particular, this applies to the lower bounds that affect the value and the units of the variable which may, in turn, affect rankings, while the upper bound only affects the units.

Having defined the minimum and maximum values (x) of SDG, the dimension indices are calculated according to the Formula presented below [50]:

$$x' = \frac{x - min(x)}{max(x) - min(x)} \tag{5}$$

where: x is the raw data value; max/min denote the bounds for the best and worst performance, respectively; and x' is the normalised value after rescaling [51].

Each indicator distribution was censored. All values exceeding the upper bound scored 100, while values below the lower bound scored 0. After establishing the upper and lower bounds, variables have been transformed linearly to a scale between 0 and 100 by using the following rescaling formula for the range (0; 100).

The I_{SD} is calculated by assuming that the basic indicators representing SD are equivalent. An equal number of economic, social and environmental indicators is necessary to evaluate the integrated sustainable development index. The weight of indices is divided by the number of indices. The economic development index is calculated as the GDP per capita, energy use or emission emitted per capita. The social development index usually represents the number of accidents on the road per 100,000 population, emission in kg/a of CO_2 per passenger car and quantity of area in m^2 or km^2 of organic farming. The environmental index is evaluated as the mass in t/a of waste generated and recycled per year, the mass flow rate of GHG emission per capita in t/a, and the installed renewable power generation in kW. The knowledge index is evaluated as a fraction of the population with higher education and digital skills, and the share of high-speed internet. The environmental footprint index is evaluated as the HDI index, the environmental footprint of consumption per capita and biocapacity per capita. According to the concept of environmental footprint, the environmental footprint value is calculated by using this Formula [47]:

$$a_i = \frac{c_i}{y_i} \times F \times E_f;\ \ and\ \ F_p = \sum_{i=1}^{n} a_i;\ \ f_c = \frac{F_p}{N} \tag{6}$$

where: a_i is the environmental footprint of investigated element (measured in gha); c_i—annual consumption (measured in kg, t, m^3, etc.); y_i—output of each element (kg/ha, m^3/ha, etc.); F—yield factor; E_f—equivalence factor; F_p—total environmental footprint for the population; f_c—footprint per capita; N—population number. A calculation of the EF uses another index called a bio-capacity index. It represents the capacity of the ecosystem to produce biological materials and to absorb generated waste.

The EF indicates the pressures resulting from the overall resource consumption, and if EF exceeds its biocapacity, this excess is denoted as an ecological deficit [45]. If the EF is higher than the biocapacity, the country runs an ecological deficit. It is possible for countries to run a footprint that is larger than the country's biocapacity; if the country imports the biocapacity from elsewhere, it uses the global commons or overuses its own territorial biocapacity [47,52].

Additionally, the social aspects have been evaluated by using Human Development Index (HDI), developed by the UN Development Programme [49]. HDI measures the key dimensions of human development: a long and healthy life, knowledge and a decent standard of living. These dimensions are measured using the life expectancy index, educational attainment or knowledge index and adjusted real GDP per capita index [49].

$$I_{HD} = (I_{Health} \times I_{Education} \times I_{Income})^{\frac{1}{3}} \tag{7}$$

Economic indicators can be chosen according to the evaluation of GDP, which is calculated by adding the final consumption of households and government, investment (gross capital formation) and exports, but deducting imports [53]. Environmental footprint and HDI indices have been retrieved from Footprint Network databases [45]. SDG values have been taken from the EU Eurostat [54] databases.

5. Results

The main aspects of sustainable development (economic, social, environmental and knowledge) have been evaluated. An additional Human Development Index and Environmental Footprint Index have been included for better reflection of the principles of the circular economy. These indices represent the involvement of the region (country) in innovative R&D actions and show the country's environmental footprint by estimating the biological capacity of the region (country). The Human Development Index emphasises the development of a country, not just the economic growth alone. The environmental footprint index presents the pressure on the environment and helps to measure the regional biocapacity and its ability to cope with anthropogenic influence. The calculation of the integrated sustainable development indices of the EU countries has been carried out for the period 2015–2020. The value of the integrated sustainable development index and the values of SDG indices reveal the attitude towards sustainable development. A larger index reveals a better sustainable development rate. If the SDG index has a negative value, it means that a certain index has decreased when comparing the years 2020 and 2015. The results reveal that almost all SDG indices have increased; only in some cases they have decreased. The results of the calculations are presented in Tables 2–5 below.

Table 2. Individual and integrated sustainable development indices of the EU countries in 2015.

2015	BE	DK	FR	D	EL	IE	IT	LU	NL	PT	ES	AT	FI	SE
I_{Econ}	12.37	22.38	12.06	16.15	5.01	12.31	8.66	15.09	14.59	6.32	6.52	15.47	14.58	24.32
I_{Soc}	9.21	18.38	13.92	16.53	13.40	16.98	12.00	8.00	25.50	12.91	15.08	10.57	17.27	12.36
I_{Env}	12.22	20.73	14.94	16.30	10.10	12.35	14.66	10.83	11.19	15.00	11.86	20.77	20.77	23.82
I_{Know}	15.29	15.18	12.77	14.48	13.79	11.89	3.65	20.89	15.28	13.16	11.76	12.20	19.72	14.93
I_{EF}	27.03	24.14	27.71	28.76	28.51	26.95	29.24	19.70	29.07	28.55	29.29	25.79	17.43	20.01
I_{SD}	76.12	100.81	81.40	92.22	70.81	80.47	68.20	74.52	95.63	75.95	74.50	84.80	89.77	95.43

Table 3. Individual and integrated sustainable development indices of the EU countries in 2020.

2020	BE	DK	FR	D	EL	IE	IT	LU	NL	PT	ES	AT	FI	SE
I_{Econ}	16.66	22.74	14.46	19.31	7.81	15.86	9.55	16.21	14.26	8.22	8.58	15.89	14.42	23.66
I_{Soc}	14.66	22.54	19.48	23.66	16.46	20.33	15.80	14.15	31.63	15.97	18.45	14.69	24.45	19.78
I_{Env}	14.57	23.61	16.54	18.89	14.26	14.89	17.47	13.28	15.02	17.22	15.94	21.51	23.40	27.47
I_{Know}	20.45	20.67	19.00	15.36	20.56	18.97	8.08	22.73	22.13	18.86	19.48	18.94	24.30	14.77
I_{EF}	27.49	29.17	27.92	29.41	29.24	27.42	27.63	20.24	29.38	28.74	29.69	26.46	18.77	21.02
I_{SD}	93.84	118.74	97.40	106.63	88.33	97.47	78.53	86.61	112.42	89.01	92.14	97.49	105.34	106.69

The results for SDG indices in the period between 2015 and 2020 show that the majority of SDG indices increased by from 14 to 34%. The largest increase was observed in the SDG knowledge index: on average about 27–32%. The increase of the economic SDG index was about 14–20%, on average; the environmental SDG index increased on average by 17–24%; while the social SDG index increased by 28–34%. In general, the integrated sustainable indicator increased on an average by 17–19%. However, a decrease in economic SDG values was observed in the Netherlands, Finland and Sweden due to the decrease in official development assistance as a share of gross national income. The EF index stayed almost at the same level of old EU 14 and new EU 13 countries, only a decreased was observed in Croatia (by 7%), Italy (by 6%), Sweden (by 5%), Latvia (by 4%), Lithuania and Romania (by 3%), Slovenia and Estonia (by 1%).

As can be seen from Tables 4 and 5, Bulgaria showed the smallest values of all SDG indices, but the integrated sustainable indicator of Bulgaria increased by 23% in 2020, compared to the same indicator in 2015. The social and knowledge SDG indices increased the most, by 62% and 41%. The economic SDG index increased the least by 6%, while the EF index stayed at the same level. The largest increase in the integrated sustainable development index was observed in Estonia (by 36%) and Ireland (by 34%), where all SDG values increased as follows (respectively): the economic index increased by 34% and 29%; the social index—by 57% and 20%; environmental index—by 45% and 21%; knowledge index—by 63% and 60%; and EF index—by 1%. The increase in the integrated SD index was also observed in Slovenia (11%), Sweden (12%), Cyprus (13%), Romania, Italy and Austria (15%), Luxemburg and Germany (16%), Finland and Portugal (17%), the Netherlands and Denmark (18%), France (20%), the Czech Republic, Croatia, Poland and Ireland (21%), Lithuania and Bulgaria and Belgium (23%), Latvia and Spain (24%), Greece (25%), Slovakia (27%), Malta (28%), Hungary (29%), Greece (30%), Hungary (31%) and Estonia (34%).

Analysis of the data presented in Tables 2 and 3 above and Tables 4 and 5 below shows that the smallest (3) index values pertain to Bulgaria, Hungary and Romania. Other countries such as the Czech Republic, Estonia, Croatia, Italy, Latvia, Lithuania, Hungary, Romania, Poland and Slovakia have two SDG indices below the value of 10. The economic SDG index has changed the most among the EU countries.

Table 4. Individual and integrated sustainable development indices of EU countries in 2015.

2015	EU27	BG	HR	CY	CZ	EE	HU	LV	LT	MT	PL	RO	SK	SI
I_{Econ}	11.93	2.06	3.33	2.99	6.78	5.05	4.96	2.18	3.96	2.81	3.50	1.69	4.29	8.88
I_{Soc}	11.99	7.42	12.30	12.13	8.99	7.37	6.35	3.73	5.09	16.18	7.51	6.78	12.08	13.44
I_{Env}	14.53	7.46	12.05	5.84	13.43	11.42	13.91	16.49	10.84	9.73	10.63	9.84	9.92	16.58
I_{Know}	8.83	5.16	8.45	21.25	14.09	11.86	7.97	14.30	18.56	10.59	13.31	5.54	10.61	13.42
I_{EF}	26.38	27.54	29.93	30.57	26.68	19.15	28.22	21.69	24.93	30.25	27.80	28.60	26.63	28.17
I_{SD}	73.66	49.64	66.06	72.78	69.97	54.84	61.41	58.39	63.38	69.57	62.74	52.45	63.53	80.49

Table 5. Individual and integrated sustainable development indices of EU countries in 2020.

2020	EU27	BG	HR	CY	CZ	EE	HU	LV	LT	MT	PL	RO	SK	SI
I_{Econ}	13.75	2.19	5.35	4.65	7.40	6.78	7.27	3.00	4.67	4.35	5.41	2.26	3.87	9.28
I_{Soc}	16.87	12.00	17.55	15.15	15.34	11.58	11.57	10.73	10.75	19.40	10.55	11.05	16.66	18.17
I_{Env}	17.19	12.27	15.23	8.42	15.63	16.52	14.63	19.78	14.32	13.39	13.38	11.11	15.67	18.12
I_{Know}	17.36	7.27	14.18	23.74	19.26	19.36	17.29	17.80	23.88	20.99	17.98	8.02	17.03	16.09
I_{EF}	26.67	27.41	27.94	30.45	27.02	18.99	28.20	20.91	24.13	30.57	28.67	27.74	27.52	28.02
I_{SD}	91.84	61.14	80.25	82.42	84.65	73.24	78.96	72.22	77.75	88.70	76.00	60.17	80.76	89.69

Denmark is one of the EU countries where the EF index increased the most, by 21% in 2020. The EF index in Sweden increased by 5%, in Finland increased by 8%, and in all other older EU 14 member states EF index has increased by 3% on average. The main reason for the increase in EF index was the decrease in biocapacity index and increase in the EF index. Finland has the largest biocapacity reserve among all EU countries; however, the index has decreased in Finland as well. The value of the EF index has changed but not very much in Germany, Estonia, Ireland, France, Croatia, Luxemburg, the Netherlands and Portugal. The natural environment remained at the same level in the old 14 EU countries. Only Italy and Sweden showed a small improvement in the EF values among the older EU 14 countries, where EF index decreased by 6% in Italy and by 5% in Sweden. The environmental conditions have improved in some of the new EU 13 countries. The EF values among new EU 13 member states have been distributed as follows: EF index has decreased in Croatia by 7%, in Latvia by 4%, Lithuania by 3%, Romania by 3%, Estonia by 1% and Slovenia by 1%. The EF index has decreased by 1% on average among the new EU 13 member states and increased by 3% on average among the old EU 14 countries. However, the assessment of the integrated sustainable development index in Table 6 shows a more stable variation of I_{SD} values among the investigated EU countries. The I_{SD} index of old EU 14 member states increased by 18% on average and for new EU 13 countries increased by 21% on average. The I_{SD} index values have distributes as follow: increased by 11% in Slovenia and Hungary, by 12% in Cyprus and Sweden, by 15% in Romania, Austria and Italy, by 16% in Luxemburg and Germany, increased by 17% in Finland, by 18% in the Netherlands, Denmark and Bulgaria, by 20% in France, and by 21% in Ireland and Poland, increased by 23% in Belgium and Latvia, by 24% in Spain and Lithuania, by 27% in Slovakia, by 28% in Malta, 29% in the Czech Republic and Hungary, and by 34% in Greece and Estonia. The EU countries with the smallest I_{SD} values have the biggest disparity in SDG indices. Sweden, for example, showed a decrease of I_{Econ} by 3% and I_{Know} by 1%, an increase of I_{Soc} by 60%, I_{Env} by 15% and I_{EF} by 2%. Slovakia, for example, showed an increase of I_{Econ} by 5%, I_{Soc} by 35%, I_{Env} by 9%, I_{Know} by 20%, but had a decrease of I_{EF} by 3%. Austria, for example, showed an increase of I_{Econ} by 3%, I_{Soc} by 39%, $I_{Ethe\ env}$ by 4%, I_{Know} by 55%, and I_{EF} by 4%. Estonia, for example, showed an increase of I_{Econ} by 34%, I_{Soc} by 57%, I_{Env} by 45%, I_{Know} by 63% and I_{EF} by 1%. The impact of all SDG indices, including the EF index, on the overall I_{SD} index value, is distributed on an average as follows: I_{Econ}

represents about 11–13%, I_{Soc} represents 16–20%, I_{Env} represents 18–21%, I_{Know} represents 18–23%, I_{EF} represents 26–31%.

Table 6. Increased of ΔI_{SD} index score of the EU countries in 2015 and 2020.

Increase of ΔI_{SD}, 2015	**BE**	**DK**	**FR**	**D**	**EL**	**IE**	**IT**	**LU**	**NL**	**PT**	**ES**	**AT**	**FI**	**SE**
I_{SD} index	17.7	17.9	16.0	14.4	18.4	17.0	10.3	12.1	16.8	13.1	17.6	12.7	15.6	11.3
Relative increase	23%	18%	20%	16%	34%	21%	15%	16%	18%	17%	24%	15%	17%	12%
Increase of ΔI_{SD}, 2020	**EU27**	**BG**	**HR**	**CY**	**CZ**	**EE**	**HU**	**LV**	**LT**	**MT**	**PL**	**RO**	**SK**	**SI**
I_{SD} index	18.2	17.9	9.2	11.3	17.5	18.4	17.5	13.8	14.4	19.1	13.3	7.7	17.2	9.2
Relative increase	25%	18%	11%	12%	29%	34%	29%	24%	23%	28%	21%	15%	27%	11%

6. Discussion

The EU made progress toward most of the SDGs over the recent five-year period and the progress toward some SDGs was faster than for others [34]. EU made strong progress in improving the EU's health situation (SDG 3); however, the COVID-19 pandemic situation has influenced the development of this and other SDGs [55]. The pandemic situation has affected the development of SDG4 and SDG17. Moderate progress is visible only in the development of SDG11, SDG2, SDG12 and SDG9 [55]. The overall assessment of SDG 13 'Climate action' remains more or less neutral. However, SDG 7 shows a slight movement away from the respective SD objectives over the past five years [55]. Probably these were the reasons influencing the overall results of the calculations of SDG values, especially given the largest differences between some values. For example, more developed countries with higher human development indices have a larger EU Environmental Footprint, so the environmental pressure is unevenly distributed among EU countries [56].

Each EU country has responsibility for its own economic and social development. The analysis of SDGs shows that the biggest differences are among social and knowledge indicators. This shows that the social and education sectors are the most sensitive. To improve the situation in these sectors the mobilization of financial resources is needed. Public finance is also important in providing essential services and public goods and in catalysing other sources of finance.

Each EU country faces specific challenges and influences sustainable development. The results of this study show that the largest contribution to the integrated SD index consists of the environmental and EF index. This proves that environmental impacts are the greatest challenges and influence the ability of EU countries to achieve sustainable development goals. The concept of the EU Environmental Footprint is still under the practical implementation phase. However, the European Commission is pushing forward the development of EU Environmental Footprint methods. Usually, the stakeholders use the carbon dioxide footprint instead, because it is more comprehensive and easy to apply practically. The EU Environmental Footprint is a good public and education tool for the evaluation of impacts on the environment from a production or consumption point of view, however. It can be used for the development of sustainable management activities and to minimize the negative environmental impacts. One of the practical solutions of the EF method is that stakeholders, producers, and consumers can evaluate products or production types by their environmental footprint. Later, the government can choose the regulatory measures to facilitate the selection of products or promotion of production by their environmental footprint.

The article presents a calculation of the integrated sustainable development indicator of economic development in EU countries from 2015 to 2020. While analysing the impact of sustainable economic development it became clear that the cases in each EU country are different. There are no strong correlations between the groups of SDG indicators in the different countries. However, the index of the environmental footprint changes the least, but it makes the biggest part among other SDG indicators. The evaluation of EF indicators shows that the older EU 14 countries have higher values of I_{EF} and I_{SD} indices compared with new EU 13 member states. The I_{EF} index on average is almost the same for both old and new EU countries; however, the integrated SD index values for old EU 14 member states are higher by 20% on average. This situation proves that the old EU 14 countries are more developed so the pressure on the environment is higher compared with the new EU 13 countries. This is one of the indicators that have the most negative values among the EU countries and it indicates that the natural environmental situation is getting worse in these EU countries despite the improvement of the situation in other economic sectors. Analysis has shown that the values of the SDG economic index change significantly among the EU countries while, in contrast, the values of the SDG social index are roughly the same or have changed the least. A decrease in the SDG economic values in the Netherlands, Finland and Sweden has been observed due to a reduction of the official development assistance (in Euros) as a share of the gross national income. The SDG knowledge index has increased among all EU countries. The analysis of the environmental footprint values indicates the deterioration of the natural environment in several countries such as Belgium, Bulgaria, Hungary, Romania, Slovakia and Cyprus. Only a few EU countries such as Denmark, Ireland, Spain, Italy and Poland, substantially improved their environmental conditions. The environmental footprint indicator affects the overall integrated sustainable development indicator the most. The results have shown the importance of the environmental footprint index in the evaluation of sustainable development of EU countries.

7. Conclusions

The analysis of the components of the I_{SD} index of the older EU 14 member states in 2015 year has shown that the SDG economic index makes up 16%, the SDG social index makes up 17%, the SDG environmental index makes up 18%, SDG knowledge index makes up 17% and the EF index makes up 32%. In 2020, the SDG economic index decreased by 1%, the SDG social index increased by 2%, the SDG environmental index makes up the same 18%, SDG knowledge increased by 3% and the EF index decreased by 4%.

The analysis of the components of the I_{SD} index of the new EU 13 member states in 2015 has shown that the SDG economic index makes up 7%, the SDG social index makes up 14%, the SDG environmental index makes up 18%, SDG knowledge index makes up 18% and the EF index makes up 42%. In 2020, the SDG economic index makes up the same 7%, the SDG social index increased by 4%, the SDG environmental index increased by 1%, SDG knowledge increased by 4% and the EF index decreased by 8%.

The analysis of sustainable development indices in the EU countries has revealed that the distribution of SDG indices varies greatly among countries. This proves that the current economic, social and environmental situation in the EU countries is different even though the development measures are similar. The I_{Econ} index varies from -10 to 61%; the I_{Soc} index varies from 20 to 188%; the I_{Env} index varies from 4 to 159%; the I_{Know} index varies from -1 to 122%; the I_{EF} index varies from -12 to 11%; the I_{SD} index varies from 11 to 36%. The highest values of individual and integrated indices show the uneven distribution of values among the EU countries. This is a consequence of the lack of data and because of the highest or lowest values calculated. Consequently, the major impact on the overall value of the integrated sustainable development index is caused by the EF index. Therefore, it can be stated that the additional use of the EF index gives greater accuracy for calculation when assessing the overall sustainable economic development. The theoretical and practical evaluation of sustainable economic development is better evaluated by using the integrated sustainable development index.

The limitation of this research study is that the EF method focuses more on environmental impacts. However, there is an increasing concern related to social impacts in the global context, including labour issues, food and water scarcity, global warming, global security and other issues. These aspects play an increasingly important role nowadays. So there is a need to closely follow the developments of social life cycle assessment analysing environmental, social and economic impacts. A majority of the SDGs have direct or indirect relevance to the well-being of current and future generations, so the importance of social sustainability issues must be highlighted in future research.

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