Chapter

# Securing Smart Grids to Address Environmental Issues in Regional Planning

*Vicent Mbonye*

## Abstract

This chapter examines regional planning and development in relation to sustainability and highlights sustainability challenges in various regional planning case studies. Creating smart cities addresses the problems that arise from rapid urbanisation and growth of the urban population. This chapter provides an overview of smart cities and discusses several global smart city efforts. It introduces the idea of smart energy highlighting the smart grid components and how it tackles environmental challenges in regional planning. Additionally, it analyses several threats to the smart grid that may hinder its efficient operation and makes suggestions on how to deal with them so that sustainable energy may be delivered to smart cities.

**Keywords:** security, regional development, smartgrids, smart cities, sustainability

## 1. Introduction

The number of people residing in cities is expected to reach approximately 5 billion by the year 2030. A significant portion of this urbanisation will take place in Africa and Asia, resulting in profound social, economic, and environmental changes [1]. However, the fast shift to a highly urbanised population poses significant difficulties for the design, growth, and management of cities [2]. Examples include challenges with waste management, a lack of resources like electricity and water, air pollution, concerns about human health and traffic congestion [3].

A number of nations have embraced the idea of smart cities as a means of reducing the issues brought on by the rapid urbanisation and growth of the urban population in their regional planning efforts [3, 4]. For instance, Bristol city and Miltonkeynes in England, Chicago city in United States of America and Shenzhen in China. More smart cities have been built in Australia, Japan and Singapore.

In Africa, various smart city initiatives are being developed. These cities include Vision City in Kigali, Rwanda, HOPE City in Ghana, Waterfall City in South Africa, and Senegal's Akon City. It also includes, Eko Atlantic City in Nigeria and Konza City in Kenya [5].

Smart city elements include smart infrastructure, smart transportation, smart energy and smart healthcare. Smart citizens, smart governance, smart buildings, smart technology, and smart education are also included [4]. In these cities, solutions to more sustainable transport, energy, health and education have been developed and some are in development. For instance, MiltonKeyness has set up an innovative solutions to support efficient transportation through a smart transport application called MotionMap [6]. In Japan, Yokohama is characterised by smart city features within its energy, waste, transportation, and water services [7].

Dealing with the difficulties of dependable electricity becomes essential when populations move to cities and increase their energy consumption [8]. This is because reliable electricity fuels economies, governments, health care, education, and leads to poverty reduction [8, 9]. Hence, the lack of adequate and reliable power is a major constraints in economic growth [10].

The core of a smart energy system in smart cities is the smart grid [11]. Smartcities implement the smart grid to integrate decentralised sustainable energy sources, effective distribution, and optimised power usage [4]. Through the smart grid utility companies can add renewable energy sources like wind, solar, and biomass, which are more ecologically friendly than the fossil fuels like coal used in many facilities for generating large amounts of electricity [12]. For example, Japan has developed the smart grid system in Yokohama with distributed power sources, self-managed power plant that uses renewables [7]. In South Africa, smart grids electric systems are being piloted [13]. Already projects in various municipalities have enabled efficiencies and effectiveness not seen before in the municipal environment [14].

Despite the fact that the smart grid solves the numerous energy concerns, the vast interconnectedness of the systems creates a significant attack surface for intruders [15]. For instance, intruders can compromise smartgrid infrastructure like the smart meter through a denial-of-service attack that prevents critical alerts, such as alarms, from being relayed to the head-end systems [15]. In addition, they can hack the smart meter and be able to see everyday life patterns of consumers and occupancy of households [15]. Hence, these assaults put human lives in danger in addition to destroying infrastructure [16].

Safety is crucial to create environments where residents may fully benefit from economic and cultural opportunities [17]. Ensuring that a city is safe is important in order to satisfy the urban safety sustainability indicator [18]. The urban safety indicator focusses on urban security and protection against crime, as well as defence against its impact [18]. This chapter argues that threats to the smartgrid reduce the possibility of having safe liveable smart cities that are sustainable.

Safeguarding the security of residents calls for a thorough comprehension of best practices and solutions backed by adequate resources [17]. Regional planners, must be knowledgeable about the smart grid and its role in sustainable regional development. They should also know smartgrid domains and the threats to the smart grid. Furthermore they need to be aware of the proposed remedies these threats. This can aid in the planning and development of more sustainable cities.

## 2. Sustainability challenges in regional planning

Sustainability involves ensuring that people can satisfy their immediate demands without compromising the ability of future generations to satisfy their own [19]. Sustainability development goals include eradicating poverty, quality education, zero hunger, good health and well-being, sustainable energy, clean water, and sanitisation [19].

Regional planners must make sure that initiatives for regional development are centered on sustainability. However, a variety of barriers that could prevent sustainable regional planning have been recognised in the literature.

The management of suburban sprawl is one of the major problems confronting planners in many nations [20]. Despite several studies and attempts to control suburban sprawl, it still poses a serious problem since it encourages unsustainable urban development. As an illustration, in India, the pressure from the growing population and the saturation of urban regions within municipal boundaries led to the densification of the central urban centres of Dhanbad and Jamshedpur. In addition, the development of built-up land at the expense of agricultural land in Ranchi Urban is documented [21]. In a similar study conducted in India, land use in Kolkata UA was altered by urbanisation and development. However, this resulted in unparalleled urban sprawl, which greatly harmed the environment [20]. Additionally, the majority of the region was converted to urban territory at the expense of agricultural land. This also applied to swamps and aquatic vegetation [20].

Furthermore, in Ethiopia, it's reported that the town's Ehud-Gabia market was converted into a bus stop, residential area and kindergarten [22].

In China, the development of new development zones and the transformation of urbanised communities were the primary reasons of fast urban sprawl [23]. However, although real estate development was a main driving factor for rapid increase in Gross domestic product (GDP) in China, it led social problems like traffic congestion in Beijing [23]. In addition, urban sprawl in Shanghai resulted in the loss of a significant amount of farmland and agricultural operations and endangering the city's traditional architectural forms [23]. Moreover, many individuals in Guangzhou who relocated to suburbs found it challenging to adjust to new life transitions and living situations [23].

Sanitation and waste disposal are also growing concerns in regional planning. The soil, water, and air can get contaminated as a result of improper waste management. This fosters unhygienic circumstances that could cause illness, damage, or death. More than 60% of the world's population lacks access to either adequate or even safe sanitation facilities or services. Additionally, the majority of wastewater produced globally is discharged without being properly treated [24].

Waste management is crucial in the construction of sustainable and habitable communities, yet it is still difficult in many developing nations and cities. Global waste production rates are growing. Annual trash generation is anticipated to increase by 73% from 2020 levels to 3.88 billion tonnes in 2050 due to high population expansion and urbanisation [25]. In low-income countries, waste is usually burned outdoors or thrown in unregulated dumps. The environment, public safety, and health are all adversely affected by these actions. Moreover, methane produced by improper waste management contributes to climate change and may even fuel urban violence [25]. In addition, effective waste management is expensive, frequently taking up 20–50% of municipal budgets. Moreover, unsustainable waste management has a greater detrimental impact on residents of developing countries than on people of industrialised countries, especially the urban poor [25]. Additionally, urbanisation also leads to an increase in waste production. High-income nations and economies are more urbanised and produce more garbage overall and per person [26]. Hence, locations with a high proportion of growing low-income and lower-middle-income countries are anticipated to have the biggest increases in waste production. This is because it is projected that waste production increases with economic development and population expansion [26]. Waste levels in the Sub-Saharan Africa and South Asia regions are expected to nearly quadruple and double, respectively, during the course of the next three decades as a result of urbanisation and economic growth [26].

Waste management challenges are documented in literature. For instance, poor collection of waste affects the effective management of waste. As an illustration, it is reported that Senegal produces more than 2.4 million tonnes of waste per year. However, about 1.08 million tonnes remains uncollected causing harm to the environment [26]. Another issue in waste management is the absence of funding for the creation of solid waste management systems, which makes it even more important to factor in continuing operating expenses up front [26]. These factors make sustainable waste management a difficult task on the path to economic growth, and the majority of low- and middle-income countries and their cities struggle to manage them [26].

Integrated systems that are effective, sustainable, and socially supported are needed to operate this crucial municipal services [25]. Smartcity initiatives have facilitated addressing waste and sanitisation issues. For instance the city of Yokohama has implemented a garbage collection and management system based on IT, the 3R (reuse, reduce, recycle) philosophy, and bioenergy generated from solid waste [7].

Additional planning challenges for a sustainable regions arises from maintaining clean air and water in urban areas. Air is one of the most important environmental factors when examining the relationship between environmental quality in populated areas and population health and wellbeing [27]. However, the safety and well-being of society are endangered when pure air is polluted [27]. This may result in disease, injury, or even death.

In addition, the quality of the world's water is impacted by the growth of metropolitan areas. Runoff from urban surfaces, for instance, may contain a variety of pollutants, such as heavy metals, sodium, nitrate, phosphorus, trash, and rubber residue [28]. Additionally, contaminants from urban surfaces have the potential to significantly worsen the water quality of urban streams and other receiving waterways [28]. Furthermore, the way rainfall is caught, stored, and released in hydrological systems is also affected by changes to slopes, elevations, soils, and plant covering [28]. These developments result in the creation of extensive flat, impervious material regions and drainage networks, significantly changing the main hydrological routes. For instance, significant wetlands in Tianjin have gradually been replaced by extensive urban development [29].

Overpopulation is also acknowledged as a significant problem in regional planning. When there are more individuals than resources available at an area. In cities, overpopulation presents a number of challenges. Firstly, it prevents a nation from using its resources effectively [30]. Secondly, it also leads to production methods that are inefficient and out of touch with consumer demand. For example, most people who work in agriculture regularly try to support their families on small pieces of land even if doing so does not ensure the family's long-term survival [30]. In India, Overpopulation has resulted in inadequate health care facilities, inadequate education, and early marriages [30].

Industrialisation is another major challenge in regional development. Pollution and environmental degradation rise as a result of industrialisation and increased capital intensity. With a contribution rate of 61%, industrial activities have been shown to be a significant contributor to the global threat of environmental pollution [31].

Furthermore, energy utilisation is a key challenge in regional planning. The majority of the world's energy is now produced by fossil fuels (coal, oil, and natural gas), which cause climate change to worsen and air quality to decline. Cities currently use 75% of the world's resources and energy, which results in the production of 80% of greenhouse gases. Therefore, there might be a significant detrimental influence on the ecosystem in the next decades [4]. City planners hence need to plan for sustainable energy solutions.

Other challenges in regional development include the lack of involvement of stake holders in the realisation of regional development goals and insufficient funds [22].

In this section, the challenges to regional planning were discussed. These challenges are all unique in their own right. For instance, it is important to decrease industrial pollution since it can harm the quality of the air and water. Additionally, inefficient waste management practices could jeopardise the health of residents. Finally, the larger issue caused by urban growth must be addressed and combated via sustainable urban development. A variety of urban sustainable development solutions may be used to address urban sustainability concerns. Regional planning and the need for sustainable energy are covered in the next section.

## 3. Regional planning and sustainability energy

The International Energy Agency (IEA) estimates that cities account for 71% of CO2 emissions and use around 67% of all energy produced globally [32]. Urbanisation will account for 66% of the global population by 2050, which would increase energy use and CO2 emissions by up to 80–90%.

A totally decarbonised electricity sector must serve as the foundation for a net zero energy system [33]. However, the energy sector is responsible for around 60% of all greenhouse gas emissions worldwide. This is because, more than 60% of the power used in the globe today is still produced from fossil fuels. That percentage must fall to 26% by 2030 in order to be compatible with the scenario of net zero emissions by 2050. To reach this goal, the implementation of low and zero-emission sources must accelerate rapidly [32]. Regional approaches to renewable deployment in Africa can lower overall system costs and enhance operation. Regional strategies can increase the flexibility and stability of national power networks and act as a complement to enable nations to accelerate the development of single sources while also lowering the risks associated with climate change [34].

By supporting renewable energy, which is more ecologically friendly than the fossil fuels utilised in many electric power producing facilities, the smart grid offers a solution [12]. Hence, measures that ensure the efficient operation of the smartgrid in smart cities are key in its success. This ensures the delivery of safe reliable and sustainable services to individuals.

## 4. Urban safety and sustainability

A smart city goes beyond the use of digital technologies for better resource use and less emissions [35]. It comprises better water supply and waste disposal systems, stronger urban transit networks, more efficient building lighting and heating systems. It also implies safer public spaces, a more active and responsive local government, and addressing the needs of an older population [35].

Safety is critical for building environments in which residents may fully use economic and cultural potential [17]. To ensure safety, coordinated policy approaches to urban safety and security are required. Also a robust knowledge foundation of good practices and effective interventions backed by suitable resources are essential [17]. The goal of urban planning and implementation is to create economically productive, environmentally sustainable, socially viable, and livable urban areas that are physically connected and interconnected [22].

One of the main goals of the 2030 Agenda for Sustainable Development's Goal 11 is to make cities and human settlements secure [17]. Through this goal member states make a commitment to promote secure and safe environments in cities and human settlements that allow everyone to live, work, and participate in urban life without fear. In this context, member states are required to adopt measures to reduce violence and promote urban safety in their nations [17].

The best methods for ensuring urban safety and security involve addressing the many factors that contribute to crime and other acts of violence, such as sexual harassment and gender-based violence. This includes strengthening local ties, fostering civic engagement and collaboration, and improving local governance of safety and security as a public good through civic engagement, place-making, vernacular arts and cultural activities, behavioural change strategies, and community development initiatives [17].

## 5. The role of smart cities in sustainable regional development

A smart city is allocation that allows for services to be enhanced by information, digital, and communications technologies to make them more adaptive, effective, and sustainable for the benefit of its citizens [4].

Smart cities include intelligent transportation systems (ITS), which encompass the rail, water, and air transportation systems as well as their interconnections [4]. The smart transportation system makes it simple for users to choose from a variety of modes of transportation for the cheapest, shortest, or quickest routes.

Smart healthcare in smart cities refers to a concept that combines traditional healthcare with smart biosensors, wearable technology, information and communication technology (ICT), and smart ambulance systems [36, 37]. Patient information may be accessed in real-time at various offices inside a smart hospital, or even at many smart hospitals in the same or separate cities [4, 38].

Additionally, smart cities incorporates "smart governance," which relies on concepts of good governance including transparency, accountability, collaboration, and citizen involvement. Smart governance is the skillful application of ICT to enhance decision-making through greater collaboration between many stakeholders, including the government and the general public [39].

Smart cities include the use of smart technology for the design, implementation, and operation of smart cities. The ICT infrastructure is the crucial smart component of the smart city, holding all the other elements together and serving as the hub for its residents [4]. Infrastructure for services is built on physical infrastructure and may include certain ICT elements. Smartgrids and mass rapid transit systems are two examples of service components.

Everything that is physically, electrically, or digitally connected to a smart city forms its infrastructure. Smart infrastructure includes smart buildings that may have a variety of hardware, software, sensors, and smart appliances for various automated activities, such as data network, access control, power management, and lighting control [4].

Additionally, the smart city incorporates smart energy which is includes smartgrids that generate, store and transport sustainable energy using information and communication technology (ICT) [4].

### 5.1 Case studies of smart cities around the world

The concept of a "smart city" refers to an area where existing networks and services have been enhanced via the use of digital technologies for the benefit of both its citizens and businesses. The following are some of a smart city's components: smart infrastructure, smart buildings, smart technologies, smart government, smart education, and smart citizens [4].

To address the problems and challenges associated with urbanisation, several nations and towns have started their own smart city initiatives. For instance, Bristol is renowned for its smart city and sustainability projects; in 2017, the city was named top in the UK Smart City Index [40] and was European Green Capital in 2015.

Milton Keynes is one of the smart cities that have developed their smart city strategy and put important initiatives into effect [6]. This project's initiatives include cutting-edge methods to assist effective mobility, such as the creation of the MotionMap smart transportation app [6].

The city of Curitiba is well known for its innovative efforts in the field of sustainable urban development. Brazil's Curitiba is regarded as a premier example of sustainable urban design. It has received numerous accolades, including the 2012 Global Green City Award and the World Habitat Award for Urban Management [41].

Australia's top three smart cities are Sydney, Melbourne, and Brisbane. The most widely used technologies in these cities are those involving the internet of things, artificial intelligence, and driverless vehicles [42].

In Japan, Yokohama has developed the smart grid system with distributed power sources to provide sustainable services to individuals. In terms of waste management, it has built an IT-based collection and management system that provides efficient collection and management of waste in the city [7].

In China, Shenzhen was designated as an experimental city to spearhead China's modernisation. It has two giant telecom firms, Huawei and Tencent which are playing pivotal roles in advancing the smart city movement in China [43]. Shezen has implemented smart technologies through carefully including innovative technologies like artificial intelligence, the internet of things.

Similar methods have been employed by Singapore to promote economic development through smart city initiatives. Singapore, for instance, has earned the title of leading smart city. Singapore was ranked first among 102 worldwide smart cities by the IMD World Competitiveness Center, with the highest rating of AAA; Singapore is ranked as the seventh-smartest city in the world by the IESE Cities in Motion Index 2019 [44].

Additionally, there are various smart city initiatives being created or planned throughout Africa. For instance, Akon City in Senegal, HOPE City in Ghana, Vision City in Kigali, Rwanda, Konza City in Kenya, and Eko Atlantic City in Nigeria are a few examples [5].

The core of the "smart city" concept is the notion that information and communication technology may promote intelligent behaviour and logical, optimum decisions in urban settings (ICTs). By utilising ICTs to process information in the form of data, urban planners, investors, and developers would be able to redesign the experience of urban life using computer power, networked technologies, and scientific discoveries. Infrastructure, energy, health, safety, and other problems might be addressed by bringing objects and people continuously online and integrating sensors and the Internet into physical-virtual interactions.

### 5.2 Smartgrid domains

Cities currently use 75% of the world's resources and energy, which results in the production of 80% of greenhouse gases. As a result, they may suffer grave environmental consequences in the following few decades. This necessitates the idea of smart cities. The development of smart cities is a logical response to the issues brought on by the fast urbanisation and population increase of cities. Smart cities, once implemented can reduce energy consumption, water consumption, carbon emissions, transportation requirements, and city waste [4]. The smart grid is the heart of a smart energy system. The information and infrastructure that make up the smart grid are in charge of gathering data on energy usage and disseminating information about provider rates. Smart appliances like dishwashers and water heaters may be operated with an acceptable degree of energy consumption using ICT. The smart grid facilitates efficient energy storage, smart metering, and effective energy management [45].

As depicted in **Figure 1**, the smart grid can be broken down into seven domains: Operations, Distribution, Service Provider Markets, Generation, Customer and Transmission [47].

In the customer domain, Consumers can control how they use and produce energy through the Home are network [48]. The consumer is the last stakeholder, the smart grid seeks to assist the customer.

In the Service Provider/Utility Domain, Service providers manage customer accounts, billing, and energy usage. The service provider links to the customer and market domains as well as the operation domain for situation awareness and system control [46].

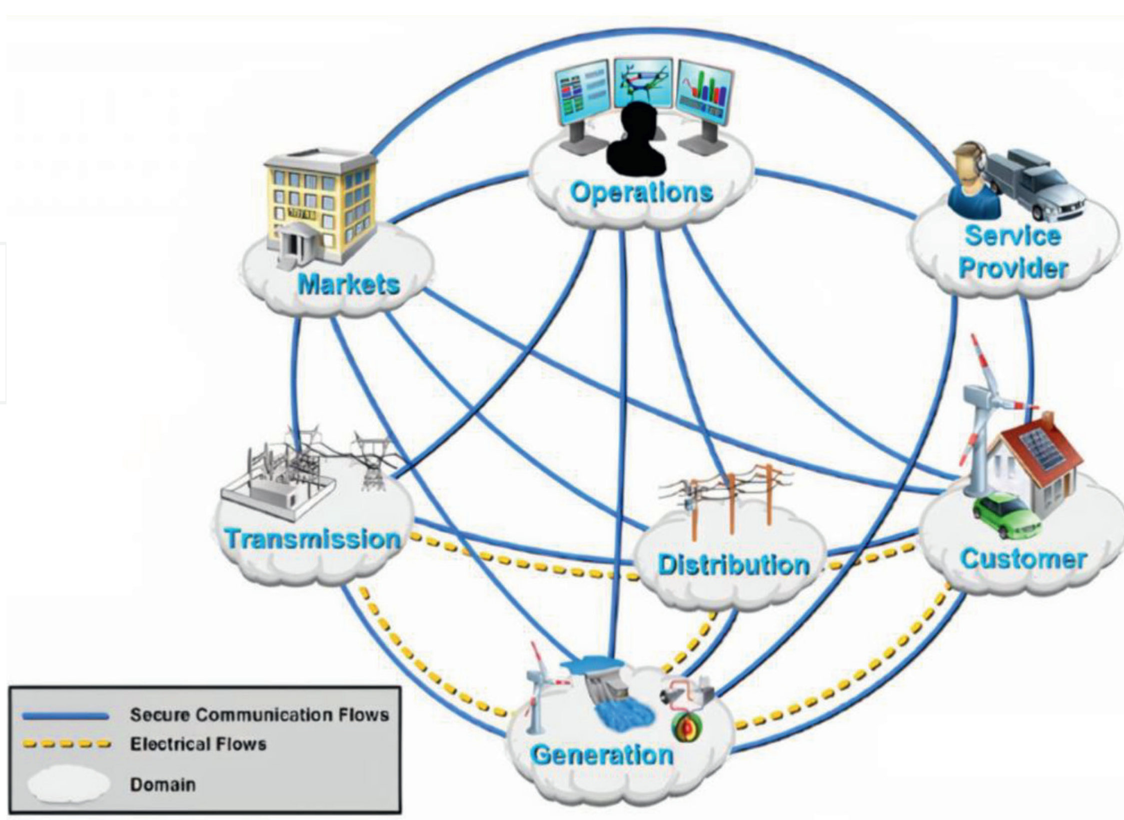


**Figure 1.**
*Interaction of actors in different smart grid domains through secure communication flows. Source: [46].*

The process of supplying electricity to the end consumer begins with energy generation. Through an interface, the bulk generating domain is electrically connected to the transmission domain and interacts with the market, transmission, and operations domains [49].

Communication with the transmission domain is crucial because without transmission, consumers cannot be served [48]. The transmission domain is in charge of the extensive transfer of electrical power via multiple substations from a generator to a distribution system [48]. The transmission domain uses several substations to move electrical energy across long distances from the generating domain to the distribution domain [46].

The transmission domain is in charge of transferring huge amounts of electrical power via a number of substations from a generator to a distribution system [48]. Electrical power production is transferred from the generation domain to the distribution domain through a large number of substations in the transmission domain [49].

Actors in the operations domain are accountable for the power system's smooth operation. The actors in charge of transporting electricity are the players in the operations domain. This department guarantees that transmission and distribution activities run smoothly [46].

Furthermore, Electrical grid resources are bought and sold via markets. Within the power system, market participants exchange prices and maintain supply and demand balance [46].

#### *5.2.1 The role of the smart grid in ensuring sustainable energy delivery*

The smartgrid provides more efficient ways to generate and distribute electricity, as well as consumers' ability to utilise electricity more effectively [50]. In electricity generation, smart grids provides numerous environmental advantages to nations by enabling the integration of renewable energy [51]. These include renewable energy sources, which are more ecologically friendly than the fossil fuels employed in many large-scale electric power producing facilities, such as wind, solar, and biomass [12]. As a result, greenhouse gas emissions that contribute to global warming may be reduced [52].

In addition, Utilities may use the smart grid to remotely monitor, troubleshoot, and manage network infrastructure. This enables faster response times to interruptions and disturbances, as well as the potential of proactive maintenance [52]. For example, if there is an unusually high voltage, the smart grid may detect it and instruct one of the network's devices to decrease the voltage [53]. This allows utilities to minimise the likelihood and frequency, as well as the cost connected to blackouts and outages [52].

Smartgrids, provide improved management and monitoring systems which allow customers to be better aware of their energy usage [52]. Customers have access to real-time production and consumption data, the ability to manage their power usage, and the ability to react to changes in the price of electricity by changing their use [51]. This not only reduces energy loss, but also saves costs incurred by the customers [11, 12].

Taking into consideration both technological and political concerns, the smart grid ensures supply security with a minimal risk of interruption. This guarantees energy independence by lowering external threats to energy supply, such as political and economic risks [51]. As regional planners plan for smart cities they need to be aware of the challenges behind powering the energy dependent infrastructure. If the smartgrid is to thrive and provide efficient service to its settlers. The planners to be prepared to deal with the many threats that threaten the smart grid. The next section highlights the smart grid domain threats to the domains.

### *5.2.2 Threats to the smart grid domains*

There are several risks to the smart grid. For instance, smart meters (SMs) enable utility providers to gather and communicate data on residential energy use [54, 55]. As a result, consumers' sensitive information may be revealed hence putting their privacy at risk [56].

In addition smart meters may be installed both inside and outside of a house or vacation rental. As a result, they are unattended and vulnerable to an attacker who can introduce malware into the devices, causing them to send false data to the concentrator [15].

Additionally, attackers might be able to determine whether there are people on the property by analysing the consumption data from smart meters, enabling burglary [57].

Additionally, if smart meters are deployed in consumers' homes and businesses without hardware security protections, they might be vulnerable to physical attacks such tampering with metering data to cause inconsistencies in billing [58, 59]. Consumers may replace the smart meter with one that has been tampered with and shows lower usage than the actual one [60]. Additionally, the unauthorised insertion, alteration, or deletion of data or control orders in communication network traffic leads smart grid equipment to behave incorrectly [61, 62].

The retail energy provider may face the threat of intentional errors from disgruntled employees. Disgruntled employees could access the smart grid systems and inflict severe damage to the infrastructure by attacking critical smart grid nodes [63, 64].

Protection relays are prone to internal technical threats from organisational practices. A key challenge in protecting relays is that the security of many commercial relays is only guaranteed by requiring each relay to have a password. Unfortunately, because many operators do not change the default password for the sake of convenience, improper password practices have always been detected in substation-level networks [65].

Additionally, attackers have the ability to alter the readings from a variety of sensors and PMUs [66]. For instance, attackers are able to conduct a False Data Injection attack by altering the readings of several sensors and Phasor Measurement Units (PMUs) in order to introduce erroneous measurements and finally inject arbitrary mistakes into the state estimations without being noticed [66].

In addition, attackers are able to launch a jamming attack near the GPS antenna of PMUs. This enables the attacker to disconnect parts at a specific location. The region that is impacted depends on the jamming device's emission power (i.e., signal transmitter) [67].

Components in the distribution domain face external technical threats. For instance, threats to IEDs have been identified in the previous section. This also covers spoofing attacks. By performing a spoofing attack, the attacker may trick a monitoring IED into sending false close/open signals to switches, causing the protection system to malfunction and perhaps shutting off electricity to customers [68].

In addition, attacks that cause a denial of service (DoS) have been recognised as a major threat to SCADA systems. By injecting their own packets into the smart grid system's packet traffic, the attacker may overwhelm the smart grid system's packet flow until it can no longer handle or accept any more packets and fails. In addition to isolating a power substation or preventing operators from accessing SCADA systems, a distributed denial of service (DDoS) assault may purposefully delay the transmission of a time-critical message in order to breach its timing requirement. This may possibly interrupt the electricity supply or, worse, cause electrical equipment to be destroyed [45]. An attacker may cause partial or full equipment failure, making vital data inaccessible until the utility provider fixes or replaces it [59].

*5.2.3 Solutions to threats in the smartgrid*

To protect against customer privacy violations, customer data should be processed and kept properly since maintaining consumer privacy is a difficult task in the customer sector [69]. In addition, utility providers can employ data aggregation technologies to protect user privacy. Instead of providing their power use information directly to the utility supplier, a group of customers use this method to transmit them to a reliable third party. The utility company receives aggregated data on all users' power usage from a dependable third party [55].

Malware injection in the smart meter hardware can be addressed by implementing protection measures when installing smart meters. Stake holders should shut down unneeded physical ports or making such ports unavailable to unauthorised users [15].

Additional measures to secure the premises and control rooms have been suggested to keep adversaries or anyone intending to harm the grid out [46]. To protect smart appliances in the customer houses holds from burglary, customers can implement physical protection measures [46].

Stakeholders can place a smart meter in a safe space, like a house, or in a public spot to solve physical meter tampering and swapping, but it must be confined in a box with a lock [15].

Furthermore, an efficient defence against jamming attacks is to send arbitrary, unauthenticated packets to each wireless station in the network [70]. When packets are filtered, they are not kept on a network device if they are determined to be invalid. This method can be applied to stop jamming assaults [71].

Regarding the threat of misconfiguration, it is recommended that operators adopt good password practices that include changing the default password in substation-level networks [65].

To solve the problem of fake data injection attacks that change sensor readings. [72] recommend using a multiplicative, limited scaling factor. [67] suggest using reliable encryption and authentication methods [67].

In order to increase the resilience of smart-grid protection systems to intentional errors and unintentional errors, Fadul, et al. [73] propose the adoption of a trust-management toolkit that makes use of network-flow techniques and reputation-based trust. This toolkit can address spoofing attacks on Intelligent Electronic Devices (IEDs).

## 6. Conclusion

Countries are undergoing significant social, economic, and environmental changes as a result of urbanisation. This poses several difficulties for city planning, growth, and management. This chapter discusses sustainability challenges in regional planning. These include challenges in waste management, energy and water shortages, air pollution, health issues, and traffic congestion.

Regional planners are responsible for ensuring that regional development projects are oriented on sustainability. The focus of recent regional advancements has been on creating smart cities to address various issues. This chapter presents the role of Smart cities in sustainable regional development. It discusses some smart city case studies around the world and presents some solutions developed to address sustainability challenges.

Among sustainability challenges is the issue of providing sustainable energy. This is because the energy sector is responsible for around 60% of all greenhouse gas emissions worldwide. In order to reduce green gas emission levels countries must implement low and zero-emission sources. The implementation of the smartgrid is seen as a possible solution to the energy challenges in regions. The smart grid is essential to how smart cities work. It not only ensures the delivery of sustainable energy, but also addresses many sustainability issues including pollution. It offers a way to create cities that are more habitable. This chapter discusses the smartgrid domains and the role of the smart grid in ensuring sustainable energy delivery.

Safety is critical for building environments in which residents may fully use economic and cultural potential. It allows residents to fully use economic and cultural potential of regions. Urban environments that are economically dynamic, ecologically sustainable, socially viable and habitable, and safe are the aims of good urban planning. This chapter hence, also examines a number of threats to the smart grid that may prevent its effective operation. It goes ahead to offer solutions to the highlighted threats so that sustainable energy may be supplied to smart cities.

## Conflict of interest

The authors declare no conflict of interest.



## Author details

Vicent Mbonye
University of KwaZulu-Natal, Durban, South Africa

*Address all correspondence to: 213571072@stu.ukzn.ac.za

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