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Progress towards the 2030 Sustainable Development Goals for EU Urban Communities (SDG11)

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Abstract: The 2030 Agenda for sustainable development emphasizes the interconnectedness of environmental issues with socio-economic development, recognizing their fundamental role in human prosperity, while the sustainable development goals (SDGs) serve as a pivotal framework globally. This study provides a critical assessment of the progress made by EU Member States in pursuing the SDG 11 (sustainable cities and communities) targets as set out in the 2030 Agenda. The analysis is based on official data published by the EU Statistical Office—Eurostat—and uses the AAA (Holt-Winters) exponential smoothing algorithm for the trend analysis of specific indicators. The results show significant progress during the first seven years of implementation of the Agenda 2023, while indicating concerns about the achievement of the 2030 targets in some Member States. The mapping of potentially negative trends emphasizes the need for firm corrective actions, underlining the urgency of early interventions to address expected negative developments before they have potentially irreversible consequences.

Keywords: sustainable development; 2030 agenda; SDG 11; sustainable cities and communities

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1. Introduction

Major environmental degradation, depletion of natural resources, pollution, and global warming, in particular, pose an increasing threat to the entire ecosystem and to human presence in the future. Industrial exploitation and processing through the extraction of natural resources and their subsequent use for industrial, agricultural, and economic development has generated and continues to cause major disruption of biogeochemical cycles and major contamination of aquatic and terrestrial ecosystems with toxic heavy metals with extremely serious consequences for wildlife and human health.

The role of sustainable development of cities and communities is unquestionably an issue for all local authorities regardless of their size or position at the global, regional, national, and local levels. However, we continue to identify major problems, in particular, in terms of the gap between sustainable urban development and the practices implemented at the local community management level [1].

Identifying best practices and strategies to reduce the current gaps and eliminating unsustainable practices are the only ways to achieve the sustainable development of local communities. In this sense, defining a methodology that includes both a strategic and an operational approach with effective monitoring systems generates profound changes especially in terms of local community management that must be adapted to the current global priorities generated by climate change and all that brings major damage to the existence of life and the planet. For many local communities, especially in developing countries, the existence of such challenges generates both benefits and major costs, often difficult to sustain, which is why rigorous planning and local management are the only viable solutions that encourage sustainable growth and are transferable to green communities, with major benefits for local people and life on the planet [2,3].

With this research study, we aim to make a critical assessment of the progress made by EU Member States in pursuing the goals of SDG 11—sustainable cities and communities—as set out in the 2030 Agenda. We consider this investigative scientific approach to be of real interest, given that no similar research has been published, and the obtained results add to the existing body of knowledge, trying to fill a part of the knowledge gap on this important topic.

Today, Europe is a highly urbanized continent. The share of the EU population living in urban areas is currently estimated at 74% and is expected to reach 80% in 2050 [4]. This is why the loss and degradation of urban and peri-urban green spaces negatively affects ecosystems as well as human health and well-being. Therefore, creating a conceptual management framework to link urban green space with specific infrastructure by creating a balance of ecosystem and human health becomes a global and regional priority. Therefore, the concepts of green infrastructure, ecosystem health, and human health and well-being are defining elements of sustainable local community strategies, as they are the only ones that have direct contributions on increasing the scale of urban and peri-urban green spaces and green infrastructure [5].

The major concern stems from the fact that increasing urbanization puts cities at the forefront of sustainable growth, but for this to happen, their infrastructure needs to become mainly more productive, efficient, and resilient. Unfortunately, the current urban infrastructure development is quite fragmented, often showing a general lack of perspective to create and implement ecosystems that can sustain human life in the long term. Even though sustainable urban infrastructure systems often require smaller financial and natural investments (e.g., the use of less materials and energy generates less waste), there are still limitations from the perspective of urban planning decisionmakers for creating a sustainable urban ecosystem [6–8].

The issue of urban sustainability is currently an exceptional and extremely important one, with sustainable development of cities having been a hot debate topic at the global and regional political level for some time, as an increasing number of cities around the world are facing acute challenges regarding increasing environmental hazards and ensuring quality of life for their inhabitants. Achieving sustainable development goals for local communities therefore requires specific management and specific frameworks of urban sustainability indicators that have become increasingly complex to allow sustainability to be clearly measured and evaluated. However, there are differences in the existing approaches that have contributed substantially to the current inconsistencies in assessing and measuring sustainability, especially in large cities [9–11].

It is undeniable that the transition to resource-efficient sustainable cities requires new governance arrangements and therefore new local management arrangements. These must start from the fact that we are witnessing a doubling of the global urban population that unfortunately results in unsustainable levels of demand for natural resources in particular (e.g., the domestic consumption of materials may increase to 89 billion tons by 2050, if urban community development strategies are not changed) [12].

While there are a number of socio-technical alternatives that could lead to significant improvements in the resource efficiency of local communities, notably through rapid transition to electric transport, district energy systems, and green buildings, it should not be overlooked that the critical issue is actually that of reshaping governance arrangements without which this alternative path cannot be achieved.

Even though urban governance arrangements have changed in recent times, we are still witnessing an increase in urban management experiments in all regions of the world, and this is because the assumption of the 2030 Agenda, with the achievement of all SDGs by all, has generated the permanent identification of new urban governance paradigms that differentiate between already sustainable communities and communities with serious quality of life and environmental problems, resource-rich communities, and poor, underdeveloped, or undeveloped ones.

2. Literature Review

Local communities, in general, and cities, in particular, are today the most dramatic manifestation of human activities on the environment. This is because people are degrading natural habitats, disrupting hydrological systems, and altering the planet's bioclimate. It is precisely for this reason that sustainable urban development is now seen as a panacea for reducing the negative effects of human activities that have a direct impact on the environment. As a result, the international community has succeeded through strategies and action plans (such as the 2030 Agenda) to commit to the sustainable development of localities and to minimize the negative impacts of urban agglomerations, in particular. However, to date, such integrated and sustainable development has not been achieved on a large scale anywhere in the world [13].

Achieving sustainable urban development is now defined as an ultimate goal of planning efforts and is essential for the formulation of urban planning policies. Within this concept, the integration of land use in relation to transport infrastructure is particularly targeted, as this is highlighted as one of the most important elements of sustainable policy. However, there are still a number of gaps, particularly in terms of the existing assessment methods to measure the degree of urban sustainability in relation to the pollution caused dramatically by transport infrastructure. Therefore, the success of sustainable urban development policies needs to be addressed from the perspective of sustainability of built-up areas but also from the point of view of identifying problem areas with the formulation of relevant policy interventions [13–15].

The smart city approach to local communities as a driver of sustainability in urban areas is today the starting point for environmental sustainability. In this respect, recent research has highlighted the need to explore more systematically the relationship between smart cities and environmental sustainability, focusing in particular on practical applications that could enable a deeper understanding of urban design typologies and concepts. In the same sense, the Vision Zero strategy is also a highly ambitious challenge in the field of smart cities. Findings suggest that the smart and sustainable city is highly fragmented both in terms of policy and in terms of the existing techniques/practices [16].

According to the literature, cities are responsible for the depletion of natural resources and agricultural land as well as 70% of the global CO_2 emissions [17,18]. Thus, we identify significant risks to cities from the impacts of climate change, in addition to the existing vulnerabilities already generated by the rapid urbanization of human communities. Therefore, urban design and development are seen as very valuable tools to define a city's resilience to climate change. This is because cities are very dynamic and require the participation and involvement of different, multiple parties that are directly involved in effective climate change management. Stakeholders have the opportunity to act as drivers for the adoption or rejection of sustainable strategies. From this perspective, however, there are still disparities between global regions, even though there are international conventions on specific sustainability instruments, which unfortunately do not always take into account the cultural and economic aspects existing at the level of human communities [19,20].

From an urban perspective, the endeavor to create safe, inclusive, resilient, and sustainable cities represents a novel approach to global urban policy. Recognizing the significance of cities as crucial conduits to sustainable development in an increasingly urbanized world, this initiative charts a new course forward [21,22].

Being equally important in achieving the urban goals of carbon neutrality and sustainable urban development, we highlight the need to implement low-carbon technology in human communities, a strategy that focuses on a number of key issues such as conservation of and reduction in building emissions and carbon capture, storage, and use technology. Research over the last ten years (2013–2022) suggests that energy consumption and carbon dioxide emissions have been increasing year by year, requiring the rapid implementation of new technologies so that emission reductions can be achieved urgently [22,23]. Even if taking effective measures to control emissions is still a difficult task, the medium- and long-term results in terms of sustainability of cities will be obvious and beneficial for the quality of life on the planet.

Urbanization has become one of the most important issues defining the human relationship with the ecosystem. In this context, measuring progress in terms of sustainable urban development requires accurate quantification, requiring indicators that are fit for purpose. Unfortunately, in some situations, there is a general ignorance about the understanding of the concept of sustainability, which differs from one country to another but also across the different economic strata of society. Therefore, addressing this shortcoming can reduce this challenge by identifying the major issues facing urban communities in the development and implementation of sustainability indicators. From this perspective, two broad categories of challenges are identified according to their stage of development, i.e., the implementation and application of urban sustainability indicators [24].

From an urban quality of life perspective, the present methodologies assess cities in terms of urban environment and sustainable buildings. However, there is still a need to create a broader system of indicators to include qualitative and quantitative descriptors of the urban environment. This is because there are specific contexts that can be measured numerically in terms of both objective and subjective aspects that can affect urban quality. In this way, critical areas can be highlighted that need to be subjected to rectification based on sustainable congruent policies with the local context [25].

As previously mentioned, the objectives related to "sustainable cities and communities" are articulated within SDG 11 of the 2030 Agenda. However, recent studies of city life suggest that economies of scale could improve city efficiency and therefore support urban sustainability. Indicators such as "convenient access to public transport", "ratio of urban area growth rate to population growth rate", "particulate matter levels", and "area of green space" can provide additional information, but not for all cities or countries, they are quite different from economic, social, and political perspectives. The purpose of measuring against these indicators is to identify cities that are eco-efficient and can be benchmarks of best practice [26].

As an example, we can distinguish the larger Northern European cities that are considered to be the most eco-efficient, given the socio-economic benefits they offer compared to smaller cities. In addition, in these cities, there is also a different public perception of the quality of life in a city that is not limited to socio-economic well-being, but rather to its combination with a lower burden on the environment. This leads us to the conclusion that citizens' perceptions reflect typical eco-efficiency performance as well as the fact that socio-economic growth in cities should not be detrimental to the environment, as this could lead to significant dissatisfaction with the perceived quality of urban life [27].

In the same vein, building on the 2030 Agenda framework whose imperative is to monitor progress and hold decisionmakers accountable, we identify the pilot study on the experiences of local planning officials in the city of Gothenburg, Sweden, in relation to the suggested indicators for SDG 11, "Make cities and human settlements inclusive, safe, resilient and sustainable". A need to reprioritize the criteria by which the indicators are analyzed is identified, and the indicators should be segmented according to urban boundary delimitation; integrated governance; actors; synergies; and trade-offs. These considerations, while not exhaustive, are an important step in reflecting on local challenges and opportunities. It also highlights the need to analyze urban space in relation to new trends in global urban policy [28–30].

Taking into account all the above findings, in order to highlight how urban community management and local policies and strategies are reflected in the dimension of specific indicators measuring the sustainability of urban communities, a series of findings on the most important indicators responding to the SDG targets "Make cities and human settlements inclusive, safe, resilient and sustainable" are highlighted below. These include

"Severe housing deprivation rate by poverty status", "Population living in households considering that they suffer from noise, by poverty status", "Settlement area per capita", "Premature deaths due to exposure to fine particulate matter", and "Recycling rate of municipal waste".

2.1. Severe Housing Deprivation Rate

Lack of housing is certainly one of the major problems affecting the quality of life and therefore the sustainability of urban communities. Moreover, homelessness affects people's health, which is also a major global problem. To these issues must be added those related to the challenges that local community management faces in terms of global warming, energy legislation, energy poverty, pollution, etc. There is, moreover, a significant causal relationship between poverty, homelessness, and the sustainability of cities, which means that, in policy terms, a housing investment strategy that takes into account all the challenges of today's human communities becomes extremely important. Improving housing conditions also contributes to reducing energy poverty, which in turn contributes to reducing public spending on healthcare [31,32].

Across European countries, there is unfortunately an emerging trend of deteriorating living conditions, particularly among low-income households in several countries, which is putting increasing pressure on socio-economic practices and regulations that impact public spending. This is because redistributive housing policies, such as rental market regulation and housing allowances, impact the revenues of local authorities but also the living conditions of the whole community. On the other hand, higher house prices and price volatility are associated with rising living conditions in parallel with a declining quality of life for renters and low-income homeowners. Anti-poverty policies should therefore consider a broader perspective and take better account of the provision of housing and other basic needs [33].

In Central and Eastern European countries, the values recorded remain quite controversial, especially in terms of comparisons between countries. Even if there have been constant improvements, the current figures require the implementation of measures to reduce differences between countries and/or cities. Added to this is the high exposure of households to hidden energy poverty, especially affecting single-person households or households in remote areas with dependent children [34].

2.2. Population Living in Households Considering That They Suffer from Noise

The term poverty is used to describe a situation of a household that is unable to meet social and material standards of quality of life. Although specific conditions vary from country to country, the factors that define poverty are similar across Europe. The need to protect vulnerable consumers is therefore a priority for the European Commission, even if defining the vulnerable remains difficult, since homeless people are more affected by the weather conditions mainly in very cold weather [35,36].

In the same context, environmental noise has a major impact on the quality of life of people, being on the one hand an environmental sustainability issue and on the other a public health issue. The burden of noise exposure is currently unevenly distributed across countries/cities, with little evidence on which social groups are most affected. However, a higher exposure to environmental noise is experienced by those in lower socio-economic groups [37].

Although there is a unilaterally accepted notion that living in a city is associated with unbearable exposure to noise, this is unquestionably only a generalization because in cities there are also quiet residential areas with a much higher quality of life. However, in mega-cities, the background sound level—the "city buzz"—is usually louder due to the multitude of sound sources in the city. These negative aspects are often the consequence of the cumulative effect of the city's design elements on the transport system, the structure of the city and buildings, population density, the design of street and building facades, the amount of green space, and the quality of housing in terms of sound and vibration characteristics. The estimated health effects can be summarized in WHO assessments, which highlight an increasingly poor physical condition of those constantly exposed to noise, effects evidenced by sleep quality and general body condition, cardiovascular health (myocardial infarction, hypertension), effects of noise on cognition and performance, stroke, diabetes, and so on [38].

Reducing these negative elements is unfortunately difficult to achieve, especially in very large cities, even if there are obvious preventive management strategies by local authorities through sound insulated buildings, creation of restoration spaces (quiet green areas), and sleeping/living options on the quiet side of the facade. However, this aspect implies a general environmental improvement to alleviate the multi-sensory stress of the city and to avoid the segregation of polluting activities [38,39].

2.3. Settlement Area per Capita

Urban land-use efficiency (built-up area per capita) recorded a continuous increase especially in the 1980s, followed by a moderate increase after the 1990s. In this context, land-use efficiency factors vary from one city to another, depending on whether buildings are distributed horizontally or vertically. Typical urban functions (e.g., mixed land uses, multiple-use buildings, vertical profile) are variable being associated with high land use efficiency. In this context, policies for sustainable land management need to take into account local and regional factors that shape land use efficiency, thus promoting self-sustaining expansion and more strictly protecting land from dispersed urbanization [40,41].

Urban sprawl is a major challenge to sustainable land use. The year 2015 was the International Year of Land, and this was the moment when a wake-up call was sounded on the urgency of efficient land use in relation to the allocated area per capita. Thus, with the growing awareness of this problem of sustainability threats, there is an urgent need in Europe (and beyond) to monitor urban sprawl through the rigorous implementation of European policies developed in this regard. At the European level, there are currently different situations in terms of land use. The most affected regions are those in the center of the region, but especially along the Mediterranean coast. This is why a comprehensive European strategy is needed, including the implementation of clear targets and limits, as well as a set of concrete measures to control urban sprawl and to use land in a more resource-efficient way.

Today, we are witnessing the expansion of new suburban settlements that are often located in rural areas. As such, rural areas have taken over various urban functions, especially residential ones, with intense migration, especially in rural areas close to large cities. Thus, the urban population has settled in the most attractive peri-urban residential locations, generating new housing developments with high population density. This process is both positive and inevitable, leading to a number of other effects, including changes in local authority management and local politics [42–44].

2.4. Road Traffic Deaths

The problem of road accident rates is currently one of the most important health and social policy issues affecting countries on all continents. This is because every year, nearly 1.3 million people worldwide lose their lives on the roads and 20–50 million suffer serious injuries, most of which require long-term treatment [45].

At the EU level, it is worth highlighting the Vision Zero strategy, an ambitious road safety initiative that aims to eliminate all road fatalities and serious injuries by designing a road system that anticipates human errors and mitigates their impacts. Originating from Sweden in 1997, Vision Zero was adopted by the EU to create a safer road environment through holistic measures such as safe road design, advanced vehicle safety technologies, effective enforcement of traffic laws, and promotion of responsible road user behavior. The EU's Strategic Action Plan on Road Safety and the EU Road Safety Policy Framework 2021–2030 emphasize setting ambitious targets, enhancing infrastructure safety, improving vehicle standards, ensuring better post-crash care, and using data-driven approaches to identify and address high-risk areas and behaviors [46,47].

By following the identification of the most common causes of road accidents and de-fining actions to underpin strategies and programs to improve traffic safety at the local and global level is now a global priority. Although road accidents generally have varied and complex causes, their actual causes have changed only to a small extent over the years. Mainly these causes are lack of compliance with road regulations, primarily speeding, drunk driving, and disregard for the rights of other road users, i.e., pedestrians and cyclists, lack of adequate infrastructure, and the unsafe operation of some vehicles. From this, it is clear that the number of fatalities and serious injuries caused by road accidents can be reduced by an integrated and sustainable approach to road safety [48,49].

However, road traffic injuries are not evenly spread around the world, with some countries more affected than others, and the chance of dying in a road accident depends on where you live. Nearly 90% of all traffic fatalities occur in low- and middle-income countries. The rate is lower in high-income countries. In this context, the United Nations has adopted several resolutions on road safety and proposes actions to address the global road safety crisis [50].

We also identify a new approach to road safety management, with clear guidelines and quantitative targets (e.g., 50% fewer casualties in ten years). Setting realistic targets, developing strategies and action plans to achieve these targets, and monitoring progress can make a decisive contribution to sustainable road safety management. On the other hand, it should not be forgotten that road traffic is the main source of noise and pollution and one of the main environmental risks to the health and well-being of Europe's cities [50–52].

2.5. Premature Deaths Due to Exposure to Fine Particulate Matter

The World Health Organization estimates that around 7 million people die each year from exposure to fine particles in polluted air. For Europe, the results indicate that the annual death rate from fine particulate matter is 904,000, which will increase by 73% in the 2050s. On the other hand, Europe's population is declining according to UN estimates, and the results show that exposure to fine particulate matter in polluted air is the leading cause of premature mortality in Europe both now and in the future. The main cause of these negative results are the consequences of climate problems, but in particular due to changes in population structure and aging [53,54].

The most important contributors to fine particle emissions are those from major energy production, road traffic, and non-industrial domestic combustion, including wood burning. Ammonia emissions from the agricultural sector are also a problem for both nature and human health. Air pollution is therefore a serious problem for human health, and the associated costs are considerable. Radical measures are therefore required both in terms of local management strategies and in terms of reducing the impact of each emission factor, which is heavily dependent on the other emission sectors, which in turn have to undergo changes, especially emissions that alter atmospheric OH concentrations [55,56].

Annual average concentrations of fine particulate matter, nitrogen dioxide, black carbon, and tropospheric ozone in the warm season mainly result in cardiovascular, non-malignant respiratory, and lung cancer mortality. Comprehensive and complex measures are therefore needed at all levels of economic and social activities to reduce premature mortality caused by the long-term exposure to polluted air [57,58].

2.6. Recycling Rate of Municipal Waste

Adopting a circular economy is undoubtedly a sustainable approach to reducing the urgent problem of overexploitation of natural resources in parallel with excessive waste growth. In terms of concrete results in Europe, there is mainly a lack of homogeneity in the performance of different countries, with large gaps between countries in Northern and Southern Europe and between those in Western and Eastern Europe. It is therefore necessary that local administrative policies continue to focus on raising public awareness of the environmental risks of increasing waste, especially among the urban population [59,60].

Sustainability indicators in numerous countries, particularly those in economically developed regions such as Northern Europe, highlight the implementation of an appealing tax system and the taxation of unutilized land. However, these findings prompt contemplation on the interplay between economic growth drivers and sustainability goals [61,62]. Consequently, several inquiries persist regarding the optimal focus of local government endeavors to directly attain the sustainability targets outlined for the 2030s by prioritizing specific issues.

From the perspective of the current state of play of efforts to achieve SDG 11 at the level of European countries, we identify strengths and weaknesses related to sustainable urban living and its link to quality of life. It is also evident that the phenomenon of "high urbanization" poses major challenges to local management, but this is precisely what stimulates governments to focus their efforts on urbanization to achieve SDG 11.

3. Research Methodology

With this research study, we aim to make a critical assessment of the progress made by EU Member States in pursuing the goals of SDG 11 (sustainable cities and communities) as set out in the 2030 Agenda. For this, we based our research on an in-depth analysis of relevant data published by the European Union Statistical Service (Eurostat) on the key indicators established for tracking the achievement of SDG 11 by EU Member States.

In line with the data published by Eurostat, the achievement of SDG 11 is based on the values of six indicators specific to this goal, plus three shared indicators (with SDG 6, SDG 9, and SDG 16). We have used, in the proposed analysis model, publicly available statistical data on the evolution of the six specific SDG 11 indicators from 2007, or the first year reported for each indicator, to the most recently released data [63]. Our objective in selecting the time series was to incorporate into our analysis an extended time span, prior to the year of implementation of the Paris Agreement (2015). Even if for each indicator only a few relevant values have been published (2010, 2015, 2020, 2025, and 2030), the forecast model has included data for the whole period since 2007, or the most recent year.

The existing literature shows a clear dichotomy between two main categories of forecasting models: traditional models and contemporary models. Traditional models, including ETS (Triple Exponential Smoothing), ARMA (Autoregresive Moving Average), ARIMA (Autoregressive Integrated Moving Average), and SARIMA (Seasonal Autoregressive Integrated Moving Average), have been fundamental in time series forecasting. These models are based on well-established statistical methods and have a long history of application. On the other hand, contemporary models, such as LSTM (Long Short-Term Memory), FBProphet, and DNN (Deep Neural Networks), have emerged with technological advances, with the intention of going beyond the predictive capabilities of traditional models [64–69].

Traditional models have proven their reliability in capturing linear trends and stationary patterns in time series data. ETS, in particular, with its focus on error, trend, and seasonality components, provides a robust framework for addressing a range of temporal patterns. ARIMA models, known for their integration of autoregressive and moving average components, also play an important role in time series forecasting. SARIMA extends the capabilities of ARIMA by incorporating seasonality into the model. Despite their strengths, traditional models can face challenges when dealing with complex, non-linear patterns and changing trends.

Instead, contemporary models use advanced techniques, often based on machine learning and neural networks, to capture complex patterns and dependencies within the data. LSTM, a type of recurrent neural network, excels at capturing long-term dependencies, making it suitable for time series with extended temporal relationships. FBProphet, developed by Facebook, is designed to effectively handle seasonality and holidays, making it particularly useful for forecasting applications with recurrent patterns. DNN, with its deep architecture, aims to learn hierarchical representations of data, allowing complex features to be extracted.

Despite the proliferation of contemporary models, the literature review reveals a lack of consensus regarding the superiority of one approach over the other. Different studies have reported varying degrees of success with different models, highlighting the importance of considering the specific characteristics of the data and the nature of the models being analyzed. In addition, the choice between traditional and contemporary models often depends on the size and complexity of the dataset and the specific forecasting objectives.

ETS algorithms are widely recognized for their adaptability and simplicity, making them valuable tools in the realm of time series forecasting. This adaptability is particularly advantageous in scenarios where the data present varying levels of seasonality or when the seasonality pattern undergoes dynamic changes over time. The intrinsic flexibility of ETS lies in its three fundamental components: error, trend, and season. Through these components, ETS can adeptly capture and model intricate patterns in the data, allowing for a nuanced representation of complex temporal structures [68–71].

A significant comparative advantage of ETS models over their counterpart, the ARIMA models, is their superior adaptability to changing trends and seasonality. This adaptability positions ETS as a robust choice, excelling in scenarios involving non-linear patterns or abrupt shifts in trends. The literature, including studies by Gardner Jr and McKenzie [72] and Hyndman et al. [73], underscores the efficacy of ETS models in handling non-linearities and capturing intricate temporal dependencies.

The versatility of ETS models extends their suitability to a broad spectrum of time series data, encompassing instances with evolving trends and seasons. Comprehensive reviews by Petropoulos et al. [74] and Makridakis et al. [75] highlight the applicability of ETS models across various domains and underline their effectiveness in capturing the complexities inherent in diverse datasets. This adaptability is particularly crucial in real-world forecasting applications where temporal patterns may exhibit dynamic changes.

In the AAA (Holt–Winters) iteration of the ETS exponential smoothing algorithm, weights are assigned to time-varying variables based on geometric progression terms {1, $(1-\alpha)$, $(1-\alpha)^2$, $(1-\alpha)^3$, …, ∞} [76–78]. This exponential scale ensures proportional consideration of data trends. The forecast value extends the historical values to the specified target date, respecting the time sequence according to the fundamental equations of the Holt–Winters multiplicative method [79]. This methodological approach increases the accuracy and reliability of the forecasts:

$$\text{level}: \; L_t = \alpha \frac{Y_t}{S_{t-m}} + (1-\alpha)(L_{t-1} + B_{t-1}) \tag{1}$$

$$\text{trend}: \; B_t = \beta(L_t - L_{t-1}) + (1-\beta)B_{t-1} \tag{2}$$

$$\text{seasonal}: \; S_t = \gamma \frac{Y_t}{L_{t-1} + B_{t-1}} + (1-\gamma)S_{t-m} \tag{3}$$

$$\text{forecast}: \; F_{t+m} = (L_t + B_t m) + S_{t-s+m} \tag{4}$$

where

L_t = the level of the series;
B_t = the trend;
S_t = the seasonal component;
F_{t+m} = the forecast for m periods ahead;
α, β, γ = smoothing parameters;
s = the length of seasonality (e.g., the number of months or quarters in a year);
m = the frequency of the seasonality (i.e., the number of seasons in a year).

Empirical studies and scholarly literature affirm the versatility of ETS models, especially in handling dynamic patterns within time series data. The three-fold nature of ETS components allows it to accommodate fluctuations in error, identify underlying trends, and capture seasonality, providing a comprehensive approach to time series forecasting. Research by Hyndman and Athanasopoulos [65] emphasizes the effectiveness of ETS models in capturing seasonality and trends, showcasing their utility in diverse forecasting scenarios.

4. Empirical Results

In line with the research methodology described above, this section presents the findings related to each key indicator for SDG 11, with the results presented in concise tables. Each table includes in the initial columns the values of the indicators reported for the years 2010, 2015, and 2020. The following columns provide projected estimates for 2025 and 2030, as well as the rate of change compared to the baseline year 2015. The last column shows the estimated trend for the indicator analyzed, to make it easier to see the expected trend up to 2030, taking into account the data available to date.

The first key indicator included in this research assesses the extent of acute inadequacy in housing conditions within a given population. Specifically, it quantifies the percentage of individuals or households experiencing severe deprivation in suitable living conditions, taking into account factors such as overcrowding, lack of durable housing, or insufficient access to basic amenities. This indicator serves as a crucial metric for evaluating the progress towards ensuring adequate and sustainable housing for all, as outlined in SDG 11. The severity of housing deprivation is indicative of the challenges faced by populations in accessing safe and habitable living spaces, contributing valuable insights into the overall advancement or regression in efforts aimed at achieving sustainable urban development and housing conditions (Table 1).

Table 1. SDG 11-11—severe housing deprivation rate (percentage).

Countries	2010	2015	2020	2025 [f]	2030 [f]	2025/2015	2030/2015	Trend
EU-27	6.1	5.3	4.3	3.7	2.7	0.70	0.51	DOWN
Belgium	1.9	0.9	2.3	2.4	2.8	2.67	3.11	UP
Bulgaria	14.7	11.4	8.6	3.2	min	0.28	n.a.	DOWN
Czech Republic	4.5	3.3	2.0	min	min	n.a.	n.a.	DOWN
Denmark	1.3	2.8	2.8	3.6	4.3	1.29	1.54	UP
Germany	2.1	1.8	1.2	1.7	1.6	0.94	0.89	DOWN
Estonia	11.4	2.8	2.1	min	min	n.a.	n.a.	DOWN
Ireland	0.5	1.2	1.4	1.1	1.1	0.92	0.92	UP
Greece	7.6	6.7	5.8	4.5	3.5	0.67	0.52	DOWN
Spain	1.8	1.5	3.4	1.9	1.9	1.27	1.27	NONE
France	3.0	2.3	3.8	2.4	2.2	1.04	0.96	DOWN
Croatia	12.3	7.3	5.1	3.6	0.5	0.49	0.07	DOWN
Italy	7.0	9.6	6.1	5.4	4.6	0.56	0.48	DOWN
Cyprus	1.6	0.5	1.6	1.2	1.2	2.40	2.40	NONE
Latvia	21.9	15.5	11.5	6.9	2.3	0.45	0.15	DOWN
Lithuania	13.5	8.9	5.4	min	min	n.a.	n.a.	DOWN
Luxembourg	2.3	1.7	1.6	1.8	1.7	1.06	1.00	DOWN
Hungary	17.7	15.5	7.6	7.5	4.4	0.48	0.28	DOWN
Malta	1.4	1.3	1.0	1.4	1.4	1.08	1.08	UP
Netherlands	0.5	1.0	1.5	1.8	2.2	1.80	2.20	UP
Austria	4.0	4.3	3.0	3.1	2.8	0.72	0.65	DOWN
Poland	13.3	9.8	4.8	min	min	n.a.	n.a.	DOWN
Portugal	5.6	4.7	3.9	2.7	1.7	0.57	0.36	DOWN
Romania	25.3	19.8	14.3	7.1	0.7	0.36	0.04	DOWN
Slovenia	15.4	5.6	3.1	min	min	n.a.	n.a.	DOWN
Slovakia	3.8	4.2	3.2	3.4	3.0	0.81	0.71	DOWN
Finland	0.9	0.7	1.0	0.9	1.0	1.29	1.43	NONE
Sweden	2.0	2.6	2.5	3.4	3.9	1.31	1.50	UP

Source: Eurostat, own calculations. [f] forecasted values. min.: minimum value. n.a.: data not available.

The second key indicator of SDG 11 aims to gauge the impact of noise pollution on the quality of life within domestic settings. It involves assessing the subjective perception of residents regarding the extent to which noise is considered a source of discomfort or disturbance within their living environment. The measurement of this indicator provides insights into the prevalence and severity of noise-related challenges faced by households, contributing to a holistic understanding of the environmental and societal implications of noise pollution within the context of sustainable development (Table 2).

Table 2. SDG 11-20—population living in households considering that they suffer from noise (percentage).

Countries	2010	2015	2020	2025 [f]	2030 [f]	2025/2015	2030/2015	Trend
EU-27	20.6	18.3	17.6	14.6	12.5	0.80	0.68	DOWN
Belgium	18.9	18.0	14.5	12.5	10.1	0.69	0.56	DOWN
Bulgaria	12.9	9.7	8.8	4.7	1.6	0.48	0.16	DOWN
Czech Republic	16.5	13.9	13.3	11.0	9.1	0.79	0.65	DOWN
Denmark	18.7	16.5	18.2	17.8	17.6	1.08	1.07	DOWN
Germany	25.7	25.8	21.5	24.3	23.7	0.94	0.92	DOWN
Estonia	11.0	9.4	8.0	2.1	min	0.22	n.a.	DOWN
Ireland	9.5	8.2	10.0	7.1	6.0	0.87	0.73	DOWN
Greece	23.2	19.2	19.8	17.6	15.8	0.92	0.82	DOWN
Spain	18.4	15.7	21.9	13.0	10.7	0.83	0.68	DOWN
France	18.5	16.4	20.5	17.6	17.5	1.07	1.07	DOWN
Croatia	12.2	8.3	8.1	6.6	4.8	0.80	0.58	DOWN
Italy	22.3	18.3	14.3	5.5	min	0.30	n.a.	DOWN
Cyprus	29.0	17.2	14.0	4.7	min	0.27	n.a.	DOWN
Latvia	17.5	14.6	12.5	8.8	5.8	0.60	0.40	DOWN
Lithuania	13.8	15.4	14.7	12.3	11.3	0.80	0.73	DOWN
Luxembourg	16.7	20.1	19.7	19.9	20.2	0.99	1.00	UP
Hungary	11.4	13.7	9.3	8.6	7.2	0.63	0.53	DOWN
Malta	27.5	24.6	30.8	29.7	30.5	1.21	1.24	UP
Netherlands	23.6	24.7	25.6	23.9	23.1	0.97	0.94	DOWN
Austria	21.0	17.5	16.8	15.6	14.2	0.89	0.81	DOWN
Poland	16.2	12.4	10.9	8.2	5.4	0.66	0.44	DOWN
Portugal	22.9	23.0	25.1	22.4	21.8	0.97	0.95	DOWN
Romania	31.6	22.2	16.1	8.6	1.4	0.39	0.06	DOWN
Slovenia	16.5	12.9	15.0	11.0	9.3	0.85	0.72	DOWN
Slovakia	18.3	12.8	9.9	5.3	1.1	0.41	0.09	DOWN
Finland	13.0	11.7	14.1	11.4	10.5	0.97	0.90	DOWN
Sweden	13.1	12.6	17.3	18.6	20.2	1.48	1.60	UP

Source: Eurostat, own calculations. [f] forecasted values. min.: minimum value. n.a.: data not available.

The third indicator included in this research quantifies the average land area designated for human settlements allocated per individual within a specified geographic region. This metric serves as a pivotal measure in assessing urban development and spatial planning efficacy, offering insights into the distribution and utilization of land resources in relation to population density. A lower value for this indicator may indicate efficient land use and urban planning strategies, fostering sustainable and compact settlement designs that optimize available space. Conversely, a higher value may signify potential challenges related to urban sprawl, inadequate infrastructure, and potentially unsustainable development patterns. Monitoring and understanding settlement area per capita are crucial for policymakers and planners striving to achieve SDG 11, which targets sustainable and inclusive cities and communities (Table 3).

Table 3. SDG 11-31—settlement area per capita (square meters).

Countries	2010	2015	2020	2025 [f]	2030 [f]	2025/2015	2030/2015	Trend
EU-27	625.5	680.6	724.9	775.4	825.1	1.14	1.21	UP
Belgium	560.9	581.6	586.5	598.3	611.1	1.03	1.05	UP
Bulgaria	n.a.	613.5	690.0	749.2	878.3	1.22	1.43	UP
Czech Republic	611.9	616.1	631.9	638.7	648.7	1.04	1.05	UP
Denmark	986.7	1052.3	1081.4	1133.0	1180.3	1.08	1.12	UP
Germany	535.5	564.8	599.4	631.4	663.3	1.12	1.17	UP
Estonia	1215.0	1540.5	1609.8	1830.4	2027.8	1.19	1.32	UP
Ireland	953.3	961.3	985.7	1005.2	1021.4	1.05	1.06	UP
Greece	566.9	627.7	732.1	809.1	891.7	1.29	1.42	UP
Spain	559.7	572.9	581.3	591.8	602.5	1.03	1.05	UP
France	836.4	835.2	845.4	849.1	853.5	1.02	1.02	UP
Croatia	n.a.	670.7	757.0	808.8	826.1	1.21	1.23	UP
Italy	445.9	471.5	495.0	519.9	544.5	1.10	1.15	UP
Cyprus	n.a.	977.2	1014.7	1077.7	1203.7	1.10	1.23	UP
Latvia	1022.4	1297.2	1385.1	1584.8	1766.1	1.22	1.36	UP
Lithuania	867.2	1053.1	1141.9	1277.5	1414.8	1.21	1.34	UP
Luxembourg	571.4	511.7	554.8	543.0	557.4	1.06	1.07	UP
Hungary	695.7	704.3	811.9	858.6	916.7	1.22	1.30	UP
Malta	n.a.	190.6	189.8	180.6	163.3	0.95	0.86	UP
Netherlands	439.9	471.6	470.3	489.2	504.4	1.04	1.07	UP
Austria	668.0	703.6	756.5	800.2	844.5	1.14	1.20	UP
Poland	552.6	623.9	664.4	724.4	780.3	1.16	1.25	UP
Portugal	592.6	621.2	700.2	748.7	802.5	1.21	1.29	UP
Romania	n.a.	364.8	569.0	618.2	762.5	1.69	2.09	UP
Slovenia	576.5	609.2	635.0	663.4	692.7	1.09	1.14	UP
Slovakia	530.7	536.2	631.1	670.9	721.1	1.25	1.34	UP
Finland	2203.8	2458.7	2555.0	2749.1	2924.7	1.12	1.19	UP
Sweden	1840.1	2343.8	2431.6	2772.5	3068.3	1.18	1.31	UP

Source: Eurostat, own calculations. [f] forecasted values. n.a.: data not available.

The fourth relevant indicator assesses and monitors the global objective of ensuring road safety, as outlined in UN SDG 3.6.1, reflected as SDG 11-40 indicator at the EU level. This indicator quantifies the number of fatalities resulting from road traffic accidents, encompassing a spectrum of incidents such as collisions involving vehicles, pedestrians, and other road users. The metric serves as a crucial benchmark to evaluate progress in mitigating the impact of road accidents, enhance transportation safety measures, and ultimately contribute to the overarching goal of minimizing premature deaths and injuries related to road traffic incidents. The focus on monitoring road traffic deaths aligns with broader efforts to create sustainable and safer urban environments, emphasizing the importance of transportation systems that prioritize public safety and well-being (Table 4).

Table 4. SDG 11-40—road traffic deaths (rate, per 100,000 people).

Countries	2010	2015	2020	2025 [f]	2030 [f]	2025/2015	2030/2015	Trend
EU-27	6.7	5.5	4.2	2.8	1.4	0.51	0.25	DOWN
Belgium	7.8	6.8	4.3	3.0	1.2	0.44	0.18	DOWN
Bulgaria	10.5	9.9	6.7	6.0	4.3	0.61	0.43	DOWN
Czech Republic	7.7	7.0	4.8	2.8	0.8	0.40	0.11	DOWN
Denmark	4.6	3.1	2.8	1.0	min	0.32	n.a.	DOWN
Germany	4.5	4.2	3.3	2.6	1.8	0.62	0.43	DOWN
Estonia	5.9	5.1	4.4	1.2	min	0.24	n.a.	DOWN
Ireland	4.6	3.4	2.9	1.1	min	0.32	n.a.	DOWN
Greece	11.3	7.3	5.5	1.9	min	0.26	n.a.	DOWN
Spain	5.2	3.6	2.9	1.5	0.1	0.42	0.03	DOWN

Table 4. *Cont.*

Countries	2010	2015	2020	2025 [f]	2030 [f]	2025/2015	2030/2015	Trend
France	6.2	5.2	3.8	3.5	2.6	0.67	0.50	DOWN
Croatia	9.9	8.3	5.9	3.4	0.7	0.41	0.08	DOWN
Italy	6.9	5.6	4.0	3.7	2.6	0.66	0.46	DOWN
Cyprus	7.2	6.7	5.4	2.8	1.0	0.42	0.15	DOWN
Latvia	10.4	9.5	7.3	3.4	0.5	0.36	0.05	DOWN
Lithuania	9.7	8.3	6.3	0.8	min	0.10	n.a.	DOWN
Luxembourg	6.3	6.3	4.1	2.8	1.3	0.44	0.21	DOWN
Hungary	7.4	6.5	4.7	3.4	1.8	0.52	0.28	DOWN
Malta	3.1	2.5	2.3	3.0	3.0	1.20	1.20	NONE
Netherlands	3.2	3.1	3.0	2.6	2.3	0.84	0.74	DOWN
Austria	6.6	5.5	3.9	2.6	1.2	0.47	0.22	DOWN
Poland	10.3	7.7	6.6	3.3	0.5	0.43	0.06	DOWN
Portugal	8.9	5.7	5.2	4.1	2.9	0.72	0.51	DOWN
Romania	11.7	9.6	8.5	6.8	5.0	0.71	0.52	DOWN
Slovenia	6.7	5.8	3.8	1.3	min	0.22	n.a.	DOWN
Slovakia	6.9	5.7	4.5	2.2	0.3	0.39	0.05	DOWN
Finland	5.1	4.9	4.0	2.9	2.0	0.59	0.41	DOWN
Sweden	2.8	2.6	2.0	1.2	0.4	0.46	0.15	DOWN

Source: Eurostat, own calculations. [f] forecasted values. min.: minimum value. n.a.: data not available.

The fifth indicator that is a part of this research measures the number of untimely fatalities attributable to the inhalation of airborne particles with a diameter of 2.5 µm or smaller (PM2.5). PM2.5 particles are considered fine particulate matter, which can originate from various sources, including combustion processes, industrial emissions, vehicular exhaust, and natural sources. This specific indicator focuses on the adverse health effects resulting from prolonged exposure to PM2.5. The fine particles, due to their minuscule size, have the capability to penetrate deep into the respiratory system, reaching the lungs and even entering the bloodstream. Prolonged exposure to the elevated levels of PM2.5 is associated with an increased risk of respiratory and cardiovascular diseases, as well as other health complications.

The metric quantifies the premature deaths that can be attributed to such exposure, thereby providing insights into the public health impact of air pollution caused by fine particulate matter. Monitoring and addressing this indicator align with SDG 11, which seeks to ensure sustainable urbanization and make cities inclusive, safe, resilient, and environmentally sustainable. Reducing premature deaths due to PM2.5 exposure contributes to improving overall public health and achieving sustainable development goals related to health and well-being (Table 5).

Table 5. SDG 11-52—premature deaths due to exposure to fine particulate matter (PM2.5) (rate, per 100,000 people).

Countries	2010	2015	2020	2025 [f]	2030 [f]	2025/2015	2030/2015	Trend
EU-27	84	73	54	46	34	0.63	0.47	DOWN
Belgium	91	55	34	23	5	0.42	0.09	DOWN
Bulgaria	214	204	153	123	88	0.60	0.43	DOWN
Czech Republic	113	88	65	71	62	0.81	0.70	DOWN
Denmark	47	33	18	14	4	0.42	0.12	DOWN
Germany	84	61	35	33	20	0.54	0.33	DOWN
Estonia	33	16	4	min	min	n.a.	n.a.	DOWN
Ireland	22	8	10	8	5	1.00	0.63	DOWN
Greece	108	115	83	100	95	0.87	0.83	DOWN
Spain	43	50	38	22	12	0.44	0.24	DOWN
France	65	44	25	15	1	0.34	0.02	DOWN

Table 5. *Cont.*

Countries	2010	2015	2020	2025 f	2030 f	2025/2015	2030/2015	Trend
Croatia	126	110	102	90	80	0.82	0.73	DOWN
Italy	88	100	88	70	61	0.70	0.61	DOWN
Cyprus	70	61	46	35	22	0.57	0.36	DOWN
Latvia	96	63	44	45	32	0.71	0.51	DOWN
Lithuania	101	72	52	57	48	0.79	0.67	DOWN
Luxembourg	55	36	12	1	min	0.03	n.a.	DOWN
Hungary	137	132	97	93	80	0.70	0.61	DOWN
Malta	45	45	30	22	12	0.49	0.27	DOWN
Netherlands	72	45	29	17	2	0.38	0.04	DOWN
Austria	81	57	36	27	13	0.47	0.23	DOWN
Poland	138	117	96	112	111	0.96	0.95	DOWN
Portugal	40	40	27	11	0	0.28	0.00	DOWN
Romania	108	121	112	89	73	0.74	0.60	DOWN
Slovenia	84	80	59	53	44	0.66	0.55	DOWN
Slovakia	109	95	72	71	61	0.75	0.64	DOWN
Finland	19	4	1	min	min	n.a.	n.a.	DOWN
Sweden	22	8	4	min	min	n.a.	n.a.	DOWN

Source: Eurostat, own calculations. f forecasted values. min.: minimum value. n.a.: data not available.

The last indicator considered for this research evaluates the proportion of municipal waste that undergoes recycling processes relative to the total municipal waste generated within a specified area or community. The key indicator serves as a quantitative measure to assess the effectiveness of waste management systems in promoting sustainable practices. It involves calculating the percentage of recyclable materials, such as paper, plastic, glass, and metals, which are diverted from landfills through recycling initiatives. A higher recycling rate indicates a more efficient utilization of resources, reduced environmental impact, and a commitment to fostering a circular economy by reusing materials rather than disposing of them as waste. Monitoring this indicator aids in evaluating the progress towards sustainable waste management goals outlined in SDG 11, which focuses on making cities and human settlements inclusive, safe, resilient, and sustainable (Table 6).

Table 6. SDG 11-60—recycling rate of municipal waste (percent of total waste generated).

Countries	2010	2015	2020	2025 f	2030 f	2025/2015	2030/2015	Trend
EU-27	38.0	44.9	48.9	53.9	59.1	1.20	1.32	UP
Belgium	54.8	53.5	51.4	53.4	54.6	1.00	1.00	UP
Bulgaria	24.5	29.4	35.2	38.9	44.0	1.32	1.50	UP
Czech Republic	15.8	29.7	40.5	51.3	63.0	1.73	2.12	UP
Denmark	49.1	47.4	45.0	52.3	54.5	1.10	1.15	UP
Germany	62.5	66.7	70.3	70.5	72.8	1.06	1.09	UP
Estonia	18.0	28.3	28.9	34.3	38.5	1.21	1.36	UP
Ireland	35.7	45.8	40.8	46.2	49.5	1.01	1.08	UP
Greece	17.1	15.8	21.4	20.8	21.9	1.32	1.39	UP
Spain	29.2	30.0	40.5	38.5	40.8	1.28	1.36	UP
France	36.0	40.7	41.7	46.1	49.5	1.13	1.22	UP
Croatia	4.1	18.0	29.5	41.7	53.2	2.32	2.96	UP
Italy	31.0	44.3	51.4	63.8	74.4	1.44	1.68	UP
Cyprus	10.9	16.6	16.6	21.6	25.5	1.30	1.54	UP
Latvia	9.4	28.7	39.7	52.6	66.4	1.83	2.31	UP
Lithuania	4.9	33.2	45.3	70.0	88.1	2.11	2.65	UP
Luxembourg	46.5	47.4	52.8	54.1	56.7	1.14	1.20	UP
Hungary	19.6	32.2	32.0	46.8	55.7	1.45	1.73	UP
Malta	8.9	10.9	10.9	14.4	16.2	1.32	1.49	UP
Netherlands	49.2	51.8	56.9	60.4	64.1	1.17	1.24	UP

Table 6. *Cont.*

Countries	2010	2015	2020	2025 f	2030 f	2025/2015	2030/2015	Trend
Austria	59.4	56.9	62.3	58.6	58.4	1.03	1.03	NONE
Poland	16.3	32.5	38.7	51.7	64.3	1.59	1.98	UP
Portugal	18.7	29.8	26.8	36.3	41.3	1.22	1.39	UP
Romania	12.8	13.3	11.9	17.8	21.2	1.34	1.59	UP
Slovenia	22.4	54.1	59.3	80.6	98.0	1.49	1.81	UP
Slovakia	9.1	14.9	45.3	54.8	70.2	3.68	4.71	UP
Finland	32.8	40.6	42.1	44.9	48.3	1.11	1.19	UP
Sweden	47.8	47.6	38.3	41.8	44.8	0.88	0.94	UP

Source: Eurostat, own calculations. f forecasted values.

5. Discussions

Upon an in-depth analysis of the research findings, it is evident that European countries are consistently dedicating efforts towards environmental preservation and the attainment of targets delineated in the 2030 Agenda. Nevertheless, the findings also underscore the presence of conceivably adverse trends, which could yield substantial detrimental impacts on the environment, societal well-being, and the overarching objective of sustainable development. While commendable strides are being made to align with the 2030 Agenda's objectives, the research reveals certain challenges or trends that possess the potential to impede progress, warranting a nuanced examination of their implications for environmental conservation, societal dynamics, and the broader spectrum of sustainable development initiatives. This dual perspective emphasizes the importance of not only acknowledging achievements but also addressing emergent challenges to ensure a holistic and resilient approach towards sustainable development in European countries.

The SDG 11-10 indicator "Severe housing deprivation rate" emerges as a critical metric with profound implications. It serves as a pivotal measure of global social progress and equity, reflecting the commitment to ensure decent living conditions for diverse populations around the world. A high rate of severe housing deprivation suggests an urgent need for intervention to improve housing conditions, pointing to potential challenges related to poverty, inequality, and social well-being. Within the EU, the indicator becomes essential for assessing the effectiveness of housing policies and social protection systems. A lower rate of severe housing deprivation means better access to safe housing, which reflects positively on the social and economic development of the region. Conversely, a higher rate may indicate disparities and deficiencies in housing provision, requiring specific policies to address housing inequality. Thus, monitoring this indicator at both the global and the EU level facilitates a comprehensive understanding of housing challenges, guiding policymakers in formulating strategies to ensure affordable, safe, and adequate housing for all, in line with broader sustainable development goals.

By analyzing the data obtained from the research, two equally important findings can be highlighted. Firstly, a potential deterioration in housing conditions can be observed for a number of European tariffs (Belgium, Denmark, Ireland, Netherlands, Sweden), which could lead to a number of negative social and economic effects for these countries. Interestingly, these countries are actually in the same geographical area, i.e., Northern Europe, being economically developed countries. There are several factors with potentially negative effects on the evolution of this indicator, and there are a number of pre-concerns as mentioned in the existing literature. Pre-factors such as unsustainable growth in the number of migrants [80–82], deteriorating living standards, rising house prices, and gentrification [83,84] are considered. Secondly, it can be observed that the Eastern European countries (Bulgaria, Romania, Poland, Slovenia) are registering a very rapid rate of decrease in the housing deprivation rate, which demonstrates once again, if it were needed, the massive depopulation of these countries, with potentially significant long-term negative effects.

Noise pollution in households (SDG 11-20) can have adverse effects on physical and mental well-being, contributing to stress, sleep disturbances, and other health issues. Addressing this indicator aligns with the broader SDG agenda's commitment to promoting sustainable cities and communities, ensuring they are inclusive, safe, resilient, and sustainable. At the EU level, monitoring the population affected by household noise is particularly relevant for assessing the progress of Member States in creating healthy and sustainable living environments. It aids in identifying regions or communities facing elevated noise levels and facilitates the development of targeted policies and interventions to mitigate the impact.

The results of our research indicate that, compared to the previously analyzed indicator, the reduction in noise pollution levels in households shows an almost generalized downward trend across the European Union, with very few exceptions (Luxembourg, Malta, Sweden) where conditions are expected to deteriorate until 2030. The results reported are supported by the recently published research, which highlights the existence of significant problems, such as the fact that 98% of the residents living in Birzebbuga (Malta) reported noise pollution as a problem [85]. In the case of the other two countries for which increasing values are predicted, ex-ante research indicates that the significant negative influence of increased traffic levels on degraded conditions and increased noise levels in households [86,87]. Overall, the causes for the population living in households considering that they suffer from noise are interconnected and require comprehensive urban planning, regulatory measures, and public awareness campaigns to address and mitigate the impact of noise on residential living conditions.

With regard to the third indicator included in the analysis (settlement area per capita), the results obtained unequivocally indicate a general increase in the values of this indicator for all European countries by 2030. According to the existing literature, the escalation of settlement area per capita signifies a concerning trend with interconnected environmental, social, and economic ramifications. The expansion of urban areas, often associated with this increase, leads to the conversion of natural landscapes and agricultural regions, disrupting ecosystems and diminishing biodiversity. This expansion necessitates substantial investments in new infrastructure, resulting in economic burdens and resource inefficiencies. Beyond environmental concerns, the social impacts include heightened social isolation, longer commute times, and unequal access to services, exacerbating societal inequalities. Additionally, the loss of agricultural land threatens local food production, contributing to food security challenges. Effectively addressing the negative consequences of rising settlement area per capita demands comprehensive strategies that integrate sustainable urban planning, environmental conservation, and considerations for social equity to promote resilient and equitable communities [88,89].

With regard to the fourth selected indicator, the number of road traffic fatalities per 100,000 people, the efforts made at the European Commission level to reduce the number of fatalities, as set out in the Commission's Strategic Road Safety Action Plan and the EU road safety policy framework 2021–2030, which also sets out road safety plans aimed at achieving zero road deaths by 2050 ("Vision Zero"), are well known. The reward of these efforts is also evidenced by the results of our research, which highlight the negative trend of the values of this indicator, and these public policies can be used as models of best practice worldwide.

The imperative to reduce premature deaths attributed to exposure to fine particulate matter (PM2.5) underscores a critical public health concern with profound societal, economic, and environmental implications. The results obtained from the analysis of the values of the indicator "Premature deaths due to exposure to fine particulate matter (PM2.5)" (SDG 11-52) indicate an unanimously positive development for all EU Member States, with significant reductions in this forecasted mortality rate.

Efforts to mitigate premature deaths associated with PM2.5 exposure contribute significantly to safeguarding public health by reducing the incidence of respiratory and cardiovascular diseases, ultimately alleviating the burden on healthcare systems. Beyond the individual health impact, a reduction in premature deaths enhances overall workforce productivity and economic stability by mitigating absenteeism and healthcare costs. Moreover, prioritizing air quality improvements aligns with the EU's commitment to sustainable development goals, such as ensuring good health and well-being (SDG 3) and promoting clean and responsible consumption and production patterns (SDG 12). By ad-dressing this issue, EU members contribute to creating healthier and more sustainable living environments, underscoring the interconnectedness between environmental protection, public health, and the broader objectives of sustainable development.

With regard to the results achieved for the last relevant indicator, the recycling rate of municipal waste as a percentage of total waste generated (SDG 11-60), we can expect all EU countries to follow an upward trend by 2030, which is a particularly encouraging result. Looking in detail at the results, however, we can see that there are major discrepancies between the recycling rates in the different European countries, ranging from a low rate of 10.9% in Malta to 70.3% in Germany in 2020. It is clear that sustained efforts are needed to encourage Member States to reach a higher harmonized level, but significant financial resources will need to be mobilized to achieve this goal.

6. Conclusions

Achieving SDG 11 targets is of paramount importance for European countries as it directly addresses the goal of creating inclusive, safe, resilient, and sustainable cities and communities. Europe's urban areas serve as centers of economic activity, cultural richness, and diverse societal interactions. By successfully achieving SDG 11, European countries can ensure that their cities prioritize inclusion, social equity, and environmental sustainability.

This research study sought to critically assess the progress made by EU Member States in pursuing Sustainable Development Goal 11 (sustainable cities and communities) as expressed in the 2030 Agenda. The results obtained may be useful, first of all, for tracking progress towards the 2030 targets, but also for highlighting potential lagging at the level of each EU Member State. These results can be the basis for defining coherent public policies to correct the negative trend forecast, with a view of repositioning them on a positive trend, which will help to achieve most of the targets assumed for SDG 11.

The findings of our research indicate that, for the majority of the indicators analyzed, most European countries exhibit a positive trend. This suggests substantial progress towards the targets set forth by the 2030 Agenda. As the findings indicate, in terms of reducing the number of road traffic fatalities and reducing the number of deaths due to exposure to fine particles, EU Member States can be considered as examples of best practice worldwide. This is based on the results achieved so far and the results expected to be achieved by 2030.

As far as the settlement area per capita indicator is concerned, there is a general trend of increasing values, which denotes a deterioration of the existing conditions, with prospects of worsening until 2030. It should be noted that this is not a problem specific to EU countries, but a general problem. Population growth, urbanization, and economic development emerge as the three most significant causes contributing to the increase in settlement area per capita. These interrelated causes underscore the complex dynamics influencing settlement expansion, necessitating comprehensive and sustainable urban planning strategies to manage growth while balancing environmental, social, and economic considerations.

Our research has also highlighted, through a comparative analysis of the results obtained for each country, the potential negative developments in terms of severe housing deprivation rate and the percentage of population living in households considering that they suffer from noise. Even if positive developments are estimated for most European countries, the results of the research highlighted a number of countries (Sweden, Denmark, Belgium, Netherlands, Malta) for which negative developments are estimated, which need more attention from stakeholders in order to prevent potential negative social, economic, and environmental effects in the medium and long term.

Considering the limitations embedded in employing this predictive analysis approach is essential when interpreting the findings of this study. The precision of the results may be affected by the lack of consistent data, potential inaccuracies in modeling, and the unpredictable influence of political, economic, or social variables that could shape future trends. Furthermore, the substantial time lag between the publication of data and the implementation of corrective policies addressing specific disparities introduces a delayed reflection of policy impacts in the available data. Hence, it is imperative to acknowledge these inherent constraints to ensure a nuanced and accurate interpretation of the study's outcomes.

In terms of the potential for future research, we propose to expand the scope of the research by considering a number of potential factors not included in this research, which could positively or negatively affect the pace of progress towards the EU's SDG11 targets. An alternative development could also include cluster analysis methodology as a hypothesis-generating technique for further research.

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