Tech Saksham

Case Study Report

Data Analytics with Power BI

“Analysis of Commercial Electricity Consumption in Indian State”

“Sivanthi Arts and science College for Women”

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ABSTRACT

This study employs advanced data analytics techniques to analyse commercial electricity consumption patterns across various Indian states. Leveraging data sourced from cloud and web platforms, the research examines the intricate dynamics influencing electricity usage in commercial sectors. Methodologies encompass descriptive statistics, machine learning algorithms, and predictive modeling to unveil insights into consumption trends, peak periods, and regional variations. Findings offer actionable intelligence for policymakers, utility providers, and businesses to optimize resource allocation, enhance energy efficiency, and foster sustainable development strategies in the Indian commercial electricity sector. This research delves into the analysis of commercial electricity consumption in Indian states using a data-driven approach facilitated by cloud and web-based data sources. Through comprehensive data analytics techniques, including clustering, time series analysis, and predictive modeling, the study uncovers patterns, anomalies, and influential factors shaping commercial energy usage. Insights derived from the analysis aid in identifying opportunities for demand management, infrastructure optimization, and policy formulation to address energy challenges and foster economic growth. The findings contribute to the advancement of data-driven decision-making in the energy sector, facilitating sustainable development and resilience in India's commercial electricity landscape.

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CHAPTER 1

INTRODUCTION

1.1 Problem Statement

The problem statement for the analysis of commercial electricity consumption in an Indian state revolves around the lack of comprehensive understanding regarding the intricate dynamics driving energy usage patterns. Despite the increasing importance of energy efficiency and sustainability, there is a notable gap in research addressing the specific factors influencing commercial electricity consumption within the state. This knowledge deficit poses challenges for policymakers, energy planners, and stakeholders seeking to develop targeted strategies for resource optimization and sustainable development. Furthermore, without a thorough understanding of the underlying drivers, it becomes challenging to accurately forecast future electricity demand trends and implement effective policies to address energy needs while minimizing environmental impact.

Proposed Solution

The proposed solution entails conducting a comprehensive analysis of commercial electricity consumption in the Indian state, utilizing advanced data analytics and modeling techniques. This solution involves collecting and analyzing extensive datasets encompassing economic indicators, government policies, technological advancements, and environmental factors influencing energy usage patterns. By employing regression analysis, predictive modeling, and machine learning algorithms, the study aims to identify correlations and forecast future electricity demand trends accurately. Additionally, stakeholder consultations and interdisciplinary collaboration will be integral to developing targeted strategies for optimizing resource allocation and promoting sustainable energy management practices. The proposed solution seeks to bridge the knowledge gap, empowering policymakers and energy planners to make informed decisions that balance economic growth with environmental stewardship.

1.2 Feature

- **Advanced Data Analytics**: The solution incorporates sophisticated data analytics techniques to analyze extensive datasets encompassing various factors influencing commercial electricity consumption, such as economic indicators, government policies, and environmental variables.
- **Predictive Modeling**: Utilizing regression analysis, machine learning algorithms, and predictive modeling techniques, the solution aims to forecast future electricity demand trends accurately, providing valuable insights for long-term planning and decision making.
- **Interdisciplinary Collaboration**: The approach emphasizes interdisciplinary collaboration, engaging stakeholders from diverse fields including energy, economics, policy-making, and environmental science to ensure comprehensive and holistic insights.
- **Targeted Strategy Development**: By identifying correlations between different factors and energy consumption patterns, the solution facilitates the development of targeted strategies for optimizing resource allocation and promoting sustainable energy management practices tailored to the specific context of the Indian state.

1.3 Advantages

- **Informed Decision-Making**: By providing accurate forecasts and insights into commercial electricity consumption patterns, the solution enables policymakers and energy planners to make informed decisions regarding energy infrastructure investment, policy formulation, and resource allocation.
- **Resource Optimization**: By identifying correlations between various factors and electricity consumption, the solution facilitates the optimization of resources, leading to more efficient energy use and reduced waste.
- **Sustainable Development**: Through targeted strategies and interventions informed by the analysis, the solution promotes sustainable development by balancing economic growth with environmental considerations, thereby fostering long-term resilience and prosperity.

1.4 Scope

The scope of this analysis encompasses a comprehensive examination of commercial electricity consumption within a specific Indian state. It involves gathering and analyzing data related to various factors influencing energy usage, including economic indicators, government policies, technological advancements, and environmental variables. The analysis will focus on understanding the correlations between these factors and electricity consumption patterns, aiming to identify trends and drivers of energy demand. Additionally, the scope includes the development and application of predictive models to forecast future electricity demand accurately. Stakeholder consultations and interdisciplinary collaboration will be integral to ensure the relevance and applicability of the findings. The analysis will culminate in actionable insights and recommendations for policymakers, energy planners, and stakeholders to optimize resource allocation, promote sustainable energy practices, and address the energy challenges faced by the state.

CHAPTER 2

SERVICES AND TOOLS REQUIRED

2.1 Services Used

- **Data Analytics Platforms**: Leveraging platforms like Python with libraries such as Pandas, NumPy, and Scikit-learn for data preprocessing, exploration, and predictive modeling.
- **Cloud Computing Services**: Utilizing cloud platforms like Amazon Web Services (AWS) or Microsoft Azure for scalable storage, processing, and analysis of large datasets.
- **Statistical Software**: Utilizing statistical software packages like R or STATA for advanced statistical analysis, regression modeling, and hypothesis testing to uncover insights into energy consumption patterns.
- **Energy Data APIs**: Accessing energy data APIs provided by energy utilities or government agencies to obtain real-time or historical data on commercial electricity consumption, facilitating accurate analysis and modeling.
- **Data Integration Services**: Power BI can integrate data from various sources including IoT devices, smart meters, and utility databases to collect electricity consumption data.
- **Data Visualization Services**: Power BI offers robust visualization capabilities to represent electricity consumption patterns through interactive charts, graphs, and maps.
- **Predictive Analytics Services**: Power BI can be used for predictive analytics to forecast future electricity consumption based on historical data, weather patterns, and other relevant factors.

2.2 Tools and Software used

Tools:

- **Power BI Desktop**: Power BI Desktop is the primary tool used for creating reports and dashboards. It allows you to connect to various data sources, transform data, and design visualizations.
- **Power Data Visualization**: Within Power BI Desktop, Power Query Editor is used for data cleaning, transformation, and shaping. It helps in preparing the data for analysis by removing duplicates, filtering, and creating calculated columns if necessary.
- **Power Query Editor**: Within Power BI Desktop, Power Query Editor enables users to clean, transform, and merge electricity consumption data from different sources before loading it into the data model.
- **DAX (Data Analysis Expressions):** DAX is a powerful formula language used in Power BI to create custom calculations and measures, which can be helpful in calculating metrics like average consumption, peak usage, or forecasting.
- **Power BI Service**: The online service component of Power BI allows for sharing and collaboration on reports and dashboards, as well as scheduled data refreshes, essential for keeping electricity consumption data up-to-date.
- **Power BI Mobile App**: Enables users to access reports and dashboards on the go, ensuring that insights into electricity consumption can be accessed from anywhere, anytime.

Software Requirements:

- **Power BI Desktop**: Power BI Desktop is the primary tool used for creating reports and dashboards. It is a free desktop application that allows users to connect to data sources, create data models, and design visualizations.
- **Data Preparation Tools**: Depending on the format and structure of the data, additional data preparation tools might be necessary. Power Query Editor within Power BI Desktop provides robust data transformation capabilities to clean and shape the data as needed.

- **Azure Services**: If advanced analytics or machine learning capabilities are desired, integration with Azure services such as Azure Machine Learning or Azure SQL Database could be beneficial. This allows for more advanced analysis and forecasting of electricity consumption trends.
- **Power BI Service**: Power BI Service is a cloud-based platform that allows for sharing and collaboration on reports and dashboards. While not strictly required for analysis, it can be useful for sharing insights with stakeholders and enabling collaboration across teams.

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CHAPTER 3

PROJECT ARCHITECTURE

3.1 Architecture

Here are some points outlining the architecture for analyzing electricity consumption in Indian states using Power BI:

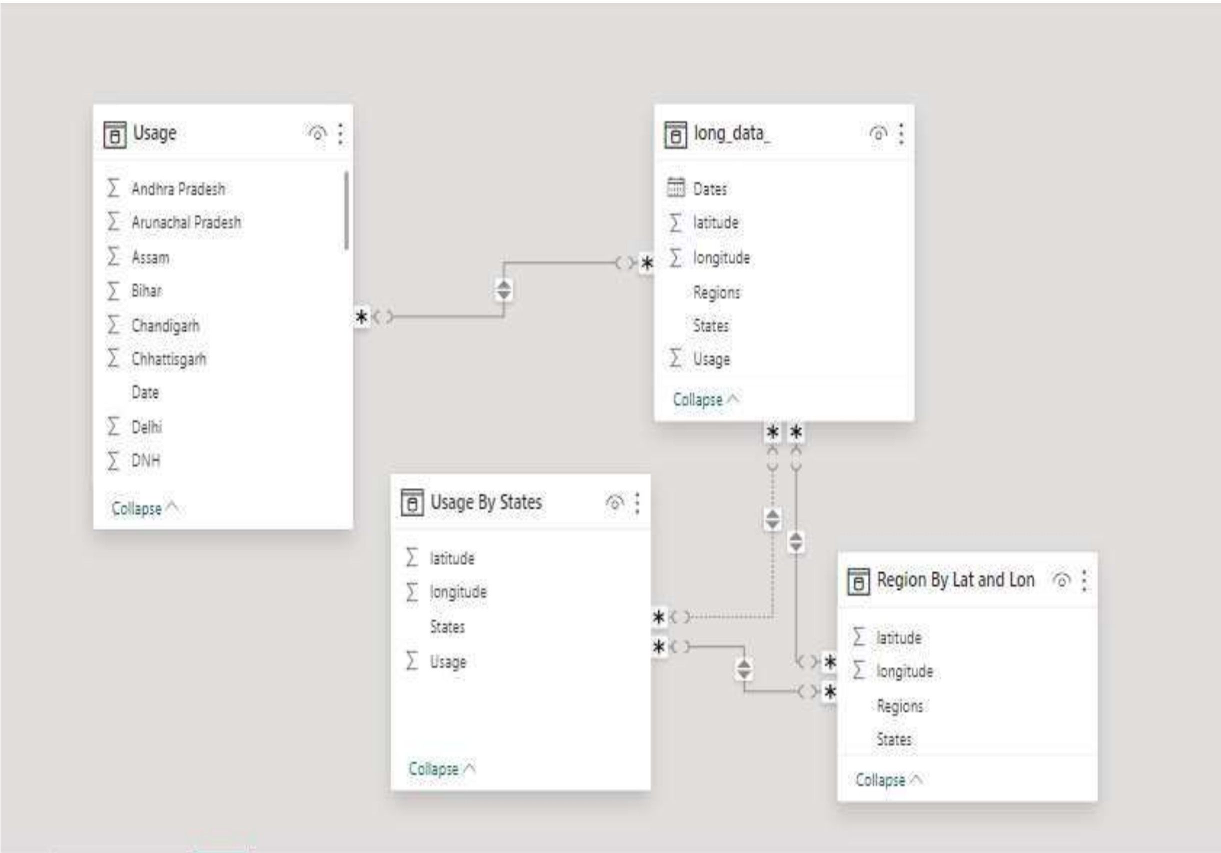
- **Data Sources**: Identify and connect to relevant data sources such as government databases, energy utilities, and third-party providers to gather data on electricity consumption. This may include historical consumption data, demographic information, economic indicators, and geographical data.
- **Data Modeling**: Create a data model within Power BI to establish relationships between different data tables. This may involve creating measures, calculated columns, and hierarchies to support analysis and visualization.
- **Geospatial Analysis**: Incorporate geospatial analysis into the architecture by leveraging Power BI's mapping capabilities. Visualize electricity consumption data on maps to identify regional disparities, hotspot areas, and spatial trends within Indian states.
- **Scalability and Performance**: Design the architecture to be scalable and performant, capable of handling large volumes of data and supporting real-time or near-real-time analysis. Optimize data refresh schedules, query performance, and resource utilization to minimize latency and ensure responsiveness.
- **Integration with Other Systems**: Integrate Power BI with other systems and tools as needed, such as data warehouses, ETL pipelines, or external analytics platforms. Ensure seamless data flow and interoperability to leverage existing investments and maximize the value of the architecture.

CHAPTER 4

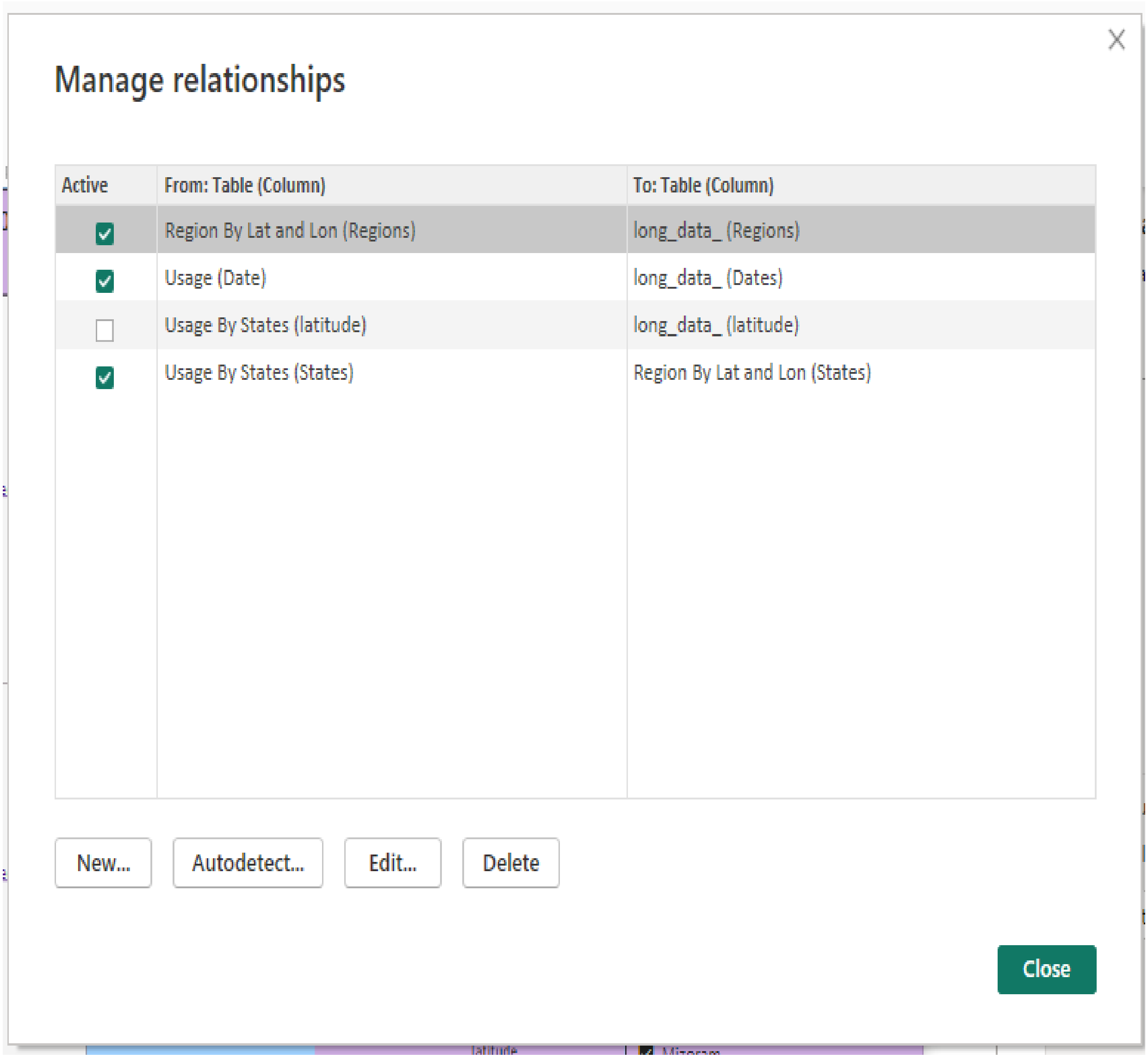
MODELING AND RESULT

Manage relationship

Managing relationships in Power BI involves establishing connections between different data tables, defining cardinality, and specifying cross-filtering behaviour. It's crucial to optimize relationships for analysis, handle many-to-many relationships using bridge tables, and validate their accuracy through testing. Documentation of relationships facilitates understanding and collaboration, while continuous monitoring ensures their relevance and effectiveness over time. Effective relationship management ensures a coherent and structured data model, enabling accurate analysis and informed decision-making in analyzing electricity consumption in Indian states.



This is the manage relationships for the given analysis of electricity consumption using power BI.



Create Relationship:

Create relationship

Select tables and columns that are related.

long_data_

States	Regions	latitude	longitude	Dates	Usage
UP	NR	27.59998069	78.05000565	02-01-2019 00:00:00	313.9
UP	NR	27.59998069	78.05000565	03-01-2019 00:00:00	311.8
UP	NR	27.59998069	78.05000565	04-01-2019 00:00:00	320.7

Usage By States

States	Usage	latitude	longitude
UP	313.9	27.59998069	78.05000565
UP	311.8	27.59998069	78.05000565
UP	320.7	27.59998069	78.05000565

Cardinality

One to one (1:1)

Cross filter direction

Both

- [x] Make this relationship active
- [ ] Apply security filter in both directions
- [ ] Assume referential integrity

In this table we have extracted a text before delimiter.1 by year and text after delimiter by month.

```
= Table.RenameColumns(#"Extracted Text Before Delimiter",{{"Text After Delimiter.1", "Year"}, {"Text After Delimiter", "Month"}})
```

	Date	1.2 Punjab	1.2 Haryana	1.2 Rajasthan	1.2 Delhi	1.2
1	02-01-2019	119.9	130.3	234.1	85.8	
2	03-01-2019	121.9	133.5	240.2	85.5	
3	04-01-2019	118.8	128.2	239.8	83.5	
4	05-01-2019	121	127.5	239.1	79.2	
5	06-01-2019	121.4	132.6	240.4	76.6	
6	07-01-2019	118	132.1	241.9	71.1	
7	08-01-2019	107.5	121.4	237.2	69	

Here, we have removed columns and changed types by Dates and Usage by using the given data.

```
= Table.RemoveColumns(#"Changed Type",{"Dates", "Usage"})
```

	States	Regions	1.2 latitude	1.2 longitude
1	Punjab	NR	31.51997398	75.98000281
2	Haryana	NR	28.45000633	77.01999101
3	Rajasthan	NR	26.44999921	74.63998124
4	Delhi	NR	28.6699929	77.23000403
5	UP	NR	27.59998069	78.05000565
6	Uttarakhand	NR	30.32040895	78.05000565
7	HP	NR	31.10002545	77.16659704
8	J&K	NR	33.45	76.24
9	Chandigarh	NR	30.71999697	76.78000565
10	Chhattisgarh	WR	22.09042035	82.15998734

Here, we transfer column types and promoted headers by using states, regions, latitude, longitude, dates, usage etc,.

```
= Table.TransformColumnTypes(#"Promoted Headers",{{"States", type text}, {"Regions", type text}, {"latitude", type number}, {"longitude", type number}, {"Dates", type datetime}, {"Usage", type number}})
```

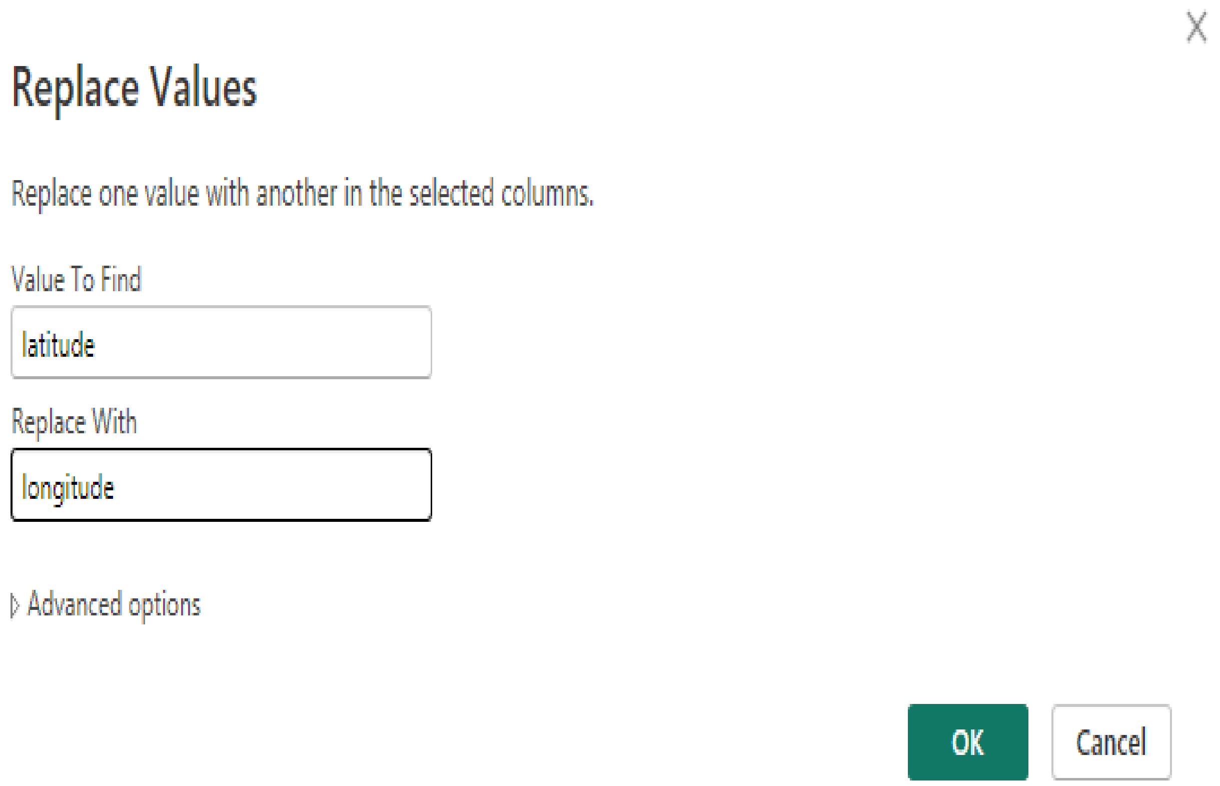
	States	Regions	latitude	longitude	Dates	Us
1	Punjab	NR	31.51997398	75.98000281	02-01-2019 00:00:00	
2	Haryana	NR	28.45000633	77.01999101	02-01-2019 00:00:00	
3	Rajasthan	NR	26.44999921	74.63998124	02-01-2019 00:00:00	
4	Delhi	NR	28.6699929	77.23000403	02-01-2019 00:00:00	
5	UP	NR	27.59998069	78.05000565	02-01-2019 00:00:00	
6	Uttarakhand	NR	30.32040895	78.05000565	02-01-2019 00:00:00	
7	HP	NR	31.10002545	77.16659704	02-01-2019 00:00:00	

In this table, we have used states and usage of electricity by regions and we have transformed data for the given data. From this we can analysis the usage of electricity for the Indian states by using power BI.

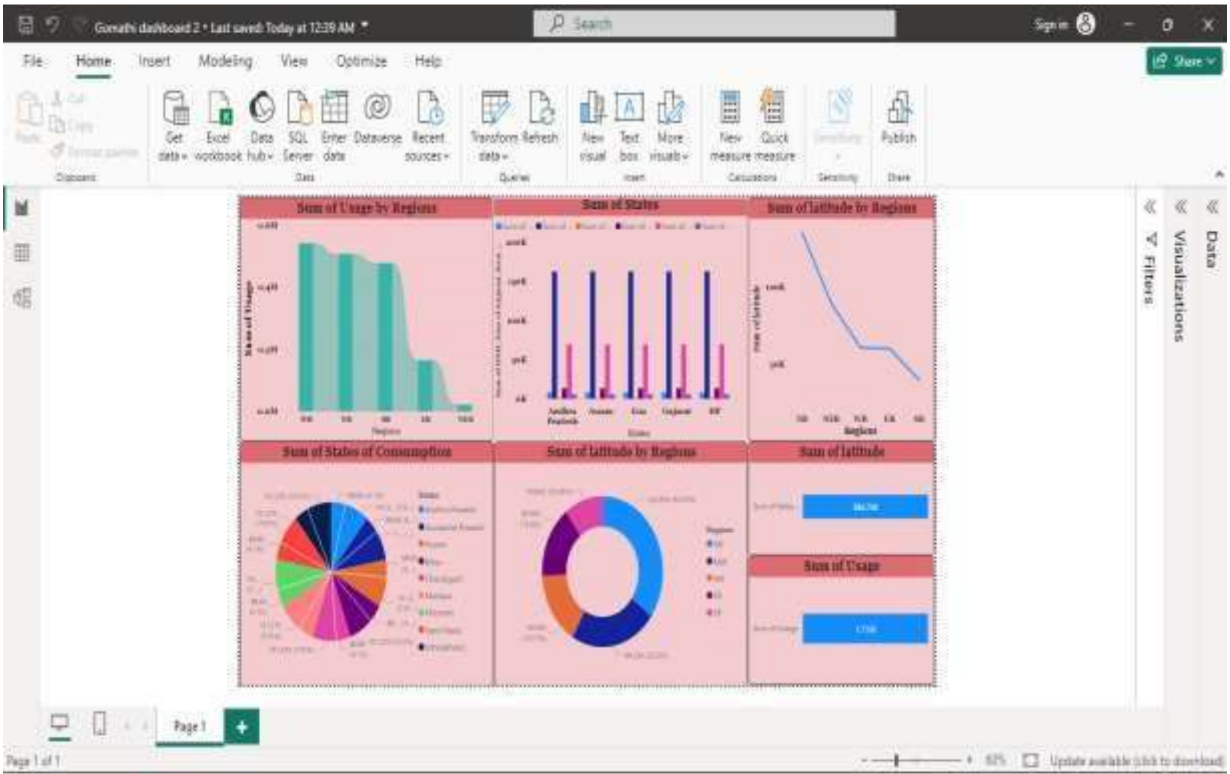
```
= Table.RemoveColumns(#"Changed Type",{"Regions", "longitude", "Dates", "latitude"})
```

	States	Usage
1	Punjab	119.9
2	Haryana	130.3
3	Rajasthan	234.1
4	Delhi	85.8
5	UP	313.9
6	Uttarakhand	40.7
7	HP	30
8	J&K	52.5
9	Chandigarh	5
10	Chhattisgarh	78.7
11	Gujarat	319.5
12	MP	253
13	Maharashtra	428.6
14	Goa	12.8

Next, We replace values by replacing one value with another from latitude in value to find and longitude in replace with for the given data.



Dashboard



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Search
Sign in
Share
File
Home
Insert
Modeling
View
Optimize
Help
Get data
Excel workbook
Data hub
SQL Server
Enter data
Dataverse
Recent sources
Transform data
Refresh
New visual
Text box
More visuals
New measure
Quick measure
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CONCLUSION

In conclusion, the analysis of commercial electricity consumption in Indian states using Power BI offers valuable insights into energy usage patterns, contributing to informed decisionmaking and sustainable development initiatives. By leveraging advanced analytics and visualization capabilities, stakeholders can identify trends, correlations, and opportunities for optimization. The establishment of robust data models and relationships ensures data integrity and facilitates comprehensive analysis. Through continuous monitoring and refinement, organizations can adapt to evolving energy landscapes and address emerging challenges effectively. Ultimately, Power BI serves as a powerful tool for transforming raw data into actionable insights, driving positive change and resilience in the management of electricity consumption across Indian states. Ultimately, with Power BI's analytical prowess combined with its seamless integration with Azure services and IoT devices, businesses can not only optimize electricity consumption but also pave the way for sustainable and environmentally conscious operations, contributing positively to both the bottom line and the planet.

FUTURE SCOPE

Looking ahead, the future scope for analyzing commercial electricity consumption in Indian states using Power BI presents numerous opportunities for further advancement. Integration with emerging technologies such as IoT devices and smart meters can provide real-time data streams, enhancing the granularity and accuracy of analysis. Moreover, the incorporation of predictive analytics and machine learning algorithms enables proactive forecasting of electricity demand and identification of potential efficiency improvements. Collaborative initiatives with energy utilities and government agencies can facilitate access to additional datasets and promote data sharing for comprehensive analysis. Furthermore, enhancing geospatial analysis capabilities can unveil spatial trends and facilitate targeted interventions in areas with high energy consumption. Additionally, Power BI's capacity for benchmarking and comparative analysis will drive continuous improvement efforts by providing insights into energy efficiency performance relative to industry standards and peers.

REFERENCES

https://www.sciencedirect.com/science/article/pii/S2666546820300094

LINKS