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Original Scientific Article

The Infrastructure-an Indicator of Sustainable Development and Consumption in Integrated Plans of Bulgarian Cities

Svilen Ivanov[1]
Boryana Serbezova[2]
Yordan Nedev[3]

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Abstract: *This paper focuses on urban infrastructure as an indicator of sustainable consumption at the city level. To achieve the objective of the study, three cities in Bulgaria were selected - the capital city - Sofia; a large regional city - Varna; and a small university city - Svishtov. The aim is to establish the presence or absence of regional differences by comparing the municipalities' integrated development plans for 2021-2027*[4]*. Energy efficiency programs and their implementation are analyzed. The study results can serve as a guide for future comparative analysis of sustainable urban development strategies within the EU and an examination of these strategies' impact on achieving its various objectives.*

Keywords: *Sustainable urban development, Sustainable consumption, Urban infrastructure, Integrated municipal development plan, Energy efficiency.*

JEL Classification F63 · O12 · Q01

✉ svilen.ivanov@ue-varna.bg
[1] Faculty of Management, University of Economics - Varna, 77, Knyaz Boris I Blvd., 9002 Varna, Bulgaria
[2] Faculty of Management, University of Economics - Varna, 77, Knyaz Boris I Blvd., 9002 Varna, Bulgaria
[3] Faculty of Management, University of Economics - Varna, 77, Knyaz Boris I Blvd., 9002 Varna, Bulgaria
[4] The plans under consideration are part of the strategy of the Ministry of Regional Development and Public Works of Bulgaria, synchronized with EU policies to achieve sustainable development goals.

1. INTRODUCTION

Sustainable development is a topic that has played a significant role in scientific developments over the past three decades. The issue was put on the agenda by the United Nations in 1992, marking the beginning of the development of theory and practice related to the achievement of sustainability. There are 17 Sustainable Development Goals, and they contain 169 tasks covering a wide range of areas related to their achievement (Lukman et al., 2016, p. 141). The formulation of goals at the global level makes it possible to focus efforts on accumulation in theory and subsequently launch real actions to achieve sustainable development.

Sustainable Development Goal 12 aims to ensure new patterns of sustainable production and consumption, namely „doing more and better with less, increasing the net welfare benefits of economic activities by reducing resource use, degradation and pollution throughout the life cycle, while increasing quality of life through the involvement of various stakeholders (Lukman et al., 2016, p. 141). The adoption in 2012 of the 10-Year Framework of Programs on Sustainable Consumption and Production Patterns (The 10YFP) underlines the essential role of sustainable consumption and production in achieving the Sustainable Development Goals.

Within the implementation of the project "Sustainable Consumption in the Urban Environment – Regional Differences, funded by the Bulgarian National Science Fund (BNSF) with contract No CAP-06-H35/7, the attention of the research team is focused on the problems of sustainable consumption in urban environments both at the level of individual households and at the city level. In this context, Kehayova-Stoycheva et al. (2023a) argue "the need to conduct selective policy actions on the part of institutions tasked with providing the infrastructure for sustainable activities - such as recycling, increasing the energy efficiency of homes and the corresponding lower consumption of energy from non-renewable sources, the use of public and/or environmentally friendly transport, etc." (Kehayova-Stoycheva et al., 2023a, p. 146).

According to Kehayova-Stoycheva et al. (2023b), the infrastructure is present as a distinct area of study, assessment, and impact on urban carrying capacity (Kehayova-Stoycheva et al., 2023b, p. 221). So, in clarifying sustainable consumption at the city level, the focus is on the state of urban infrastructure and its elements as an indicator of sustainable consumption in cities and a basic prerequisite for sustainable household consumption.

The main research questions related to the focus are:

1. Is there a link between infrastructure and sustainable consumption in cities? The answer to the question aims to determine the importance of infrastructure for measuring sustainable urban consumption and supporting sustainable household consumption.
2. What are the strategies of Bulgarian cities in terms of achieving sustainable consumption by providing appropriate infrastructure? The authors aim to track the real actions in cities concerning sustainable consumption.
3. Are there any implementation of the measures foreseen, and what results have been achieved? The idea is to find data on the achieved effect of the goals set and the activities performed.
4. Are there regional differences in strategies and results between Bulgarian cities?

To achieve the purpose of the study, three cities on the territory of Bulgaria were selected, which belong to different demographic, economic, social, and cultural aspects, municipalities: Sofia – the largest and most developed city in the country and its capital, Varna – the third largest city and district center and Svishtov – a small university town.

The purpose of this paper is to establish the presence or absence of regional differences related to the strategies of the municipalities based on secondary data collected by comparing the "Plans for the Integrated Development of Municipalities" for the period 2021 – 2027 (PIDM). Secondary data on energy efficiency programs and their implementation have been analyzed to illustrate the actions of local municipalities and cities in this direction. An attempt is made to explore the relationship between the results achieved by 2022 and the formulated strategic objectives for each of the studied cities related to the use of energy in a sustainable way.[5]

The methodology used to achieve the goal includes:

1. Literature review of theoretical sources for derivation and argumentation of infrastructure as an indicator and prerequisite for sustainable consumption.
2. Desk study – analysis of secondary statistical data and data published by municipalities for the following purposes:
   - Content analysis of the integrated development plans of the three municipalities for the period 2021 – 2027.
   - Tracking the actual state of certain indicators related to the results of actions at the municipal level in terms of infrastructure and resource consumption in cities.

The results of the desk study, the processed secondary data, and the analysis made can serve as guidelines for conducting future comparative analyses of strategies for sustainable urban development within the EU and an examination of the impact of these strategies on the achievement of different sustainability goals.

2. LITERATURE REVIEW

2.1. Sustainable Development and Sustainable Consumption in the Context of the Urban Environment

In the study of Bai et al. (2016), it is argued that cities are constantly evolving, but this physical, institutional, and cultural development is dependent on the capabilities of their environment. This fact often leads to a blockage of infrastructure, inertia in practice, preservation of social stratification, and limited social commitment to the sustainability agenda. To overcome the problem, it is necessary to adopt a new approach that does not necessarily require additional funding but rather the careful consideration of systems and behaviors that save costs by eliminating the duplication and unnecessary repetitions that abound in isolated management, for example of infrastructure, or by coordinating multi-partner initiatives (Bai et al., 2016, p. 73).

In this unprecedented time of rapid urbanization, cities, instead of being the cause, can offer solutions to the challenges facing the modern world. Properly conceived and managed, urbanization can become a powerful tool for achieving sustainable development in both developing and developed countries. Ideas, standards, and principles for achieving sustainability are protected in the "New Urban Agenda" adopted at the United Nations Conference on Housing and Sustainable Urban Development in Quito, Ecuador, on 20 October 2016 (United Nations, 2017). This document offers a shared vision of a better and sustainable world, and urban systems and their physical form are seen as crucial factors in achieving this vision. The standards and principles set out in the agenda serve the planning, construction, development, management, and improvement of urban spaces, mainly based on five pillars: national urban policies, urban legislation and regulation,

[5] The municipalities include the city as a major administrative center and the adjacent smaller settlements and tourist complexes if any. For this reason, strategies at the municipal level have been considered.

urban planning and design, local economy, and municipal finance, and implementation at the local level (United Nations, 2017, p. iv). In other words, in specialized theory, cities are at the forefront of achieving a state of sustainability, and to do so, it is necessary to rethink traditional methods of planning and use of resources to put an end to the practices of chaotic and inappropriate development of urban space (Lai & Chen, 2005, p. 3929).

One way to achieve sustainable development of the city is to rethink urban forms and infrastructure to provide a framework for restructuring everyday practices and planning approaches, mainly tailored to the essence and requirements of sustainable consumption (Samson & Freudendal-Pedersen, 2022, p. 01). According to Serbezova and Nedev (2020), sustainable consumption is a complex concept that is "consumption based on conscious and thoughtful decisions to purchase, use, extend the life and disposal of consumed products and services, enabling continuous economic and social progress, while at the same time minimizing the use of natural resources and toxic materials, emissions of waste and pollutants throughout the life cycle of the service or product, responding to everyone's needs and aspirations for a better quality of life, now and for future generations" (Serbezova & Nedev, 2020, p. 4).

In the context of cities, sustainable consumption can be seen as behavior related to the improvement of quality of life, to be achieved through reduced and controlled use of environmental resources, the pursuit of reduction, and, where possible, the elimination of damage caused by urban growth and development, change in habits and actions of individuals and organizations, the consumption of products and services related to both the personal well-being of citizens and the development of the economic, social and cultural environment. In their study, Nematchoua et al. (2021), believe that "a significant increase in carbon emissions in cities is a function of their strong growth; however, it can also be attributed to different economic structures, different urban forms, modes of transport and infrastructure, as well as the high demand for energy in our homes" (Nematchoua et al., 2021, p. 9).

Lehmann (2011), also takes the view that "cities and urban development are the areas where all concepts are brought together and can be put into practice to redesign urban systems with a view to zero waste and material flows, transforming the existing city and modernizing its recycling infrastructure into low-to zero-carbon urban neighborhoods" (Lehmann, 2011, p. 91). Achieving sustainable consumption is a process that requires time, careful planning, and joining the efforts of all stakeholders in an urban environment, namely individual citizens, businesses, NGOs, and governance structures.

2.2. Planning and Importance of Infrastructure to Achieve Sustainable Consumption

Bibri (2018), says that urban planning should be concerned with "guiding and directing the use and development of land, the urban environment, and urban infrastructure, as well as ecosystems and human services in a way that ensures efficient use of natural resources, intelligent management of infrastructures and facilities, efficient operations and services, optimal economic development and a high quality of life and well-being" (Bibri, 2018, p. 769).

In another study urban planning in the 21st century "should evolve towards an environmentally oriented macroarchitecture that fully integrates the design and location of energy- and materially efficient buildings and urban infrastructure with overall spatial planning to minimize the use of materials" (Agudelo-Vera et al., 2011, p. 2302). This means that achieving sustainable consumption, respectively development, "requires careful consideration and planning of the effectiveness

of development strategies both depending on behavioral characteristics and the limitations of people and organizations (Van den Bergh, 2011, as cited in Cruz & Katz-Gerro, 2016, p. 28). According to Bibri (2018), urban planning includes "the preparation, design, evaluation, and forecasting of an organized, coordinated, and standardized physical structure and infrastructure system of the city and related processes, functions, and services" (Bibri, 2018, p.769).

Da Silva and Wheeler (2017, p. 32) underline that „traditionally, infrastructure includes all human-made assets, including human capital, required by the social (e.g., educational, health, cultural and financial) and economic sectors (e.g., energy, water and sewage, transportation)." Agudelo-Vera et al. (2011), consider that "the infrastructure is designed to extract, transform, transport, supply and dispose of resources. As a consequence, an interactive link between cities and the environment is established, with cities having a huge impact on the natural environment and the natural environment influencing urban configurations" (Agudelo-Vera et al., 2011, p. 2299). Referring to the cited positions, infrastructure can be defined as a major component of consumption, making it an important factor in planning and implementing sustainable consumption strategies. In almost all developments related to resource planning, sustainable consumption, and sustainable development activities in general, infrastructure is mentioned as an important and decisive factor for change and development in this direction, and according to Zucaro et al. (2022, p. 4), it "not only determines the spatial extent of the city and urban patterns but plays a decisive role in urban sustainability, as 'physical, social welfare".

In their study, Wang et al. (2020a), referring to several studied authors, draw attention to the importance of the state of infrastructure in promoting economic, environmental, and social urban development. "Socially, different functional urban infrastructures should be able to generate the capacity to meet the basic living requirements of a certain scale of urban residents. From an environmental perspective, the carrying capacity of the various infrastructures must strike a balance in urban sustainable development through green space infrastructure linked to environmental benefits. In terms of economic development, the different urban infrastructure should have sufficient carrying capacity to carry out a certain volume of economic activities to ensure economic growth without negative impacts" (Wang et al., 2020a, p. 1). Sun, Chen and Tian (2018) argue that the capacity efficiency of urban infrastructures has become a barometer of sustainable urban development (Sun et al. 2018, as cited in Wang et al., 2020b, p. 1).

In different developments, the authors present divergent views on the constituent elements of infrastructure, especially in terms of the scope of the concept. In some of the studies, a greater number of elements included in the infrastructure composition have been proposed, and in others, fewer in number. The different theoretical positions are shown in Table 1.

Table 1. Elements included in the infrastructure

Authors and scientific publications	Elements of infrastructure
Bibri (2018)	Transport Water supply Communication systems Distribution networks
Zucaro et al. (2022)	Built environment Buildings Utilities Roads Other civil transport structures

"Indicators for sustainable cities", Science for Environmental Policy, (EC, 2018) Zhou and Jiang (2019)	Waste treatment Green areas and buildings Public transport
Onishi (as cited in Oh et al., 2005) Jennifer Bennett et al., 2020 (as cited in Miller, 2021)	Water supply Sewerage Waste processing LP Line Road Dwellings Recreational, educational, and administrative services
Oh et al. (2005) Wei et al. (2015) Zhou and Jiang (2019)	Energy Green areas Roads Metro Stations Water supply Wastewater treatment Waste treatment

Source: Own processing

Regardless of the different number of elements indicated, the table makes it clear that the main areas that are directly related to the state of the infrastructure are outlined, namely – the ratio between built-up areas and green spaces, buildings and related water consumption and electrical energy; the state of the roads and the organization of the various modes of public transport; policies on the treatment of different types of waste; provision of recreational, educational, and administrative services.

From all that has been said so far, it can be summarized that the process of achieving sustainable consumption in cities can begin with careful planning of adequate measures and actions related to the outlined areas of urban infrastructure, which will facilitate and support the development and perception of such consumption in all areas of urban life.

Based on the information obtained so far, the following conclusions can be drawn regarding the importance of infrastructure for achieving sustainable development:

1. In almost all sources considered, infrastructure is present as a distinct field of research that is directly related to sustainable consumption at the city level.
2. The capacity efficiency of urban infrastructures may be considered an indicator of sustainable urban development, and their elements can be used as a framework for orientation and solutions for action towards achieving sustainable consumption.

3. COMPARATIVE ANALYSIS OF THE INTEGRATED DEVELOPMENT PLANS OF THREE BULGARIAN MUNICIPALITIES

Despite the importance of urban planning for sustainable consumption and sustainable development mentioned in the previous point, each city may take a different approach in formulating measures and approaches to achieving them. Weingaertner (2010) defends the position that "the realization of visions of a sustainable city depends on whether cities can identify the issues and approaches that are best suited to their particular needs and circumstances. As the city develops, circumstances may change, as can strategies to achieve sustainability goals. Even within a city, priorities may differ, and so each city needs to identify context-specific strategic initiatives to promote sustainable development on a local scale" (Weingaertner, 2010, p. 38). For this reason, to achieve the objective of the study, three Bulgarian cities were selected for analysis, which differ in demographic, economic, social, and cultural profile (see Table 2).

Table 2. Objectives and priorities set out in the integration plans for development

Strategic objectives and priorities set out in the integration plans for the development of Svishtov Municipality, Varna Municipality, and Sofia Municipality	
Svishtov Municipality	
Strategic Objective 1:	**Economic growth and industrial infrastructure**
Priority 1	Development of "Danube Industrial Technology Park Svishtov"
Priority 2	Supporting the transition to a circular economy
Priority 3	Promoting sustainable employment and increasing entrepreneurial activity
Strategic Objective 2:	**Waste management and environmental protection**
Priority 4	Higher efficiency in waste management
Priority 5	Water protection, risks, and climate change
Strategic Objective 3:	**Improving the living environment in settlements**
Priority 6	Improvement and connectivity of settlements
Priority 7	Modernising public services for the population
Strategic Objective 4:	**Creating more favorable conditions for the development of human potential**
Priority 8	Development of education and sport
Priority 9	Improving the quality of health and social services
Priority 10	Protection and promotion of cultural heritage and development of cultural tourism
Strategic Objective 5:	**Good local governance**
Priority 11	Increasing the management capacity of municipal administration
Priority 12	Increasing the participation of citizens and businesses in local governance
Varna Municipality	
Strategic Objective 1:	**A healthy, preserved, and fair city that is capable of climate change**
Priority 1	Green City
Priority 2	Socially Fair and Healthy City
Strategic Objective 2:	**Leading regional leader in the integrated development of the region with knowledge and innovation**
Priority 3	Centuries-old and diverse city
Priority 4	New and educated city
Priority 5	Territorial connectivity and accessibility
Priority 6	Administrative and regional leader
Sofia Municipality	
Strategic Objective 1:	**More sustainable development and improved connectivity**
Priority 1	Sofia Municipality - sustainable, green and adaptable
Priority 5	Sofia Municipality – Connected and Integrated
Strategic Objective 2:	**Increasing the competitiveness of the municipality and developing a knowledge economy**
Priority 2	Sofia Municipality – competitive, innovative and intelligent
Strategic Objective 3:	**More developed social and cultural environment**
Priority 3	Sofia Municipality – diverse, authentic and vibrant
Priority 4	Sofia Municipality – social and inclusive

Source: Own research based on data in the "Plans for the Integrated Development of Municipalities – Sofia, Varna and Svishtov 2021-2027"

When analyzing the set goals and priorities, it is noteworthy that Svishtov Municipality has set itself five strategic objectives and 12 priorities; Varna Municipality - has two strategic objectives and six priorities; Sofia Municipality - has three strategic objectives and five priorities. In confirmation of the position of Weingaertner (2010), the municipalities in Bulgaria also take an individual approach to determining the goals and priorities in their development. This example shows that the municipality with the smallest economic and demographic capabilities has set more goals than the capital and the regional city. This is understandable from the point of view of the desire of the Municipality of Svishtov to become a more attractive territory for life and development and to improve its demographic characteristics. It is satisfying that all three municipalities set goals and priorities related to improving the state of infrastructure to a large extent and achieving better sustainability indicators.

4. ANALYSIS OF REAL ACTIONS AND RESULTS

Within the framework of the analyses, an overview of the information on the achieved results of the three monitored municipalities (Sofia, Varna, and Svishtov) is also included. Despite the established good intentions for changes and development aimed at achieving sustainability in urban consumption set out in the integration plans for the development of municipalities, the abstraction of secondary statistical data to find information on the results achieved by the cities under consideration in this direction proved to be a challenge because:

- Much of the data is at the level of country, region, district center, or municipality. There are no specific indicators only for cities;
- For some of the indicators related to the state of urban infrastructure, no reporting data are collected at all;
- Refusal of the companies concerned to provide information on the state of the infrastructure.

For the above-mentioned reasons, additional information was sought from the municipalities themselves. For this purpose, the only published and publicly available energy efficiency reports that each municipality fills in and reports to the relevant ministry are reviewed. They contain information about the goals set for limiting electricity consumption within the cities and the implementation of these goals (see Table 3).

Table 3. The energy efficiency of Sofia, Varna, and Svishtov for the period 2014 – 2022

Energy Efficiency Reports 2014-2022		**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Sofia										
Objective of the Energy Efficiency Programme		N/A	N/A	N/A	0	0	0	0	0	836,7
Performances of the program:	GWh	N/A	N/A	N/A	0	0	0	0	0	3,8
	%	N/A	N/A	N/A	0	0	0	0	0	0
Energy savings proven by certificates		N/A	N/A	N/A	0	0	0	0	0	0
Varna		**2014***	**2015***	**2016***	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Objective of the Energy Efficiency Programme		5,42	5,42	5,42	0,43	0,1	0,18	0,13	1,2	1,2
Performances of the program:	GWh	0,6	0,4	0,4	6	0,3	0,6	0,1	1,3	0,3
	%	12	7	14	135	342	314	108	106	25
Energy savings proven by certificates		-	-	5,8	0	0	0	0	0	0
Svishtov		**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Objective of the Energy Efficiency Programme		N/A	N/A	N/A	N/A	N/A	0	2,58	2,58	2,58
Performances of the program:	GWh	N/A	N/A	N/A	N/A	N/A	0	0,5	0,2	0,5
	%	N/A	N/A	N/A	N/A	N/A	0	20	8	19
Energy savings proven by certificates		N/A	N/A	N/A	N/A	N/A	0	0	0	0

* Formulated target is common for the period 2014-2016
*** Energy efficiency targets

	MWh/1000 persons								
Sofia	-	-	-	0	0	0	0	0	687,1196
Varna*	16,1334012	16,20494	16,17056	1,280318	0,297172	0,53537	0,391102	3,607005	3,857367
Svishtov	-	-	-	-	-	0	109,4333	112,5802	143,8127

Source: Own research

The first fact that impresses is that there is no long enough dynamic order to be compared, as the largest municipality of Sofia has published reports under this program only since 2017, given that the documents in the period 2017-2021 have zero values and Svishtov - from 2019 (for 2019 the document has zero values). Only the Municipality of Varna published its reports from the very beginning of the launch of the national program which is 2014.

In the period under review, the Municipality of Varna always has a plan implementation in the range of 7% to 342% (in 5 periods, the plan has been over-implemented), which we can say is due to too minimalist planning because in the periods for which we have comparative data, the planned savings in Varna compared to Svishtov are between 31 and 280 times lower comparing the indicator set savings MWh per 1000 people, and with Sofia for 2022 – approximately 178 times lower staked values. For Svishtov in the period 2020-2022, the implementation of the plan is between 8% and 20%, and for Sofia for 2022 – 0% (a decrease in electricity consumption of 3.8 GWh was reported, and a decrease of 836.7 GWh was planned.

There is also a difference in the reported implementation of the program. For the period 2014-2022, Varna Municipality has achieved a reduction in the use of electrical energy between 0.3911 and 16.2049 MWh/1000 people; in the last two periods, just over 3.6 MWh/1000 people. These values compared to Svishtov (2020-2022) are between approximately 2 and 70 times lower and for Sofia – approximately 3 times lower in 2022.

In conclusion, it can be said that there is still no data on the full comparison of the indicators under consideration and on the generalization of conclusions. However, the different planning approaches speak of the relative autonomy of administration in the cities under review, which shows that it is possible to monitor and compare the indicators under consideration to detect differences within the ideas of sustainable consumption at the city level.

5. FUTURE RESEARCH DIRECTIONS

As a subject of future research, the factors influencing the lack of good planning and implementation of measures and activities under the set goals and priorities in the plans for the integrated development of municipalities can be studied. In addition, it can seek information on whether the measures taken by municipalities have an impact on the change in the behavior of other subjects in the urban environment, namely individual governments, businesses, and non-governmental organizations. Data can be sought and analyzed to determine the extent to which the measures are adequate and correspond to the vision of individual citizens and regional businesses in terms of sustainable consumption and development.

6. CONCLUSION

In this paper, the existence of regional differences in sustainable consumption strategies is confirmed. Following the logic of the comparative analysis, such differences can be established for other municipalities surveyed. The findings can serve as a basis for a more in-depth analysis to specify whether the reasons for these differences are due only to the profiles of the municipalities surveyed or whether there are other factors.

Several difficulties have been identified in collecting secondary data on indicators important for the sustainable development of cities. This finding is useful for municipalities because it can serve as an argument for creating a single, adequate, up-to-date, and detailed database that will be the

basis of the analysis and comparison of cities about the achievement of specific results related to sustainable consumption.

Arguments in favor of infrastructure as an important indicator and prerequisite for sustainable consumption are outlined, and this can be a starting point for developing a methodology for constant monitoring of certain indicators related to its condition.

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