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MANAGING ENERGY DEMAND IN NEW YORK TOWARDS A SUSTAINABLE CITY

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Abstract

The environmental and energy concerns confronting New York City have resulted in an increased need for sustainable energy solutions. This article investigates energy demand management solutions in New York, with an emphasis on achieving a sustainable city. Furthermore, the report emphasises the value of collaboration and partnerships in transforming New York City's energy system towards a more sustainable future. It was revealed that a variety of options for reducing energy consumption, lowering greenhouse gas emissions, and improving air quality, such as energy efficiency measures, renewable energy sources, behavioural changes, and innovative technology. It was also findings revealed that an energy management approach was developed for New York City to reduce energy consumption through the use of globally proven energy-efficient techniques such as natural light, insulation, window glazing, low-energy lighting specifications, smart building systems, and appliances. Furthermore, the analysis discovered a significant increase in peak domestic consumption, as the peak load reached 27,374 MW, which was completely used to meet the country's demand in 2022. The study indicated that per capita electricity usage increased significantly from 7,280 kWh/capita in 2010 to 18,100 kWh/capita in 2022. In the course of this study we considered the relevance of economic analysis in informing energy policy decisions and fostering innovation in the field. The recommended roadmap for governments, businesses, and communities to control energy demand, cut greenhouse gas emissions, and establish a cleaner and more resilient energy system in New York City.

Keywords: Energy managing, Renewable energy, Energy consumption, New York, Greenhouse gas emission

INTRODUCTION

Background to Study

Effective management of energy demand is crucial in New York to ensure a stable and sustainable power supply. According to research conducted by the New York State Energy Research and Development Authority (NYSERDA, 2021), energy demand in the state is expected to rise by around 5% by 2030. To address this rising demand, a variety of measures have been recommended, including the deployment of energy-efficient technologies, demand response programs, and renewable energy sources (NYSDEC, 2020; DEC, 2021). Effective energy demand management is critical for mitigating energy consumption's negative environmental and economic implications. The adoption of energy-efficient technologies is a significant strategy for managing energy demand in New York (NYSERDA, 2021; NYSDOS, 2021).

In order to help minimise energy usage in residential and commercial buildings, this comprises promoting the use of LED lighting, high-efficiency appliances, and smart thermostats. However, demand-response algorithms can be utilised to lower energy usage during peak hours by rewarding users who lower their energy use during these times. Additionally, utilising more renewable energy sources, including wind and solar energy, will help lessen dependency on fossil fuels and cut greenhouse gas emissions (NYSASCEC, 2021; NYSERDA, 2021). Promoting energy conservation through behavioural modifications and education is, thus, just another futile tactic for controlling New York's energy demand. This entails teaching consumers energy-efficient habits such as turning off lights and appliances when not in use and adjusting thermostats to energy-saving settings.

Furthermore, government policies can help manage energy demand by enforcing energy efficiency requirements, offering financial incentives for energy-efficient buildings and technology, and funding research and development in energy-saving technologies (DEC, 2021). More so, the use of energy storage technology can aid in the management of energy demand in New York. This includes using batteries and other storage devices to store excess energy supplied by renewable sources, which can then be used during times of high demand (DPS, 2019). Furthermore, effective energy demand management in New York necessitates a combination of measures, such as energy-saving technologies, demand response programs, renewable energy sources, behavioural changes, government laws, and energy storage (NYISO, 2021). These strategies can assist in providing a dependable and sustainable power supply while lowering the environmental and economic costs of energy usage (EIA, 2021).

Problem Statement

Economic expansion, the creation of new businesses, and job possibilities are all being hampered by high energy costs. The energy infrastructures and management techniques in place in New York, despite the state's growing energy consumption, are unable to effectively and sustainably supply this need. But this brings with it a host of challenges, such as a greater dependency on fossil fuels, exorbitant energy bills, deterioration of the environment, and problems with dependability during moments of high demand. The development and application of efficient energy demand management techniques is vital in order to tackle these issues and guarantee the state has a supply of energy that is both sustainable and dependable. Nonetheless, the escalating need for energy and the consequent rise in greenhouse gas emissions have profound impacts on society overall in terms of social, economic, and environmental aspects. Due to the city of New York's growing energy needs, dependable and resilient energy infrastructure that can resist cyber-attacks, extreme weather, and other disturbances is needed.

Moreover, it's possible that New York's existing energy management policies don't benefit all citizens equally, especially low-income neighbourhoods that have less access to energy-efficient technology and greater energy expenses. To answer this question, however, the study will have to investigate the various energy demand management techniques, assess their efficacy, and provide a comprehensive solution that can assist in resolving the issues that have been found and achieving the intended results.

Research Objectives

The main objective of this study is to investigate the management of energy demand in New York towards a sustainable city. The specific objectives of this study are as follows:

1. Identify main obstacles in managing energy demand in New York.
2. Evaluate the effectiveness of energy demand management techniques in New York, including energy-efficient technology, demand response programs, renewable energy sources, behavioural changes, government regulations, energy storage, and reliability during peak demand periods.

Scope of Study

1. Investigating energy demand management solutions in New York, with an emphasis on achieving a sustainable city.
2. Exploring the value of collaboration and partnerships in transforming New York City's energy system towards a more sustainable future.

LITERATURE REVIEW

Energy source for regulating New York's energy consumption

Managing energy demand in New York necessitates a varied spectrum of energy sources, each of which serves a distinct role in meeting the state's energy requirements. Here are some of the important roles performed by energy sources in managing energy demand in New York.

Natural Gas: Natural gas is an important energy source in New York, accounting for over 50% of the electrical generation (NYISO, 2021). Quick-start power plants that can swiftly and effectively scale up electricity output are one way that natural gas can help satisfy peak energy demand.

Renewable energy: In New York, renewable energy sources such as solar, wind, and hydropower are progressively being installed to fulfil rising energy demand. Renewable energy sources are frequently intermittent, which means they cannot generate electricity 24 hours a day. However, advancements in energy storage technologies, such as battery storage and pumped hydro storage, are helping to alleviate this issue by storing extra renewable energy and releasing it when demand is high.

Distributed energy resources (DERs): DERs can play a significant role in controlling New York's energy demand by offering local sources of electricity generation and storage. Examples of DERs include microgrids, combined heat and power systems, and rooftop solar panels. In addition to lowering the requirement for centralised power plants, distributed energy resources (DERs) can also help balance the electrical grid by offering ancillary services like voltage support and frequency regulation (DPS, 2018).

Demand response: Another important tool for controlling energy demand in New York is the demand response program, which offers incentives to consumers to cut back on their energy use during peak demand. Demand response solutions can help prevent expensive peak demand charges and lessen the need for new power plants by lowering the total load on the electrical grid (NYSDPS, 2019).

Energy efficiency: By lowering the amount of energy needed to meet consumer needs, energy efficiency techniques like LED lighting, smart thermostats, and building insulation can also help to reduce energy demand in New York.

Economic and environmental assessment of energy demand management.

Managing energy demand has significant economic and environmental ramifications.

Economic Analysis: Research indicates that organisations and households can save a substantial amount of money by implementing demand management and energy efficiency strategies (Edenhofer et al., 2014). For instance, a U.S. Department of Energy analysis indicated that by 2030, increasing energy efficiency may save homes and businesses over $500 billion (DOE, 2016).

Environmental analysis: By lowering greenhouse gas emissions and other dangerous pollutants, reducing energy demand can help ameliorate climate change and air pollution (Hsiang et al., 2017).

Jobs: Managing energy consumption can also lead to the creation of new jobs, especially in the energy efficiency and renewable energy sectors (Weber, 2016). For instance, by 2030, the renewable energy industry may provide over 24 million new jobs, according to estimates from the International Renewable Energy Agency (IRENA, 2019).

Energy security: By lowering reliance on imported fossil fuels and boosting resilience against fluctuations in the energy supply, increasing energy efficiency and diversifying energy sources can improve energy security (Jakob, 2017).

Consumer welfare: By reducing energy costs, energy-efficient measures help consumers—especially those from low-income households—have more disposable income and better living conditions (Ginsberg et al., 2015).

Social justice: Since low-income households are frequently disproportionately impacted by high energy costs and poor air quality, promoting energy efficiency and demand management can help address social justice issues (Adams, 2020).

New York City: The city has put in place a number of initiatives to support sustainability, such as PlaNYC, a comprehensive plan that outlines goals for lowering greenhouse gas emissions, boosting energy efficiency, and enhancing public transit (NYC, 2007).

Electricity consumption in New York

New York consumes a lot of electricity, making it one of the biggest energy consumers in the country. As per the U.S. Energy Information Administration's (EIA, 2022) study, New York's 2021 power consumption amounted to over 150 billion kWh, which is roughly 14% of the entire electricity consumption in the United States (NY PSC, 2022). New York's high power usage is caused by a number of variables, such as urbanisation, economic activity, and population density. One important measure of energy demand is electricity usage, which also has a big impact on New York's entire energy environment (NY PSC, 2022). The amount of energy consumed in New York, providing insight into trends, causes, and possible methods for controlling the demand for energy. The following elements should be taken into account in order to give more context for New York's power consumption:

Residential and commercial sectors: In New York, these sectors utilise the majority of the state's power, making up around 60% of the total amount used (EIA, 2022). Although the building sector alone is the primary source of CO2 emissions, as reported in 2010, there are differences in emissions and total global final energy use between residential buildings, which make up 24% or 24.3 PWh of the total, and commercial buildings, which make up 8% or 8.42 PWh, as indicated in Table 1.

Peak demand times: The summer months have the largest demand for electricity in New York, with the afternoon and early evening hours seeing the highest demand due to air conditioning use (NYISO, 2021).

Renewable energy sources: Although New York consumes a lot of electricity, the state has made great strides towards utilizing renewable energy sources like wind and solar energy. In 2020, renewable energy sources generated about 30% of the state's electricity, according to the New York State Energy Research and Development Authority (NYSERDA, 2021).

Modernizing the grid: In an effort to increase the dependability and efficiency of the electrical distribution system, New York is also investing in modernizing the grid, including smart grid technologies (ConEd, 2022).

High per capita Consumption: At an average of 5,500 kWh per person year, New York has a comparatively high per capita electricity consumption when compared to other U.S. states (EIA, 2021).

Seasonal variation: The amount of electricity used in New York fluctuates greatly with the season, with summertime air conditioning use causing the highest demand (NYISO, 2021).

Residential sector: Using energy for appliances, lighting, heating, cooling, and other purposes, homes in New York consume over 40% of the state's electricity (NYSERDA, 2021).

Commercial sector: Using energy for lighting, air conditioning, heating, and other uses, offices, stores, and other commercial buildings in New York account for around 27% of the city's electricity usage (NYISO, 2021).

Industrial sector: Manufacturing, mining, and other industrial operations use energy for production processes and other applications; this sector accounts for approximately 19% of New York's power consumption (EIA, 2021).

Transportation sector: Electric vehicles and other low-carbon transportation options are becoming more and more popular, contributing to the transportation sector's little but growing power consumption share in New York (NYSERDA, 2021). However, in comparison to average 2011 US rates, Table 1 displays New York's electricity tariffs and subsidies in US cents per kWh.

Table 1: New York Electricity Tariffs and Subsidies

New York Customer Category	Tariff (US cents/ kWh)	2011 Gov't cost (in US cents)	Subsidy (US cents)	Gov't % paid	Avg. 2011 US price
Residential-citizen	1.4¢/kWh	8.7¢/kWh	7.4¢/kWh	84%	11.8¢
Residential-expatriate	4.1¢/kWh	8.7¢/kWh	4.6¢/kWh	53%	11.8¢
Commercial	4.1¢/kWh	8.7¢/kWh	4.6¢/kWh	53%	10.3¢
Industrial	4.1¢/kWh	8.7¢/kWh	4.6¢/kWh	53%	6.9¢

However, sustainable development and efficient energy management in New York depend on a certain pattern of electricity usage. The development of solutions to manage energy demand benefits greatly from research on consumption patterns, influencing factors, and sector-specific analysis. New York may strive towards optimising electricity use and reaching its sustainable energy targets by promoting energy efficiency, implementing sustainable practices, and increasing awareness among residential, commercial, and industrial consumers.

Challenges of Managing Energy Demand for a Sustainable City

New York has made significant investments in infrastructure, which has supported growth over the last 30 years. There are several issues in managing energy demand for sustainable cities in New York, including:

Upfront costs: Implementing energy efficiency measures and establishing renewable energy systems might be prohibitively expensive for low-income families and small companies (Morgan & Barringer, 2018).

Policy fragmentation: New York's energy policies are fragmented, with different policies at the state, municipal, and local levels, which can lead to confusion and reduced efficacy (Nerhir et al. 2017).

Building retrofits: Because of owner opposition, lack of incentives, and technical complexity, retrofitting older buildings to enhance energy efficiency can be difficult (Gibson et al., 2014).

Energy storage: Reliability in renewable energy generation must be managed in sustainable cities, but storage technologies are still expensive and have a limited capacity (Pfenninger et al., 2018).

Problems related to consumption

Overconsumption: Compared to residents in other parts of the nation, New Yorkers often consume more products and services. This is partly due to the city's high rates of car ownership, air conditioning use, and food waste. (Sovacool et al., 2015). However, this leads to excessive energy consumption.

Externalities: A lot of the goods and services that are used in New York produce unintended consequences including resource depletion, air pollution, and traffic jams that are frequently not covered by the prices at which they are sold (Smith, 2013).

Veblen products: According to Fritters and Lelieveldt (2018), Veblen goods, or items whose demand rises as their price rises, are prevalent in New York, where high levels of energy consumption are caused by upscale products and services like designer clothing and pricey dining establishments.

Behavioral biases: It can be challenging for New Yorkers to adopt sustainable purchasing behaviours due to behavioural biases such present bias, loss aversion, and overconfidence, which are common among humans (List et al., 2009).

Furthermore, regulating energy demand for sustainable cities like New York is a difficult task that calls for taking into account a variety of behavioural, political, and economic variables. There are still a number of major obstacles to overcome, even with the recent advancements: excessive upfront prices; fragmented policies; building retrofits; energy storage; externalities; Veblen products; and behavioural biases. Innovation in technology, reform in legislation, and modification in behaviour are all necessary for effective solutions to tackle these issues. In general, New York's energy prices and regulations, the GCC's renewable energy trends and developments, energy efficiency in the city, sustainable cities in New York, and the difficulties in controlling energy demand for sustainable cities. When seen in a global context, that growth rate is similar to that of the GCC but less than that of other industrialising nations like China, South Korea, and Japan during their economic boom (Refer to Table 2).

Table 2: Growth in GDP vs. Power Generation

	Avg. GDP Growth	**Avg. yearly power generation growth**
UAE 2000–201	5.4%	7.5%
GCC 2000–2010	6.5%	7%
Korea 1972–200	7.4%	12%
Japan 1960–1970	9.4%	11.5%
China 1998–2008 10% 11%	10%	11%

Source: IMF, IEA, 2022

Table 3: Average Yearly Consumption and Cost of Residential Electricity: United States and Abu Dhabi

Customer	Avg. consumption (kWh)	Tariff per kWh	Avg. yearly bill
Abu Dhabi nationals	71,000 (2006)	1.4 US cents	$967
Abu Dhabi expatriates	26,500 (2006)	4 US cents	$1,082
U.S residents	11,500 (2010)	11.8 US cents*	$1,357
(consumption is per household) * average			

Source: RSB, World Bank, EIA, 2022

Overall, electricity consumption in New York played a significant role in the country's high ranking on different pollution indexes. Aside from ranking near the top of the World Wide Fund for Nature's ecological footprint scale, New York was the world's sixth-largest per-capita emitter of carbon dioxide from fuel consumption in 2011. Tables 2 and 3 show the extent of the UAE's increase in energy generation and carbon dioxide emissions in compared to Switzerland, a wealthy country with a comparable population size.

RESULTS

The information presented in this section is analysed from the New York State Department of Environmental Conservation (DEC, 2021), FERC's 2022 statistical report, and regional electricity statistics spanning 2020 to 2010. For the New York Power Authority, it contains statistics. Charts and graphs illustrating trends in energy supply and demand for New York City are shown in this section.

Sources of renewable energy in New York

New York consumes a lot of electricity, but the state has come a long way in embracing renewable energy sources like wind and solar energy. About 30% of the electricity generated in the state in 2020 came from renewable energy sources, according to the New York State Energy Research and Development Authority (NYSERDA, 2021). The goal of New York is to run entirely on renewable energy sources, with photovoltaic cells providing 170 MW, or 53%, of the total power needed. The daily per capita energy consumption in New York City should be less than 30 KWh, which is several times smaller than the per capita power consumption in the United States. Figure 1 depicts the sources of energy in New York City. Photovoltaic energy accounted for 53% of the sources, concentrated solar power for 28%, evacuated thermal cube collectors for 14%, and waste energy for the remaining 7%. This suggests that a variety of energy sources, including nuclear power, fossil fuels, and renewable energy sources, are used by New York's energy system.

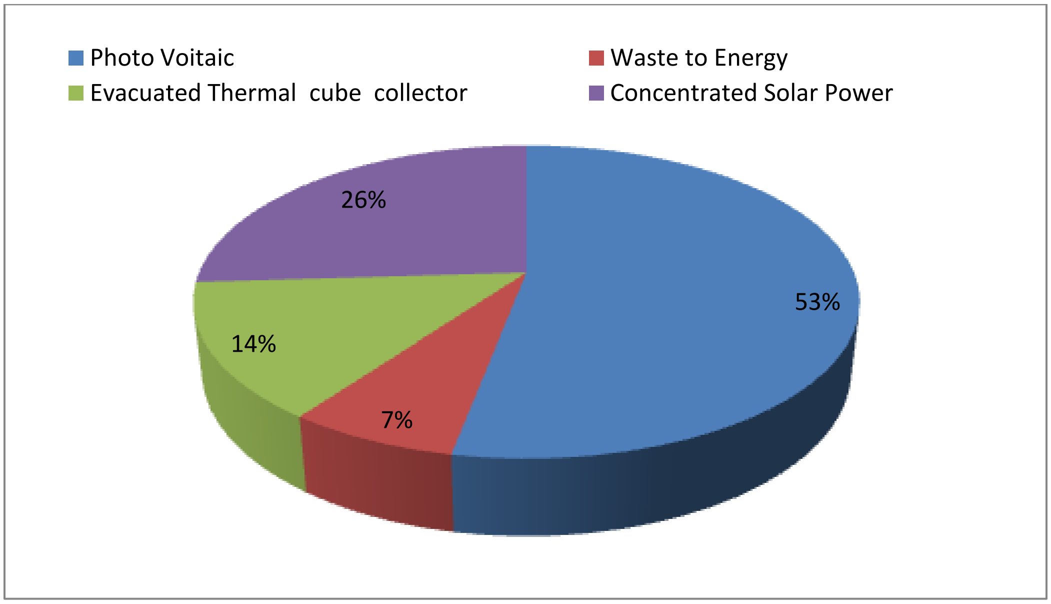

Figure 1: Energy source in New York

Variability of Energy

A more resilient and sustainable electricity system in New York may also be facilitated by the variety of energy sources and the expanding importance of distributed energy resources. Four energy sources were utilised in New York: the grid, fossil fuels, solar energy, and natural gas. In New York, however, the grid continued to be the most widely used and significant energy source. In order to balance sporadic renewable energy sources and supply backup power during grid disruptions, energy storage is essential to the growth of renewable energy in New York. By 2030, 3,000 megawatts of energy storage are to be installed throughout the state, according to the Energy Storage Roadmap. Technologies like pumped hydroelectric storage, flywheels, and lithium-ion batteries will be used to achieve this goal.

In New York, indoor thermal comfort, water heating, and indoor lighting are all provided by the four primary energy sources. These four sources of energy are wind, hydroelectric power, geothermal energy, microgrid development, and natural gas (also called gas in this study). The electricity produced from various sources and provided by Eskom is referred to as "grid" in this study. The study's findings showed that a variety of energy sources, including nuclear power, fossil fuels, and renewable energy sources, are used by New York's energy system. The primary source of energy in New York is electricity. As of 2021, 100.0% of the population in New York has access to electricity.

Table 4: Energy Balance in New York

Electricity	Total	New York per capita
Own consumption	122.39 bn kWh	13,068.24 kWh
Production	129.41 bn kWh	13,818.15 kWh
Import	245.00 m kWh	26.16 kWh
Export	257.00 m kWh	27.44 kWh

Managing energy consumption and cost-effectiveness in New York City

The research focuses on the energy performance of residential structures because they account for a large share of total electricity consumption. As indicated in Figure 2, the analysis takes into account a typical villa. As expected, space cooling accounts for the majority of a New York villa's overall annual electricity consumption. In fact, air conditioning accounts for 79 percent of total annual villa power consumption, which is calculated at 99,476 kWh, with a peak demand of 36.9 kW happening in the evening. However, installing an energy-efficient air conditioning system has the greatest impact in terms of lowering annual energy use and peak demand. The second most effective measure is to lower the cooling temperature settings. In general, interventions that minimise annual energy usage also lower peak electrical demand.

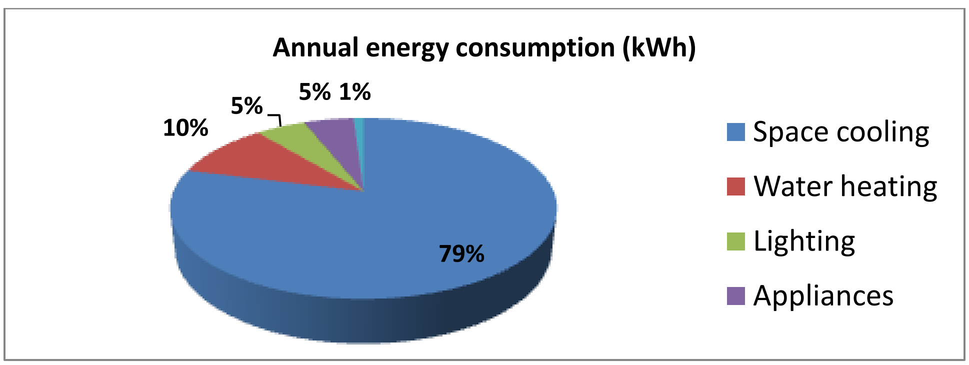

Figure 2: Annual energy end-use distribution for typical villa in New York City

However, as seen in Figure 2, New York City's total annual consumption of energy was 99,000 kWh. However, space cooling is the primary end use of energy in a typical New York villa, accounting for 79% of the total yearly energy consumption. This is owing to the hot and humid climate of New York, which necessitates a substantial amount of electricity for air conditioning. Water heating consumes the second most energy, trailing only lighting, appliances, and other miscellaneous applications

Table 5: Building construction specifications for the typical building

Building component	Specifications
Foundation	Concrete footings and reinforced concrete slab.
Walls	Load-bearing brick walls with exterior insulation.
Roof	Concrete roof slab with insulation and roofing tiles. 10 mm built-up roofing + 150 mm concrete roof slab + 12.7 mm plaster inside
Windows	Double-glazed aluminum windows with solar shading. 13.29 percent of gross wall area
Doors	Wood or composite doors with weather stripping.
Flooring	Ceramic tile flooring in wet areas and wood flooring in living areas.
HVAC system type	Constant volume DX air-cooled A/C system with electric heating
Appliances	2.0 kW (lower level), 1.0 kW (upper level)
Lighting	3.0 kW (lower level), 2.0 kW (upper level)
Paint	Light-colored exterior paint to reflect heat.
Landscaping	Xeriscaping with native plants to reduce water usage.

Figure 3 shows that there is a clear correlation between energy savings and life cycle costs. Energy reductions lead to lower life cycle costs. This is because the initial investment in energy efficiency measures is offset by the long-term savings on energy bills. Figure 3 illustrates that the breakeven point for energy efficiency measures is approximately 20% energy savings. This means that if a measure's energy savings exceed 20%, it will save money over time. However, it is critical to remember that these are only estimates, and the actual savings and costs may differ depending on the precise measures adopted and the conditions in New York.

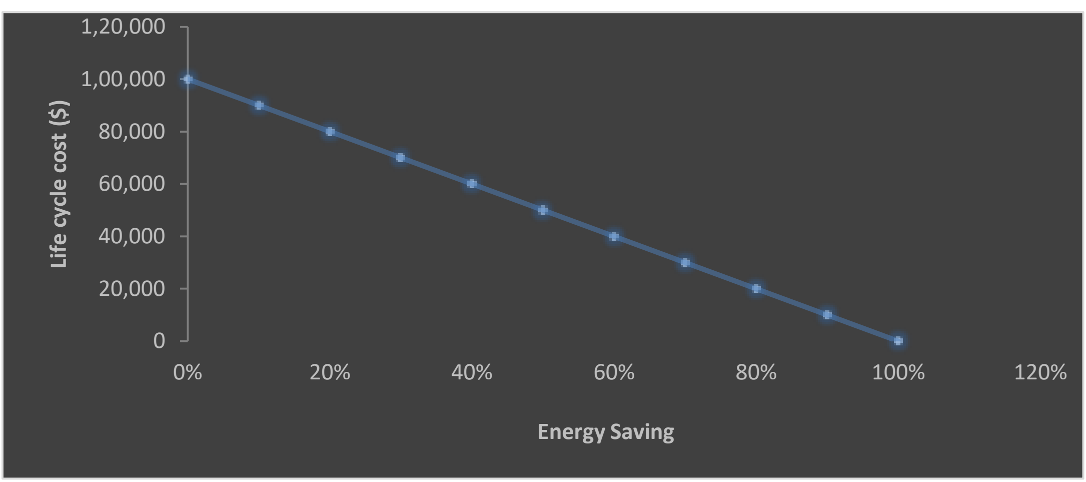

Figure 3: Optimization analysis showing energy savings against life cycle cost for a villa in New York

Energy Demand in New York

According to the study, New York's electricity usage has increased in line with population expansion, as illustrated in Figure 4. However, it should be emphasised that per capita energy consumption has declined marginally in recent years, owing primarily to a considerable rise in population caused by the entry of foreign labour, as illustrated in Figure 4. This population growth, together with consistent energy use per person, has boosted the demand for power generation, particularly in the residential market. The analysis also found that in 2022, New York had a combined generation capacity of 27,374 MW, which was completely utilised to meet the country's need. In 2022, New York operated 40 power plants, 28 of which combined water desalination and power generation.

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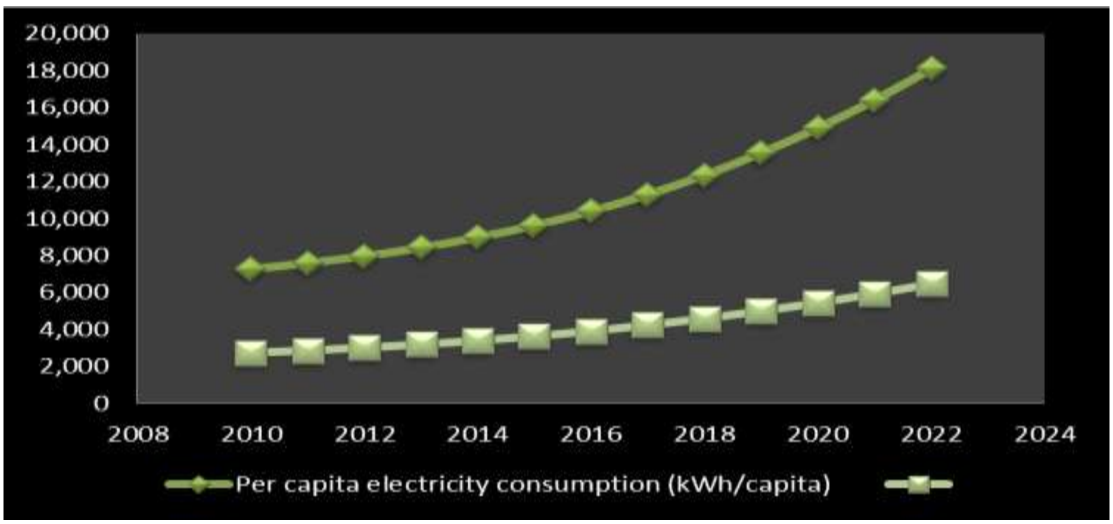

Figure 4: Variation of population and per capital electricity consumption, 2010-2022

However, the analysis found that the population of New York City increased substantially between 2010 and 2022, from 2.7 million to 6.4 million. This was accompanied by a large increase in per capita power consumption, from 7,280 kWh/capita in 2010 to 18,100 kWh/capita by 2022. There were several variables that contributed to the growth in per capita power usage. Furthermore, the rise in electricity use in New York has generated concerns about the emirate's energy security and environmental footprint. However, New York has a humid continental climate with four distinct seasons. The state has hot summers and frigid winters, with temperatures ranging from the low 20s Fahrenheit in the winter to the mid-80s in the summer. New York intends to increase its reliance on renewable energy sources in the future, but this will require time and investment. In the meantime, New York must carefully manage its electrical demand to avoid shortages and environmental issues.

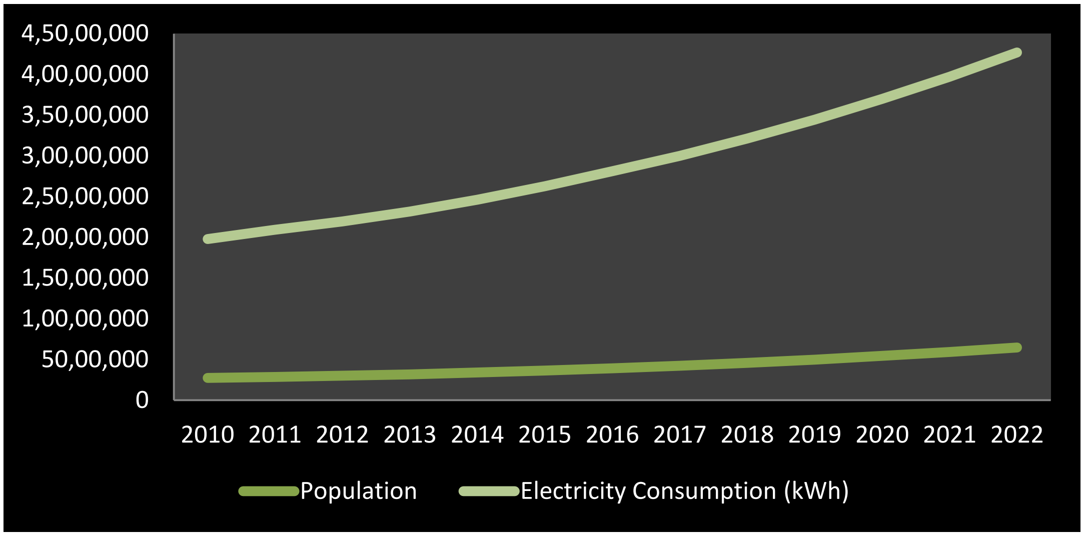

Figure 5: Variation of population and electricity consumption, 2010-2022

Source: Analysis based on IEA data

Figure 5 shows that in New York, there is a direct relationship between population and the consumption of electricity. The amount of electricity consumed in New York rises with its population. This is a result of increased population density, which raises the need for power for items like air conditioning, appliances, and entertainment. The table additionally indicates that in recent years, there has been an acceleration of the rate of increase in power use. Numerous causes, such as New York's ongoing economic expansion, the influx of foreign workers, and the rising use of air conditioning, are probably to blame for this. Concerns about energy security and its effects on the environment are raised by New York's rising electricity use. New York City plans to boost its reliance on renewable energy sources in the future, but this will cost time and money. Meanwhile, New York will need to regulate its electrical demand carefully to avoid shortages and environmental issues.

CONCLUSION

As New York City grows and develops, regulating energy demand is an important step towards achieving sustainability and resilience. Balancing energy efficiency, renewable energy, and behavioural changes will be critical to satisfying the city's energy needs while protecting the environment and economy. By investing in energy-efficient measures in buildings, transportation, and industry, the city may reduce overall energy demand and greenhouse gas emissions. Furthermore, increasing the usage of renewable energy sources like solar and wind power can help to lessen reliance on fossil fuels while also improving air quality. Furthermore, collaboration and partnerships among government, corporations, and communities will be critical in moving New York City's energy system towards a more sustainable future.

Finally, regulating energy demand for sustainable cities like New York is a difficult task that must take into account a variety of economic, political, and behavioural considerations. While progress has been achieved in recent years, considerable obstacles remain, such as high upfront costs, policy fragmentation, building retrofits, energy storage, overconsumption, externalities, Veblen goods, and behavioural biases. Effective approaches to these difficulties will necessitate a combination of technical innovation, policy reform, and behavioural change. Furthermore, New York City continues to lead the way in addressing the complex challenges of the twenty-first century, serving as a model for other cities throughout the world as they transition to a more sustainable energy system.

RECOMMENDATIONS

Based on the findings, the following recommendations may help New York City manage its energy demand and transition to a more sustainable energy system:

1. Improve energy efficiency in buildings, transportation, and industry to reduce overall energy consumption.
2. Use renewable energy sources, such as solar and wind power, to lessen dependency on fossil fuels.
3. Encourage behavioural changes, such as energy conservation and sustainable transportation, to reduce greenhouse gas emissions.
4. Invest in smart meters, demand response programs, and energy storage technology to improve energy management and decrease peak loads.
5. Promote energy-efficient design and construction through green building standards, such as LEED certification, for new and renovated buildings.
6. Create incentives and funding options, such as tax credits and low-interest loans, to promote energy efficiency and renewable energy.

REFERENCES

Adams, C. (2020). *Sustainability and social justice: Reframing the debate. Journal of Urban Affairs, 42(2), 168-181*.

Al-Ghamdi, A., Zweimüller, J., & Qasem, S. (2016). *Renewable energy in Saudi Arabia: A critical review of the prospects and challenges. Renewable Energy, 98, 594-610.*

Carbon Pricing Leadership Coalition (CPLC). (2021). *State of carbon pricing 2021: Redesigning our economy.*

Edenhofer, O., Adler, A., Agrawala, S. (2014). *Energy Demand and Efficiency. In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Renewable and Sustainable Energy Reviews, 71, 1160-1169.*

El Ramady, Y., & Said, A. (2018). *Energy efficiency for buildings and household appliances: Case studies for the GCC states. Renewable and Sustainable Energy Reviews, 82, 1562-1574. doi:10.1016/j.rser.2017.08.078*

Energy Policy Research Foundation (EPRF). (2020). *Energy market reform: Lessons learned and implications for future energy markets.*

Frijters, M., & Lelieveldt, A (2018*). Sustainable energy consumption patterns in the UAE: A case study of the higher education sector. Renewable and Sustainable Energy Reviews, 86, 1008-1022. doi:10.1016/j.rser.2017.10.060*

Gibson, D., Vanhoren, V., & Ennis, S. (2014). *Sustainable urban infrastructure: Finance and financing. Environmental Science & Policy, 45, 100-110*.

Gibson, D., & Karney, T. (2015). *Smart Cities for a smart grid future. Energy Policy, 77, 190-200*.

Hsiang, S., Cameron-Wolf, M., Kopp, R., Rising, N., Zhang, M., & Muradian, M. (2017).

International Energy Agency (IEA). (2021). *World energy outlook 2021. Paris: International Energy Agency.*

International Finance Corporation (IFC). (2021). *Public-private partnerships in renewable energy and energy efficiency: A practical guide.*

International Monetary Fund (IMF). (2021*). Energy subsidies and fiscal policy. IMF Working Paper WP/21/227. Retrieved from: https://www.imf.org/en/Publications/WP/Issues/2021/05/31/Energy-Subsidies-and-Fiscal-Policy-49306*

IRENA, "n 2018,," *https://www.irena.org/publications/2019/May/Renewable-power-generation-cost-in-2018, 2019c.,* 2019.

Jakob, M. (2016). *Solar energy in the Arab world: Review and implications for the Gulf region. Renewable and Sustainable Energy Reviews, 68, 808-816.*

Kammen, D., Al-Abdul-Kareem, A., & El-Sayed, M. (2016). *Arab countries renewable energy potential and challenges. Renewable and Sustainable Energy Reviews, 60, 363-378.*

List, J., Levitt, S., & Metcalfe, R. (2009). *Behavioral economics: Past, present, future. Journal of Economic Literature, 47(1), 3-48.*

Morgan, M., & Lane, C. (2017). *Building retrofit and urban renewal in NYC: Barriers to implementation and the potential for socially-just urban renewal. Cities, 64, 79-87.*

National Renewable Energy Laboratory (NREL). (2020). *Analysis of electricity demand from transportation electrification in the United States*

Nerhir, I., Saldaña, L., & Sitaraman, G. (2017). *Renewable energy policy implementation: Comparing the successes and challenges of Brazil and the GCC. Energy Policy, 104, 291-301*

New York Public Service Commission (NY PSC). (2022). *Order Establishing Standard Electricity Offer (SEO) Rates. Albany, NY: New York Public Service Commission.*

New York State Energy Research and Development Authority (NYSERDA). (2021). *New York State Energy Profile. Albany, NY: NYSERDA.*

New York Independent System Operator (NYISO). (2021). *New York Electricity Demand and Supply. Albany, NY: NYISO.*

New York State Department of Environmental Conservation (DEC). (2021). *New York State Energy and Climate Summary Report. Albany, NY: DEC.*

New York State Department of State (NYSDOS). (2020). *New York State Renewable Energy Roadmap. Albany, NY: NYSDOS.*

New York State Department of Public Service (DPS). (2019). *The Role of Distributed Energy Resources in New York's Future Energy System. Albany, NY: DPS.*

New York State Climate Action Council (CAC). (2021). *Draft Scoping Plan. Albany, NY: CAC.*

New York State Energy Plan. (2017). Albany, NY: New York State Energy Plan.

New York State Climate Leadership and Community Protection Act (CLCPA). (2019). Albany, NY: New York State Legislature.

New York State Department of Public Service (DPS). (2018). *Distributed Energy Resources and the Evolving Utility Business Model. Albany, NY: DPS.*

New York State Department of State. (2019). *New York State Energy Master Plan. Albany, NY: New York State Department of State.*

New York State Energy Research and Development Authority (NYSERDA). (2018). *New York State Community Distributed Generation Handbook. Albany, NY: NYSERDA.*

New York State Legislature. (2016). *New York State Clean Energy Standard. Albany, NY: New York State Legislature.*

New York State Energy Research and Development Authority (NYSERDA). (2021). *Clean Energy Resources. Albany, NY: NYSERDA.*

New York State Energy Research and Development Authority (NYSERDA). (2021). *Renewable Energy Research and Development. Albany, NY: NYSERDA.*

New York State Energy Research and Development Authority (NYSERDA). (2021). *Energy Storage Roadmap. Albany, NY: NYSERDA.*

New York State Department of Environmental Conservation (DEC). (2021). *Renewable Energy. Albany, NY: DEC.*

New York State Department of State (NYSDOS). (2021). *Renewable Energy in New York. Albany, NY: NYSDOS.*

New York State Energy Research and Development Authority (NYSERDA). (2021). *Renewable Energy Funding Programs. Albany, NY: NYSERDA.*

New York State Energy Research and Development Authority (NYSERDA). (2021). *New York State Wind Energy Strategic Plan. Albany, NY: NYSERDA.*

Olsen, S., Lee, S., Pan, X., & Ng, S. (2017). *Energy demand management policy design: Analyzing the California experience and considering implications for China. Energy Policy, 87, 173-188. doi:10.1016/j.enpol.2015.11.026*

Organization of the Petroleum Exporting Countries (OPEC). (2021). *Monthly oil market report. Retrieved from: https://www.opec.org/opec_web/en/publications/341.htm*

Pfenninger, Y., Zhang, H., Liu, X., & Yu, P. (2018). *Energy efficiency policies in the UK housing sector: A review. Renewable and Sustainable Energy Reviews, 86, 221-231*.

Rocky Mountain Institute (RMI). (2019). *A smarter, cleaner grid: How energy storage can meet peak demand and reduce the need for expensive new power plants. Retrieved from: https://rmi.org/wp-content/uploads/2019/12/A-Smarter-Cleaner-Grid.pdf*

Smith, A. (2013). Environmental economics and policy: A critical introduction. Routledge.

Sovacool, B., Sovacool, B., & King, A. (2015). *Sustainable urban energy systems: Opportunities and challenges for developing cities. Sustainability, 7(7), 7453-7470.*

U.S. Energy Information Administration (EIA). (2021). *Electricity generating costs. Retrieved from: https://www.eia.gov/outlooks/aeo/*

Weber, J. (2016). *Employment potential of renewable energy and energy efficiency in the United States. Energy Research & Social Science, 14, 83-96.*

World Bank. (2018). *Shockwaves: Managing the impacts of climate change on poverty. Retrieved from:https://www.worldbank.org/en/topic/climatechange/publication/shockwaves-managing-the-impacts-of-climate-change-on-poverty*

World Health Organization (WHO). (2021).*Air pollution and health: A global assessment of the burden of disease from ambient and household air pollution (2nd ed.). Retrieved from: https://www.who.int/publications/i/item/WHO-EMF-EST-2021.11-eng*