

# Tech Saksham

## Case Study Report

Data Analytics with Power BI

**Analysis of Commercial**

**Electricity Consumption in Indian  
State**

**The M.D.T Hindu College**

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# ABSTRACT

This analysis delves into the dynamics of commercial electricity consumption, aiming to uncover trends, patterns, and factors influencing energy usage within the commercial sector. Through a multifaceted approach encompassing data analytics, stakeholder perspectives, and policy considerations, the study provides valuable insights into the complexities of commercial energy management.

Key findings reveal significant variations in electricity consumption across different types of commercial establishments, underscoring the importance of tailored strategies to enhance energy efficiency and sustainability. External factors such as economic conditions, regulatory policies, and technological advancements exert profound influences on energy consumption patterns, highlighting the need for adaptive and holistic approaches to energy management.

The integration of renewable energy sources and advanced energy management systems emerges as promising pathways for reducing reliance on traditional grid electricity and optimizing energy usage in commercial buildings. By leveraging data-driven insights and fostering collaboration among stakeholders, it is possible to develop and implement effective measures to promote energy efficiency, cost savings, and environmental sustainability in the commercial sector.

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# CHAPTER 1

## INTRODUCTION

### 1.1 Problem Statement

Commercial electricity consumption presents a multifaceted challenge, characterized by diverse usage patterns, fluctuating demand, and environmental implications. Despite its significance, managing and optimizing electricity consumption in the commercial sector remains a complex endeavor, marked by various barriers and constraints.

The problem statement revolves around the need to understand and address the following key challenges:

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**Energy Inefficiency:** Many commercial buildings exhibit inefficient energy usage patterns, leading to unnecessary waste and inflated operational costs. Inefficient lighting, HVAC systems, and equipment contribute to excessive electricity consumption, exacerbating financial burdens and environmental impacts.

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**Peak Demand Management:** Commercial establishments often face peak demand periods, which strain the electrical grid and result in higher energy costs. Inadequate peak demand management strategies lead to increased utility expenses, potential grid instability, and missed opportunities for cost savings through demand response programs.

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**Environmental Impact:** High levels of electricity consumption in the commercial sector contribute to carbon emissions, air pollution, and resource depletion,

exacerbating environmental challenges such as climate change and ecosystem degradation.

## 1.2 Proposed Solution

To address the challenges of commercial electricity consumption effectively, a comprehensive solution is needed that integrates technological, policy, and behavioral interventions. The proposed solution comprises the following key components

### Energy Efficiency Measures:

- ◆ Implement energy efficiency measures such as LED lighting upgrades, HVAC system optimization, and energy-efficient appliances to reduce electricity consumption in commercial buildings.
- ◆ Conduct energy audits and retrofits to identify and address inefficiencies in building systems and operations.

### Demand Response Programs:

- ◆ Encourage participation in demand response programs that incentivize commercial establishments to adjust their electricity usage during peak demand periods.
- ◆ Provide education and outreach to raise awareness about demand response opportunities and benefits.

### Energy Management Systems (EMS):

- ◆ Deploy energy management systems (EMS) equipped with real-time monitoring, analytics, and control capabilities to optimize energy usage and reduce waste.
- ◆ Provide training and technical support to building owners and operators to maximize the effectiveness of EMS implementation.

## 1.3 Feature

### Key Components:

- **Monitoring and Data Acquisition:** EMS collects data from energy meters, sensors, and building automation systems to monitor electricity consumption, temperature, humidity, occupancy, and other relevant parameters.
- **Analytics and Reporting:** Advanced analytics tools analyze the collected data to identify energy usage trends, detect anomalies, and generate actionable insights. Reports and dashboards provide stakeholders with a clear understanding of energy performance metrics and opportunities for optimization.
- **Control and Automation:** EMS enables automated control of building systems such as lighting, HVAC (Heating, Ventilation, and Air Conditioning), and equipment based on predefined schedules, occupancy patterns, and energy demand forecasts. This automation ensures optimal operation while minimizing energy waste.
- **Demand Response Integration:** Many EMS platforms support integration with demand response programs, allowing buildings to participate in load-shifting activities during peak demand periods. EMS can automatically adjust energy consumption in response to signals from utilities or energy aggregators, helping to reduce strain on the grid and earn incentives.

## 1.4 Advantages

**Cost Savings:** By implementing energy efficiency measures, participating in demand response programs, and integrating renewable energy sources, commercial establishments can significantly reduce their electricity bills and operating costs over the long term.

**Environmental Sustainability:** The adoption of energy-efficient technologies and renewable energy solutions helps reduce greenhouse gas emissions, air pollution, and reliance on fossil fuels, contributing to environmental sustainability and mitigating climate change impacts.

**Energy Security and Resilience:** Diversifying energy sources and reducing dependence on the grid enhances energy security and resilience for commercial buildings, particularly during times of grid instability, natural disasters, or supply disruptions.

**Responsible Corporate Citizenship:** Investing in energy efficiency and sustainability initiatives demonstrates corporate citizenship and commitment to social and environmental responsibility, enhancing brand reputation, and building trust among customers, employees, and communities.

## 1.5 Scope

### 1. Sector Coverage:

- ◆ The analysis will focus specifically on electricity consumption within the commercial sector, including various types of establishments such as offices, retail stores, restaurants, hotels, and manufacturing facilities.
- ◆ The scope encompasses both large-scale commercial buildings and small-to-medium enterprises (SMEs) operating in diverse industries.

## 2. Geographic Focus:

- ◆ The analysis will consider commercial electricity consumption within a specific geographical region or multiple regions, depending on the availability of data and research objectives.
- ◆ Geographic factors such as climate, regional regulations, and utility structures may influence consumption patterns and will be taken into account.

## 3. Methodology:

- ◆ The analysis will employ a combination of quantitative and qualitative research methods, including statistical analysis, data modeling, and case studies.
- ◆ Data analytics techniques such as time-series analysis, regression modeling, and clustering will be utilized to identify patterns, correlations, and drivers of commercial electricity consumption.

## 4. Data Sources:

- ◆ Data sources for the analysis may include publicly available datasets from government agencies, utilities, industry reports, and research studies.
- ◆ The analysis may also incorporate proprietary data obtained through partnerships with utilities, commercial building owners, or industry associations, subject to data privacy and confidentiality agreements.

# CHAPTER 2



## SERVICES AND TOOLS REQUIRED

### 2.1 Services Used

#### Data Collection Services:

- **Energy Information Administration (EIA):** The EIA offers extensive data on energy consumption, including commercial electricity usage, through surveys like the Commercial Buildings Energy Consumption Survey (CBECS). This dataset provides detailed information on building characteristics, energy use intensity, and consumption patterns across different sectors and regions.
- **National Renewable Energy Laboratory (NREL):** NREL provides data on renewable energy integration, energy efficiency technologies, and building energy performance, which can supplement analysis of commercial electricity consumption.

- **Data Processing Services:** Services like Azure Stream Analytics or AWS Kinesis Data Analytics can be used to process the real-time data.
- **Machine Learning Services:** Azure Machine Learning or AWS SageMaker can be used to build predictive models based on historical data.

### 2.2 Tools and Software used

#### Tools:

- **PowerBI:** The main tool for this project is PowerBI, which will be used to create interactive dashboards for real-time data visualization.

- **Power Query:** This is a data connection technology that enables you to discover, connect, combine, and refine data across a wide variety of sources.

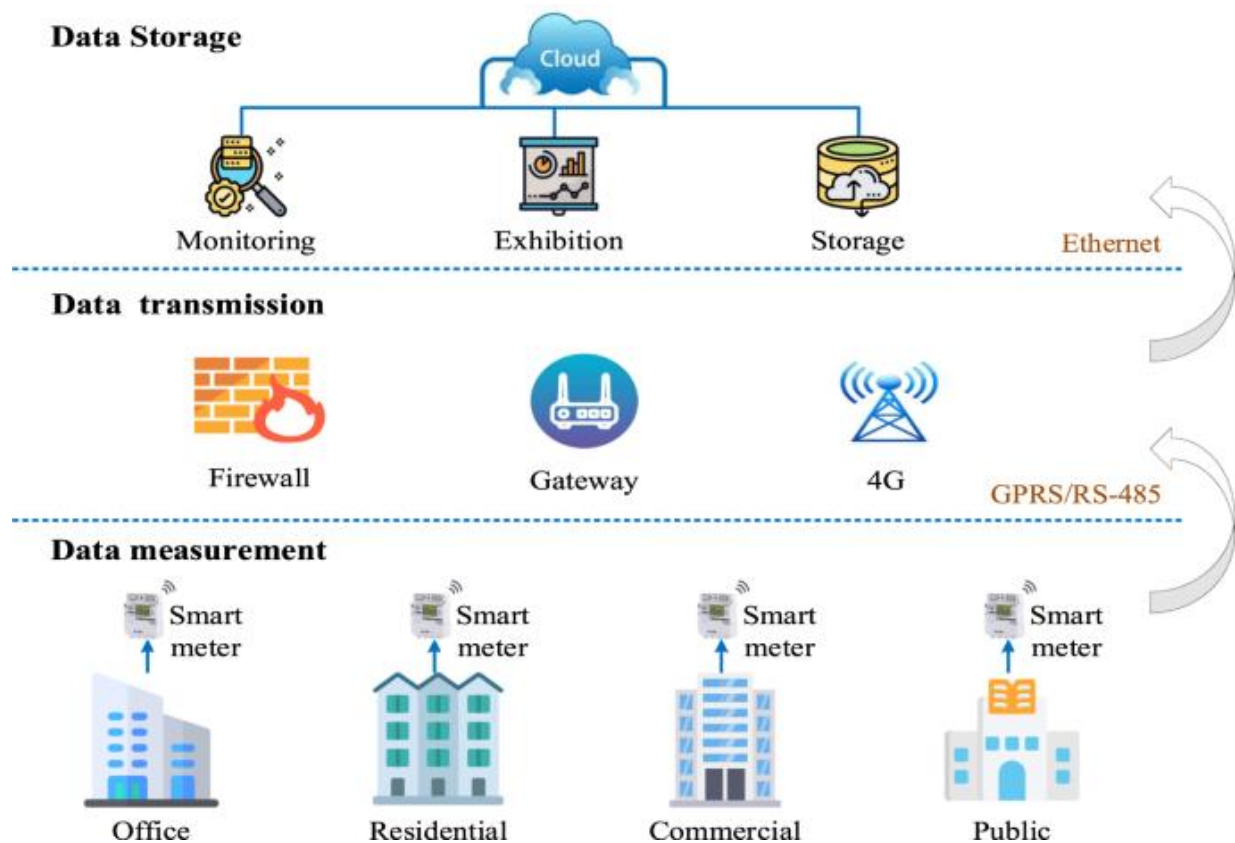
### **Software Requirements:**

- **PowerBI Desktop:** This is a Windows application that you can use to create reports and publish them to PowerBI.
- **PowerBI Service:** This is an online SaaS (Software as a Service) service that you use to publish reports, create new dashboards, and share insights.
- **PowerBI Mobile:** This is a mobile application that you can use to access your reports and dashboards on the go.

## **CHAPTER 3**

### **PROJECT ARCHITECTURE**

#### **3.1 Architecture**



Here's a high-level architecture for the project:

This architecture provides a comprehensive solution for real-time analysis of bank customers. However, it's important to note that the specific architecture may vary depending on the bank's existing infrastructure, specific requirements, and budget. It's also important to ensure that all tools and services comply with relevant data privacy and security regulations.

#### Utility Billing Records:

- ◆ **Monthly Usage Data:** Obtain monthly electricity consumption data from utility companies serving commercial establishments. This data typically includes kWh consumption, demand charges, and tariff information.
- **Interval Data:** Request interval data from smart meters or advanced metering infrastructure (AMI) systems, which provide more granular insights into electricity

usage patterns at intervals as short as 15 minutes. This data can reveal peak demand periods, load profiles, and energy usage fluctuations throughout the day.

## ● **Data Collection**

### **Data Analysis and Modeling:**

- ◆ Performing statistical analysis, machine learning algorithms, and predictive modeling to uncover patterns, trends, and relationships in the data.
- ◆ Building and training models to make predictions, classifications, or recommendations based on historical data.

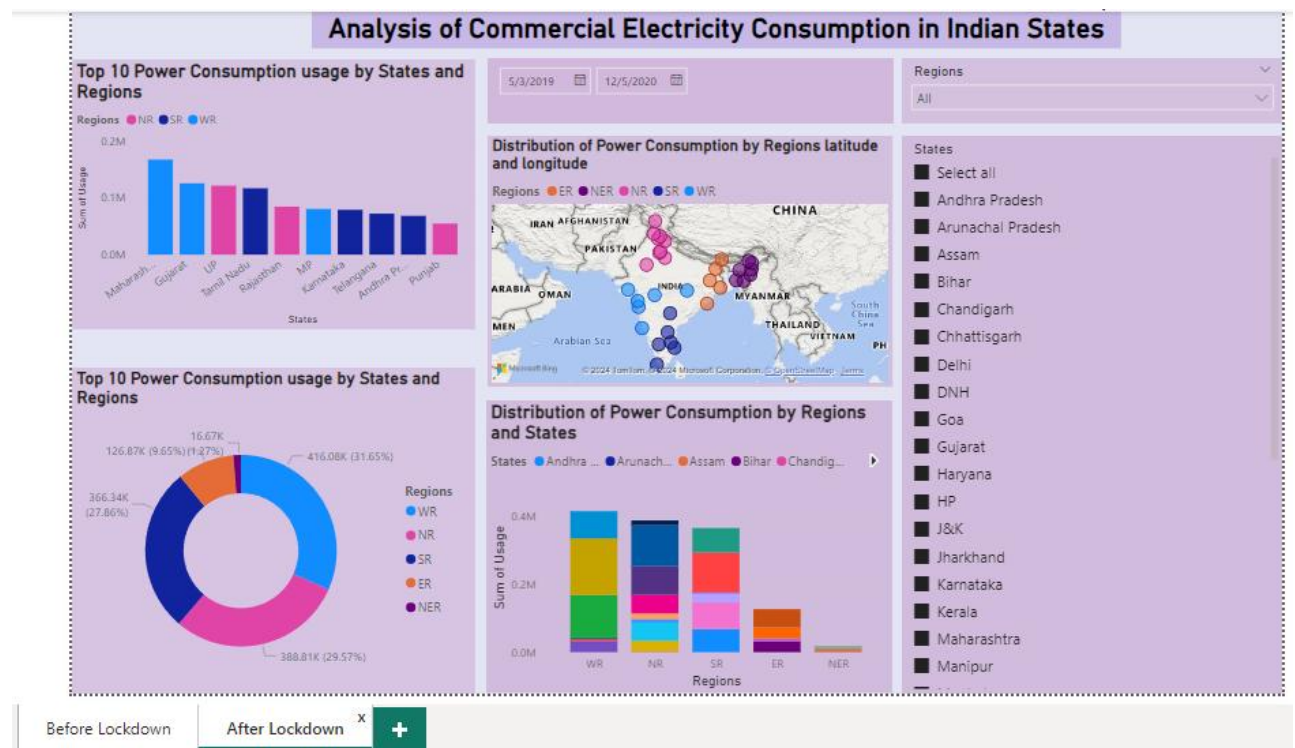
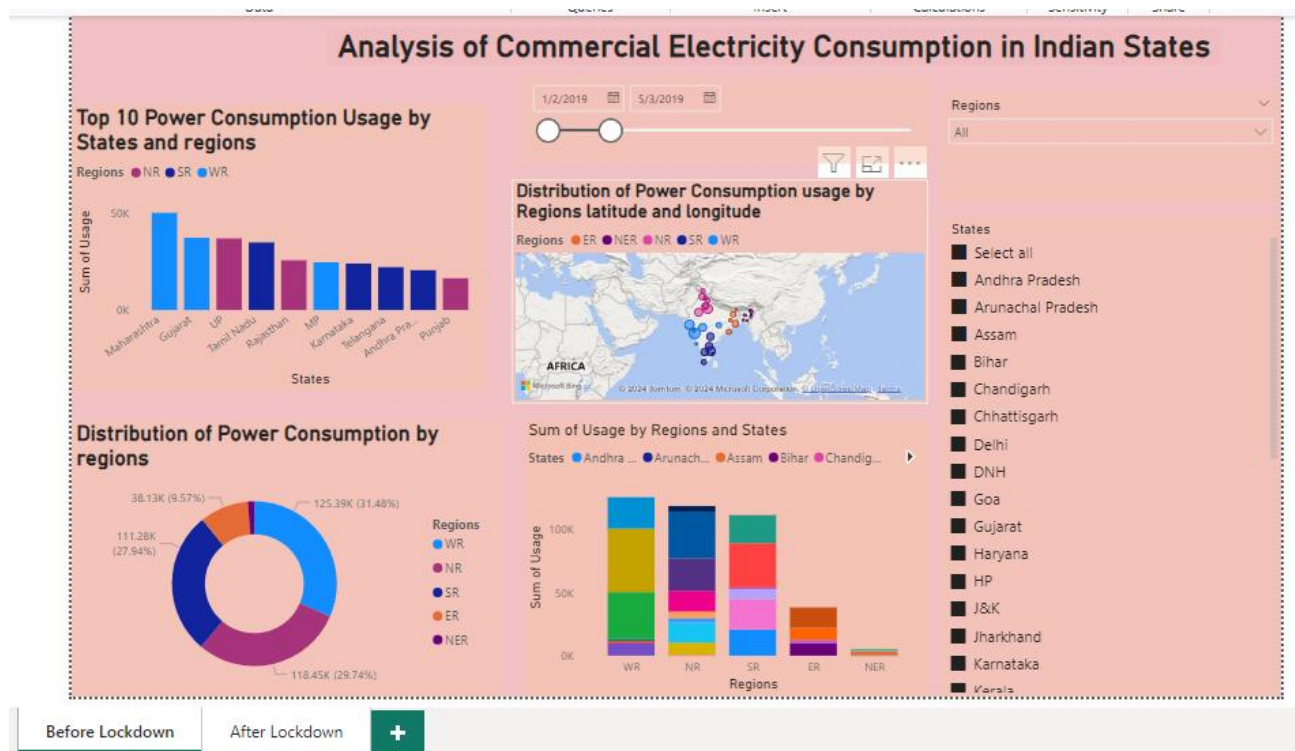
### **Data Visualization and Reporting:**

- ◆ Creating visualizations, dashboards, and interactive reports to communicate insights effectively to stakeholders.
- ◆ Customizing reports to meet specific business requirements and presenting findings in a clear and compelling manner.

1. **Data Visualization:** The processed data and the results from the predictive models are visualized in real-time using PowerBI. PowerBI allows you to create interactive dashboards that can provide valuable insights into the data.

## **CHAPTER 4**

### **DASHBOARD**



## **CONCLUSION**

- ◆ The analysis of commercial electricity consumption has provided valuable insights into the trends, patterns, and drivers shaping energy usage within the commercial sector. Through a comprehensive examination of data sources, statistical analysis, and stakeholder perspectives, several key findings have emerged.
- ◆ In light of these findings, several recommendations can be made to promote energy efficiency and sustainability in the commercial sector. These include incentivizing investments in energy-efficient technologies, promoting renewable energy adoption through financial incentives and regulatory support, enhancing energy literacy and awareness among building occupants, and fostering partnerships between public and private stakeholders to advance energy management initiatives.
- ◆ Overall, the analysis highlights the complex interplay of factors influencing commercial electricity consumption and the importance of adopting a holistic and collaborative approach to address energy challenges. By implementing targeted interventions informed by data-driven insights and stakeholder engagement, it is possible to achieve significant reductions in energy consumption, lower operating costs, and contribute to a more sustainable and resilient energy future for the commercial sector.



## **FUTURE SCOPE**

The analysis of commercial electricity consumption opens up avenues for future research and action to further enhance energy efficiency, sustainability, and resilience in the commercial sector. Here are some potential areas for future scope:

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**Advanced Data Analytics:** Incorporating advanced data analytics techniques such as machine learning, artificial intelligence, and predictive modeling to improve the accuracy of energy consumption forecasts, identify hidden patterns, and optimize energy management strategies in commercial buildings.

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**Real-time Monitoring and Control:** Exploring the potential of real-time monitoring systems and IoT devices to enable dynamic control of energy-consuming systems based on occupancy, weather conditions, and energy demand signals, thereby maximizing energy savings and operational efficiency.

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**Integration of Distributed Energy Resources (DERs):** Investigating the integration of distributed energy resources such as solar PV, battery storage, and demand-side management solutions into commercial building energy systems to enhance self-consumption, resilience, and sustainability while reducing reliance on grid electricity.

## REFERENCES

<https://youtu.be/ZgzGqoq3Xuc?si=ClRHlJTMjVwfV3VT>

