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Managing the Cities of the Future and the Energy Needs of Cities

Abstract: Managing the cities of the future is one of the key challenges of modern societies facing increasing urbanization, technological advances and climate change. The purpose of the publication is to discuss the concepts of cities of the future, such as "smart cities" and "green cities," and various governance models that take into account the needs of residents, sustainability and technological innovation. Special attention is given to the role of the energy sector, which is becoming a key factor influencing urban development in the face of the energy crisis. Cities of the future must integrate renewable energy sources, smart grids and energy management systems to reduce environmental impact and improve quality of life. Sustainability, efficient management of natural resources, and attention to biodiversity and green spaces are the foundations for the development of cities of the future. Technologies such as the Inter-net of Things (IoT), artificial intelligence and Big Data will be key to monitoring and optimizing city operations, as well as real-time decision-making. Cities of the future will also promote sustainable transportation, such as electric vehicles, bicycles and autonomous vehicles, as well as nurture social inclusion, access to public services and education. Closed-loop economies, the digitization of public services and the development of technological skills will be key to creating a dynamic, safe and innovative urban ecosystem. The future of cities will depend on the ability to adapt to new technological, environmental and social challenges, while maintaining the privacy and security of residents' data.

Key words: urban governance, energy needs of cities, city of the future, urban governance models

Introduction

Contemporary cities are facing enormous challenges as a result of ongoing climate change, increasing energy demands and dynamic de-

mographic and technological changes. The concept of cities of the future is to create spaces that are sustainable, smart and resilient to crises, but the implementation of these assumptions faces a number of barriers. One of the key aspects of this transformation is managing energy needs in a way that is efficient and tailored to local circumstances.

The research problem focuses on how cities can plan and implement energy policies in line with the idea of sustainability, while taking into account real financial, organisational and competence constraints. Although there are many innovative technological solutions to support the energy transition (e.g. smart grids, RES, energy storage), their implementation requires not only financial outlays, but also adequate institutional facilities and expertise on the part of the local administration.

This problem justifies the need for a researcher dealing with urban transformations, public management and energy policies to undertake the study. The analysis of the experiences of cities (both Polish and foreign), the diagnosis of barriers and the identification of good practices will allow for the development of recommendations that can support decision-making processes and increase energy efficiency under conditions of limited resources. The research may also contribute to a better understanding of the role of competence and intersectoral cooperation in the transformation of urban energy infrastructure.

Managing cities (Yigitcanlar, 2024) in the context of the future is one of the key challenges of modern societies. Changing urban realities, technological advances, growing and changing social needs or environmental pressures pose new questions for city managers, including how to organize urban space so that it is not only functional, but also sustainable for the development of the city and the needs and preferences of its residents.

As urban populations grow and natural resources become more scarce, space becomes a scarce value, it becomes necessary to search for new models of urban management that respond to these changes.

The purpose of this publication is to introduce the concept of cities of the future, discuss different approaches to their management, and understand how the technological and ecological innovations being introduced may affect the way we live in cities. The author considers the energy sphere to be an important factor, the importance of which is increasing and in the coming years will be a factor even blocking the development of cities.

For the purpose of the publication, the researcher adopted the following research hypothesis, which she validated based on the acquired

knowledge from secondary sources. H_1 reads as follows: *Contemporary cities are not prepared to transform themselves into cities of the future*.

The transformation of cities into so-called “Smart Cities” (Jonek-Kowalska, Wolniak, 2023; Paulin, 2018, p. 54) and “green cities” (Xie, Li, Grunewald, Kümper-Schlake, 2018, pp. 24–30) is becoming a necessity, and their success depends on the ability to integrate new technologies, effectively manage resources and take care of sustainability (Jassim Al-Yasiri, 2022, pp. 186–196).

Faced with the global challenges of climate change and increasing energy demand, cities are facing the need to implement sustainable energy solutions. In this context, renewable energy technologies, smart grids, as well as energy management systems that optimize consumption and minimize environmental impact are becoming important.

Cities of the future should also focus on integrating green solutions, such as sustainable water management, green infrastructure, recycling and efficient waste management. Moving toward carbon neutrality and reducing emissions will require thoughtful transportation strategies, including the development of electric vehicles and charging infrastructure, as well as investments in public transportation and bicycle systems.

An important aspect will also be the use of data and analytics for real-time decision-making, which will allow efficient management of resources and improve the quality of life for residents. Smart city technologies, such as the Internet of Things (IoT) (Gwiaździński, 2025, p. 13–18) and artificial intelligence, will be crucial in monitoring, analyzing and optimizing city operations.

The author points to the following as important data in the area of future city management:

– the year 1992, the Rio Conference (UNCED) was held and the beginning of “Agenda 21”, which launched global thinking on sustainable urban development (Silvius, Huemann, 2024, pp. 32–35);
– year 2000, which marked the beginning of the development of the first smart city projects in developed countries such as the US, Canada, Japan and in Europe (Haddad, 2024);
– the year 2008, which introduced the terms “smart city” in the context of projects in Barcelona and other European cities that began to use information technology to manage the city (*Smart Cities Council*, 2012).

The concept of the city of the future, smart city or green cities – when did they appear?

The concept of the “city of the future” began as early as the beginning of the 20th century, more than 100 years ago, especially in the context of urban planning, the development of technology and social and demographic changes (Motak, 2012, pp. 523–533). In the 1920s, visionaries such as Le Corbusier (Fontana, Mayorga Cárdenas, Roa, 2016, pp. 87–98), in his urban planning projects (“Ville Radieuse”), imagined future cities as spaces that would be well-planned and functional, while respecting aesthetics and modern technology. In later decades, as technology developed, the notion of the city of the future became increasingly associated with the idea of modern metropolises in which advanced technological infrastructure would play a key role in ensuring the quality of life of residents.

The concept of the city of the future has also begun to gain prominence in the context of the idea of sustainable development and urban management in the face of increasing urbanization. In the 1960s and 1970s, as urbanization accelerated, the search began for new concepts of urban management (Clarke, Buckley, 2009, pp. 1–45) that could effectively respond to problems of overcrowding, pollution and infrastructure inefficiency.

As for the general definition of the city of the future (Glazebrook, Newman, 2018, pp. 1–20). The author cites a definition that views the city in a systemic and comprehensive way. It is a city characterized by a comprehensive space that integrates modern technologies, sustainable development and urban solutions in a way that responds to changing social, economic and environmental needs. The city of the future focuses on innovation, improving the quality of life of its residents and protecting the environment.

In the last dozen years or so, the name “city of the future” has been superseded by the definition of smart city otherwise smart city. In the case of this concept, no single researcher or institution can be identified as the creator and originator of the definition.

It is the result of an evolution in urban planning, technology and urban management. The idea of smart cities emerged from a combination of different approaches to urban development, where information and communication technologies (ICT) play a key role in improving the quality of life of residents, the efficiency of urban management and sustainable development (Oluwagbemiga Paul, Bashir, Aminu Dodo, Ahmed Said, 2023, pp. 1–14).

Forerunners of the concept of the city of the future include: Marshall McLuhan (Dickel, Schrape, 2016, pp. 163–178) or Peter Drucker (Rosenstein, 2013, pp. 6–15). There was a shift from theoretical to practical considerations in the early 1990s in the 20th century. This was triggered by the emergence of modern information systems, or the development of the Internet, which affected the changes taking place in the way cities are managed.

In cities such as Amsterdam, Barcelona and San Francisco, the first initiatives that could be considered steps towards smart cities have begun to appear (Mora, Bolici, 2016, pp. 155–181).

The literature views the concept of a smart city as a city that uses modern technologies such as the Internet of Things (IoT), Big Data, and artificial intelligence to optimize city management. It is characterized by automated systems for managing traffic, energy, water and other resources, which improves the quality of life of residents and reduces the negative impact on the environment (Rehan, 2023, pp. 1–16).

Another synonym for the city of the future is the so-called “green city,” that is, a city that focuses on sustainability and care for the environment. It is characterized by green spaces, efficient management of natural resources, low emissions, and the use of renewable energy sources, including solar and wind energy.

The author points out that the city of the future should be seen as an ecosystem that includes:

- Sustainable infrastructure, serves to minimize its environmental impact. This means the use of renewable energy sources such as solar or wind power, efficient transportation systems based on electric vehicles, and stormwater and waste management systems. Sustainable infrastructure also includes so-called “green” architecture, by which is meant roofs, bioclimatic buildings and heating and cooling systems using geothermal energy (Tafida, Salah Alaloul, Amila Bt Wan Zawawi, Ali Musarat, Sani Abubakar, 2024**)**.
- Smart technologies (IoT) (Gwiaździński, 2025, pp. 13–18), this consists of sensors, devices and monitoring systems will collect real-time data on air quality, traffic volume, energy and water consumption, as well as noise levels or safety. The above data will allow better management of the city, anticipating crises and responding quickly to changes.
- Sustainable transportation (Doğan, Burcu Gültekin, 2018, pp. 232–252) in cities of the future promotes public transportation and alterna-

tive forms of transportation, such as bicycles, electric scooters and autonomous electric vehicles. Transportation networks are integrated, allowing seamless transitions between different modes of transportation, and the vehicles themselves will be closely monitored by traffic management systems.

- Green spaces and biodiversity. Cities of the future will place greater emphasis on the development of green spaces. Parks, urban gardens, urban forests and “living walls” will be key to improving quality of life, reducing the urban heat island effect and protecting biodiversity. These spaces will not only serve as recreation, but also as places for food production in urban farms or community gardens.
- The city of the future focuses on social inclusion, providing access to services, education, work and culture for all residents, regardless of their social, economic or physical status. Technology is making it possible to create digital spaces that facilitate communication and collaboration, as well as to adapt urban spaces to the needs of people with disabilities.
- Closed loop economy (Sosnowski, Cyplik, 2022, pp. 505–513). This is about the dominance of the closed loop economy, in which waste will be treated as a resource. This model seeks to minimize waste production, maximize recycling, and use technology to reprocess materials to make new products. An example is a waste management system that allows for waste separation and processing at the municipal level.
- Sustainability will be the foundation of urban planning in cities of the future. Proper distribution of residential, service, recreational and industrial spaces will reduce the need for long commutes, reduce air pollution and create more livable spaces.
- Cities of the future will rely on the widely developed digitization of public services. E-government will enable residents to quickly access public services, such as vehicle registration, tax payments, and consultation with officials. There will also be services based on artificial intelligence to help solve problems at the municipal level, such as crisis management or optimization of resource consumption.
- Access to knowledge, training and skill development in new technologies will be key to creating a dynamic ecosystem. Business incubators, coworking spaces and universities will collaborate to create new technologies and social solutions.
- Given the huge role of data in cities of the future, digital security and privacy issues will be key. Securing residents’ personal data and pro-

tecting them from cyber threats will become a priority in creating city management policies. The future of cities will also require appropriate regulations for using data in a way that does not violate residents’ privacy.

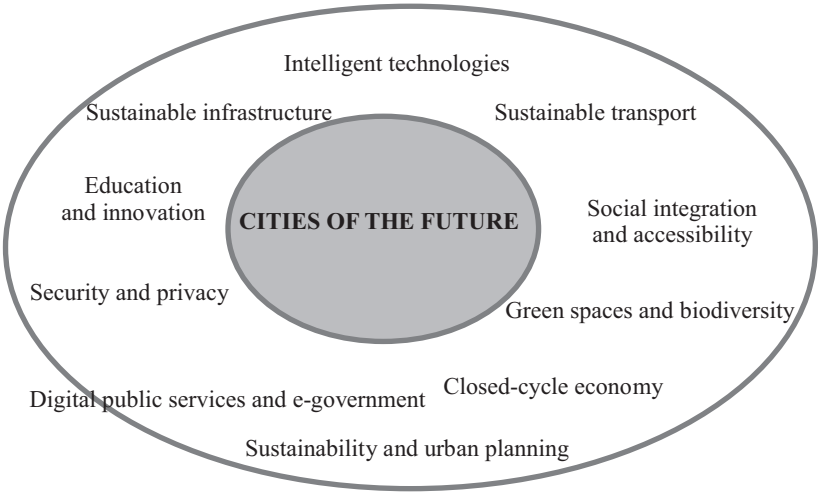

Fig. 1. Ecosystem of the city of the future

Source: Own compilation based on S. Ikeda (2023), *Cities of the Future*, in: *A City Cannot Be a Work of Art. Learning Economics and Social Theory form Jane Jacobs*, S. Ikeda, Palgrave Macmillan, New York, pp. 309–358.

The city of the future as an ecosystem, in which the city is treated as a biological system (Lizia Thankam, Gnanaraj, Prasad, Ann Thomas, 2024, pp. 1–23), in which all elements – from transportation to infrastructure – must interact with nature to maintain ecological balance. An important aspect of this is the regeneration of the urban environment and the reduction of the carbon footprint.

A barrier-free city is a living organism in which equal opportunities are provided to all residents, regardless of their age, health or social status. Thus, the author concludes that a city without barriers is an organism from which the negative phenomenon of social exclusion in its various forms is eliminated.

In the cities of the future, urban space is designed (Dursun, Kozikoglu, 2015, pp. 2–10) with accessibility for people with different needs in mind.

Management of the traditional city versus the city of the future. Similarities and differences

Traditional city management is a process focused on the classic aspects of urban management, such as urban planning, infrastructure management, transportation and the provision of public services (Ali, Alqasi, Ahmed, Alkelanie, 2024, pp. 625–637), which focus on the provision of basic city functions such as the provision of water, electricity, education and health, the so-called basic human physiological needs (Pasek, 2019, pp. 56–81).

The governance model of traditional cities is mainly based on simple administrative structures with strong local authorities such as mayors, councilors or elders. Decisions are often made in an authoritarian manner or based on traditions and social norms. Governance focuses mainly on issues related to the day-to-day operation of the city, such as maintaining order, providing basic public services and ensuring security.

The governance model of traditional cities cannot be attributed to one historical period or a particular person. It developed as a result of a long process of urban evolution. Urban management practices in their traditional form developed gradually over centuries. As early as in ancient civilizations such as Mesopotamia, Egypt, Greece and Rome, the first principles of city management began to be applied, although they varied according to culture and needs. In the Middle Ages, on the other hand, in Europe, the development of cities and local government organizations provided the framework for further refinement of governance systems. During this time, cities often obtained special laws, such as the so-called “Magdeburg Law,” which allowed for greater autonomy in governance. In general, the governance model of traditional cities does not have a single creator, but rather developed in response to the needs of communities in different historical periods.

The author counts among the strengths of traditional city governance:
– direct responsibility of local authorities;
– high social cohesion;
– simplicity in governance structures;
– local approach to development.

On the other hand, a group of weaknesses in the management of traditional cities include:
– lack of flexibility;
– organic access to modern tools and technologies;
– lack of scalability;
– low community involvement.

As the author mentioned in the publication, the city of the future is defined as a social organism with sustainable management and innovative management, in which modern technologies are used. The main goal is to increase citizenship, improve the quality of life of residents and the efficiency of resource management or minimize negative environmental impact.

The model of the city of the future appeared at the beginning of the 21st century in the form of so-called “smart cities,” such as the city of Songdo in South Korea and the Masdar City project in the United Arab Emirates, which have become models to follow.

The author counts among the strengths of managing the cities of the future:
– sustainability;
– smart technologies;
– improved quality of life;
– citizen involvement;
– efficiency of people management.

In turn, a group of weaknesses in the management of cities of the future are:
– high investment costs;
– privacy and data security problems;
– social inequality;
– scalability.

A consequence of the development of cities of the future is the growing energy needs associated with the growth in the supply of innovative infrastructure generating increased energy needs (Zeng, Li, Magazinno, 2024, pp. 1–15).

Of course, in the model of traditional cities, the energy generated was 100% or mostly from non-renewable sources. In the model of cities of the future, which is based on sustainable development, there must be significant investment in infrastructure that creates renewable energy, in particular solar panels (solars), photovoltaic panels or solar towers. The above infrastructure is adapted to the structure of cities and will optimally fit into the layout of modern cities.

Are “city of the future” and “smart city” close terms?

Although the terms “city of the future” and “smart city” are closely related, they are not fully interchangeable.

A smart city refers to a specific concept that focuses on the use of information technology, the Internet of Things (IoT), artificial intelligence and other innovative solutions to optimize urban management. In smart cities, infrastructure is integrated with technological systems that support the management of transportation, energy, public health, security and other urban services. It’s a city that uses data to make decisions and provide greater efficiency in operations.

The city of the future is a broader, general term that encompasses various urban, social and technological aspects. It can range from smart cities to green, sustainable cities based on new forms of society and economy.

In summary, the concept of the city of the future includes the smart city, but is not limited to this definition. It can be said that a smart city is one possible type of “city of the future.”

Green cities (Xie, Li, Grunewald, Kümper-Schlake, 2018, pp. 24–30) is a term that refers to cities that are designed or transformed to be more environmentally friendly, sustainable and healthy for their residents. Green cities emphasize integrating nature with urban planning, minimizing negative environmental impacts, and improving residents’ quality of life through access to green spaces and clean air. Green cities strive to meet the needs of today’s residents while taking care of the environment and future generations.

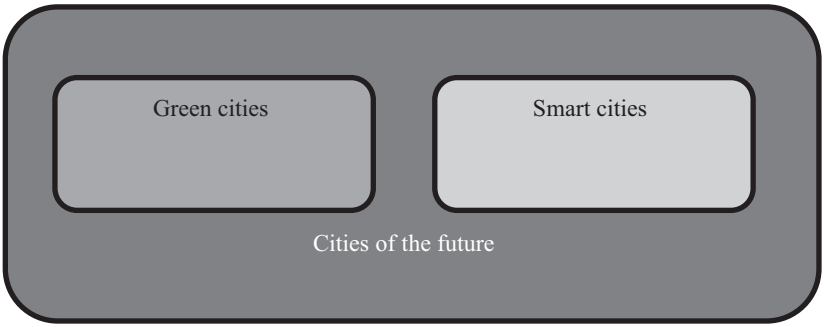

Fig. 2. Concepts of the future city

Source: Own study.

The city of the future is a more general concept in relation to the smart city or green city, which includes both technological aspects (as in smart cities) and ecological aspects (in relation to green cities).

In the model of the city of the future, attention should be paid to a cognitively broader concept. This is a more general term, referring to a vision of a city that will be adapted to changing social, economic, technological and environmental conditions in the future. It can encompass a wide range of solutions, from sustainability to modern infrastructure to climate change adaptation. The city of the future encompasses a broader vision of urban development in the context of a changing world, taking into account various aspects – not only technological, but also social, economic and environmental. The Smart City, on the other hand, is a more concrete model that focuses on using technology to manage the city. The Smart City places a strong emphasis on technology as the foundation of development, while the cities of the future may take a broad approach that is not limited to technology, but also to changes in lifestyles, social structure or economic models.

Typology of city management

Urban governance can be divided into several types depending on the approach to development and innovation. The author points out 4 proposals.

Traditional management, which focuses on the basic function of managing urban space and providing public services. It requires good urban planning, management of infrastructure, transportation and public space.

Smart City management focuses on the use of information and communication technologies (ICT) and the Internet of Things (IoT) to improve the quality of life for residents and increase management efficiency. Examples include energy management systems, smart transportation systems, environmental monitoring, and remote infrastructure management.

Sustainable management involves the implementation of policies and solutions aimed at protecting the environment, conserving natural resources, improving air, water and soil quality, and sustainable social and economic development. It focuses on creating people-friendly and environmentally friendly cities, aiming to reduce greenhouse gas emissions.

The fourth proposal is participatory governance. This model involves residents in decision-making processes, both at the local and national levels. It envisions citizen participation in urban planning, public services and urban policy.

Threats and opportunities in transforming traditional cities into cities of the future

Transforming cities into “cities of the future” involves many opportunities, but also significant risks, especially in the context of energy issues. On the one hand, the pursuit of sustainability and energy efficiency can benefit cities by reducing greenhouse gas emissions, lowering energy costs and improving the quality of life for residents. On the other hand, the transition process involves a number of challenges, which can be particularly difficult to solve in cities with high population density and outdated energy infrastructure.

First, the high cost of transformation. Transforming cities into more sustainable and technologically advanced spaces involves large investment costs.

Second, social inequality. In the process of transforming cities, new inequalities can arise among city residents, especially in access to modern technology and green spaces, which can marginalize parts of society.

Third, dependence on technology. Overdependence on technology can lead to problems related to cyber security, surveillance or lack of resilience to system failures.

Fourth, increased energy needs, which, in a situation of energy resource deficits and concern for the environment, requires that cities of the future pursue the principle of green energy, i.e. energy infrastructure aimed at producing energy from renewable sources, adapted to the urban planning of the city.

The state of urban transformation and current energy problems in Poland

Managing the cities of the future poses numerous challenges, but also brings great opportunities. The use of new technologies and innovations in management, as well as attention to sustainability, can help create cities that are greener, more efficient and more socially sustainable. However, for these goals to be achievable, close cooperation between governments, local authorities, the private sector and residents is necessary.

A gradual transformation of cities towards smart and green spaces is evident in Poland. While it is true that many European cities are implementing projects related to the development of public transportation,

electromobility, renewable energy sources and green spaces, in Poland we are still struggling with the challenges of modernizing infrastructure, but there are also efforts to promote sustainable development, such as the development of bicycle networks, improving air quality and modernizing public transportation. The author concludes that Poland’s transformation, although still in its early stages, is becoming increasingly noticeable in cities such as Warsaw, Krakow, Wroclaw and Gdansk.

Table 1

Changes in the management of Polish cities and regions

Category	City/Region	Description	Timeframe
Evolution of management methods	Warszawa	Traffic management system and traffic signal optimization	2016–2024
	Wrocław	Application for real-time parking availability information	2016–2024
	Gdynia	E-services platform integrating city services	2016–2024
	Warszawa	Mobile app to report city problems	2016–2024
Sustainable development of cities	**Revitalization of green areas and development of bicycle infrastructure**		
	Gdańsk	Introduction of green areas and new bicycle paths	2016–2024
	Poznań	Development of bicycle infrastructure and urban parks	2016–2024
Energy problems	**Energy poverty**		
	Mazowsze	5% of residents did not have sufficient heat, 8% were in arrears on utility payments	2021
	Efficiency of district heating systems		
		10 municipalities out of 25 had efficient district heating systems	2024
	Energy transformation. Coal cities		
	Kozienice	Closure of coal-fired power plants and rising unemployment	2020–2024
	RES infrastructure		
		Number of connection refusals for RES: 7,448 refusals, which exceeds the total installed capacity	2023

Source: Own elaboration based on J. Wąchol (2019), *Modern management methods and process organization in a global enterprise*, Silesian University of Technology Publishing House, Organization and Managment Series No. 136, pp. 643–651.

Between 2016 and 2024, Polish cities have undergone significant changes in governance and energy, aiming to transform themselves into modern agglomerations of the future.

Of course, the lead is held by the largest ones, which not only have larger budgets but, above all, there is greater pressure from the public, which is voicing its needs for changes in city management.

Modern societies face many difficulties in ensuring stable and sustainable access to energy. Below I outline some of the main energy problems. Energy sustainability. As global demand for energy grows, it is becoming increasingly challenging to provide energy in a sustainable, environmentally sound manner. Many countries, especially developing ones, still rely on non-renewable energy sources such as coal, oil and natural gas, which contribute to climate change, air pollution and environmental degradation.

Dependence on fossil fuels and yet most of the world’s energy comes from fossil fuels, leading to many problems.

- Air pollution: Burning fossil fuels produces harmful emissions that affect human health, air quality and climate.
- Climate change: Emissions of greenhouse gases (mainly carbon dioxide) contribute to global warming, causing extreme weather events, rising sea levels and changes in ecosystems.

Increasing demand for energy. Global demand for energy continues to grow, especially in developing countries, where urbanization and population growth are leading to greater demand for electricity, transportation, heating and cooling. Traditional energy sources may not be sufficient to meet this demand in an efficient and environmentally friendly manner.

Limited fossil fuel resources, the author points out, although fossil fuel deposits are vast, they are limited and non-renewable. As they become depleted, they become more expensive, which can lead to problems with the availability and stability of energy supplies. In addition, exploiting resources in more difficult conditions, such as in the Arctic or at great depths, presents additional technological and cost challenges.

Inequalities in access to energy, resulting in energy exclusion. Although access to energy is growing worldwide, about 13% of the world’s population still lacks access to basic electricity. This is particularly problematic in countries in Africa, Asia or remote regions, where lack of energy limits economic development, access to education and medicine, and improvements in quality of life.

As demand for energy increases, many existing power grids are becoming outdated and overloaded. This leads to frequent failures, power outages and increased maintenance costs. Grid modernization, integration with renewable energy sources and real-time energy management are among the key challenges.

Although renewable energy sources, such as solar, wind, geothermal and biomass, offer an alternative to fossil fuels, there are difficulties in their implementation:

- Volatility and instability of supply: Wind and solar are intermittent sources, making them difficult to integrate into power grids that require stability.
- High initial costs: Although the cost of producing energy from renewable sources is falling, the initial investment in infrastructure is still high.
- Energy storage: One of the main challenges is the efficient storage of energy generated from renewable sources during periods when demand is lower.

Threats to the development of future cities in the context of energy needs

Energy issues have a huge impact on the management of cities of the future. In this termiar as global energy challenges become more apparent, cities must adapt to new realities and face complex issues such as sustainability, reducing CO_2 emissions, modernizing infrastructure or integrating new technologies.

Here are some key areas where energy issues will affect the management of cities of the future.

First, it is important to point out the process associated with sustainable urbanization and resource management. In the cities of the future, there should be a greater need for efficient management of energy resources. With a growing urban population and increasing energy demand, cities need to develop new strategies for sustainable development in terms of:

- Smart grids which refers to energy management in cities of the future will be based on advanced energy monitoring and distribution systems. Smart grids will allow efficient management of energy production, distribution and consumption, as well as integration of renewable energy sources such as solar and wind power.
- Building energy efficiency. Cities of the future require advanced building systems that will reduce energy consumption, such as through better insulation, heat recovery technology and solar energy. Smart homes and green building will become the norm.

Second, the dependence of city development and operation on renewable energy sources is important. In the cities of the future, an increasing

proportion of energy should come from renewable sources, up to 70–100% in 2050 (*Global Energy*..., 2018). However, due to the instability of such sources as wind and solar power, managing them will become a challenge.

Examples include cities such as Freiburg in Germany, which is close to achieving 100% renewable energy in the electricity sector, or Copenhagen (the Danish capital), where carbon neutrality should be achieved this year and 100% energy from renewable sources as early as 2035.

Cities of the future in the area of renewable energy sources should develop primarily:

- Energy storage, involving the implementation of energy storage technologies (e.g., batteries), which will allow the accumulation of energy generated at times when production from renewable sources is higher, to be used during periods of peak demand.
- Microgeneration, a phenomenon that must be egalitarian in nature, will involve private homes, buildings or even entire neighborhoods, which can become “energy islands.” Using their own energy sources (such as photovoltaics) and managing them autonomously or as part of integrated urban systems.

Third, the author points to so-called infrastructure and transportation challenges. Managing the city of the future requires a modern, green transportation infrastructure that minimizes energy consumption and emissions. These consist of:

- The development of electric transportation (buses, cars, bicycles) and the construction of charging infrastructure will be crucial in reducing the need for traditional energy sources, such as fossil fuels.
- Sustainable public transportation in the cities of the future, which will force an increase in investment in the area of green public transportation, using electric vehicles, hydrogen or other low-carbon technologies.
- Introducing the concept of “smart mobility” involves integrating various forms of urban transportation, such as urban bicycles, electric scooters and car-sharing, to reduce energy demand and minimize traffic congestion.

Fourth, crisis management and energy emergencies, which may become an inevitable affliction for the cities of the future and is certainly an aspect that must be taken into account in planning the cities of the future. In the cities of the future, not only traditional energy challenges will be problematic, but also the risk of energy failures, for example, as a result of extreme weather events associated with climate change:

- Resilient energy systems, relying on cities to build resilient energy systems that can operate even in the event of an emergency. This includes decentralizing energy production, storage and creating local energy management systems.
- Crisis response What in the face of natural disasters such as hurricanes or floods, a city will need to have contingency plans and backup energy sources to ensure uninterrupted energy supply at key facilities such as hospitals and emergency stations.

Fifth, environmentally friendly measures will reduce emissions and the global warming crisis is resulting in a fight against climate change in the various city systems of the future. Managing the city of the future requires taking measures to reduce greenhouse gas emissions and combat climate change. In this context, energy issues are forcing the decision makers of the cities of the future:

- Decarbonization process. This requires cities to switch to clean energy sources and minimize CO_2 emissions. This requires not only investment in renewable energy sources, but also in carbon capture and storage (CCS) technologies.
- Adapting cities to climate change, special attention should be paid to solutions that improve the resilience of cities to climate change, such as by building green spaces that lower temperatures (so-called urban cooling) and using energy more efficiently.

And sixth, implementing technological innovations in energy management. Cities of the future will need to integrate new technologies in energy management. These include:

- Using artificial intelligence (AI) to manage energy consumption, forecast demand or optimize energy systems.
- With IoT, it is possible to collect data from devices, buildings or vehicles to help optimize energy consumption and monitor the condition of energy infrastructure in real time.

Summary

Managing the cities of the future is a huge challenge, which involves the need for new technologies, innovation and attention to sustainability. In Poland, despite the initial stage of transformation, efforts to create smart and green urban spaces are evident, including the development of public transportation, electromobility and renewable energy sources.

However, challenges remain in modernizing infrastructure, sustainable energy access and reducing CO_2 emissions.

The analysis of the current state of the energy economy, the financial, organisational and often also competence constraints among decision-makers force the researcher to confirm the hypothesis adopted for the publication.

Energy issues such as dependence on fossil fuels, air pollution, climate change and growing energy demand are affecting the development of cities of the future. The implementation of renewable energy sources, smart grids, the development of green transportation and environmentally friendly measures, as well as the creation of resilient energy systems that can handle breakdowns and crises associated with extreme weather events are becoming crucial. Technologies such as artificial intelligence and the Internet of Things (IoT) will play a key role in optimizing energy management in cities of the future.

Interesy konkurencyjne:

Autor oświadczył, że nie istnieje konflikt interesów.

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Zarządzanie miastami przyszłości i zapotrzebowaniem energetycznym miast

Streszczenie

Zarządzanie miastami przyszłości to jedno z kluczowych wyzwań współczesnych społeczeństw, które stają w obliczu rosnącej urbanizacji, postępu technologicznego i zmian klimatycznych. Celem publikacji jest omówienie koncepcji miast przyszłości, takich jak „smart cties” i „zielone miasta”, oraz różnych modeli zarządzania, które uwzględniają potrzeby mieszkańców, zrównoważony rozwój i innowacje technologiczne. Szczególną uwagę poświęcono roli sektora energetycznego, który w obliczu kryzysu energetycznego staje się kluczowym czynnikiem wpływającym na rozwój miast. Miasta przyszłości muszą integrować odnawialne źródła energii, inteligentne sieci energetyczne oraz systemy zarządzania energią, aby zmniejszyć wpływ na środowisko i poprawić jakość życia. Zrównoważony rozwój, efektywne zarządzanie zasobami naturalnymi oraz dbałość o bioróżnorodność i przestrzenie zielone stanowią fundamenty rozwoju miast przyszłości. Technologie, takie jak Internet Rzeczy (IoT), sztuczna inteligencja i Big Data, będą kluczowe w monitorowaniu i optymalizacji funkcjonowania miast, a także w podejmowaniu decyzji w czasie rzeczywistym.

Miasta przyszłości będą także promować transport zrównoważony, taki jak pojazdy elektryczne, rowery czy autonomiczne pojazdy, a także dbać o inkluzyjność społeczną, dostęp do usług publicznych i edukacji. Gospodarka obiegu zamkniętego, cyfryzacja usług publicznych oraz rozwój umiejętności technologicznych będą kluczowe w tworzeniu dynamicznego, bezpiecznego i innowacyjnego ekosystemu miejskiego. Przyszłość miast będzie zależała od umiejętności adaptacji do nowych wyzwań technologicznych, ekologicznych i społecznych, przy jednoczesnym zachowaniu prywatności i bezpieczeństwa danych mieszkańców.

Słowa kluczowe: zarządzanie miastami, potrzeby energetyczne miast, miasto przyszłości, modele zarządzania miastami

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