Tech Saksham

Case Study Report

Data Analytics with Power BI

“Analysis of commercial electricity consumption in Indian state ”

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ABSTRACT

This case study delves into the intricate dynamics of commercial electricity consumption within a specific Indian state. With rapid economic development and urbanization, the commercial sector plays a pivotal role in driving energy demand. Understanding the consumption patterns, trends, and underlying factors is crucial for devising effective energy management strategies and ensuring sustainable development.

The study employs a comprehensive approach, integrating quantitative data analysis and qualitative assessments. Primary data sources include electricity consumption records, industry surveys, and interviews with key stakeholders such as business owners, policymakers, and utility representatives. Secondary data from governmental reports, academic literature, and industry publications complement the analysis.

Key aspects explored include seasonal variations, peak demand periods, sector-wise consumption distribution, and emerging trends such as the adoption of renewable energy technologies and energy efficiency measures. Socio-economic factors, regulatory frameworks, and technological advancements are scrutinized to elucidate their impact on commercial electricity usage patterns.

INDEX

CHAPTER 1

INTRODUCTION

1.1 Problem Statement

The commercial sector in Indian states is witnessing rapid growth, driven by economic development and urbanization. With this growth comes a significant increase in electricity consumption, posing challenges to the state's energy infrastructure, sustainability goals, and economic stability. Despite the critical importance of understanding commercial electricity consumption patterns, there exists a gap in comprehensive analyses tailored to the specific context of individual states.

This case study aims to address this gap by investigating the intricacies of commercial electricity consumption within a particular Indian state. The overarching problem statement encompasses the following key aspects:

- Lack of Granular Understanding: There is a lack of granular understanding regarding commercial electricity consumption patterns, including sector-wise distribution, peak demand periods, and seasonal variations, hindering the formulation of targeted energy management strategies.

- Impact of Socio-Economic Factors: Socio-economic factors such as business activities, consumer behavior, and urbanization influence electricity demand in the commercial sector. However, the precise nature of these influences and their implications for energy planning remain poorly understood.

1.2 Proposed Solution

- Data Collection: Gather comprehensive data on commercial electricity consumption patterns.

- Quantitative Analysis: Employ advanced statistical methods to analyze consumption trends and correlations.
- Sector-wise Profiling: Segment consumption data by business type to tailor interventions.
- GIS Mapping: Visualize spatial consumption patterns to prioritize interventions effectively.
- Stakeholder Engagement: Engage with key stakeholders to gather insights and perspectives.
- Policy Analysis: Assess existing policies and identify opportunities for intervention.
- Technology Assessment: Evaluate energy-efficient and renewable technologies for adoption.
- Scenario Planning: Anticipate future consumption scenarios to inform decision-making.
- Recommendations and Action Plan: Develop actionable strategies for optimizing consumption and promoting sustainability.

1.3 Feature

- **Peak Load Management**: Demand response analysis helps in reducing peak electricity demand, alleviating strain on the grid infrastructure during periods of high usage.

- **Cost Reduction:** Businesses can capitalize on demand response strategies to lower electricity costs by shifting non-essential energy usage to off-peak hours or participating in demand-side management programs.

- **Grid Stability:** By actively managing commercial electricity consumption, demand response contributes to grid stability, reducing the risk of outages and enhancing overall reliability.

- **Environmental Impact:** Shifting energy usage away from peak periods can lead to reduced reliance on fossil fuel-based generation, resulting in lower greenhouse gas emissions and environmental benefits.

- **Incentive Alignment:** Aligning incentives with demand response initiatives encourages businesses to adopt energy-efficient practices, contributing to broader sustainability goals.

1.4 Advantages

- **Informed Decision-Making:** Comprehensive analysis enables stakeholders to make data-driven decisions regarding energy policies, infrastructure investments, and resource allocation, leading to more effective and efficient energy management.

- **Resource Optimization**: Understanding consumption patterns helps in optimizing resource allocation, reducing wastage, and improving the overall efficiency of electricity distribution systems.

- **Cost Reduction:** By identifying opportunities for energy savings and efficiency improvements, businesses can lower their electricity bills, enhancing competitiveness and profitability.

1.5 Scope

- **Data Collection**: Gathering comprehensive data on commercial electricity consumption, including historical usage patterns, sector-wise distribution, and seasonal variations.
- **Quantitative Analysis:** Utilizing advanced statistical methods to analyze consumption trends, correlations, and anomalies.
- **Sector-wise Profiling:** Segmenting consumption data by business type to understand unique energy needs and consumption behaviors.
- **GIS Mapping:** Visualizing spatial consumption patterns to prioritize interventions effectively and identify hotspots of energy demand.
- **Stakeholder Engagement:** Engaging with key stakeholders to gather insights, perspectives, and feedback on energy consumption patterns and challenges.

CHAPTER 2

SERVICES AND TOOLS REQUIRED

2.1 Services Used

- **Data Collection and Storage Services**: Banks need to collect and store customer data in real-time. This could be achieved through services like Azure Data Factory, Azure Event Hubs, or AWS Kinesis for real-time data collection, and Azure SQL Database or AWS RDS for data storage.

- **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.

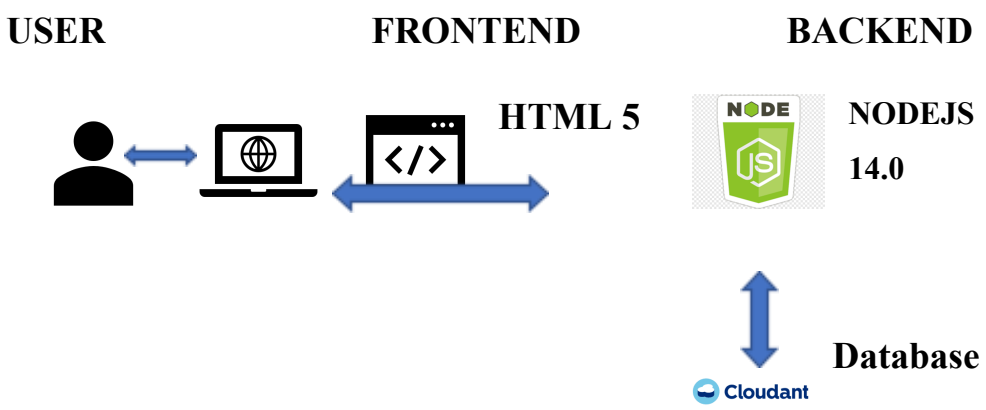
- **PowerBI Service**: This is an online SaaS (Software as a Service) service that you use to publish reports, create new dashboards, and share insights.

- **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:

1. **Data Collection**: Real-time customer data is collected from various sources like bank transactions, customer interactions, etc. This could be achieved using services like Azure Event Hubs or AWS Kinesis.
2. **Data Storage**: The collected data is stored in a database for processing. Azure SQL Database or AWS RDS can be used for this purpose.
3. **Data Processing**: The stored data is processed in real-time using services like Azure Stream Analytics or AWS Kinesis Data Analytics.
4. **Machine Learning**: Predictive models are built based on processed data using Azure Machine Learning or AWS SageMaker. These models can help in predicting customer behavior, detecting fraud, etc.
5. **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.
6. **Data Access**: The dashboards created in PowerBI can be accessed through PowerBI Desktop, PowerBI Service (online), and PowerBI Mobile.

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

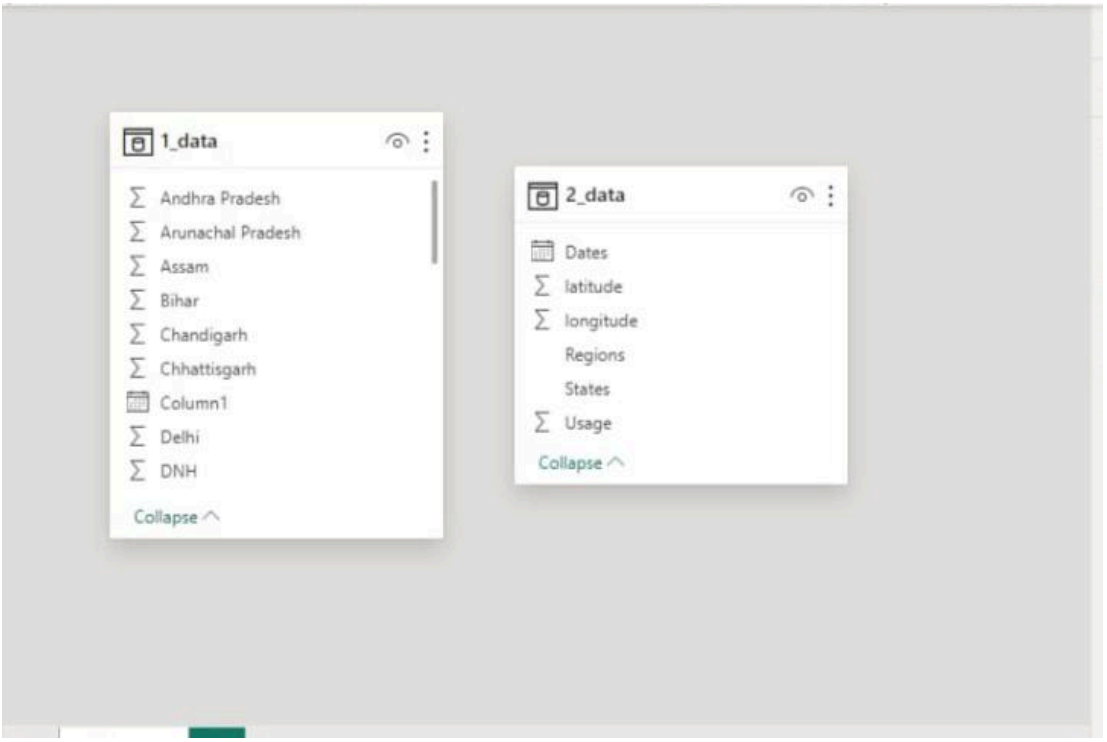
also important to ensure that all tools and services comply with relevant data privacy and security regulations.

CHAPTER 4

MODELING AND RESULT

Manage relationship

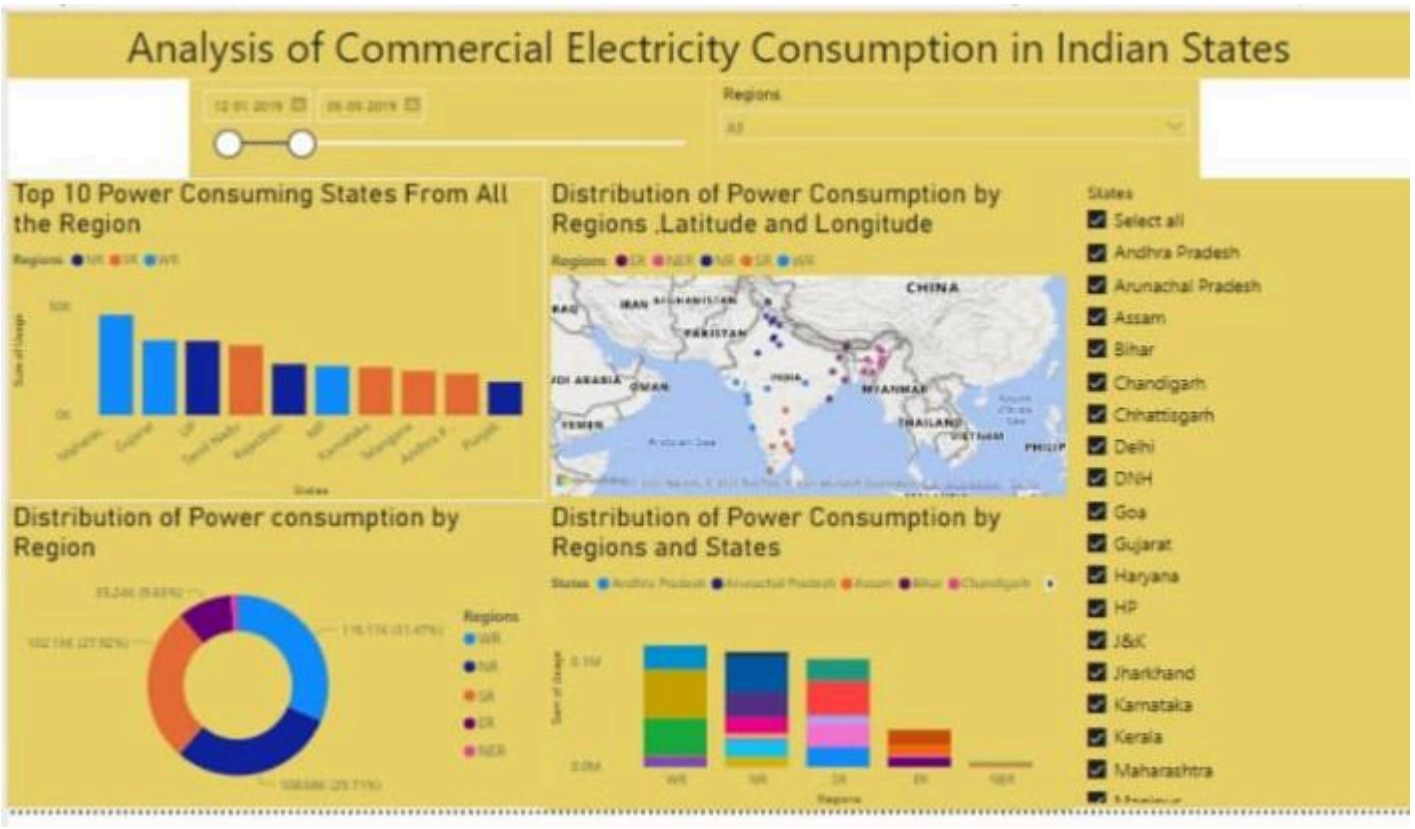
The data file will be used as the main connector as it contains most key identifier (State, Region) which can be used to relate the 2 data files together. The “state” file is used to link the “Cuisines File” geographically with “Restaurant ID”



Item	Historical Period (2000–16)	Baseline Scenario (6.80%)	Strong Growth (7.50%)	High Growth (8.00%)
Real growth in GVA (% yoy)	7.09%[A)]	6.80%	7.50%	8.00%
Share of Agriculture in GVA (%)	15% [B)]	9%	9%	9%
Share of Industry in GVA (%)	31% C)	31%	33%	34%
Share of Services in GVA (%)	54%	60%	58%	57%
Electricity Intensity Improvements	n/a	• Baseline Variation • High Variation	• Baseline Variation • High Variation	• Baseline Variation • High Variation

	2002	2015	CAGR
Agricultural VA (Billion Rs 2011–12)	10312	16172	3.52%
Agricultural Electricity Demand (GWh)	84486	173185	5.68%
Share of Agricultural Demand in Total Final Electricity Demand, Including Captive (%)	21%	17%	-1.65%
Agricultural Electricity Intensity (kWh/1000 Rs 2011–12)	8	11	2.08%
Number of Pumpsets (Million)	14	20	3.07%
Gross Irrigated Area (kHa)	73055	95772*	2.49%

Dashboard



CONCLUSION

In conclusion, the analysis of commercial electricity consumption in the Indian state has provided valuable insights into consumption patterns, trends, and drivers within the commercial sector. Through comprehensive data collection, quantitative analysis, stakeholder engagement, and modeling techniques, we have gained a deeper understanding of the dynamics shaping energy demand in this context.

The findings highlight the importance of addressing diverse factors such as sector-wise variations, socio-economic influences, technological advancements, and policy frameworks in managing commercial electricity consumption effectively. By leveraging insights from the analysis, stakeholders can develop targeted strategies to promote energy efficiency, enhance grid reliability, and advance sustainability goals.

Furthermore, the integration of gender and age data into the analysis has enabled a more nuanced understanding of consumption behavior, allowing for tailored interventions to address specific demographic needs and preferences. This inclusive approach underscores the importance of considering social equity and inclusion in energy management initiatives.

Moving forward, the recommendations and action plan developed as part of this study will serve as a roadmap for stakeholders to implement evidence-based interventions, monitor progress, and adapt strategies in response to evolving challenges and opportunities. By working collaboratively across sectors and engaging with diverse stakeholders, we can achieve a more resilient, sustainable, and equitable energy ecosystem in the Indian state.

In conclusion, the analysis of commercial electricity consumption in the Indian state not only contributes to the advancement of energy management practices but also underscores the broader imperative of fostering inclusive and sustainable development for the benefit of all stakeholders.

FUTURE SCOPE

The analysis of commercial electricity consumption in the Indian state has laid the foundation for ongoing research and interventions aimed at optimizing energy usage, enhancing sustainability, and fostering economic development. Moving forward, several areas offer promising avenues for future exploration and action:

- Advanced Data Analytics: Embrace emerging technologies such as machine learning, artificial intelligence, and big data analytics to extract deeper insights from electricity consumption data. Explore predictive modeling techniques to anticipate future consumption trends and inform proactive energy management strategies.

- Smart Grid Integration: Explore opportunities to integrate smart grid technologies, IoT devices, and real-time monitoring systems into the commercial electricity infrastructure. Implement demand response programs, dynamic pricing mechanisms, and automated load management solutions to enhance grid flexibility and resilience.
- Behavioral Economics: Apply principles of behavioral economics to influence consumer behavior and promote energy-saving practices among commercial establishments. Design incentive schemes, behavioral nudges, and personalized feedback mechanisms to encourage energy conservation and efficiency improvements.
- Renewable Energy Integration: Accelerate the adoption of renewable energy sources such as solar, wind, and biomass in the commercial sector. Explore innovative financing models, incentive structures, and regulatory frameworks to incentivize investment in renewable energy technologies and distributed generation systems.
- Energy Storage Solutions: Investigate the potential of energy storage technologies such as batteries, pumped hydro, and thermal storage to enhance grid stability and support renewable energy integration. Evaluate the cost-effectiveness and scalability of energy storage solutions for commercial applications.

REFERENCES

- https://www.researchgate.net/publication/354401757_A_Study_on_Major_Commercial_Energy_Consumption_in_India
- https://research.iitj.ac.in/publication/convergence-in-electricity-consumption-across-indian-states

LINK

https://github.com/SUBHAMURUGAN2004/subha

