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A BRIEF REVIEW ON GREEN ECONOMY IN SMART CITY APPLICATIONS

***Hicran Hamza CELIKYAY** *(Orcid Id: 0000-0002-4256-1397)*[1]
****Mehmet CELIKYAY** *(Orcid Id: 0000-0003-4243-896X)*
*Duzce University
**Gebze Technical University

ABSTRACT

The majority of the world's population lives in cities. Cities now house more than half of the world's population. The urban population is expected to increase to 75 percent by 2030. By 2050, the number of "megacities" with 10 million or more inhabitants will have increased at the same rate.

Recently, the world has faced a slew of global issues. Cities are dealing with climate change, global warming, flash floods, wildfires, and, most recently, the COVID-19 pandemic. Cities' resilience is critical to the urban population. Smart applications must be developed so that cities can deal with global issues while also providing high-prosperity services to their citizens. As a result, many central and local governments are in charge of smart city applications.

One of the six fundamental components of smart cities is smart economy. Green economy practices have emerged as a means for cities to become more resilient in the face of global environmental problems. Smart cities, smart city components, smart economy, and green economy are all discussed conceptually in this study. The smart economy component is highlighted in particular, and the extent to which the green economy occurs in smart economy applications is investigated using its main characteristics, concepts, and applications.

Keywords: *Smart City, Smart Economy, Green Economy*

Introduction

By 2050, 75% of the world population will be living in urban areas while the number of ‘‘mega-cities’’ with 10 million inhabitants or more is expanding at the same pace (UN DESA, 2014). The Economist declared in 2007, ‘Wisely or not, Homo sapiens have become Homo Urbanus.’ Today, the global problems that cities have to face have increased visibly. Global warming, climate change, flash floods, earthquakes, forest fires, volcanic eruptions, chemical leaks, terrorism, possible energy cuts after the Ukraine-Russia War, financial crises, cyber-attacks, and finally COVID-19 that the world is facing. Global epidemics are among them. (Moraci, vd., 2020: 1).

Rapidly growing economic activity and industrialization encourage migration. The "Smart Urbanism" perspective will play a major role in turning possible difficulties that may arise in urban life as a result of increasing population density into opportunities. While planning the city and determining strategic goals and targets, it is of great importance to develop Smart City-themed approaches and intensify activities in these areas. In the development of urbanism activities, especially human-oriented, economic, social, and environmental dimensions should always be considered.

Cities are an important key in tackling all these problems. Cities use sustainable technologies to increase resilience and raise the living standards of the citizens and increase their welfare level; they carry out solutions. These solutions are only possible with a strong economic structure. Smart applications come to the front to make these solutions easy.

Cities are an important key in overcoming all these problems. Cities use sustainable technologies to increase resilience and improve citizens' living standards and well-being; implement solutions. These solutions are only possible with a strong economic structure. Smart applications come to the fore to make these solutions easy. Smart City applications aim to improve the service they provide to citizens both

[1] Corresponding author

economically (high efficiency) and socially (meeting the needs and wishes of their stakeholders effectively) (Aguilera, et. al., 2017: 234).

In this study, smart cities, smart city components, smart economy, and green economy are discussed conceptually. Especially the smart economy component is emphasized and the extent to which the green economy takes place in smart economy applications is examined with its main characteristics, concepts, and applications.

FINDINGS

The Definition of Smart City

Some of the main goals of smart cities are to improve the quality of life, support sustainable local development and improve urban services efficiently and effectively. Today, when Industry 5.0 and even 6.0 are being talked about, "Industrie 4.0" refers to the 4th industrial revolution following the previous three generations: mechanization (Industrie 1.0), Electrification (Industrie2.0) and Digitization (Industrie3.0). Smart Cities are the application of Technologies on a much larger scale by connecting people in a city to all "Smart Technologies" to provide real-time information to the citizens with the right details at the right time (Hui, 2017: 359).

It can be said that there are two different approaches to the smart city concept. The first approach is to evaluate the concept of "smart" in the urban context as more efficient, sustainable, equitable and livable. The second approach is an approach closer to the industry, which prefers to emphasize that the smart city represents an interconnected and smart city with all its functions such as innovation on technology, policy and management (Diaz-Diaz et. al., 2017: 199).

The smart city provides a platform where traditional networks and services are made more efficient through the use of digital solutions for the benefit of citizens and local economic development. A smart city is a place where more efficient options are presented for the improvement of urban transport networks, water resources and solid waste disposal facilities and the installation of smart buildings by adopting the goal of better resource use, less emission and carbon footprint. At the same time, a more sensitive and participatory city management, safer public spaces and meeting the needs of the aging population are given priority in smart cities (EC, 2022).

With the latest developments in information and communication technologies, smart cities have emerged as a new paradigm in order to use the resources in the city effectively, to provide better living spaces and to increase the quality of life (Sookhak, et. al., 2019:1718). The concept of "smart city" has attracted the attention of both scientists and industrial experts due to its characteristics and practical applications in urban applications. Many cities have started to develop their own strategies for the concept of smart cities in order to improve the quality of life and provide better service to citizens (Al-Turjman, et. al., 2019). The smart city offers advanced urban spaces that stand out in economy, governance, society and life through strong human capital, social capital and ICT infrastructure (Dlodlo et. al., 2016: 1).

The key sectors for a smart city are transportation, energy, health, water and waste. A smart city can meet urban and global challenges faster as long as it interacts with its citizens. The importance of smart cities is becoming more important with the latest issues such as climate change, global warming, wildfires, floods, online logistics services, and pandemics especially like COVID-19 seen last years (Ferrera, 2015: 4725).

Modules (Components) of a Smart City

The smart city is defined by a smart combination of investments in human, social, infrastructure, technological and working capital resources that support sustainable economic growth and ensure a high quality of life. It encompasses the conditions for wise management of natural resources and a strongly supported governance system. The six main components where these digital innovations are expected to make a difference are as follows: smart living, smart governance, smart economy, smart environment, smart people and smart mobility (Diaz-Diaz et. al., 2017: 199).

A smart city values creativity and is open to new ideas. It promotes entrepreneurial leadership and offers various economic opportunities to its citizens. Thus, it supports local development. The challenges and opportunities of economic globalization faced at the local level. While a smart ciyt thinks locally, it acts

regionally, and competes globally. It means, all activities and work done at local and regional level but their impact seen globally (Kumar and Dahiya, 2017:13).

Table 1. Smart City Components and Applications

Smart City Components	Applications
Smart People	Building Information Society
	Easy access to information and technology
	Open to innovations, being equipped with information.
	Openness to developments
	City Councils
Smart Governance	Access to services such as transport, infrastructure, water, waste management
	Open and transparent governance
	Compliance with EU Governance principles (transparency, participation, accountability, efficiency and consistency),
	R&D, Decision-Making Processes, Public and Social Services, Transparent State Administration
	Political Strategies and Perspectives
Smart Living (Quality of Life)	Improving living standards
	Providing health insurance to city residents
	Providing education and safety
	Providing equal opportunities and suitable housing
	The elderly population
	Supporting cultural studies and sports activities
	Different cultures
	Preservation of cultural heritage and urban memory
Smart Environment	Green Buildings, Green Energy, Green City Planning
	Protection of water and energy, green areas and natural environmental resources
	Green certification of new residential buildings and especially public buildings
	Sustainable energy
Smart Economy	Entrepreneurial, Innovative, Efficient, Local and Global connections
	High quality job and employment opportunities
	Supporting local businesses to complement globalization
	Promoting entrepreneurship
	Fostering productivity and leadership
	Providing an efficient and competitive environment
	Increasing the local economic activities in the city
	Being a center of attraction
Smart Mobility (Connections)	Prioritizing rail systems for transportation
	Integrated smart transportation systems
	Easy accessibility to transfer points
	Low carbon emissions
	Local and International Accessibility
	Strong ICT infrastructure
	Sustainable innovative and safe transportation systems

Source: Celikyay (2017).

Smart cities have six components: 1) Smart Economy 2) Smart Mobility (Connections) 3) Smart Environment 4) Smart People 5) Smart Living 6) Smart Governance Table 1 shows smart city components and applications.

With the development of ICT technologies, the following components have been added to the Smart Cities structure besides the basic 6 components. These are: smart energy, smart building, smart technology, smart health-care, smart education, smart security (Shohkak, 2019: 1718).

And also Smart Infrastructure, Smart Water and Sewerage, Smart City Planning, Smart Energy, Smart Building, Open Data, Smart Digital Citizenship, Smart Transport Smart Buildings and Smart Production can be listed as smart city components.

Smart Economy

Information and communication technologies-based production and service delivery reveal new types of business models. The concepts of "e-business", which refers to the interaction of producers, consumers and business partners in the electronic environment, and "e-commerce", which refers to commerce over the internet, have changed the traditional production and business methods; It enables the rapid and effective circulation of goods, services and information in the virtual environment. This situation has a leverage effect and positively affects entrepreneurship, employment and productivity.

The important thing here is to benefit from emerging technologies in a way that will contribute to the entrepreneurship and production capacity of the city. In this context, it is important to prepare the technological infrastructure that can create potential. In order to find solutions to the problems encountered in the urban area and to create new business opportunities in this context, making the data obtained by local governments open will bring new initiatives to the agenda. Again, applications such as ensuring the meeting of consumers and local businesses with the development of smart applications by local governments or increasing all kinds of attractiveness of the city with the brand value created through the "smart city" can be realized.

Smart Economy is the handling of micro and macro dimensions of a city's economic inputs, outputs and activities within the framework of smart industries. In the face of increasing consumption factors in every field, it aims to use existing resources efficiently and to develop measures for increasing consumption and to increase the quality of life. Competitiveness, brand value and sharing economy are prominent concepts (ÇSB, 2019: 13). In a smart economy efficiency is considered as the delivery of innovative services and business models. It also builds smart communities and global ecosystems (for example, digital businesses and entrepreneurship) (EC, 2022). Being resource limited, technological development and socioeconomic opportunity are main drivers of smart economy.

According to Kumar and Dahiya (2017:13), as a component, smart economy is one of the building blocks of smart cities. A smart city has a sense of understanding its economic DNA. Because it is driven by innovation and supported by universities studying on cutting-edge researches. In a smart city, universities not only study for science, industry, and business but also for cultural heritage, architecture, planning, development, etc. Smart economy aims to (Kalenyuk & Uninets, 2020: 4):

1. Reduce Pollution
2. Ensure Energy Efficiency
3. Ensure Sustainable Resource Management
4. Preserve Natural Beauties,
5. Increase Urban Aesthetics
6. Create Environmentally Friendly
7. Built Sustainable Green Buildings and Living Spaces
8. Ensure high rates of economic growth,
9. Increase the participation of intellectual workers
10. Create a productive and innovative business environment,
11. Form "green economy",
12. Ensure social stability, etc.

Smart economy applications feed the feedback shaped according to the needs of consumers and users. It contributes to the increase of product and service quality. It prompts market actors to seek new marketing

and sales methods such as social media and e-commerce. It helps market actors to develop new products, service areas, new ideas and business models in a competitive environment. It provides dynamic pricing by creating the necessary forecasts for prices to show variability and flexibility in response to real-time supply and demand.

With a focus on smart cities, it creates added value on national resources and values. It provides ease of access to products, services and raw materials for both consumers and other actors of the production chain. It provides sustainable development and savings. Increases economic transaction mobility. It ensures effective, efficient and economical use of resources. It contributes to the correct and efficient investments. It contributes to the healthy functioning of economic planning, policy and predictions and decision mechanisms. Motivations and challenges of smart economy is seen in Table 2.

Table 2. Motivations and Challenges of Smart Economy

Motivations	Challenges
Increase of product and service quality. Encourage to seek new marketing and sales methods such as social media and e-commerce. Contributes to the development of new products, service areas, new ideas and business models within the competitive environment of market actors. Creates added value on national resources and values Ease of access to products, services and raw materials Provides sustainable development and savings. Improves economic transaction mobility. Ensures effective, efficient and economical use of resources. Contributes to the correct and efficient investments. Contributes to the healthy functioning of economic planning, policy and forecasts and decision mechanisms	High initial investment costs High unit prices of technological products to be used High operating and maintenance costs Lack of competent human resources Need for hardware upgrades to smarten the existing infrastructure Existing infrastructure is old and in use Insufficient regulations Lack of city-based guiding policy Technical constraints Low level of interoperability in a multi-vendor environment Low level of interoperability of systems Security and privacy concerns Cyber security threats

In a smart economy, strategic investments done on strategic assets. Smart economy develops and supports compelling national brand/s and it insists on balanced and sustainable economic growth[2]. With a smart economy, the smart city makes the most of its resources while finding solutions to problems. The smart economy allows a city to have high flexibility of the labor market. In a smart economy, human resources are handled professionally. In a smart city, sustainable natural resource management is at the forefront (Kumar and Dahiya, 2017:13). A characteristic feature of the concept of the smart economy is the combination in a single system of processes of intellectualization, institutionalization, greening and socialization. When these conditions are met, all components of the smart economy can take place in a balanced ecosystem.

GREEN ECONOMY IN SMART CITY APPLICATIONS

Main Characteristics of Green Economy

Sustainable green development is the goal of the "green economy." For this, it seeks to lessen environmental risks and increase the sustainability of ecological resources. Although the two are closely related, the formulation and application of policies in this area are more robust in the green economy. "For an economy to be considered green, resources must be distributed equally in addition to being used

[2] In most of references, it is preferred using “growth” instead of “development”

effectively and sustainably. Aims to ensure the global, national, and local transition to a low-carbon, resource-efficient, and socially inclusive economy (The Green Economy Report, 2011).

The role of cities in global warming, climate change and other environmental problems worldwide followed by the properties of smart cities on green technology innovation (Tomar & Kaur, 2019). Smart cities are related to environmental policies in many aspects. These policies produce more effective and powerful results, especially when implemented at the local level. Therefore, the management of smart cities is based on the principles and characteristics of the green economy, which is a key issue (Ferrara, 2015: 4725).

The green economy cannot be viewed as an addition to or a traditional economic model. The impoverished and incompetent users who can be investigated from the environmental standpoint of wildlife protection and the environment are addressed by the green economic model. Our earth and people are significantly threatened by the global economic and ecological crisis. Only the green economy and the smart city applications of the green economy within the smart economy can overcome these challenges (Balaban, 2019: 69).

The urban spaces become centers of innovation for green economy applications so, cities are in an appropriate position to implement a greener economy. The model of the green economy can be based on the idea of smart city. Land use, smart buildings, intelligent transportation, and waste management are the key factors to establish a green economic model in a smart city (Balaban, 2019: 69).

Cities in various parts of the world are now striving to deal with global problems with greener and smarter methods, especially using the methods of producing, supplying and using energy. Clark and Cooke (2016:2) call this new era as “the Green Industrial Revolution”. The Green Industrial Revolution is a revolutionary global change with extraordinary potential and opportunities from fossil fuels to renewable energy sources. It includes remarkable innovations in science, technology and energy.

United Nations General Assembly approved Sustainable Development Goals (SDGs) in Rio+20 Conference in 2012. Also “Millennium Development Goals” are approved in 2015. The SDGs include “Goal 11—Make Cities and Human Settlements inclusive, safe, resilient and sustainable.” So, sustainability which is the key concept for the Smart Green city, is also one of the vital SDGs’ issues for UN. For sustainable, smart and carbon-free living spaces, non-polluting energy sources such as solar, wind and geothermal and smart technologies should be developed.

The green economy is based on six components: Renewable Energy, Green Buildings, Sustainable Transport, Water Management and Waste Management (Burkart, 2012). The Green Economy is defined as an economic system that focuses entirely on the concept of "green". This type of economy is based on green finance, green investments and social equality. It is a model that advocates an “environmental”-centered approach. The green economy is based on the ancient concept of sustainable development; highlights the importance of the sustainability model. Reducing carbon emissions, focusing on the equitable distribution of resources, and maintaining a harmonious and equitable social relationship between people are the core beliefs of the green economy. The components of the green economy are green buildings, green finance and social inclusitivity (Kaushik, 2021). And the principles are;

1. **Eco-efficiency principle**: It involves maximizing the beneficial properties of goods and services while minimizing environmental impact.
2. **Resource saving principle**: making managerial decisions taking into account the conservation of natural resources
3. **Unity principle**: refers to the coherence of all activities of the economy in the development process;
4. The principle of “intersectoral” is the participation of representatives of various sectors of society in the decision-making process (Onyusheva, et. al., 2018: 152):

The green economy model is crucial for the efficient use of natural resources, the preservation and growth of natural capital, the maintenance of social balance and the equitable distribution of resources, the rise in income and employment, the reduction of environmental pollution, the sustainability of ecological systems, and the protection of biodiversity.

Green Economy Applications

Green Economy focuses on eco-friendly investments. Government spending on solar energy, wind energy, hydroelectricity, and geothermal energy is optimal and balanced in countries that follow the green economy model. The production and consumption of organic food are given priority in this economic model. People's daily lives are shaped by the green economic model in places that have implemented it. For instance, green energy is employed, organic farming is practiced, green buildings (plant based homes) are constructed, and electric vehicles, non-motorized transit options (recycling lithium batteries), bicycles, and scooters are chosen as transportation options.

1.Plant based homes: Plant homes are healthy and sustainable. They have proper systems for rooftop harvesting, the blend of healthy homes with a tint of tradition is allowing people to experiment with the traditional styles of living. These homes have a designated mini recycling arena and proper ventilation systems that makes them better than traditional homes.

2. Recycling Lithium Batteries: Lithium-ion batteries are used in laptops, and mobile phones. These batteries contribute to the increase in global warming as they use mining for the extraction of cobalt and lithium. Although they are the lifeline of processing systems their impact on the environment cannot be overlooked. Lithium batteries overheat and are non sustainable. Recycling lithium batteries is the best way to solve the existing problems.

3. Organic Farming: Natural farm manure is the best way to increase a crop's production without using pesticides and fertilizers. This unique blend of green manure, bone meal and compost meal that only uses fertilizers derived from organic origin, is known as organic farming (Kaushik, 2021).

There are some technologies that make a city smart and green. For example, Storage Technologies, Vehicle to Grid (V2G), Power Storage in Electric Cars, Hydrogen—a Breakthrough Technology, Smart, Green Grids, Greener Waste Collecting, Emerging Green Technologies, A Revolution in Lighting Technologies and Peak Demand Response, Cool Roofs Will Offset Carbon, Nanotechnology – "Really" Small Things, Microgrids, Smart Meters, Green City Planning, Energy Efficient Smart Street Lighting, Smart Water Management and Drainage Systems are some of them (Clark and Cooke, 2016).

CONCLUSIONS

Cities are expanding all over the world, their structures are becoming more complex, and their populations are rapidly increasing while resources are decreasing. Municipalities and local governments must use smart solutions and more technology to provide better quality and efficient service with fewer resources. Innovation is a never-ending process. Renewal is required for service sustainability and quality. As a result, both municipalities and local governments should research and implement new and different service processes.

A technological strategy and development road plan should be created by the federal, state, and municipal governments. Cities will have a better understanding of how technology fits into their long- and short-term strategic growth strategies and how they see themselves. Local governments ought to think about collaborating with the private sector on the creation and administration of specific technologies. Due to widespread environmental issues including climate change, global warming, flash floods, wildfires, and most recently pandemics, both national and municipal governments should pay more attention to what is happening in cities and offer more assistance in the battle against these issues. With the use of smart city applications, this might be simpler and more effective.

Six major components comprise smart cities. A part of this is the smart economy. The advantages of the technological system to be used should be examined, the distinctive features of each city should be taken into account, and citizens should be involved in all decision-making processes pertaining to the smart economy and the city in order to address the problems with the environment on a global scale. Prior to the implementation of the smart economy system, consideration should be given to green economy practices and economic activities.

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