Tech Saksham

Case Study Report

Data Analytics with Power BI

“Analysis of Commercial Electricity Consumption in Indian State ”

“College Name”

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ABSTRACT

The demand for energy has been increasing over the years in India, which may be the result of its rapid economic growth trajectory. In this context, this study examines the direction of the Granger-causal relationship between electricity consumption and economic growth at the state and sectoral levels in India. In doing so, the panel cointegration tests with the structural break, the heterogeneous panel causality test, and the panel VAR based impulse-response model are employed. The study covers overall economic growth and growth in agricultural and industrial sectors for eighteen major Indian states for the period 1960–61 to 2014–15. The results provide evidence in support of a long-term relationship between economic growth and electricity consumption only in the agriculture sector. Further, the results provide evidence for the presence of unidirectional Granger-causality flowing in the direction of overall economic growth to electricity consumption at the aggregate state level. However, at the sectoral level, there is a unidirectional causal relationship running from electricity consumption to economic growth for the agriculture sector, and economic growth to electricity consumption for the industrial sector.

Energy has been universally recognized as one of the most important input for economic growth and human development. Generally, it has defined as "Capacity to do work" thereby, for bring out desirable design on economic level there must be need of intensive of energy performance in various sectors of the country. Perceiving commercial energy at the one of economic viability consumption has equip the present status of economic level to be boost and reach global advance in due period with identification of which are highly consumes among public and the statistics of this has brought out in this study. Electricity, LPG, kerosene, coal and natural gas are the chosen commercial energy and data for the specified years have collected from central electricity authority CAE and Energy statistics 2015 for 2007-2014.

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CHAPTER 1

INTRODUCTION

1.1 Problem Statement

Over the years, the capacity to generate electricity has increased, however the actual generation of electricity has not been commensurate with this increased capacity. Key reasons for the low utilisation of generation capacity are: (i) shortage of fuel, especially coal, and (ii) unviable Power Purchase Agreements.

Power outages due to coal shortage are a major concern for industries as they fear production setbacks. Although the situation has improved, we still don't have enough coal reserves. The only long-term solution to this problem is switching to renewable sources of energy such as solar, wind, biogas, ocean etc

What are the problems with electricity usage?

The environmental problems directly related to energy production and consumption include air pollution, climate change, water pollution, thermal pollution, and solid waste disposal.
Record prices, fuel shortages, rising poverty, slowing economies: the first energy crisis that's truly global. Energy markets began to tighten in 2021 because of a variety of factors, including the extraordinarily rapid economic rebound following the pandemic.

1. 2 Proposed Solution

1. Buy Electrical Appliances with a 5-Star BEE Rating Only. ...
2. Switch to LED Lights. ...
3. Switch to Smart Appliances for Remote Control and Optimal Usage. ...
4. Switch to BLDC Fans. ...
5. Harness Solar Energy with Solar Panels. ...
6. Operate the AC at 24 degrees Celsius.

- Switch off lights and electrical appliances when not using them. ...
- Switch to energy-saving LED light globes. ...
- Shut doors and close curtains. ...
- Understand and improve your home's energy use. ...
- Manage your heating and cooling. ...
- Get the best energy deal. ...
- Insulate your roof. ...

- Save money with solar energy.

1.1 Feature

This paper studies growth in electricity consumption, the key factors affecting it, and its link with economic activity. To do so, the paper discusses the major characteristics of India's power sector, and the historical trends of power consumption and economic growth, by tracing the changes over the years. The study also briefly discusses the key factors that have impacted consumption measures, including captive power, deficits, enhanced efficiency, etc. It also discusses the historical role of the manufacturing sector, the growing importance of the agriculture and household sectors, and the introduction of new and more energy-efficient technologies (such as the LED bulb), in determining power-sector outcomes. In the process, the study provides an overview of the existing relationship between energy and gross domestic product (GDP) in India, using past data and extant literature. Finally, the study conducts a time-series analysis to estimate the elasticity of energy consumption with respect to overall economic activity (using gross value added (GVA) as a measure). It finds that despite ups and downs in consumption and elasticity estimates over time, the long-term elasticity has been close to unity. Therefore, given that long-term annual economic growth is expected to be in the five-seven per cent range, India should plan for capacity increases at six-seven per cent for the next five- to ten-year horizon as it is better to err on the side of excess than shortage. At fairly conservative growth rates we find that India will need to plan for electricity consumption levels that are approximately double of those at present, and higher than other estimates like central electricity authority (CEA). This calls for significant investments in

electricity-generation capacity. However, elasticities can change over time. India is an emerging economy, moving away from its dependence on fossil fuels. This is as a consequence of the global decarbonisation process and adding more renewable capacity. This study notes that as elasticities may change in the future, the power planning horizon should be limited to ten years, appropriate investments made in electricity-generation capacity, a constant watch kept on electricity-consumption growth, and consumption closely monitored.

1.2 Advantages

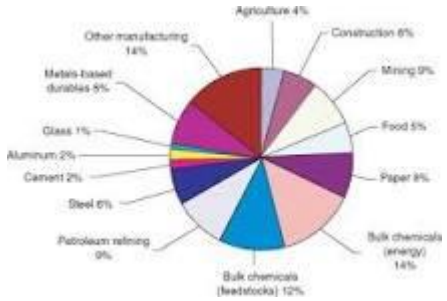
Energy (specifically electricity) is an essential input in determining the agricultural growth of a nation [1][2][3]. In a country like India, the rising population puts an enormous burden on agriculture to produce more to maintain food and nutritional security [4]. Hence, there is an increasing inclination towards using modern inputs and farm mechanization to meet the needs by increasing crop yield. ...

... Using Johansen's co-integration test, they found the existence of cointegration amid EC and APG in India. Likewise, Tiwary et al. [4] investigated the direction of the GC connection between EC and APG in 18 major Indian states for the period 1960-61 to 2014-15. The result showed a long-run connection amid APG and EC, and a unidirectional causal association running from EC to APG. ...

... First, recent studies from a global perspective have examined this relationship [1,3,[22][23][24]27,32], but their findings cannot be generalized to Odisha due to the state-specific features that play a critical role in the agricultural sector. Second, studies focused on state-specific or aggregate India have provided some new insights [4,7,8,[37][38][39][40], but their findings may not be universally applicable exclusively to Odisha's economy because of the state-specific features in the agricultural sector. Third, very few empirical studies have focused explicitly on the influence of EC on aggregate APG in Odisha [9,11,41,42]. ..

1.3 Scope

Whereas commercial heating, ventilation and air-conditioning (HVAC) already consume over 50 percent of its total demand, this could likely grow up to 75 percent as total commercial demand grows to 247-348 TWh (7.6-10.1 percent CAGR) by 2030.



India has the sixth highest energy demand in the world accounting for 3.5% of commercial energy consumption globally. Oil demand in India is expected to grow by a factor of 2.2 by 2030, thus increasing the oil import dependency from 69% at present to 91%

CHAPTER 2

SERVICES AND TOOLS REQUIRED

2.1 Services Used

presents some basic facts about the services sector electricity demand. Services was the fastestgrowing economic sector at 8.87% yoy in the historical period assessed, leading to its climbing share in the total GVA. Services electricity demand grew faster than GVA, driven by the somewhat rising electricity intensity of the services sector between the start year and end year of the data (the trend is actually downward sloping when all intervening years are considered). The trend for services sector electricity intensity has been erratic, albeit around a fairly small band; the drivers of this erratic trajectory are not clear (Figure 5). Table 10 and Figure 6 present the results of the econometric projection for the services sector. The projections are based on the driver of services sector

m residential electricity sector demand. Demand from this sector has grown

the second-fastest after the services sector. Per capita residential sector demand remains very low, however, at just 31% of China's level and 11% of the EU's. The residential sector has exhibited a rising trend of electricity intensity, albeit with a somewhat erratic trend (see Figure 7). In the following Section 3, we will investigate the historical experience of other countries to see whether one can expect a rising trend of residential sector electricity intensity. Finally, one can see that the residential sector electricity demand is highly correlated with both GVA/capita and household demand expenditure. In the econometric projections that follow, we use as the driver GVA/capita, due to the challenges of projecting household-consumption/savings rates in the simple macroeconomic framework we used in this study to develop our scenarios.

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.

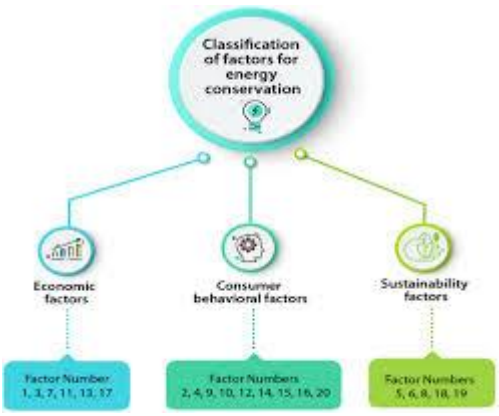
- **PowerBI Service**: This is an online SaaS (Software as a Service) service that you use to publish reports, create new dashboards, and share insights.

- **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:

India has doubled its floor space between 2001 to 2005 and expected to add 35 Billion square meter of new buildings by 2050. Currently, buildings account for 35% of total energy consumption and growing at 8%# annually. As per a report of the Royal Institution of Chartered Surveyors (RICS), 4127 million square meter of real estate space (which includes residential, retail, offices, hotels, health care and education sectors) is expected to be built between 2012 and 2020 which is on an average construction of 460 Million square meter of real estate space per year. Lack of statistical data of the Indian building sector like stock of existing buildings, upcoming buildings, energy consumption of buildings, etc. is not only a deterrent in adequate and effective policy making but is also a hindrance in monitoring progress of schemes and evaluation of their impact. There is an urgent need to improve the existing system for collection and management of building sector related data. Objective & Scope of Work The intent of conducting study on collection of data for upcoming and existing commercial buildings throughout India, is for finding measures that are required for wide scale implementation of ECBC in built environment to # http://eecbindia.com/ achieve the target of 75% of all new starts of commercial buildings are ECBC compliant by end of the 12th five year plan period, Administration & Enforcement of ECBC Implementation through notification of commercial buildings as designated consumers and all new commercial buildings being ECBC complaint. As per amendment of Energy Conservation Act 2001 in the year 2010, buildings having connected load of 100 KW and above or contract demand of 120 KVA and above have been targeted for thisstudy. Keeping this in mind the objective of thisstudy is to: • Develop a robust mechanism to create an institutional framework for the collection and analysis of data. • Prepare a baseline for existing commercial buildings to assess energy consumption

based on the building type, hours of use and climatic zone. • Project the annual addition of new construction growth in this sector in the current five year plan and estimate the energy savings potential. The effort is expected to provide benchmarking indices that can be used by policy makers, building designers, ESCOs, energy auditors, energy analysts and researchers to get a better understanding of energy use in thissector. • Also to develop portal for disseminating continuous information for the latest updates. K

CHAPTER 4

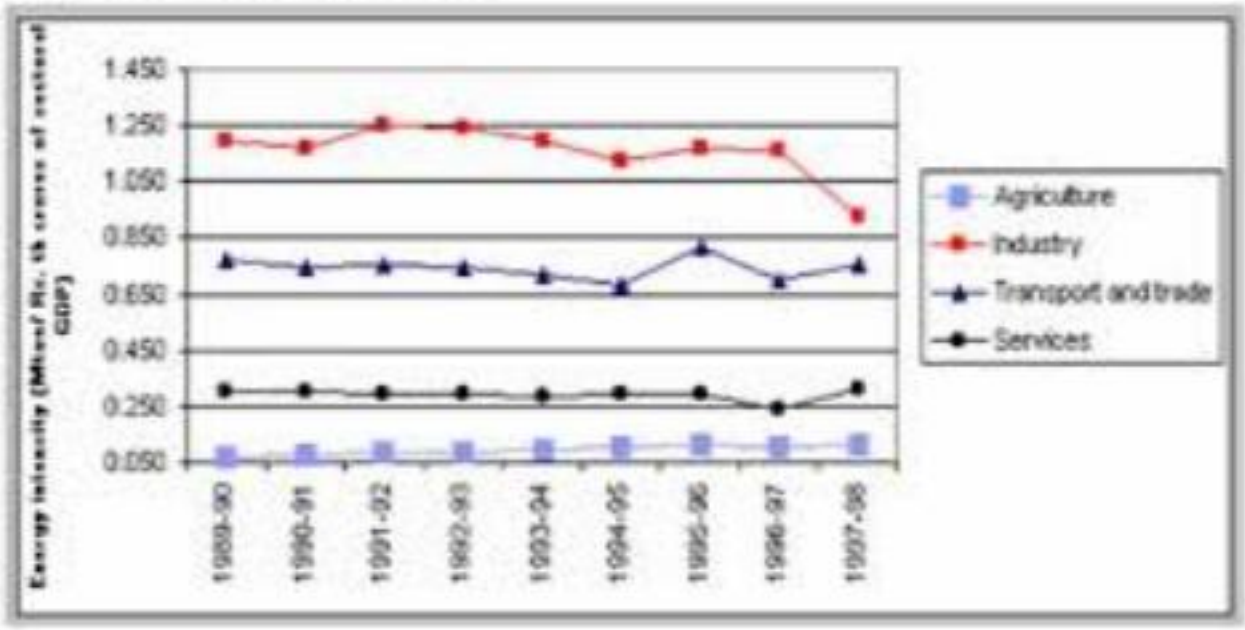
MODELING AND RESULT

Manage relationship

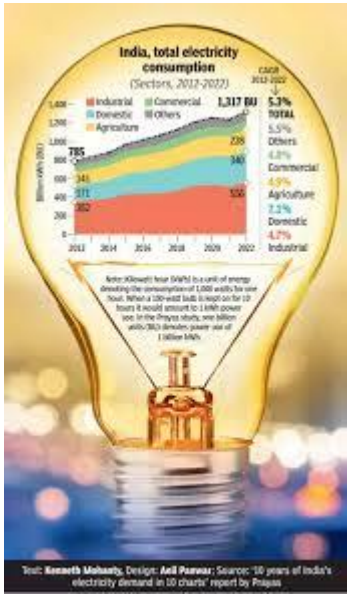
b The relationship between energy consumption, of which electricity is a vital part and economic growth, is a frequent issue for discussion. Over the years, much research has been carried out to determine the key factors impacting economic growth, with energy being relatively new factor, and one not included in traditional economic growth models (Stern, 2011). Energy plays a vital role in development of every sector of an economy. There is a direct correlation between degree of economic growth, the size of per capita income and per capita consumption of energy, (Raj, 1995). Without energy it is difficult to achieve desired development. Agricultural, industrial development is closely associated with electricity consumption. After the reforms in Indian economy, many sectors of the economy have got boost to contribute to the economy. Identifying the relationship between electricity

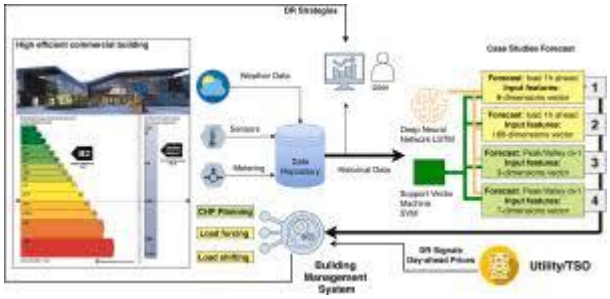
consumption and economic growth has important policy implications too.

Figure 2. Sectoral energy intensities.



Source: authors' calculations





For Age, we shall assume it is year 1999 as explain previously and use it to minus from the birth year.

```
1  age = 1999 -RIGHT(client[Birthday],4)
```

client_id	birth_number	district_id	Gender	Birthday	age	age (groups)
2	450204	1	M	04/02/1945	54	36 -54 Baby Boomers

Replacing values

Set some fields to English for easy understanding, we replace values to English with the Power Query Editor.This paper studies growth in electricity consumption, the key factors affecting it, and its link with economic activity. To do so, the paper discusses the major characteristics of India's power sector, and the historical trends of power consumption and economic growth, by tracing the changes over the years. The study also briefly discusses the key factors that have impacted consumption measures, including captive power, deficits, enhanced efficiency, etc. It also discusses the historical role of the manufacturing sector, the growing importance of the agriculture and household sectors, and the introduction of new and more energy-efficient technologies (such as the LED bulb), in determining power-sector outcomes. In the process, the study provides an overview of the existing relationship between energy and gross domestic product (GDP) in India, using past data and extant literature. Finally, the study conducts a time-series analysis to estimate the elasticity of energy consumption with respect to overall economic activity (using gross value added (GVA) as a measure). It finds that despite ups and downs in consumption and elasticity estimates over time, the long-term elasticity has been close to unity. Therefore, given that long-term annual economic growth is expected to be in the 5–7 percent range, India should plan for capacity increases at 6–7 percent for the next five- to ten-year horizon as it is better to err on the side of excess than shortage.

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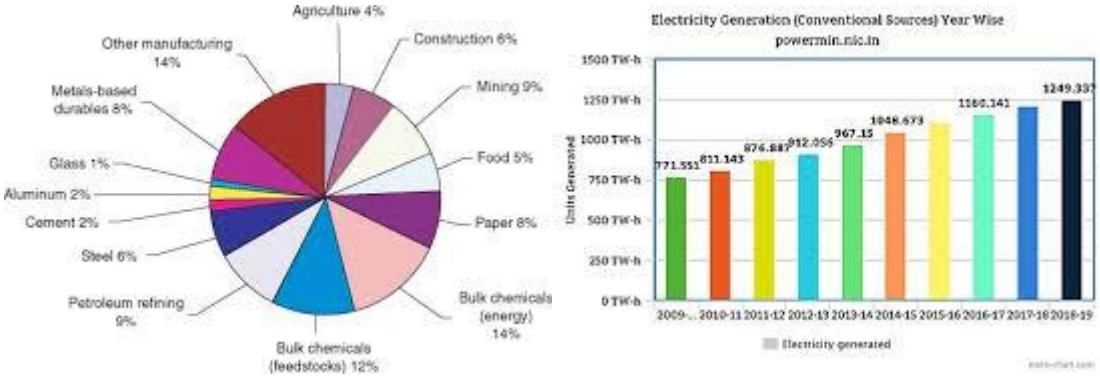
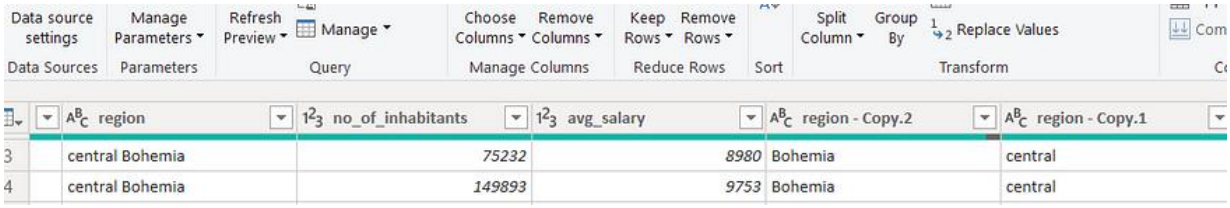
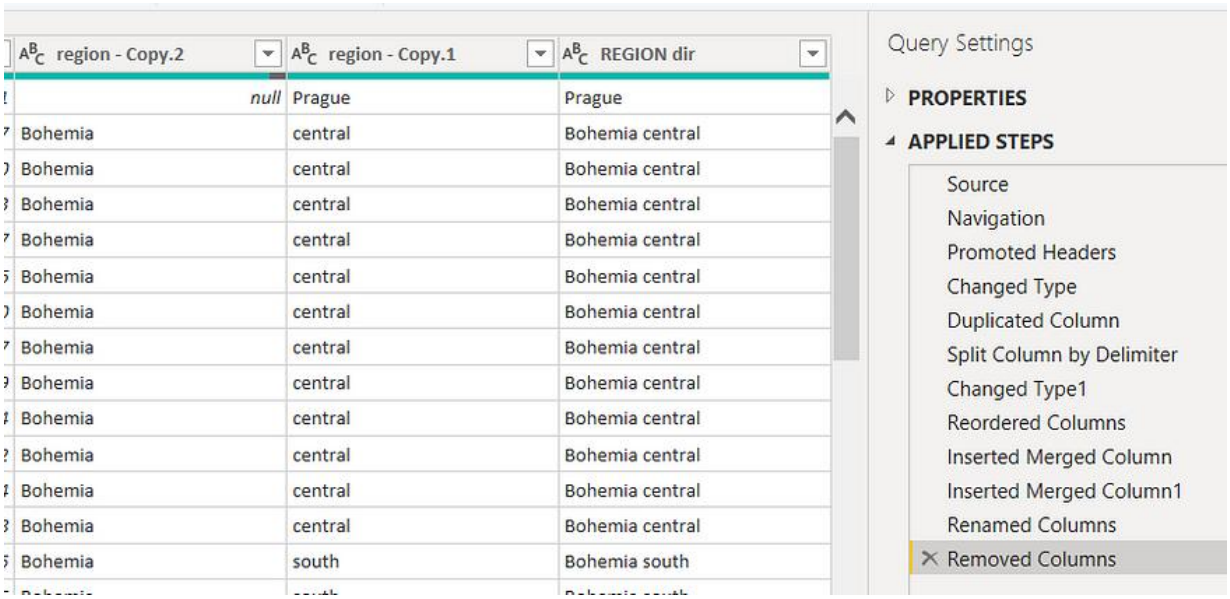


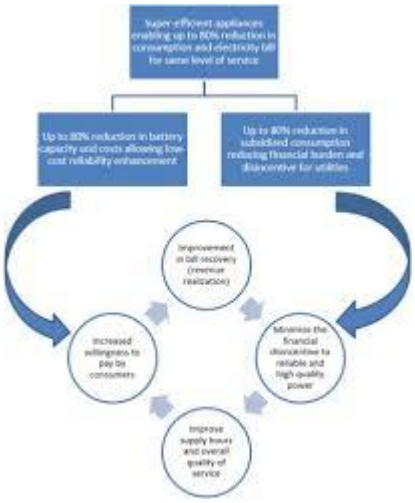
Changing the order of Region name at Power Query

Duplicate the “district /region” then split column using space as delimiter.

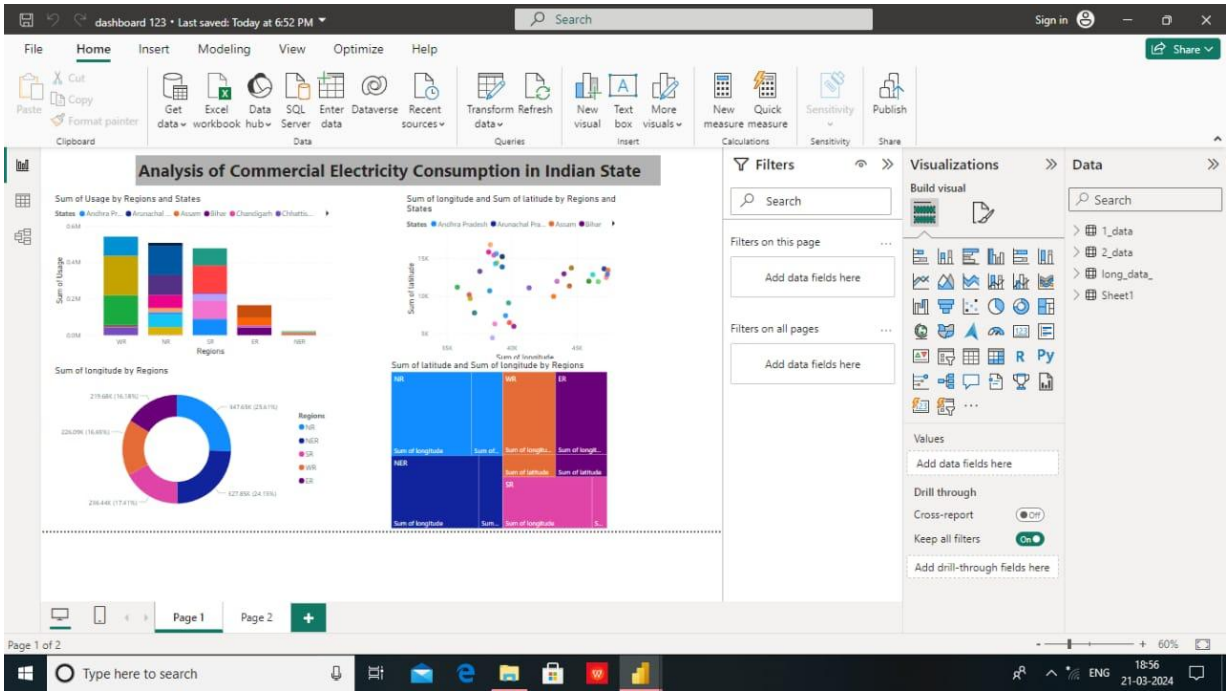


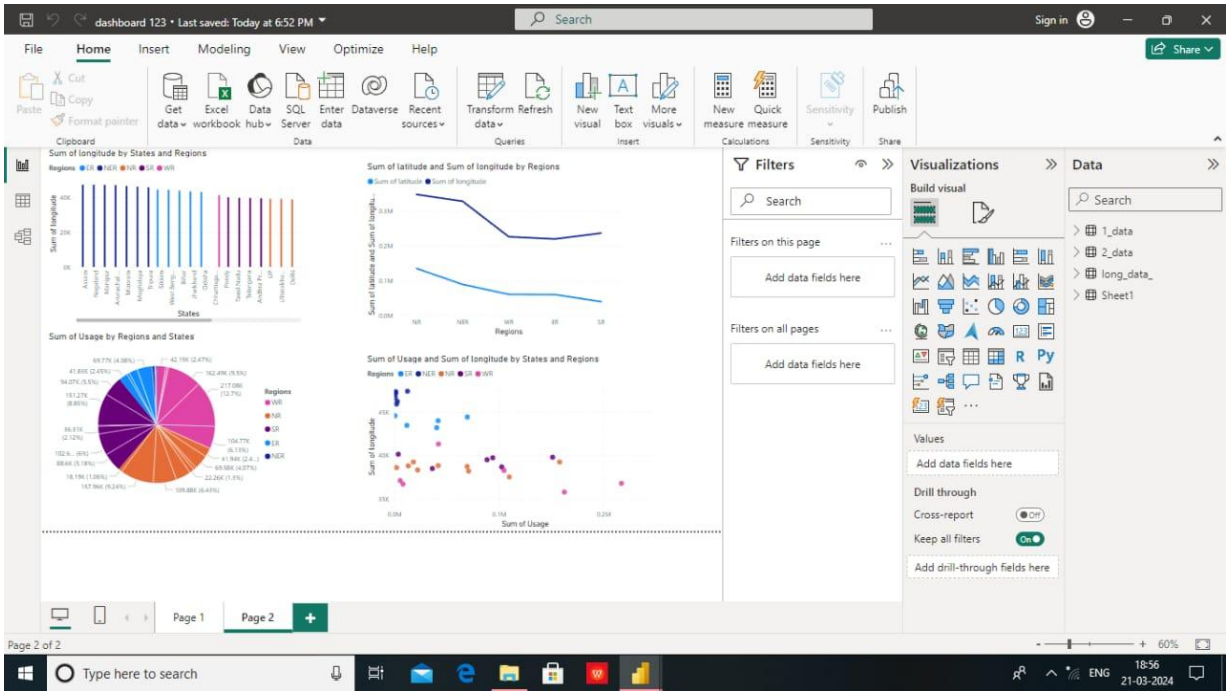
Then merge column by Region and direction. Refer to applied steps for details.





Dashboard





The Power BI dashboard designed for analyzing commercial electricity consumption in an Indian state provides a comprehensive view of power distribution and consumption patterns.

Here's how it can be structured:

Power Distribution Overview: A section that visualizes the overall electricity distribution network within the state, highlighting key substations and transmission lines.

Consumption Trends: Interactive line charts or area charts that display the trends in electricity consumption over time, with the ability to filter data for pre-lock down and post-lock down periods.

Sector-wise Breakdown: Pie charts or bar graphs that show the proportion of electricity consumed by different commercial sectors, offering insights into which sectors are the most energy-intensive.

Geographical Analysis: A map visualization that indicates consumption levels across different regions of the state, identifying areas with the highest and lowest usage.

Comparative Analysis: Side-by-side comparisons of consumption data before and after the lock down, emphasizing the impact of COVID-19 on commercial energy usage.

CONCLUSION

The project titled “Analysis of Commercial Electricity Consumption in an Indian State” has meticulously utilized Power BI to dissect and understand the commercial electricity consumption patterns during the critical period of 2019–2020, marked by the COVID-19 lock downs. The analysis has illuminated the stark changes in energy usage, providing a narrative of resilience and adaptability within the commercial sector. By leveraging Power BI advanced data visualization and analysis capabilities, the project has offered actionable insights that are crucial for strategic energy management and policy formulation. This study not only reflects on the past but also equips stakeholders with the knowledge to navigate future challenges, ensuring sustainable energy consumption in the evolving commercial landscape.

FUTURE SCOPE

By 2030, the total electricity demand in the country, including captive demand (excluding T&D losses) is projected to be 2,060 – 2,699 TWh. The utility level demand including T&D losses would likely be in the range of 2,039-2,454 TWh

The electrical equipment market in India is poised for remarkable growth, with a projected CAGR of 11.68% between 2022 and 2027. This growth is expected to translate into a substantial increase of USD 52.97 billion in the market size.

Stepping up to endless opportunities. India has huge ambitions in energy transition and plans to have 500 GW of non-fossil based electricity installed capacity by 2030, so that non-fossil cleaner fuel comprises of 50% of the installed capacity mix by 2030.

Based on recent data from the Central Electricity Authority (CEA), the peak power demand is expected to reach 230 GW by 2035. Meeting this demand requires strategic capacity addition and robust infrastructure development

Whole home electrification means operating your home on electricity, ideally from a renewable energy resource such as a home solar system. Electrifying your home may involve removing a natural gas heating system and replacing it with more efficient electric heat pumps

• This study projects application-wise end-use electricity demand from consuming sectors as categorised by the Central Electricity Authority. It includes both grid-based as well as industrial captive demand in the future which enhances visibility from the perspective of supply planning. o The analysis is based on the range of possibilities of growth in service demand (eg. lighting, cooling, industrial production, pumped water for irrigation, etc.), and sector-wise and cross-cutting technology and policy options. o The base and terminal years for the analysis are 2015 and 2030. This is keeping in mind at 2015 is the most recent year for available data on disaggregated official baseline, and 2030 fits with a number of strategic objectives, including India's climate change commitments. Base year results are calibrated and synced with CEA data. o 'New loads' expected to gain prominence in the future, such as inorganic household demand from new households constructed under the affordable housing programme, electric cooking, and electric vehicles are included. Apart from these, the impact of air-conditioning and high manufacturing growth by 2030 are specifically emphasised. o Overall, nine 'cases' of electricity demand are generated for three scenarios of GDP growth (6.5, 7 and 7.5 percent) and three levels of energy efficiency and conservation interventions applied across applications. • Aggregate electricity demand could grow from 949 TWh in 2015 to between 2074 TWh (low GDP, high efficiency) and 2785 TWh (high GDP, low efficiency) by 2030. o This corresponds to a CAGR of 5.4-7.4 percent, compared with 6.9 percent CAGR in electricity demand between 2000 to 2015. A

plausible mid-scenario CAGR between 2015 and 2030 is derived at 6.2 percent.

o The big changes in sectoral shares (and therefore growth rates) occur in the commercial and agriculture sectors—commercial likely surpassing agricultural (irrigation pumping) demand in 2030 when it was less than half of the former in 2015.

REFERENCES

https://www.jstor.org/stable/24725791

LINK

