Case Study Report

Data Analysis with Power BI

“Analysis of Commerical Eletricity Consumption in India”

“Sri Paramakalyani College-Alwarkurichi”

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ABSTRACT

The energy demand has been increasing over the years in India, which may result from its rapid economic growth trajectory. In this case 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 co-integration 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 from 2023 to 2024. The results support a long-term relationship between economic growth and electricity consumption only in the agriculture sector. Further, the results provide evidence for 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.

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Chapter 1

Introduction

India's power consumption increased by over 8 percent, reaching 127.79 Billion Units (BU) in February, compared to the same period last year, according to government data. The data revealed that power consumption for February 2023 was 118.29 BU, which is higher than the 108.03 BU recorded in February 2022. The month of February 2024 had 29 days since it is a leap year, resulting in a slightly higher growth rate of power consumption. The highest supply in a day, or peak power demand met, increased to 222 GW in February 2024, while it stood at 209.76 GW in February 2023 and 193.58 GW in February 2022.

Experts suggest that power consumption and demand surged in February due to the low mercury levels, particularly in north India. The extended cold wave led to an increased use of heating equipment, such as heaters, blowers, and geysers, resulting in higher power demand and consumption.

The power ministry had anticipated the country's electricity demand to reach 229 GW during summer last year, but it did not reach that level in April-July due to unseasonal rainfall. However, peak supply touched a new high of 224.1 GW in June before dropping to 209.03 GW in July. Peak demand was the highest in August 2023, at 238.82 GW, followed by 243.27 GW in September, 222.16 GW in October, 204.77 GW in November 2023, 213.79 GW in December 2023, and 222.73 GW in January 2024.

Industry experts suggest that power consumption was affected in March, April, May, and June last year due to widespread rainfall, while consumption grew in August, September, and October, mainly due to humid weather conditions and an increase in industrial activities ahead of the festive season.

Experts predict a steady power consumption growth due to improvements in economic activities and the anticipated early onset of summer in March.

Chapter 2 Studies of Electricity

Studies on Electricity Economics According to Stephane de la Rue du Can, Michael McNeil, and Jayant Sathaye (2009) in India the complete picture of energy use with disaggregated levels is drawn to understand how energy is used in India and to offer the possibility to put in perspective the different sources of end use energy consumption. For each sector, drivers of energy and technology are identified. Trends are then analyzed and used to project future growth. Results of this report provide valuable inputs to the elaboration of realistic energy efficiency scenarios. Caldwell, Stephen (2008) analysed that the global climate change has become a topic of increasing importance to political leaders, policymakers, and the general public. Roughly one third of US greenhouse gas (GHG) emissions come from electricity generation. Improved energy efficiency in electricity end-uses offers the promise of reductions in GHG emissions and other benefits. Market failures have prompted federal and state governments to intervene to promote energy efficiency. One of the largest interventions has been in the form of demand-side management (DSM) programs run by electric utilities, state agencies, and third parties. Given policymakers considerations of further investments in energy efficiency through expanded DSM and other programs to help mitigate climate change, it is important to evaluate how effective DSM expenditures have been in improving energy efficiency. This study analyzes a state-level panel data set to estimate the effect of DSM expenditures on state-level electricity efficiency controlling for relevant factors and employing a Fisher Ideal index measure of efficiency that distinguishes changes in electricity usage due to changes in electricity efficiency from those due to changes in economic activity. Santoshkumar Sahu (2008) is of the view that it has been universally recognized as one of the most important inputs for economic growth and human development. There is a strong twoway relationship between economic development and energy consumption. On one hand, growth of an economy, with its global competitiveness, hinges on the availability of cost-effective and environmentally compassionate energy sources, and on the other hand, the level of economic development has been observed to be depended on the energy demand. Energy intensity is an indicator to shows how efficiently energy is used in the economy. Virginie E.Letschert, Michael A. McNeil (2007) have studied that India seems to be on track to experience rapid long-term economic expansion. With this growth will surely come continued massive growth in energy demand. This paper explores the dynamics of that demand

Chapter 3

Electricity Transmission and Distribution

Capacity	Substations (MVA)	Transmission lines (circuit km)	c.km / MVA ratio
HVDC ± 220 kV & above	22,500	15,556	0.691
765 kV	197,500	36,673	0.185
400 kV	292,292	173,172	0.707
220 kV	335,696	170,748	0.592
220 kV & above	847,988	396,149	0.467

India lit up at night. This image, courtesy of NASA, was taken by the crew of Expedition 29 on 21 October 2011. It starts over Turkmenistan, moving east. India begins past the long wavy solid orange line, marking the lights at the India-Pakistan borderline. New Delhi, India's capital and the Kathiawar Peninsula are lit. So are Mumbai, Hyderabad, Chennai, Bangalore and many smaller cities in central and southern India, as this International Space Station's video shifts south-eastward through southern India, into the Bay of Bengal. Lightning storms are also present, represented by the flashing lights throughout the video. The pass ends over western Indonesia.

The total length of high voltage (HV) transmission lines (220kV and above) would be enough to form a square matrix of area 266 km^2 (i.e. a square grid 16.3 km on a side, so that on average there is at least one HV line within a distance of 8.15 km) over the entire area of the country. This represents a total of almost 20% more HV transmission lines than that of the United States (322,000 km (200,000 mi) of 230 kV and above). However the Indian grid transmits far less electricity.[232] The installed length of transmission lines of 66 kV and above is 649,833 km (403,788 mi) (on average, there is at least one ≥66 kV transmission line within 4.95 km across the country). The length of secondary transmission lines (400 V and above) is 10,381,226 km (6,450,595 mi) as of 31 March 2018. The spread of total transmission lines (≥400 V) would be sufficient to form a square matrix of area 0.36 km^2 (i.e. on average, at least one transmission line within 0.31 km distance) over the entire area of the country. In a future grid dominated by decentralized power generation like solar and wind power, unscientific expansion of the electrical grid would yield negative results due to Braess's paradox. The all-time maximum peak load met was 182,610 MW on 30 May 2019. The maximum achieved demand factor of substations is nearly 60% at the 220 kV level. However, the operational performance of the system is not satisfactory in meeting peak electricity loads. This has led to the initiation of detailed forensic engineering studies, with a plan to make capital investments in a smart grid that maximizes the utility of the existing transmission infrastructure.

The introduction of an availability based tariff (ABT) originally helped to stabilize the Indian transmission grids. However, as the grid transitions to power surplus the ABT has become less useful. The July 2012 blackout, affecting the north of the country, was the largest power grid failure in history as measured by the number of people affected.

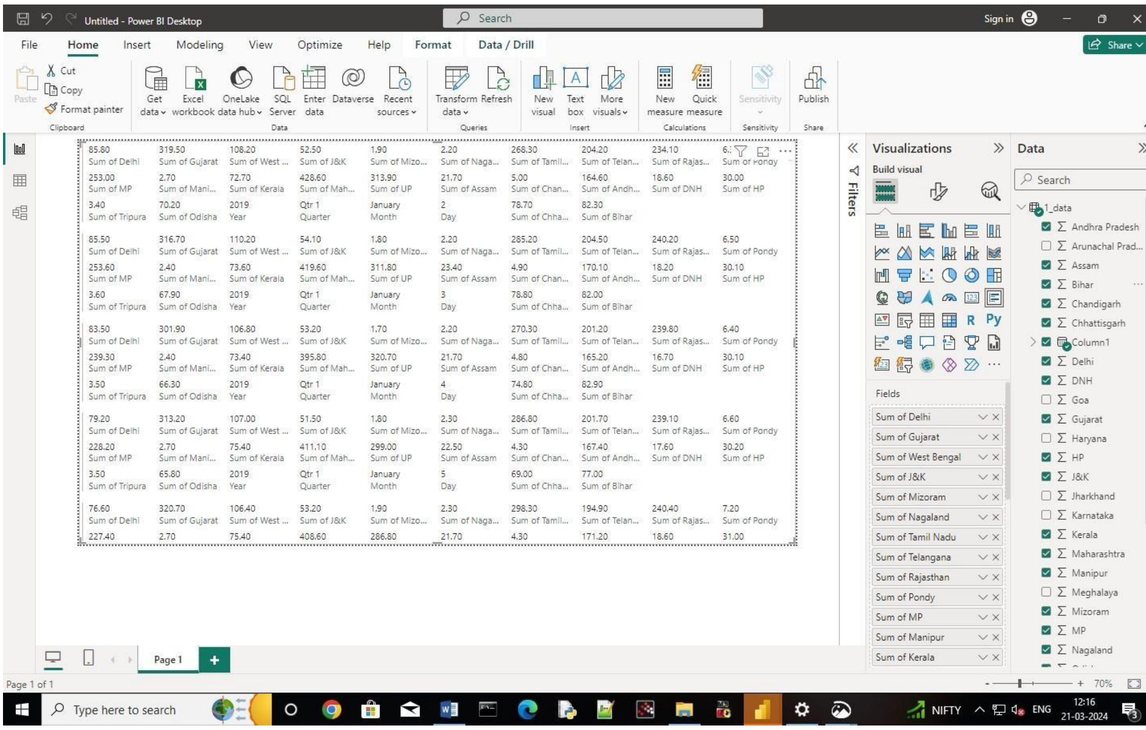
India's aggregate transmission and commercial (ATC) losses were nearly 21.35% in 2017–18. This compares unfavorably to the total ATC loss in the electricity sector of the United States, which was only 6.6% out of 4,404 billion kWh electricity supplied during the year 2018. The Indian government set a target of reducing losses to 17.1% by 2017 and to 14.1% by 2022. A high proportion of non-technical losses are caused by illegal tapping of lines, faulty electric meters and fictitious power generation that underestimates actual consumption and also contributes to reduced payment collection. A case study in Kerala estimated that replacing faulty meters could reduce distribution losses from 34% to 29%.

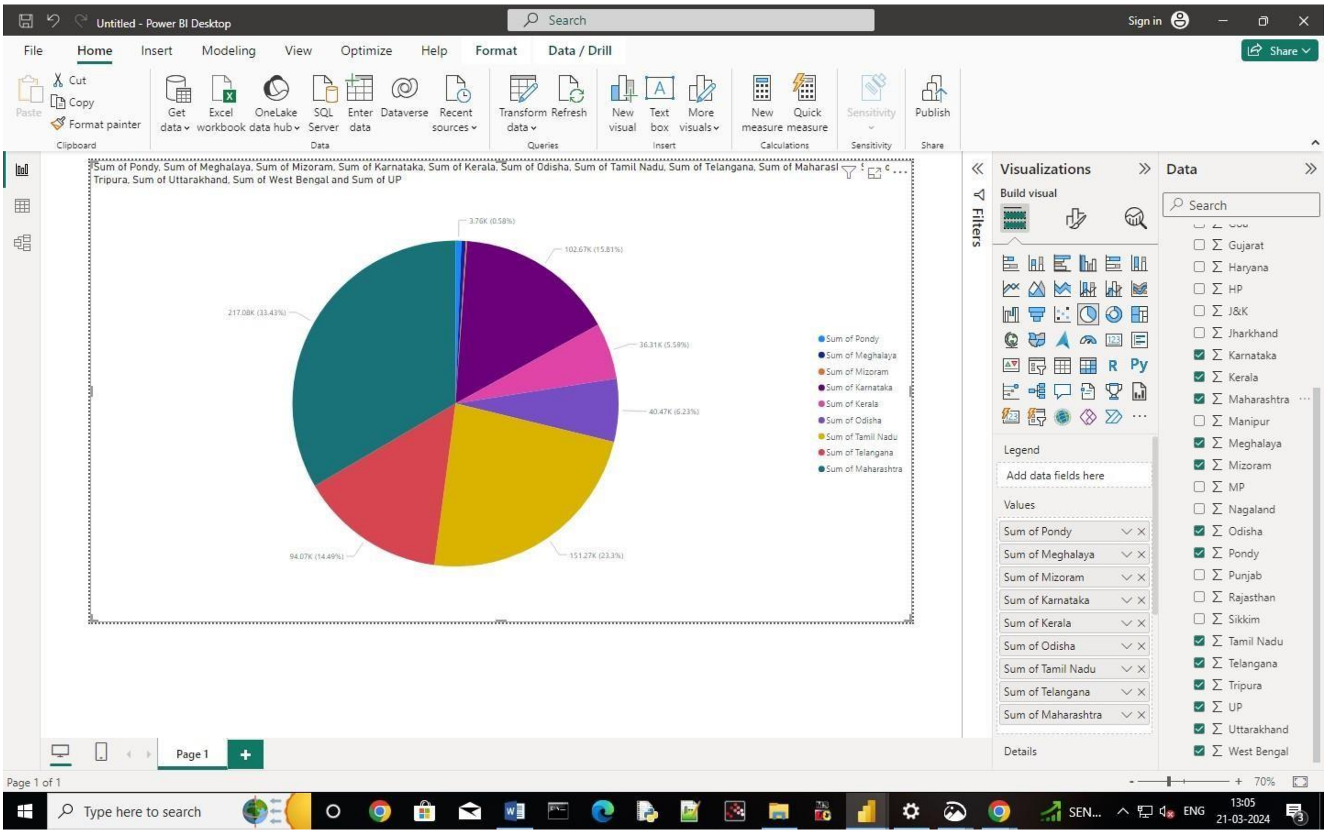
Electricity generation

India has recorded rapid growth in electricity generation since 1985, increasing from 179 TW-hr in 1985 to 1,057 TW-hr in 2012.The majority of the increase came from coal-fired plants and non-conventional renewable energy sources (RES), with the contribution from natural gas, oil, and hydro plants decreasing in 2012–2017. The gross utility electricity generation (excluding imports from Bhutan) was 1,484 billion kWh in 2021–22, representing 8.1% annual growth compared to 2020–2021. The contribution from renewable energy sources (including large hydro) was nearly 21.7% of the total. In 2019–20, all the incremental electricity generation is contributed by renewable energy sources as the power generation from fossil fuels decreased.During the year 2020–2021, the utility power generation decreased by 0.8% (11.3 billion kWh) with a reduction in power generation from fossil fuels by 1% and power generation from non-fossil sources is more or less same of the previous year. In 2020–21, India exported more electricity than it imported from neighboring countries.[Solar power generation in 2020–21, occupied third place after coal and hydropower generations surpassing wind, gas and nuclear power generations. In 2022–23, renewable power generation was 22.47% of total utility power generation when total utility power generation increased by 8.77% to 1614.70 billion kWh.

Chapter 4

Final Result

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Visualizations
Data
Legend
Values
Sum of Pondy
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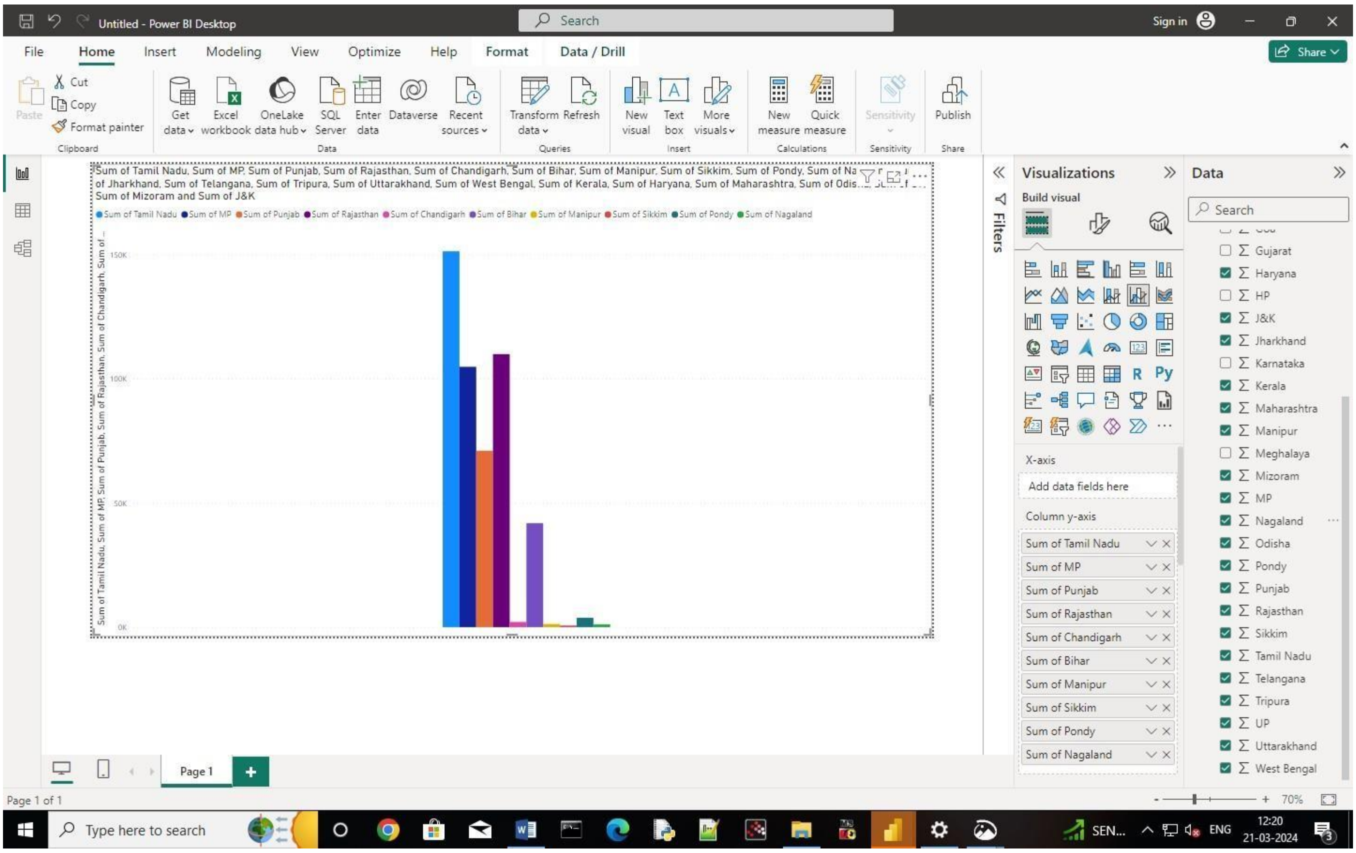
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Visualizations
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X-axis
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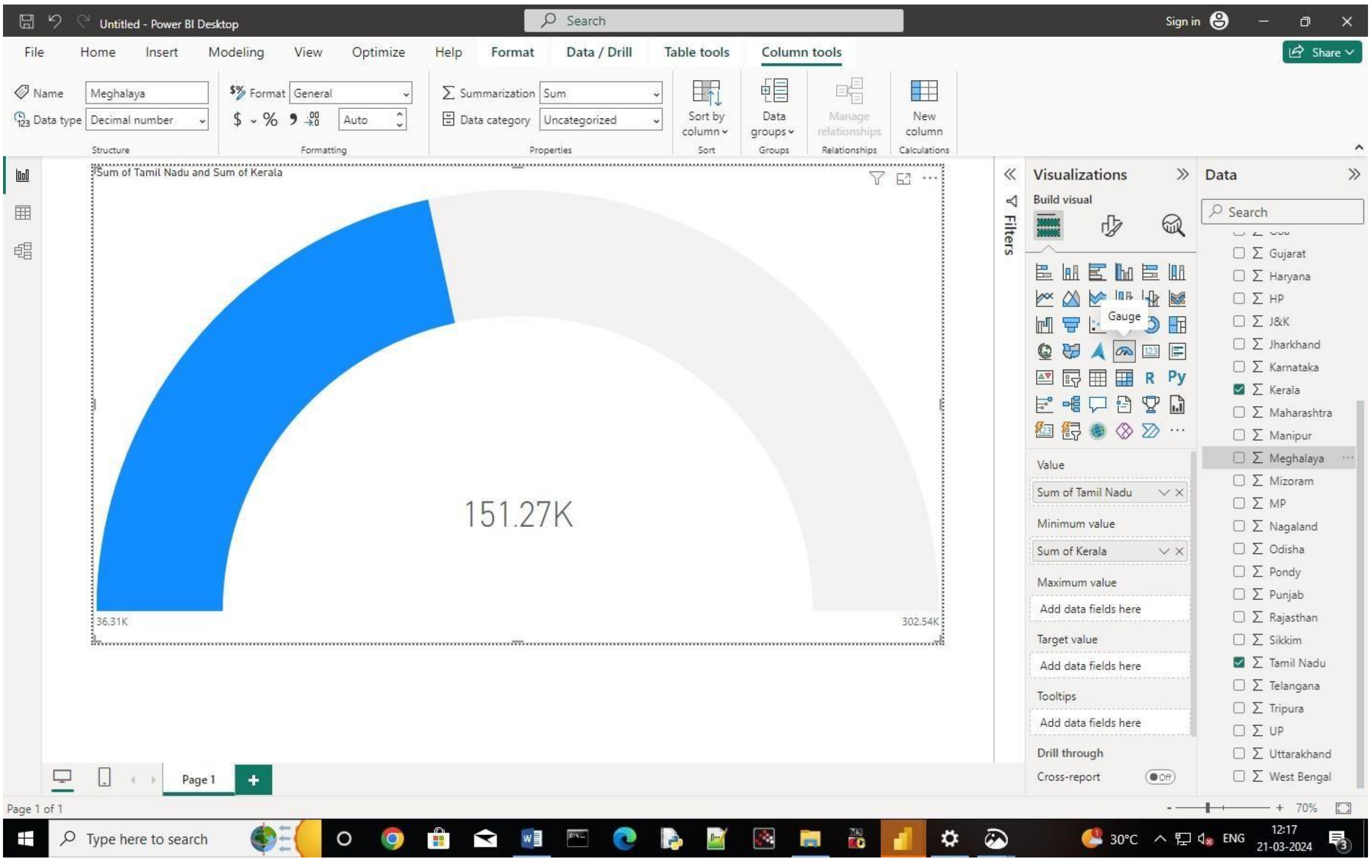
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Visualizations
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Minimum value
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Maximum value
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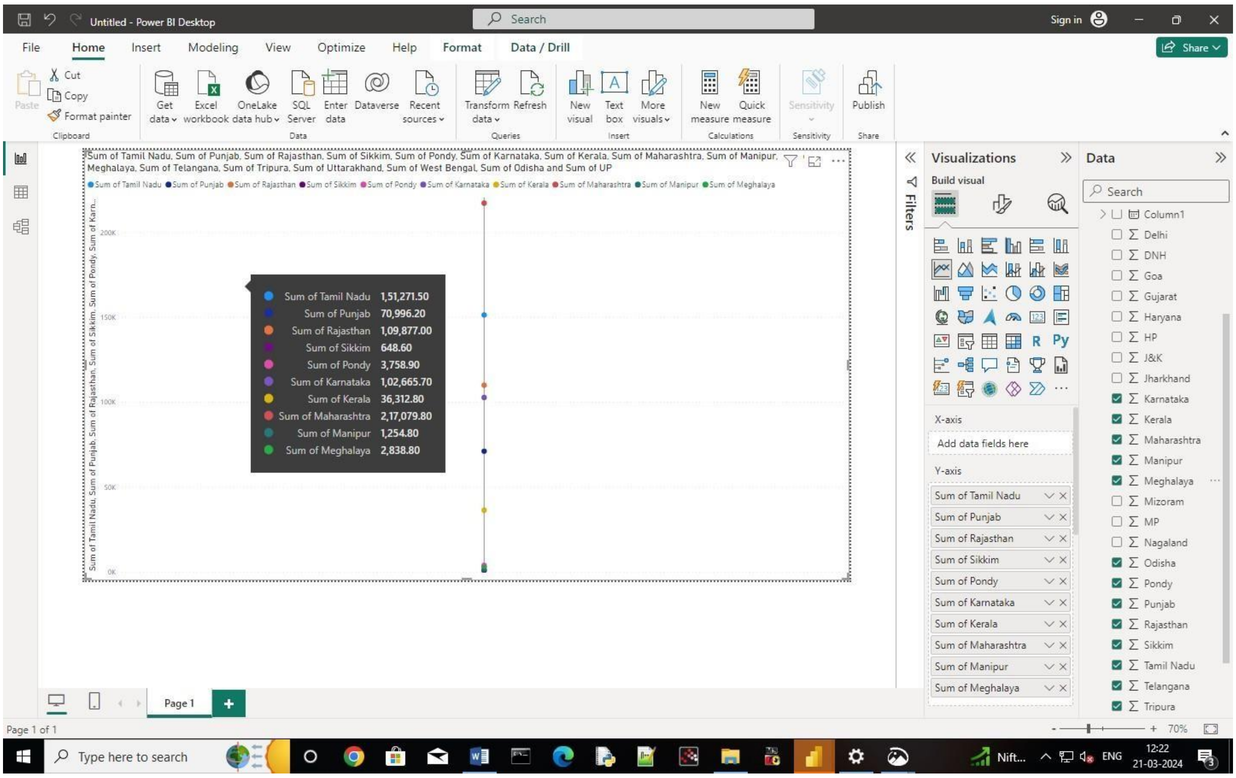
Page 1



Conclusion

Energy conservation is the effort to reduce energy consumption by using less energy or using renewable energy. Energy conservation can be achieved by: Using energy more efficiently, Reducing the amount of service used, and Using renewable energy.

Energy conservation can bring about significant economic benefits, including: cost savings, job creation in the renewable energy sector, and local economic growth.

Energy consumption can be attributed to many reasons, including: social behavior, economic conditions, and the pattern of energy consumption.

Energy is a very important natural resource that should be saved because it's not free.

Future Scope

The future scope of a project is the potential opportunities and prospects in a specific field, industry, or career. It's important to consider because it helps individuals make informed decisions about their education, career, and personal development.

A project scope is a way to set boundaries on a project and define exactly what goals, deadlines, and project deliverables will be worked towards. The documentation of a project's scope is called a scope statement or terms of reference. A project scope statement includes: timeline, budget, assigned tasks, project stakeholders, and workflow strategies.

Reference link

https://www.iea.org › reports › electricity-consumption