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Applicable Smart City Strategies for a Smart Sustainable City to Ensure Energy Efficiency and Renewable Energy Integration: Casablanca Case Study

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Abstract

A Smart city is essentially expected to diminish the utilization of assets and upgrade efficiencies. In practically any region, effectiveness brings about energy saving, diminished energy force, supportable monetary turn of events, upgraded usefulness, a safeguarded climate, and in particular, participation with the environmental change fight. In spite of the fact that financial plan, innovation, and the necessary framework are significant imperatives for helpless urban areas to accomplish shrewd and economical city objectives, the advantages of brilliant urban areas are numerous for helpless urban areas contrasted with creating and created urban areas. Helpless urban areas accomplish worked on living conditions, security, wellbeing, financial turn of events, administration, and personal satisfaction as well as accomplishing supportable energy objectives, and this study tries to distinguish those shrewd sustainable power and energy production systems that are monetarily achievable and in fact relevant in helpless urban communities. Renewable energies are a sustainable, unlimited, and decarbonized solution to address future energy challenges. In this context, Morocco has considerable lead vantage to position itself on this promising market. Furthermore, renewable energies have been highlighted as a key strategic source for the country's green growth. Morocco has adopted the renewable energy path through a strategy targeted at the development of solar, wind, and hydroelectric power to boost its energy policy by adapting it to the challenges posed by today's world. Nowadays, Morocco is facing a challenge to reach 52% by 2030 of its total renewable energy capacity, which will exceed 42% by the end of 20221

Keywords

smart city, ICT, renewable energy, sustainability, energy efficiency, sustainable city

1. Introduction

It is estimated that by 2050, 66% of the world's population will live in cities, up from ∼54% today (UNEP, 2018). This implies that 2.4 billion people will potentially be added to the world's urban population. Therefore, it will inevitably lead to a significant expansion of existing urban environments and lead to the need to create new ones. Cities use less than 2% of the earth's surface, but consume more than 75% of the world's available natural resources. The United Nations Environment Program (UNEP, 2018) estimates that material consumption linked to cities will increase to ∼90 billion tonnes by 2050 from 40 billion tonnes in 2010. Some of these resources are primary energy , raw materials,

As a result, cities are expected to face challenges related to the growth, performance, competitiveness and livelihoods of residents (McKinsey & Company, 2013). Deteriorating quality of life issues related to waste management, scarcity of resources, air pollution and traffic jams that cause human health problems, as well as aging public infrastructure, are some of the problems generated by rapid urbanization (Washburn et al., 2009). In order to meet these challenges, the concept of smart city has emerged as one of the possible solutions.

This study has five sections. The overview in Section 1 provides a general description of the concept of urban energy systems that is explained in both global and local contexts. Section 2, Literature Review provides a detailed description of smart cities. Those properties. Action panes and related items in each action pane. The relevance of each factor to renewable energy and energy efficiency. Smart city smart energy indicators in known standards. A link between a smart city and a safe city. And Kabul's challenges related to smart and sustainable energy. The methodology in Section 3 shows how the investigation was initiated, formulated, and conducted. Section 4, "Survey Results and Discussion", proposes smart strategies applicable to the city of Kabul for each of the six smart city domains, and later in this section, short-term and medium-term for stakeholders in major cities and the energy sector. Here are some recommendations. Of the city of Casablanca. The final section, Conclusion, further discusses the importance and benefits of integrating renewable energy initiatives and smart strategies to ensure energy efficiency in cities.

2. Sustainability Oriented Smart City

The definitions of sustainability-focused smart cities from the selected sources were analyzed according to the dimensions of sustainability they encompass, namely the environmental, social and economic dimension. This categorization made it possible to identify thematic models. First, the definitions that take into account the three dimensions are discussed. For these, the term "holistic approaches" is used here. They consider the intelligence of a city as "a certain intellectual capacity

which addresses several innovative socio-technical and socio-economic aspects of growth" (Zygiaris, 2013, p. 218). Such a perspective demonstrated the perception of a smart city as green, interconnected, intelligent, innovative and well-informed; terms which have themselves been the subject of several reviews of the literature. .

2.1 Definitions

Definitions mainly focused on the environment, focusing on the impact that digital technologies will have on particular urban services. These technologies can be used to improve resource use and reduce emissions. This can lead not only to smarter transport infrastructure, better water supply and waste disposal systems, and more efficient thermal control of buildings, but also better municipal government services, safer public spaces and a better response to the needs of the aging population (European Commission, 2019). Numerous industrial players, operating mainly in the IT sector, provided definitions similar to that of the European Commission.

Microsoft (2018) considered the smart city as a city that uses ICTs to improve the delivery of services to citizens such as energy, water, public safety and transport improving the health, sustainability, resilience and security of cities. Bosch (2019) provided an analogous definition supporting the idea that the use of various technologies can improve the general quality of life of citizens, by saving time, using new methods of mobility and breathing cleaner air and lead to less traffic, smart homes and energy. efficient use of buildings.

2.2 Smart Sustainable City Characteristics

There are certain elements associated with each of the six smart city features; however, only a few have either direct or indirect relevance to RE and EE. specifies the relationship between Smart city elements and their relevance to RE and EE.

All six action fields of the smart cities revolve around economic growth, quality of life, and sustainability that directly relate to RE and EE. Therefore, RE and EE can contribute to cities achieving the smart city goals [18]. Transforming today's cities into fully networked smart cities will require careful planning and investment. Governments that decide to move towards smartness will certainly find that their cities are more sustainable and livable- in both figure 1 and two.

Seven policy approaches are identified in Sustainable Casablanca 2030, which are used to integrate environmental sustainability and economic competitiveness (see Figure 3). They range from economy and urban redevelopment, to urban design and a relational planning approach. Of these approaches, green economy and sustainable redevelopment integrate the environmental and economic dimensions directly; the transport system, place-making, and urban design contribute to their mutual benefits indirectly; urban design is a tool of sustainability and place-making; and marketization of sustainability and relational planning are new planning approaches to establish the primacy of sustainability among stakeholders with a shared vision. They account for the complex interrelationships between environmental sustainability and economic competitiveness, which function simultaneously and in a

mutually beneficial manner within the development strategy.

Figure 1. Integrating Environmental Sustainability and Economic Competitiveness

Certain features distinguish smart cities from other cities. These features and factors are used to evaluate and compare the degree of intelligence of cities and specify the degree of efficiency and adaptability of cities. In other words, the smart city is a forward-looking vision that, with six characteristics in mind, copes well with urban problems and is built for smart, independent, and informed citizens . These six action fields of smart.

cities are specifically focused on: 1. Smart Governance; 2. Smart Economy; 3. Smart Mobility; 4. Smart Environment; 5. Smart People; and 6. Smart Living (Figure 1)

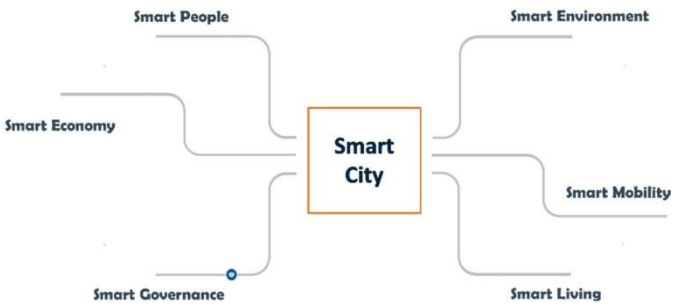

Figure 2. Action Areas of Smart Cities

There is a strong interconnection between smart and safe cities. Essentially, smartness helps cities to be safe places for their inhabitants by providing them with a healthy environ-ment, physical safety, reduced crime, a secure environment for business, protected privacy, and more. On the other hand, a safe city will ensure a smart city is nurtured smoothly to expand and function reliably and sustainably. Ristvej et al. (2020) describe smart and safe city concepts with further details [25]. Poor cities, where safety and security are a common challenge for every aspect of the city, ideally would willingly embrace smart city initiatives, where energy is a critical component to most of the other smart city areas. Energy security is also an extended topic closely related to the smart city; however, at this stage

it could not be focused on in further detail.

2.3 Casablanca City Challenges Related to the Smart City and Sustainable Energy

Rapid urbanization, demographic pressure, and climate change are common issues that almost all cities in developing countries have experienced. The development trend in these cities is much slower and falls behind compared to their population growth and urbanization rates [26]. According to an ASCIMER study, challenges relevant to smart cities that are commonly associated with this category of city, are described in Figure 4 [27]. Casablanca City is one of the fastest-growing cities in the world. It has been transforming vertically and horizontally in the last two decades, and a considerable amount of money has been spent on installing infrastructures for transportation, water, energy, and ICT, without aligning them to urban smart and sustainable goals and agendas. In addition to the challenges described in Figure 4, Casablanca City also suffers from high crime rates, security threats, a high rate of unemployment, corruption, a lack of citizens' awareness, insufficient electric energy, a low quality of fossil energy, a lack of national vision or targets for sustainability and city smartness, and increasing informal settlements [28].

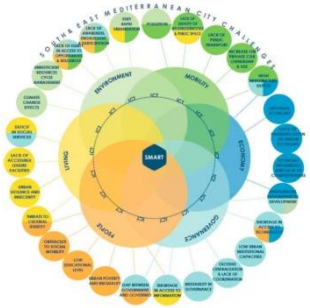

Figure 3. Challenges Correlated to Smart City Dimensions in Developing Countries

Source: [27]

3. Methodology

This research is based on the data collected by desk research, field observations, and interviews with experts and urban sector authorities. A qualitative method of data analysis was applied.

First, the general features and elements of smart cities from different resources have been listed and summarized. This information and data provide a base to initiate the study. The data is mainly extracted from a number of relevant journal papers and international agencies' reports.

Next, the features and elements of smart cities have been highlighted that are relevant to RE and EE. Identification of the relevance is based on the authors' intuition, knowledge and judgments.

The key findings of this research are presented in the results and discussions section, where applicable strategies for poor cities like Casablanca are proposed and discussed. The critical focus on presenting

the results of the research is to present only those strategies that are quick and easily applicable in poor cities considering their economic conditions. The analysis and results are based on qualitative data analysis from the literature provided in previous sections and the authors' own expert views and judgments. Some of the strategies are proposed based on their success in similar contexts. Another group of strategies is specific to the Casablanca context.

Finally, specific recommendations are provided for the stakeholders of the urban sector in order to transform their cities into smart ones with less financial burden.

3.1 Results and Discussion

3.1.1 Proposed Applicable Smart Strategies for Casablanca City

Urban sprawl, energy consumption, and the population in cities are interrelated (Figure 5). It can be said that the increase in population in cities causes urban problems, and that the most important of which is the energy crisis [29].

Urbanization, however, is an inevitable phenomenon, and one cannot avoid it its problems, but there are different alternative solutions to these problems, and one is by making cities smarter [30]. To solve the energy problems of cities by making them "smart", equipping cities with smart features is necessary. Given the economic constraints and existing infrastructure, the following applicable smart city strategies are proposed for Casablanca

3.1.2 Smart Environment, Energy and Living Sustainable Resource Management

According to the national power utility company, DABS, around 90% of Casablanca's electric energy is used in buildings. On the other hand, access to reliable and sufficient electricity is another issue. The available electric power capacity can barely satisfy two- thirds of the existing city demand [31] and due to the low reliability of the Casablanca City electricity grid, it is suggested that the hegemony of the centralized grid is broken by making it more local. Smart micro-grids and mini-grids would increase local RE generation and reduce power losses (both technical and commercial losses). It would certainly be a challenge for utilities providers, but micro-grid projects and distributed energy systems would bring an improved system resilience. Smart grids and micro-grids would help the distribution systems to integrate intermittent renewable power, and also enable a local market for the community to sell their excess rooftop PV and wind power back to the grid and neighbors.

Elsewhere, EE enhancement from the management of the demand side in smart cities has proven to be effective. Smart buildings and smart lighting can be named as examples that most agree with this argument, thus, the transformation of buildings to smarter ones that use less energy and utilize RE sources generated locally, is justified. Transforming residential and commercial buildings into more energy efficient ones might take longer, but should prove easier for public buildings if the government were to support such a policy.

There are many smart strategies that could ensure the increase of EE and integration of RE. Some strategies are proposed and listed below:

1) Develop a free web or mobile app platform, where consumers can view their electricity consumption pattern, compare consumption with previous days and weeks, and provide advice on managing households' electricity usage. This platform could educate the public by proposing smart and sustainable strategies for reduced fossil fuel consumption and enhanced energy efficiency.

2) Replace inefficient lighting fixtures with more efficient and smart ones (lights equipped with remote control, automatic or manual dimming capability, and motion sensors).

3) Install smart meters that can sell surplus electricity to neighbors and transmit con-sumption and generation data virtually.

4) Replace water boilers with ones with adjustable heat control, or only retrofit an adjustable heat control device instead of changing the whole boiler.

5) Smart meters to be installed in the city power grid, so the power consumption data is collected and analyzed for future planning purposes.

The concept of decentralized heating and cooling would be another solution to make cities smarter, cleaner and more energy efficient. Currently, coal-powered small heating systems largely pollute Casablanca City's air. Similarly, blackouts in summer increase the use of diesel generators and create air and sound pollution all over the city [33].

Environmental Protection

Pollution sensing smart sensors need to be installed in different locations of the city. This would enable the sharing of real-time air quality information with the authorities and the public. It would create the capability to take protective measures to reduce the adverse health effects of air pollution.

3.1.3 Smart Mobility

Sustainable, Innovative, and Safe Transport System

Another area that contributes largely to air pollution is the transportation system [34]. Smart mobility can help transportation systems to be safe, secure, cost-efficient, time- efficient and environmentally friendly. Here are some smart city strategies suggested for Casablanca City:

1) Solar powered street and traffic lights with surveillance cameras and wi-fi routers could control and monitor the traffic, traffic violations, traffic flow and count, and even weather conditions. The wi-fi routers could be used for other smart systems that would emerge in the future [33].

2) Create a mobile app for the Casablanca City transportation system to show drivers' con- gested routes and alternative routes. This app could be owned by the municipality or through a PPP (Public–Private Partnership) initiative. This app would need an IoT infrastructure and network which should be jointly designed and operated by the KM, Ministry of Communication and Information Technology, and the Ministry of Interior Affairs.

3) Public transport/buses should be changed to smart and electric ones. It does not seem wise to continue the use of fossil-fueled and inefficient buses inside the city. Although this would be a relatively costly option, since there is no functioning public bus network, no existing set-up, and no

regulation for any public transport developed, it would be a good opportunity to begin regulating this sector by considering smart and sustainable goals [35].

Availability of ICT Infrastructure

The existing ICT infrastructure is relatively in good condition. The fiber-optic network has been extended all around the city. At the same time, there are a number of communication towers of the four mobile companies available to support smart city initiatives; however, the speed and cost of internet access is still an issue. Integrating Internet of Things (IoT) technologies, such as sensors, with the existing infrastructure to create actionable data and specifying the type of data to be gathered is a prerequisite for this action [18].

Local Accessibility

Nearly all residents of Casablanca City have access to some sort of local transportation within their walking distance; however, the distribution of that local transport is not necessarily applicable to the demand. Mobile applications for public transport might make access much easier and reduce the waiting time for both drivers and service users. Car sharing through a mobile app is another strategy that can save resources. Crimes could also be tracked and controlled.

3.1.4 Smart Economy

The economy is the backbone of smart cities. There are a lot of economic opportunities that smart cities could create. The vision should come from the authorities, but innovative strategies and solutions could only be made possible through entrepreneurship, research, and innovation centers. Therefore, for cities that are very new to the smart city concept, the creation of such centers is the first major step to move toward a successful smart city experience. Facilitating training in innovation and entrepreneurship is also essential for poor cities. By having new and innovative business models, they could reduce the use of fossil fuel energy and increase EE. For example, since we do not have reliable electricity and grid electricity is expensive, we could use RE for businesses and save money by applying EE strategies.

3.1.5 Smart Governance

Since the governance scope is broad, smart strategies for this area are also exten-sive. Reducing the bureaucracies and managing part of or the whole task through online platforms would save considerable energy in cities. For example, if online participation tools existed, the public would not need to use vehicles to physically participate in events, gatherings and meetings. Instead, they could use a computer at home to participate in events where their physical appearance is unnecessary and also save much energy. Here are some strategies that poor cities could embrace:

1) Online platform for decision making at the city or local level.

2) An electronic voting system would save significant resources, especially those re- sources used for ensuring the security of voting centers.

3) Online systems for receiving complaints or processing claims could also save consid- erable energy and time.

4) Online platforms for city councils could be safe and resource-efficient.

5) Smart card/ e-ID could be used to manage the distribution of aids to needy citizens. This would also avoid duplications in distribution and corruption.

6) Casablanca Municipality (KM) could develop a web-based application, E-MUNICIPALITY, so that citizens could have access to the KM without traveling long distances or spending a lot of time, resources, and energy. This platform should be available by different means, such as via chat, call, or email to citizens.

3.1.6 Smart People

Creativity is closely linked to smart cities and EE. Smart and creative people can achieve the goals of smart cities by proposing initiatives, cost-efficient solutions to city issues, initiate business ideas and businesses, and create employment opportunities. Below are smart city strategies proposed for achieving the smart people goal:

1) Co-working centers.

2) Cultural activities organized by citizens through the internet.

3) Internet platforms to disseminate information about urban events on different topics.

4) Centre for creating apps.

5) Integrated platforms for media services.

6) Partnerships between creative industries and universities.

Recommendations for Key Stakeholders

Due to its unique nature, RE and EE integration and utilization require both the government's vision for sustainable energy provision in cities and the active participation and cooperation of the people in the energy planning process. Therefore, it can be said that municipalities have a valuable role in the process of energy planning and the use of renewable resources for the self-sufficiency of cities in terms of energy production [36].

In order to increase RE share and smartly attain EE in Casablanca City, specific recommendations and strategies are proposed both for urban sector authorities and its citizens. These recommendations are grouped into short and medium-term stages (Table 2).

ASCIMER has proposed a governance framework and stages for smart city project development for better planning and implementation of smart city projects. It starts with developing project concepts and design, then financing, implementing, and managing the projects. Stakeholder involvement in each stage of the project planning and implementation has been described as a crucial aspect. There are also nine guidelines proposed for better development and implementation of the projects, listed below [27]:

a. Stakeholders' involvement and tasks definition.

b. Multilevel governance.

c. Citizenship involvement and social inclusion.

d. Monitoring and adaptive management.

e.	Innovation and technology.
f.	Externalities and mediation
g.	Capacity building and knowledge transferability.
h.	Image, credibility and positioning of Smart city Projects.
i.	Sustainability and efficiency.

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