Tech Saksham

Case Study Report

Data Analytics with Power BI

“Analysis of Commercial Electricity Consumption in Indian States”

“ Thiruvalluvar College ”

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ABSTRACT

This study aims to provide a comprehensive analysis of commercial electricity consumption across various states in India, examining its trends, patterns, and implications for energy policy and sustainable development. As India undergoes rapid economic growth and urbanization, the demand for electricity in the commercial sector has surged, posing challenges for energy planners and policymakers. Using a combination of statistical methods and data analytics, this research investigates the factors driving commercial electricity consumption, including economic growth, industrial activities, urbanization, and technological advancements.

The analysis draws upon a rich dataset encompassing electricity consumption figures, demographic profiles, economic indicators, and policy frameworks from different Indian states. Through time-series analysis, regression models, and spatial mapping techniques, the study uncovers the dynamics of commercial electricity consumption at both aggregate and regional levels. It defines disparities in consumption patterns among states, highlighting the influences of diverse socio-economic factors and regulatory environments.

Furthermore, this research explores the implications of commercial electricity consumption energy sustainability, environment impact and energy security. By examining the relationship between electricity consumption and carbon emissions, it assesses the environment footprint of commercial activities in different states. Additionally, the study evaluates the effectiveness of existing energy policies and proposes strategies for enhancing energy efficiency, promoting renewable energy adoption, and mitigating demand-side pressures.

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CHAPTER 1

INTRODUCTION

1.1 Problem Statement

Currently, electricity is used I every home for various tasks, including watching television, charging smartphones, using an electric light bulb, and other things. Electricity has become an essential part of our daily life. It powers our homes, businesses, and industries, and has enabled us to achieve unprecedented levels of comfort, convenience, and productivity. However, this growing dependence on electricity has led to significant increase inn its consumption, placing enormous pressure on energy resources and the environment. As a result, it has become imperative to analyze and control the supply and demand of electricity, tp ensure its sustainable use and reduce the impact of its production on the environment. In recent years, there has been a noticeable rise in electricity consumption, driven by the increasing use of electronic devices, appliances, and industrial machinery. This trend is expected to continue in the coming years, with the growth of emerging markets and the adoption of new technologies, such as electricity demand, utility companies are exploring new ways to optimize energy production and distribution, while waste and reduce emissions.

1.2 Proposed Solution

To achieve this goal, big data analytics has emerged as a promising tool for analyzing electricity consumption patterns ad identifying opportunities for energy savings. By analyzing large volumes of data generated by smart meters and other monitoring devices, utility companies can gain insight into the behavior of individual consumers, as well as the overall trends in consumption. This information can be used to develop targeted strategies for reducing energy use, promoting energy efficiency, and managing peak demand. The paper ais to present a study on the electricity consumption patterns of 500 residential consumers in a particular area over 24months, using big data analytics. The data was obtained from the MSEB and analyzed to identify trends in consumer behavior.

1.3 Feature

- **Real-Time Analysis**: The dashboard will provide real-time analysis of Electricity Consumption data.
- **Customer Segmentation**: It will segment customers based on various parameters like Dates, Usages, Latitudes, Longitudes, etc.
- **Trend Analysis**: The dashboard will identify and display trends in Electricity Consumption.
- **Predictive Analysis**: It will use historical data to predict future Electricity Consumption.

1.4 Advantages

- **Data-Driven Decisions**: Government can make informed decisions based on real-time data analysis.
- **Improved Customer Engagement**: Understanding electricity consumption and trends can help Government to engage with their followers more effectively.
- **Increased Revenue**: By identifying consumption rate for wind energy and water energy, government can increase their revenue.

1.5 Scope

The scope for analyzing electricity consumption in Indian states is broad and multifaceted, offering opportunities for various research directions and methodologies. Investigating the historical trends and patterns of commercial electricity consumption over time to identify long term growth trajectories, seasonal variations, and cyclical trends. Examining geographical variations in commercial electricity consumption among different Indian states, regions, and urban areas to understand the spatial distribution of energy demand and its implications for infrastructure planning and resource allocation. Segmenting commercial electricity consumption by sectors such as retail, hospitality, manufacturing, services, and information technology to discern sector specific consumption patterns, drivers, and

challenges. Exploring the role of technological advancements, such as smart meters, energy management systems, and loT-enabled devices, in optimizing commercial electricity consumption and enhancing energy efficiency.

CHAPTER 2

SERVICES AND TOOLS REQUIRED

2.1 Services Used

- **Data Collection and Storage Services**: Electricity consumption of Indian states is collected from various industrial sectors consuming the power and the energy production resources are also collected and stored in cloud.

- **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 Sage Maker 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.

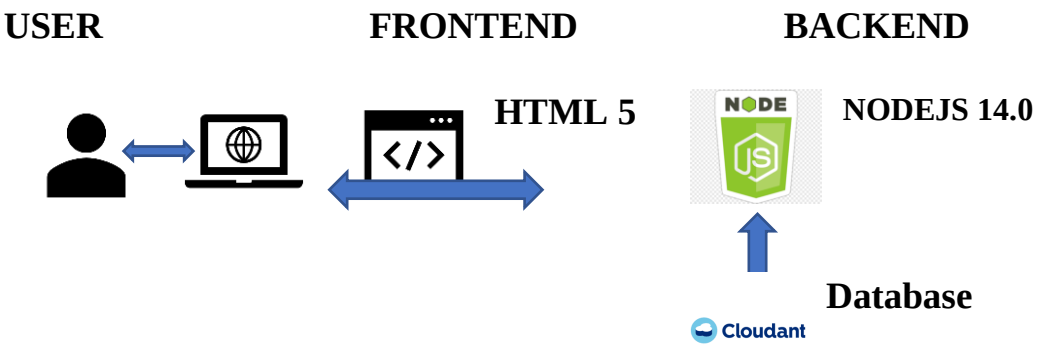
- **PowerBI Service**: This is an online SaaS (Software as a Service) service that you use to publish reports, create new dashboards, and share insights.

- **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**: Gather energy consumption data from various sources, such as smart meter, sensors, or utility bills. Ensure that the data is accurate and covers a suitable timeframe for analysis.
2. **Data Storage**: Data storage is the relation of information using technology specifically developed to keep that data and have it as accessible as necessary. Data storage refers to the use of recording media to retain data using computers or other devices.
3. **Data Processing**: It is a process of standardizing how an organization collects, stores, transforms distribute, manages, and uses data. The end-goal of data architecture is to deliver relevant data so that stakeholders can leverage it to make strategic decisions and enhance business processes.
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 power consumption. However, it's important to note that the specific architecture may vary

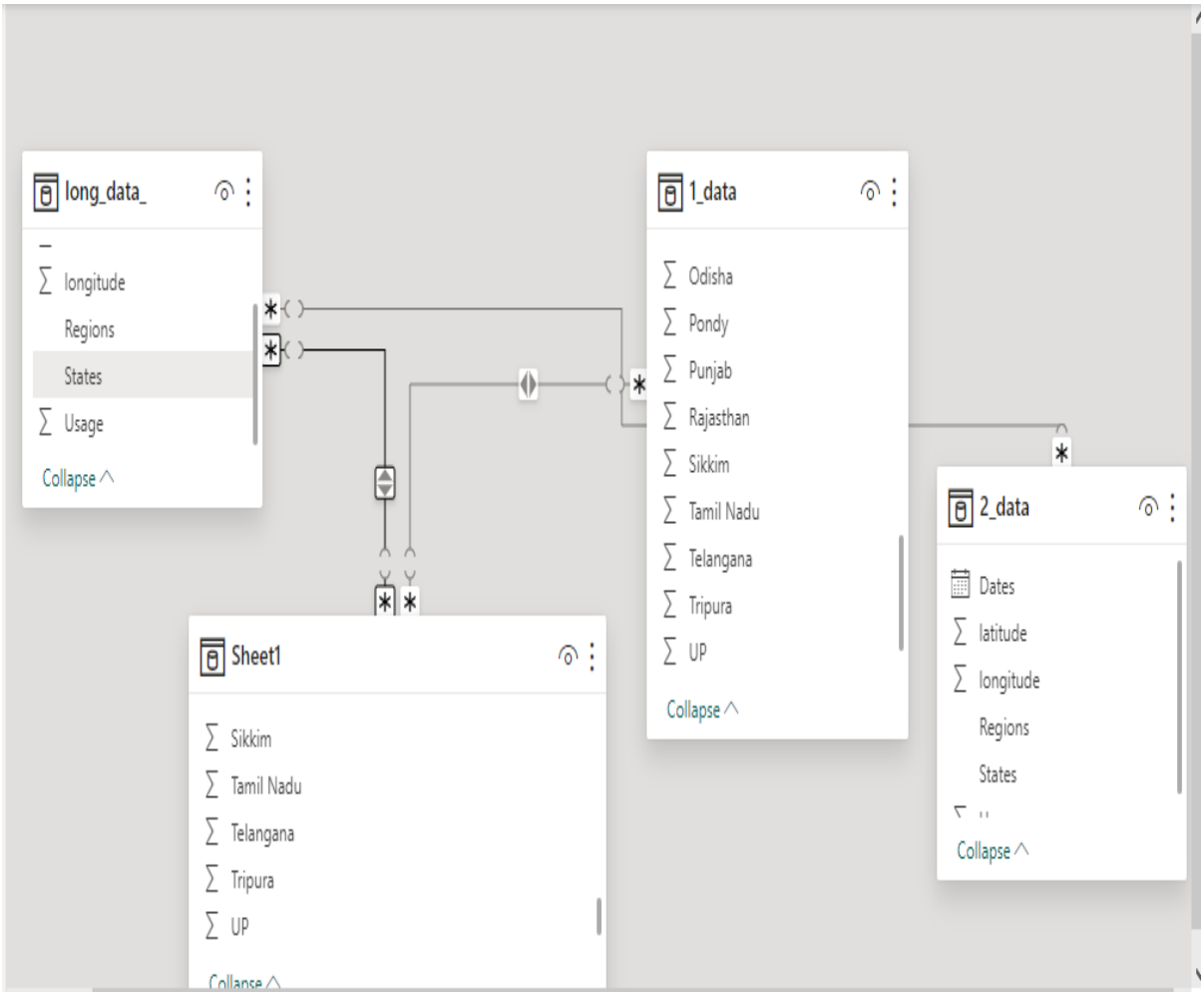
depending on the electricity's existing infrastructure, specific requirements, and budget. It's also important to ensure that all tools and services comply with relevant data privacy and security regulations.

CHAPTER 4

MODELING AND RESULT

Manage relationship

The “1_data” file will be used as the main connector as it contains most key identifier (column1) which can be use to relates the 4 data files together. The “long.data” file is use to link the client profile geographically with “dates”.



Manage relationships

Active	From: Table (Column)	To: Table (Column)
☑	1_data (Column1)	Sheet1 (Column1)
☑	long_data_ (Dates)	2_data (Dates)
☑	long_data_ (Regions)	Sheet1 (Column1)

New... Autodetect... Edit... Delete

Close

Edit relationship

Select tables and columns that are related.

1_data

Column1	Punjab	Haryana	Rajasthan	Delhi	UP	Uttarakhand	HP	J&K	Chandigarh
03-01-2019 00:00:00	121.9	133.5	240.2	85.5	311.8	39.3	30.1	54.1	4
04-01-2019 00:00:00	118.8	128.2	239.8	83.5	320.7	38.1	30.1	53.2	4
05-01-2019 00:00:00	121	127.5	239.1	79.2	299	39.2	30.2	51.5	4

Sheet1

Column1	Punjab	Haryana	Rajasthan	Delhi	UP	Uttarakhand	HP	J&K	Chandigarh
03-01-2019 00:00:00	121.9	133.5	240.2	85.5	311.8	39.3	30.1	54.1	4
04-01-2019 00:00:00	118.8	128.2	239.8	83.5	320.7	38.1	30.1	53.2	4
05-01-2019 00:00:00	121	127.5	239.1	79.2	299	39.2	30.2	51.5	4

Cardinality: Many to many (*:*)

Cross filter direction: Both

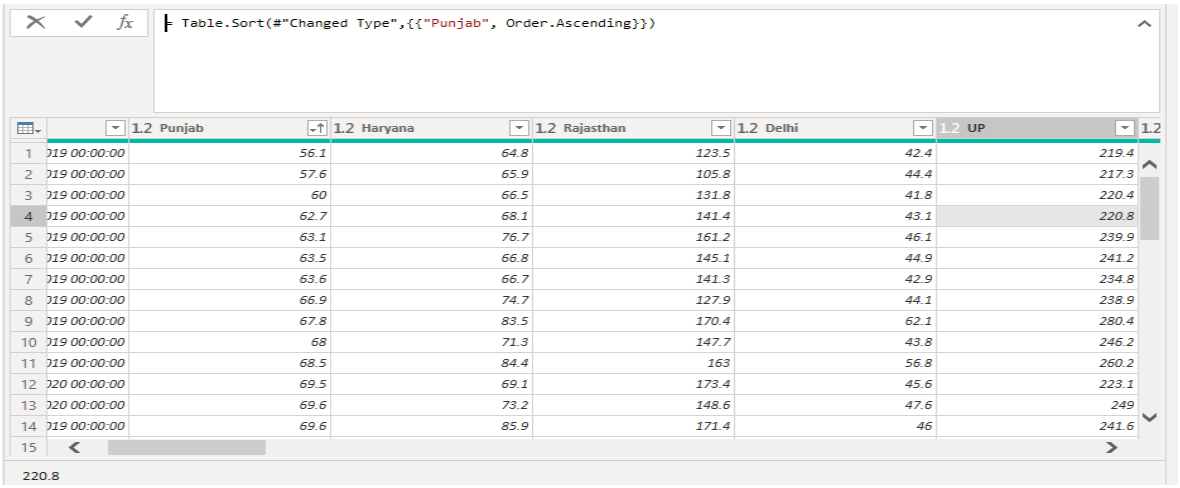
☑ Make this relationship active

☐ Apply security filter in both directions

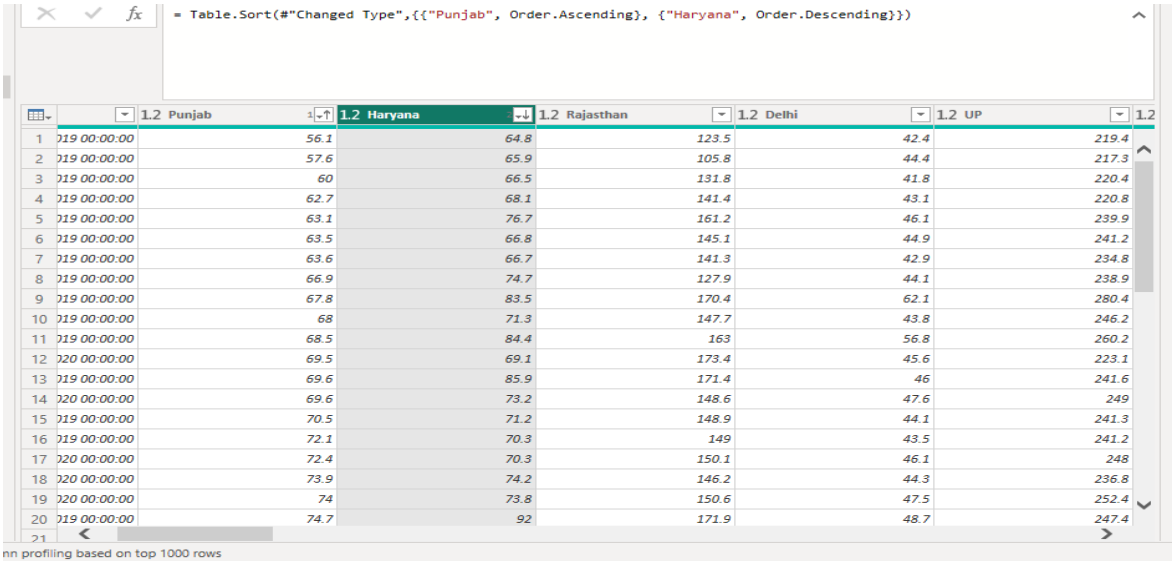
☐ Assume referential integrity

Modelling for data and consumption data

Notice that the Dates and usage of the consumption of electricity are there in the datasets by not sorted, so by using the ascending command, it is been sorted in ascending order.

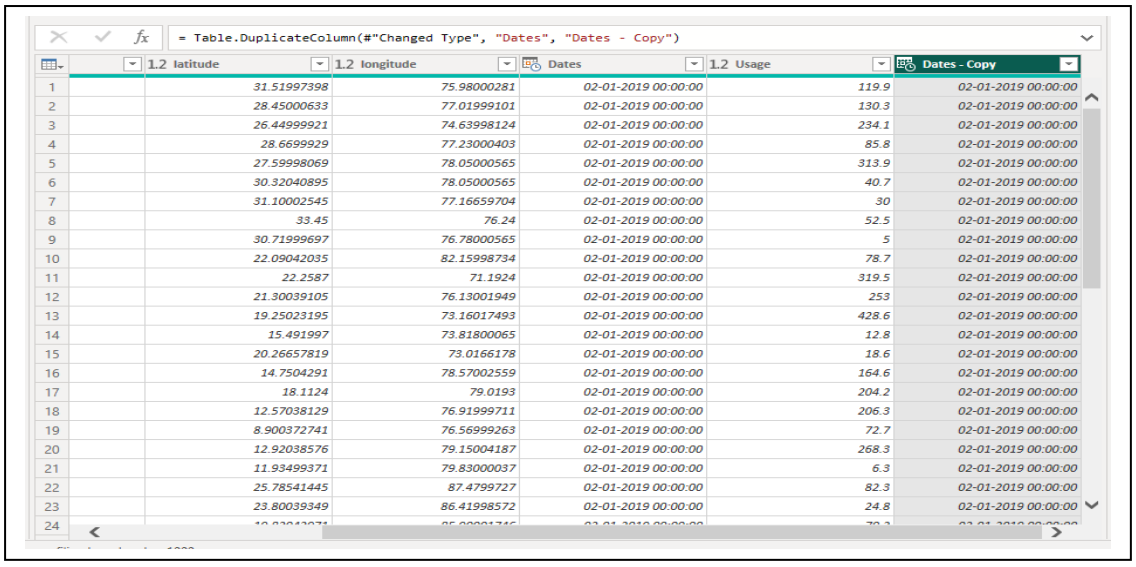


The Haryana values are sorted in descending order.

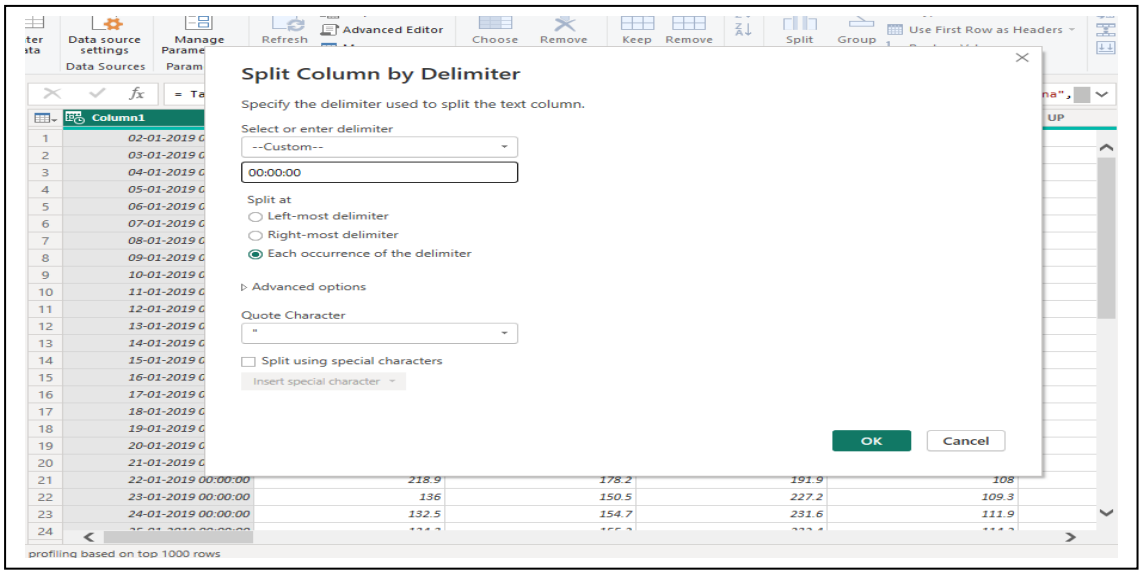


Changing the order of dates of power query

Duplicate the “dates” then split column using space as delimiter.

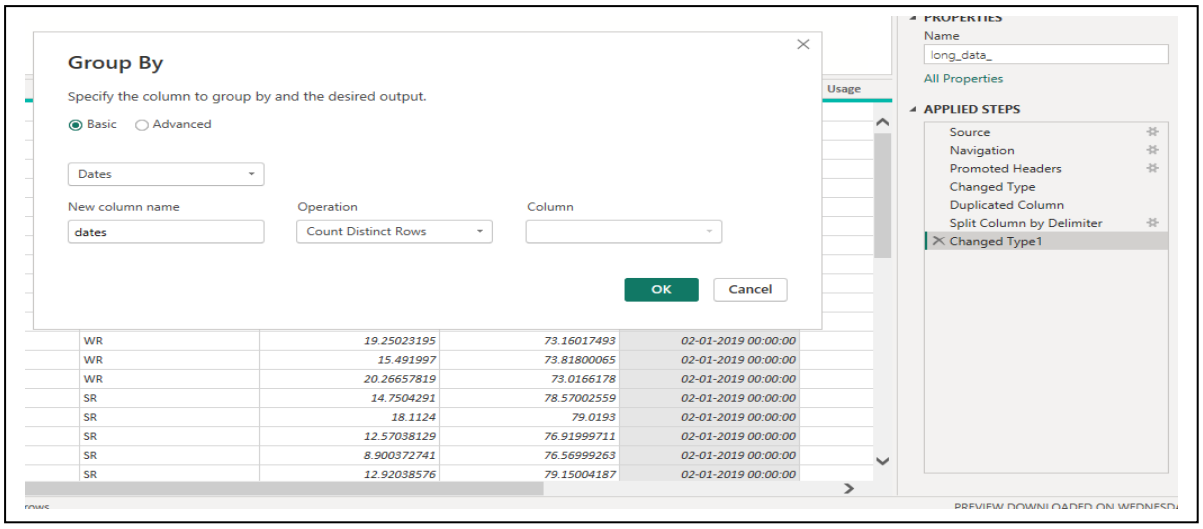


	1.2 latitude	1.2 longitude	Dates	1.2 Usage	Dates - Copy
1	31.51997398	75.98000281	02-01-2019 00:00:00	119.9	02-01-2019 00:00:00
2	28.45000633	77.01999101	02-01-2019 00:00:00	130.3	02-01-2019 00:00:00
3	26.44999921	74.63998124	02-01-2019 00:00:00	234.1	02-01-2019 00:00:00
4	28.6699929	77.23000403	02-01-2019 00:00:00	85.8	02-01-2019 00:00:00
5	27.59998069	78.05000565	02-01-2019 00:00:00	313.9	02-01-2019 00:00:00
6	30.32040895	78.05000565	02-01-2019 00:00:00	40.7	02-01-2019 00:00:00
7	31.10002545	77.16659704	02-01-2019 00:00:00	30	02-01-2019 00:00:00
8	33.45	76.24	02-01-2019 00:00:00	52.5	02-01-2019 00:00:00
9	30.71999697	76.78000565	02-01-2019 00:00:00	5	02-01-2019 00:00:00
10	22.09042035	82.15998734	02-01-2019 00:00:00	78.7	02-01-2019 00:00:00
11	22.2587	71.1924	02-01-2019 00:00:00	319.5	02-01-2019 00:00:00
12	21.30039105	76.13001949	02-01-2019 00:00:00	253	02-01-2019 00:00:00
13	19.25023195	73.16017493	02-01-2019 00:00:00	428.6	02-01-2019 00:00:00
14	15.491997	73.81800065	02-01-2019 00:00:00	12.8	02-01-2019 00:00:00
15	20.26657819	73.0166178	02-01-2019 00:00:00	18.6	02-01-2019 00:00:00
16	14.7504291	78.57002559	02-01-2019 00:00:00	164.6	02-01-2019 00:00:00
17	18.1124	79.0193	02-01-2019 00:00:00	204.2	02-01-2019 00:00:00
18	12.57038129	76.91999711	02-01-2019 00:00:00	206.3	02-01-2019 00:00:00
19	8.900372741	76.56999263	02-01-2019 00:00:00	72.7	02-01-2019 00:00:00
20	12.92038576	79.15004187	02-01-2019 00:00:00	268.3	02-01-2019 00:00:00
21	11.93499371	79.83000037	02-01-2019 00:00:00	6.3	02-01-2019 00:00:00
22	25.78541445	87.4799727	02-01-2019 00:00:00	82.3	02-01-2019 00:00:00
23	23.80039349	86.41998572	02-01-2019 00:00:00	24.8	02-01-2019 00:00:00
24					



Grouping of age by ranges

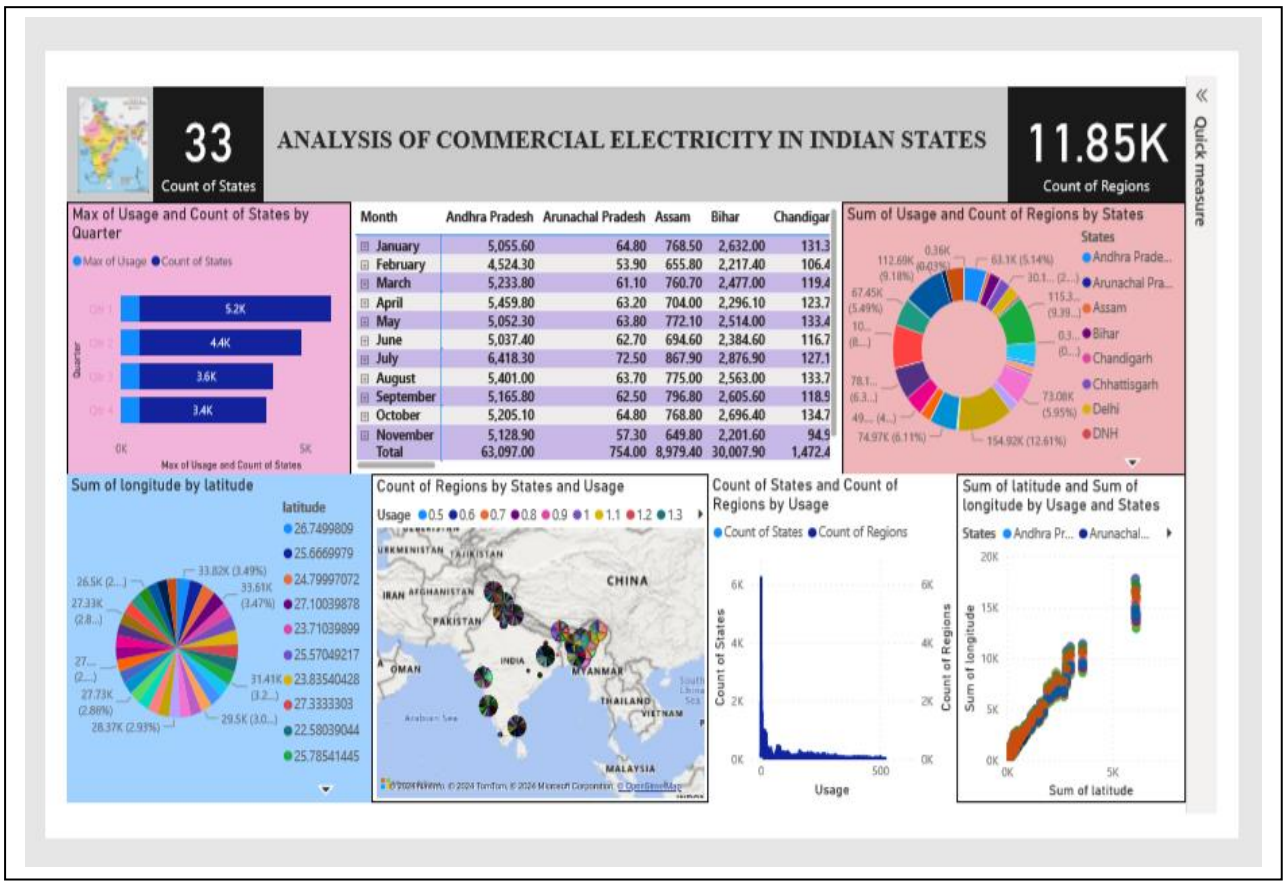
As the states ranges from 0 to 29, we shall group them into different state range for easier profiting, we will group the states with the value of median.



lues of such as “account Id” have also been set as Text.

And District name have been categorized as place to be use for the map to show the sum of the inhabitants in each region.

Dashboard



CONCLUSION

The analysis of commercial electricity consumption in Indian staes reveals a complex and dynamic landscape shaped by various socio-economic, technological, and policy factors. Through comprehensive examples of historical trends, spatial variations, sectoral dynamics, and environmental implications, this study provides valuable insights into the patterns, drivers, and challenges of energy usage in the commercial sector. Key findings from this analysis underscore the significant growth in commercial electricity consumption driven by economic expansion, urbanization, and industrial activities across Indian states. While certain regions exhibit higher consumption levels due to concentrated economic activities and urban centers, disparities persist among states, highlighting the need for targeted interventions to address regional imbalances and enhance energy access and affordability.

FUTURE SCOPE

Future scenarios of sectoral value added and overall and per capita GDP, are used to determine service demands in certain sectors, that in turn determine the employment of various appliances and equipment to convert electricity into end use services. The government over successive years has prioritized the manufacturing sector to draw surplus labor from primary activities and enhance growth, productivity, and meaningful employment. This has reflected in the national manufacturing policy as well as the more recently launched make in India campaign.

REFERENCES

https://economictimes.indiatimes.com/industry/energy/power/indias-power-consumption-grows-nearly-8-pc-to-847-billion-units-in-first-half-of-fy24/articleshow/104254849.cms?from=mdr

https://www.youtube.com/live/kbe61N-qQ-s?si=yDuEQ1chLVG06_uF

