Plugging into the Future: An Exploration of Electricity Consumption Patterns

A PROJECT REPORT

Submitted by

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1. INTRODUCTION

1.1. OVERVIEW:

Electricity consumption patterns refer to the way in which electricity is used by different individuals, households, industries, and countries over a certain period. Here's an overview of electricity consumption patterns:

Residential: Residential electricity consumption typically includes lighting, heating and cooling systems, refrigeration, and other appliances such as TVs, computers, and smartphones. It varies significantly depending on factors such as location, weather, and household size.

Commercial: Commercial electricity consumption refers to the use of electricity by businesses such as offices, hospitals, schools, and shops. It includes lighting, air conditioning, heating, refrigeration, and other equipment such as computers and printers.

Industrial: Industrial electricity consumption refers to the use of electricity in manufacturing, processing, and other industrial processes. It includes energy-intensive processes such as smelting, refining, and other industrial processes that require high energy inputs.

Transportation: Transportation electricity consumption includes electric vehicles and public transportation systems such as trains and subways.

Renewable energy: Renewable energy consumption refers to the use of electricity generated from renewable sources such as wind, solar, and hydropower.

Non-renewable energy: Non-renewable energy consumption refers to the use of electricity generated from non-renewable sources such as coal, natural gas, and oil.

Overall, electricity consumption patterns vary depending on the location, economic conditions, energy policies, and individual behaviours. However, there is a growing trend towards sustainable energy use, with more focus on renewable energy sources and energy-efficient technologies.

1.2. PURPOSE:

Analysing electricity consumption patterns can have several purposes, including:

Understanding Energy Usage: By analysing electricity consumption patterns, individuals, businesses, and governments can gain a better understanding of how energy is being used in

different contexts. This information can help identify areas where energy consumption can be reduced or optimized.

Identifying Opportunities for Energy Savings: By analysing electricity consumption patterns, it is possible to identify areas where energy can be saved. This information can be used to implement energy-saving measures, such as improving insulation, upgrading appliances, or changing lighting systems.

Predicting Energy Demand: By analysing historical electricity consumption patterns, it is possible to predict future energy demand. This information can be used to plan for future energy supply, such as building new power plants or investing in renewable energy sources.

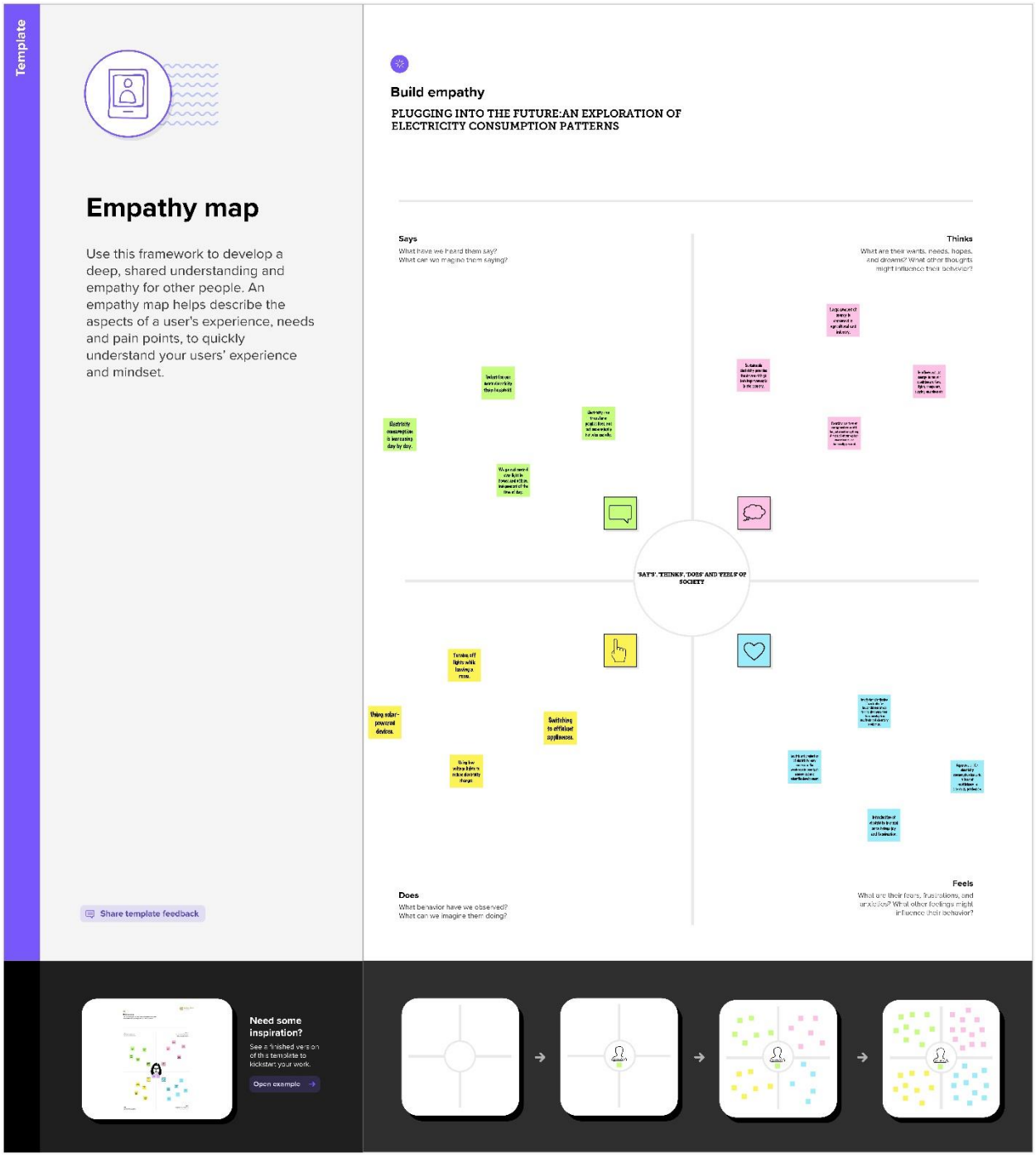
Monitoring Energy Efficiency: By analysing electricity consumption patterns over time, it is possible to monitor the effectiveness of energy efficiency measures. This information can be used to identify areas where additional measures are needed, or to track the progress of existing measures.

Billing and Budgeting: Electricity consumption patterns are used by utility companies to bill customers for their energy usage. Businesses and households can also use this information to budget for their energy costs and make decisions about energy use.

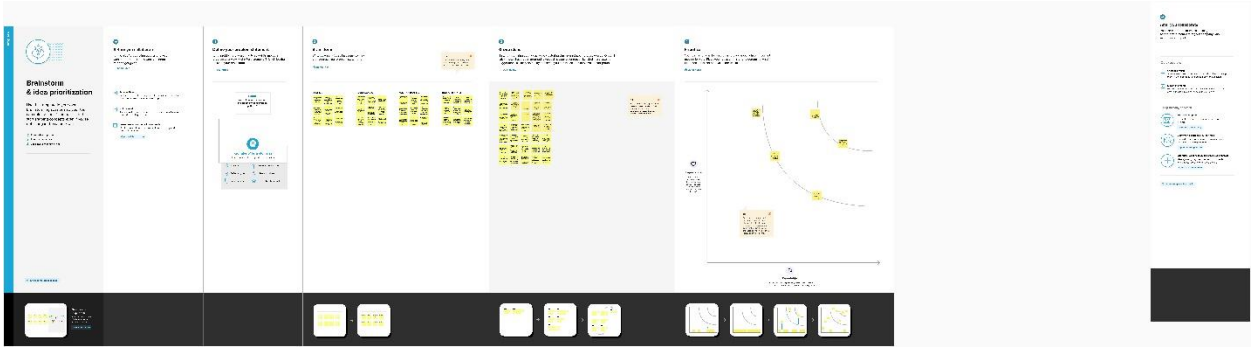
Overall, analysing electricity consumption patterns is essential for managing energy use effectively and efficiently. It helps individuals, businesses, and governments make informed decisions about energy use, reduce energy costs, and minimize environmental impact.

2. PROBLEM DEFINITION & DESIGN THINKING

2.1. EMPATHY MAP:

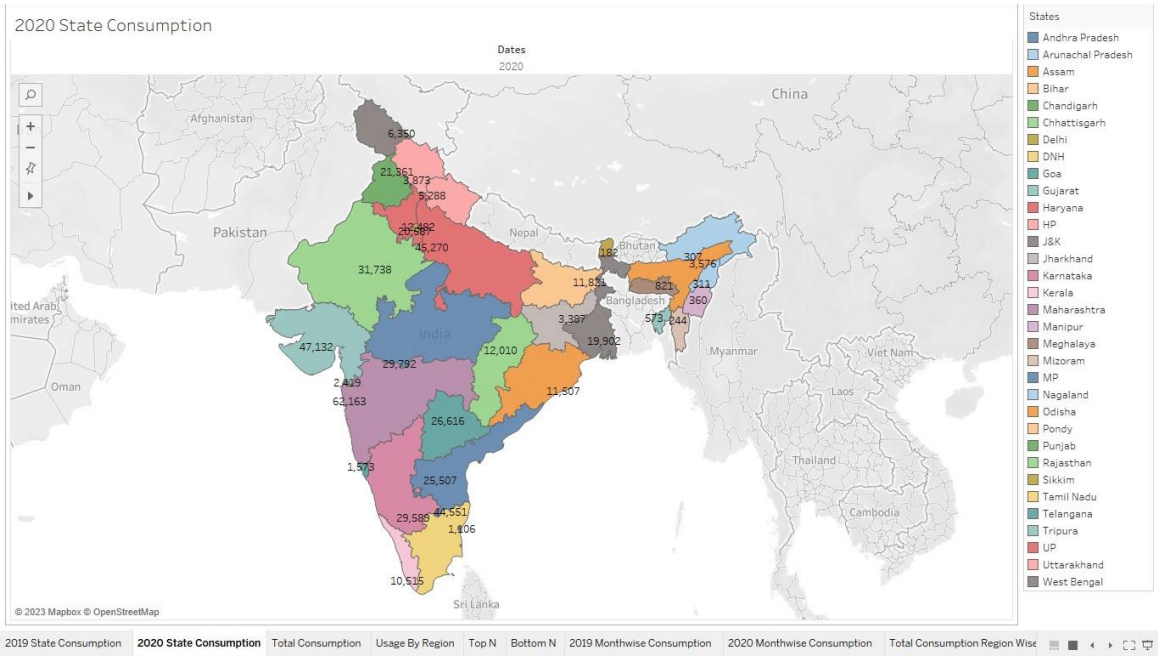


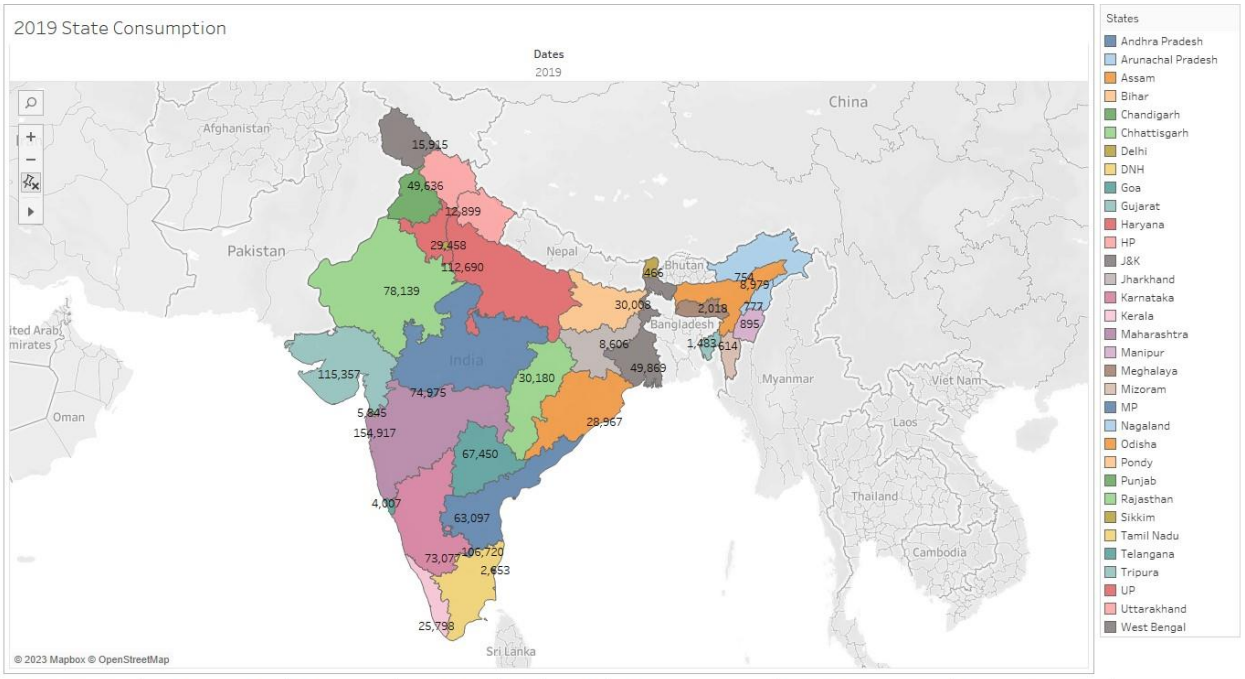
2.2. IDEATION & BRAINSTORMING MAP:



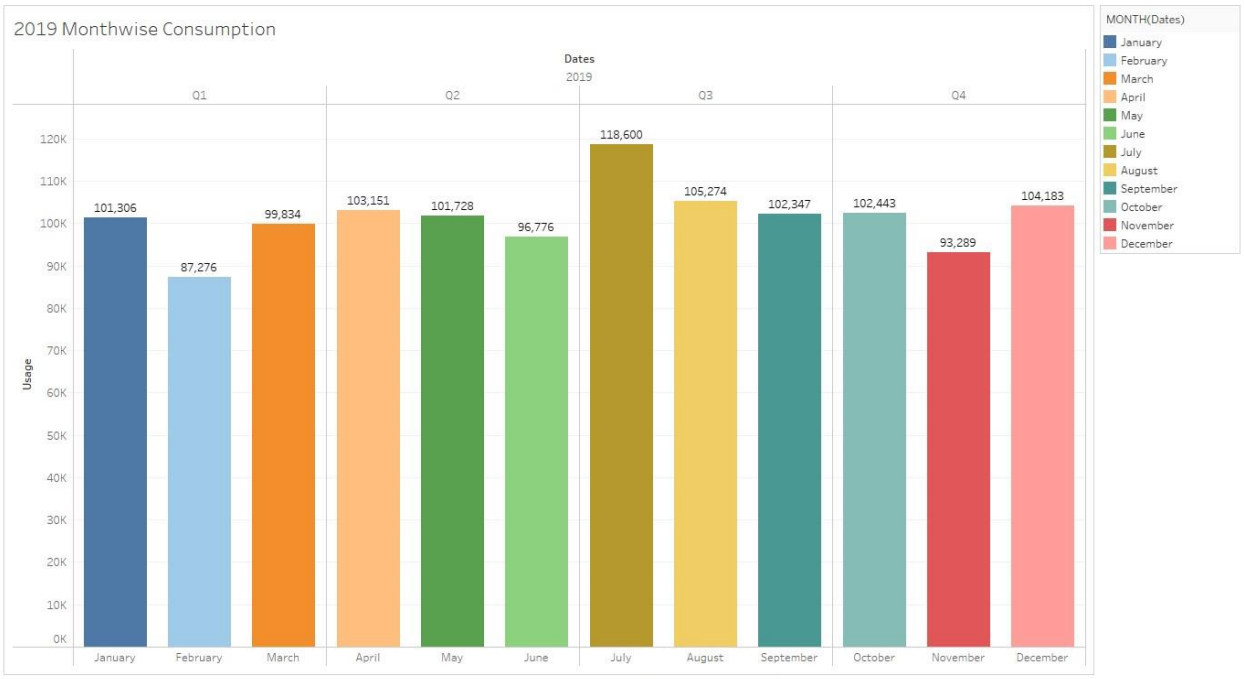
3. RESULT:

VISUALIZATION:

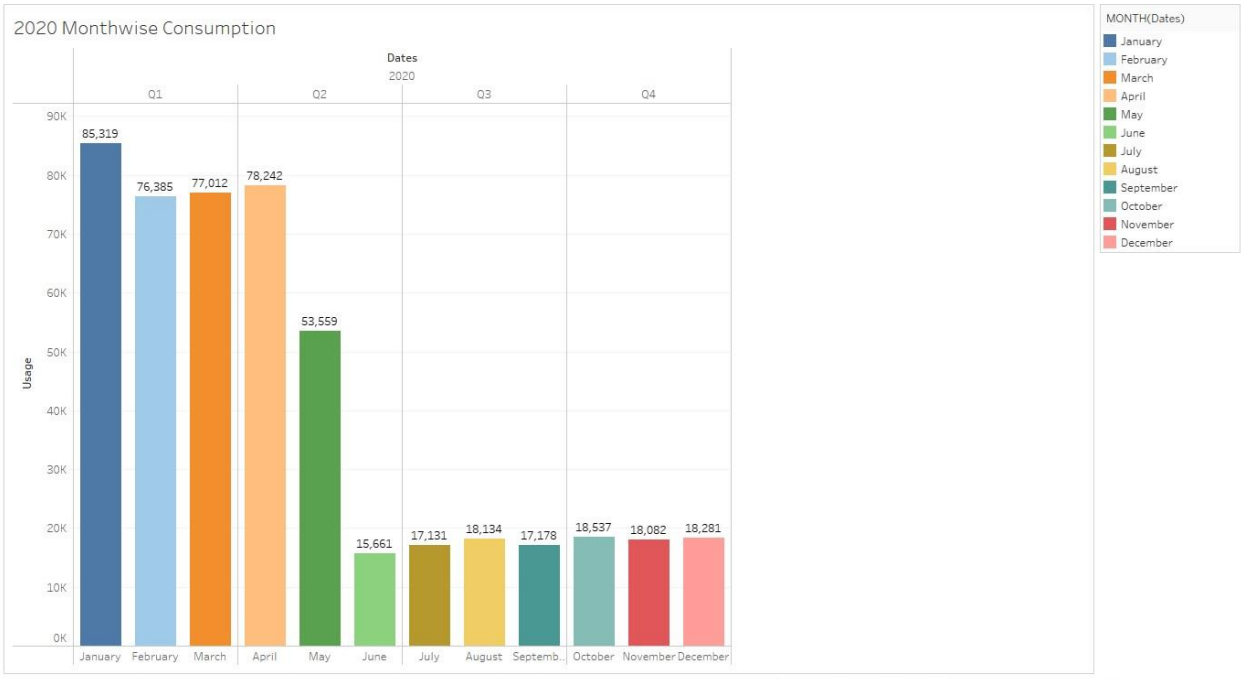




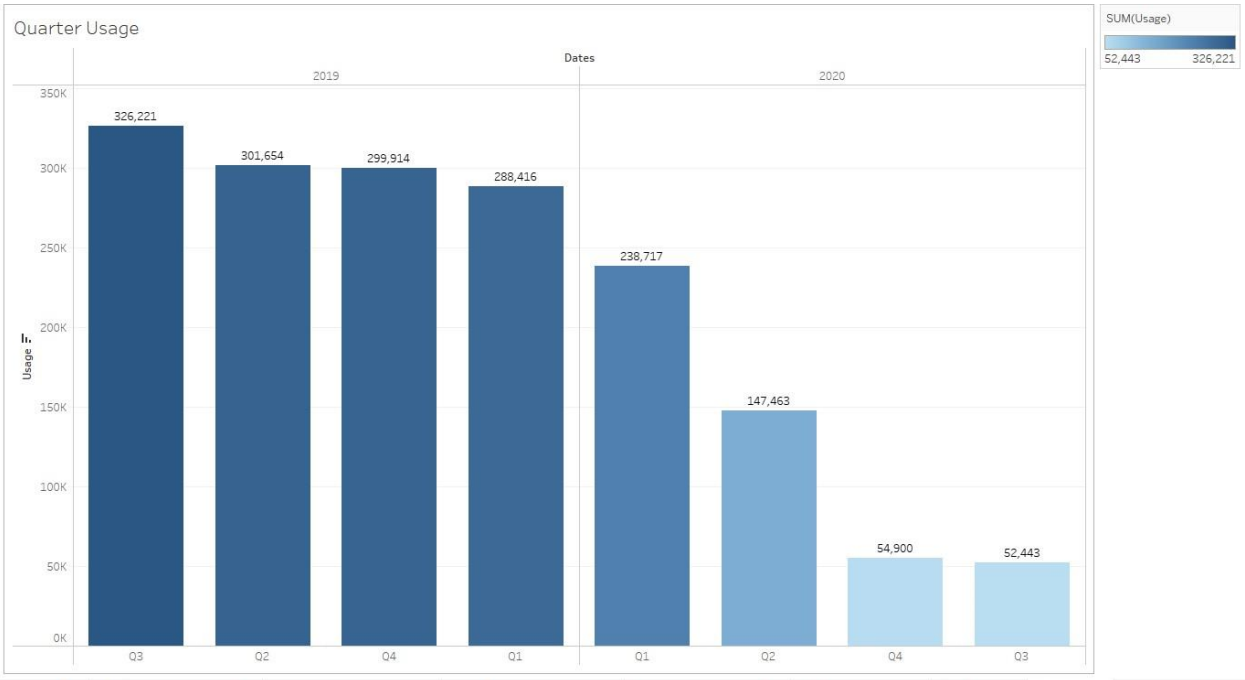
2019 State Consumption | 2020 State Consumption | Total Consumption | Usage By Region | Top N | Bottom N | 2019 Monthwise Consumption | 2020 Monthwise Consumption | Total Consumption Region Wise



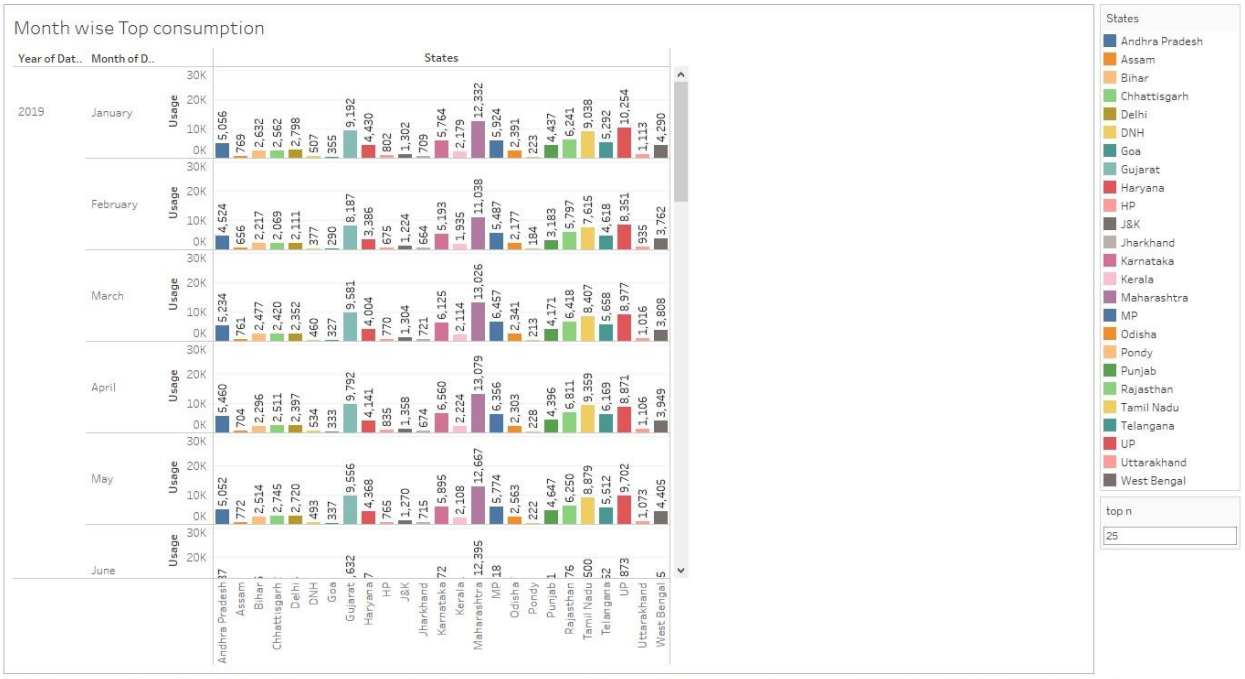
2019 State Consumption | 2020 State Consumption | Total Consumption | Usage By Region | Top N | Bottom N | 2019 Monthwise Consumption | 2020 Monthwise Consumption | Total Consumption Region Wise



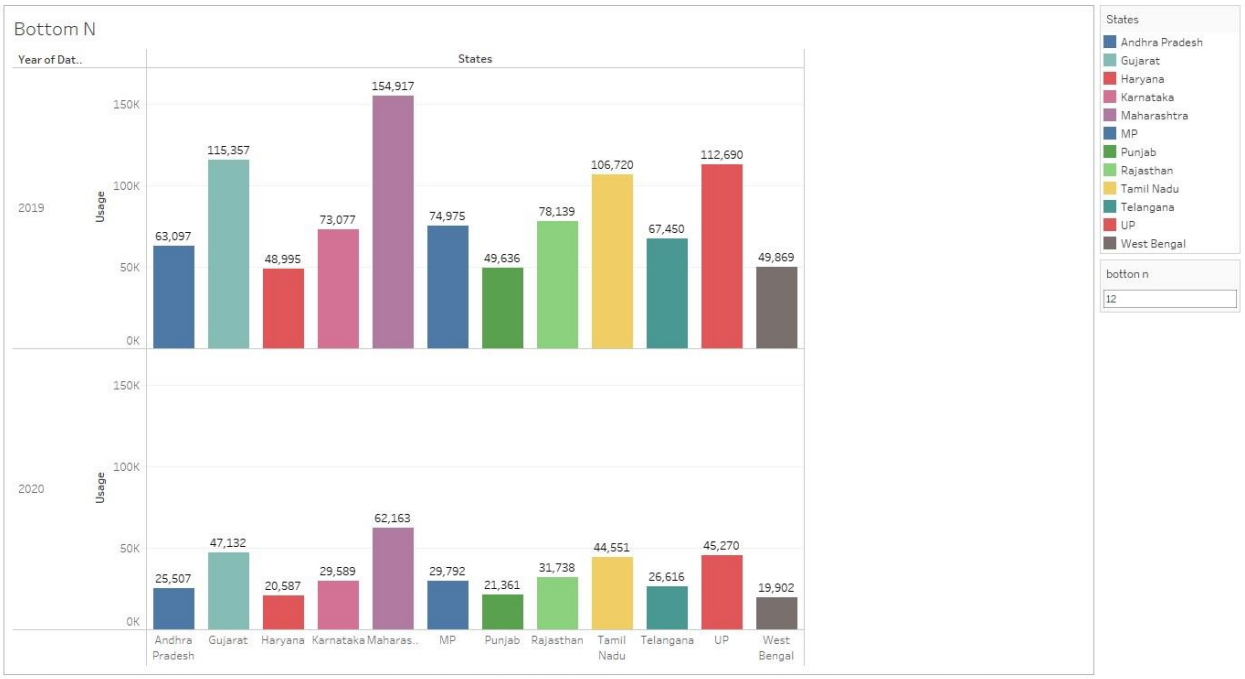
2019 State Consumption | 2020 State Consumption | Total Consumption | Usage By Region | Top N | Bottom N | 2019 Monthwise Consumption | **2020 Monthwise Consumption** | Total Consumption Region Wise



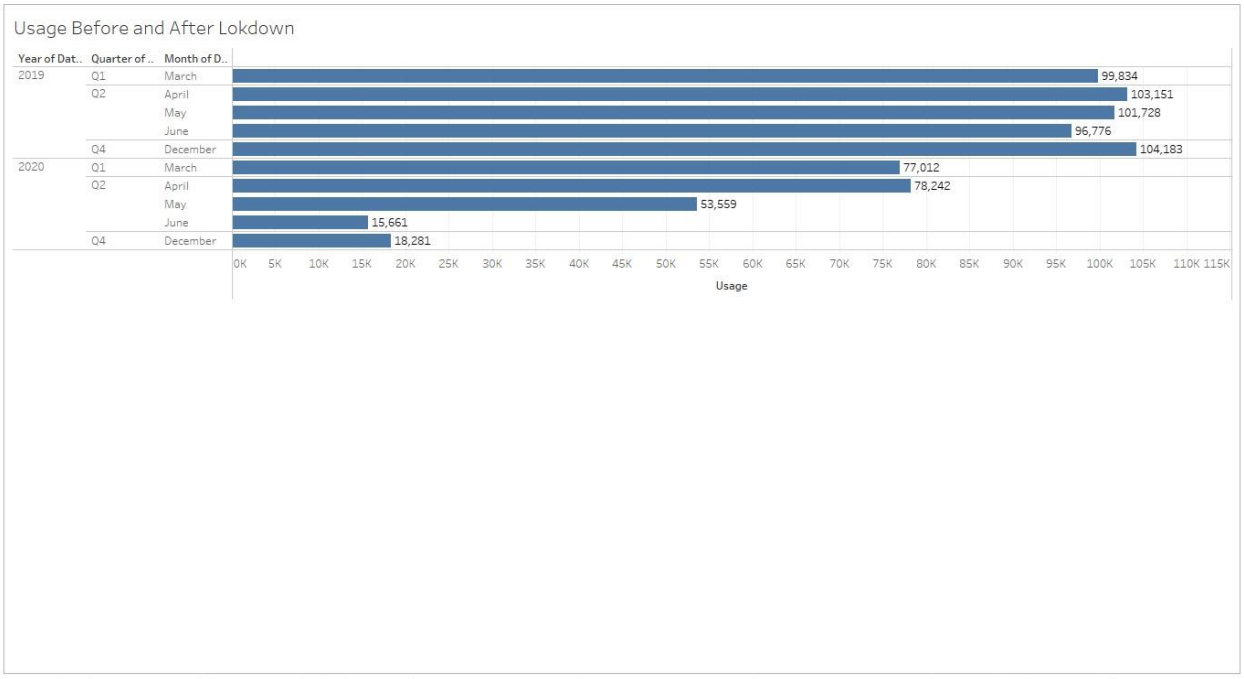
e Consumption | 2020 Monthwise Consumption | Total Consumption Region Wise | Usage Before and After Lokdown | Month wise Top consumption | Region wise State Usage | Usage by region | **Quarter Usage**



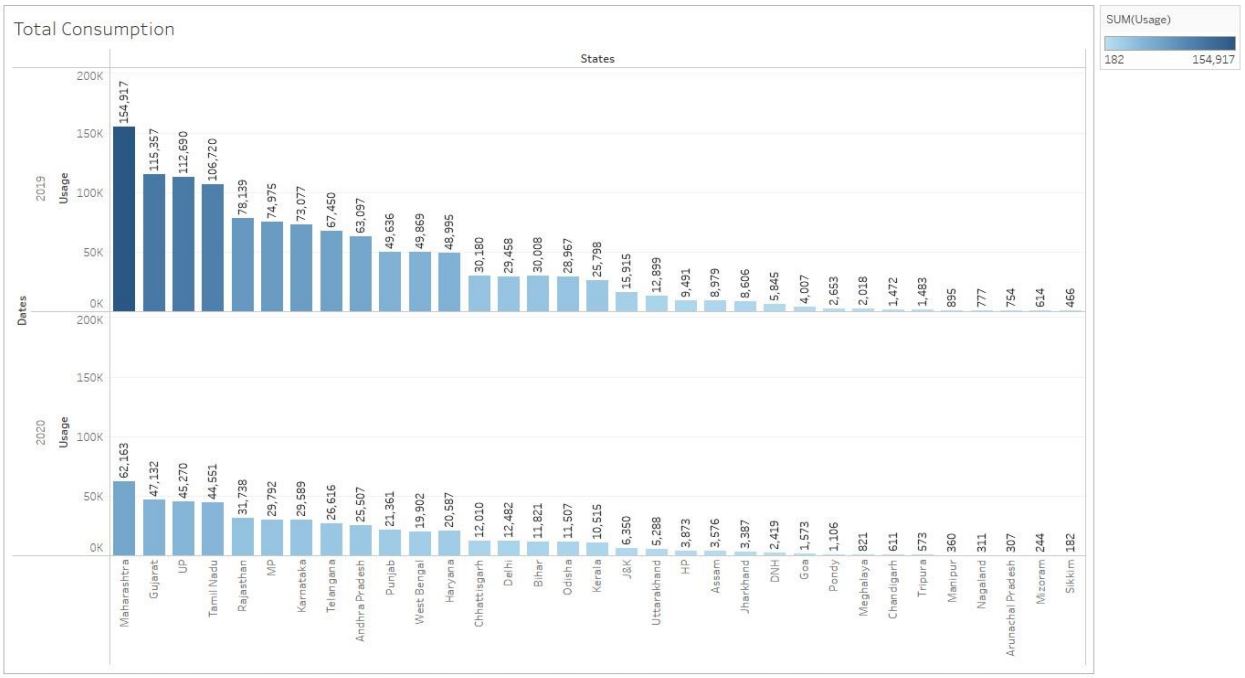
ption | Usage By Region | Top N | Bottom N | 2019 Monthwise Consumption | 2020 Monthwise Consumption | Total Consumption Region Wise | Usage Before and After Lokdown | **Month wise Top consumption**



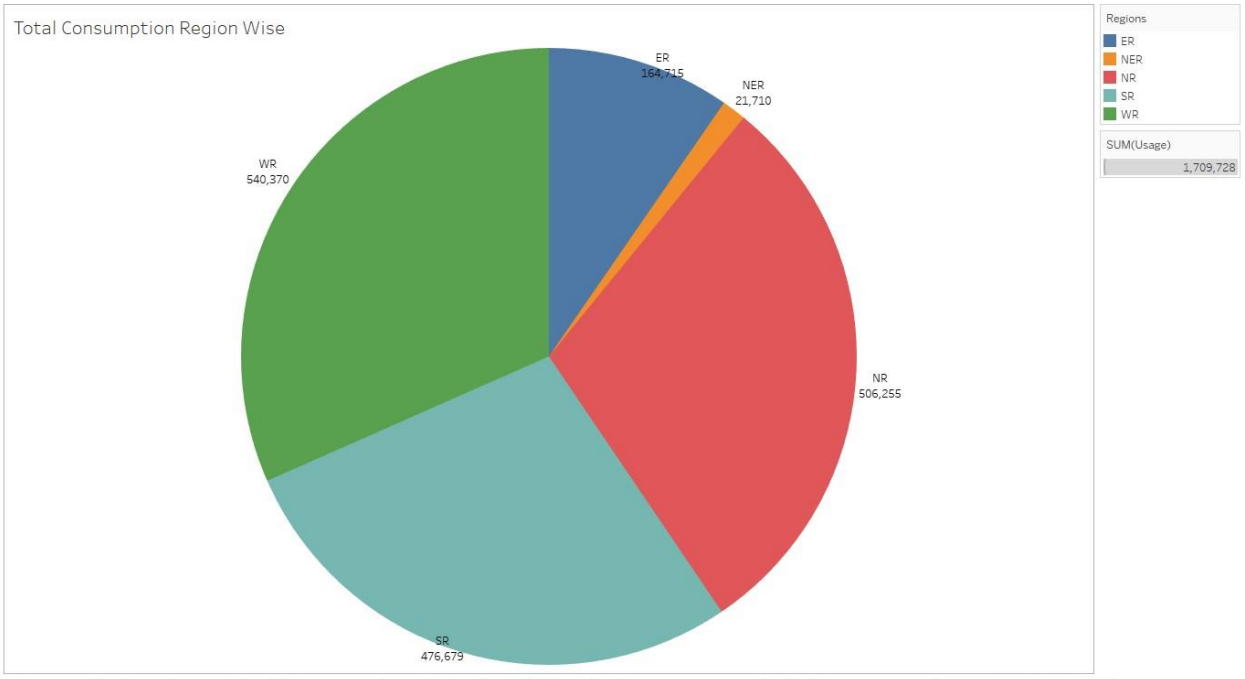
2019 State Consumption | 2020 State Consumption | Total Consumption | Usage By Region | Top N | **Bottom N** | 2019 Monthwise Consumption | 2020 Monthwise Consumption | Total Consumption Region Wise

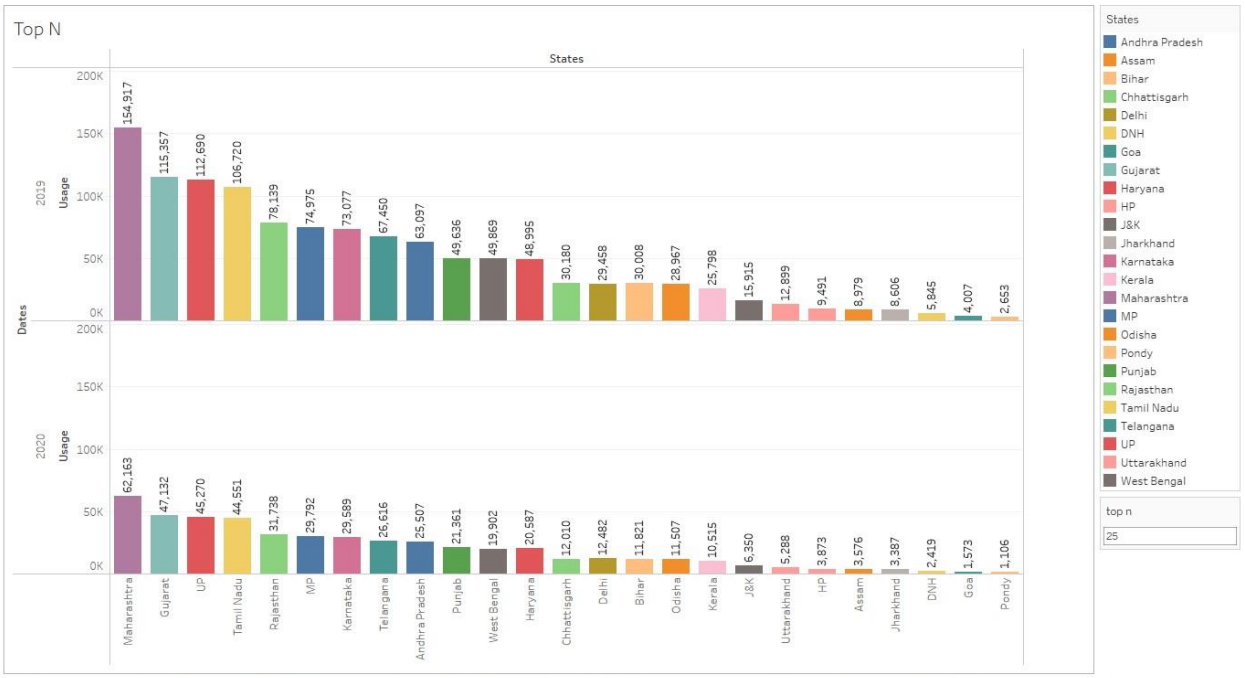


e Consumption | Total Consumption | Usage By Region | Top N | Bottom N | 2019 Monthwise Consumption | 2020 Monthwise Consumption | Total Consumption Region Wise | **Usage Before and After Lokdo...**



2019 State Consumption | 2020 State Consumption | **Total Consumption** | Usage By Region | Top N | Bottom N | 2019 Monthwise Consumption | 2020 Monthwise Consumption | Total Consumption Region Wise


Total Consumption Region Wise
ER
164,715
NER
21,710
NR
506,255
SR
476,679
WR
540,370
Regions
ER
NER
NR
SR
WR
SUM(Usage)
1,709,728


Top N
States
2019
Usage
2020
Usage
Dates
200K
150K
100K
50K
0K
154,917
115,357
112,690
106,720
78,139
74,975
73,077
67,450
63,097
49,636
49,869
48,995
30,180
29,458
30,008
28,967
25,798
15,915
12,899
9,491
8,979
8,606
5,845
4,007
2,653
62,163
47,132
45,270
44,551
31,738
29,792
29,589
26,616
25,507
21,361
19,902
20,587
12,010
12,482
11,821
11,507
10,515
6,350
5,288
3,873
3,576
3,387
2,419
1,573
1,106
Maharashtra
Gujarat
UP
Tamil Nadu
Rajasthan
MP
Karnataka
Telangana
Andhra Pradesh
Punjab
West Bengal
Haryana
Chhattisgarh
Delhi
Bihar
Odisha
Kerala
J&K
Uttarakhand
HP
Assam
Jharkhand
DNH
Goa
Pondy
States
Andhra Pradesh
Assam
Bihar
Chhattisgarh
Delhi
DNH
Goa
Gujarat
Haryana
HP
J&K
Jharkhand
Karnataka
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West Bengal
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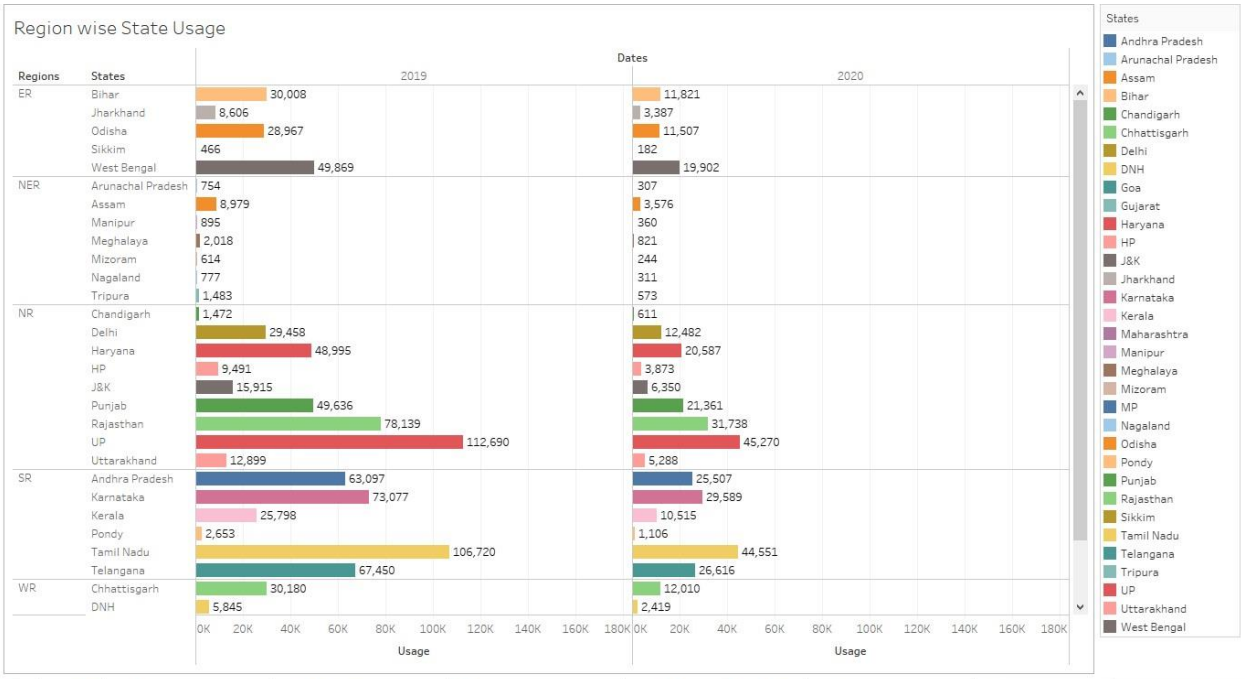
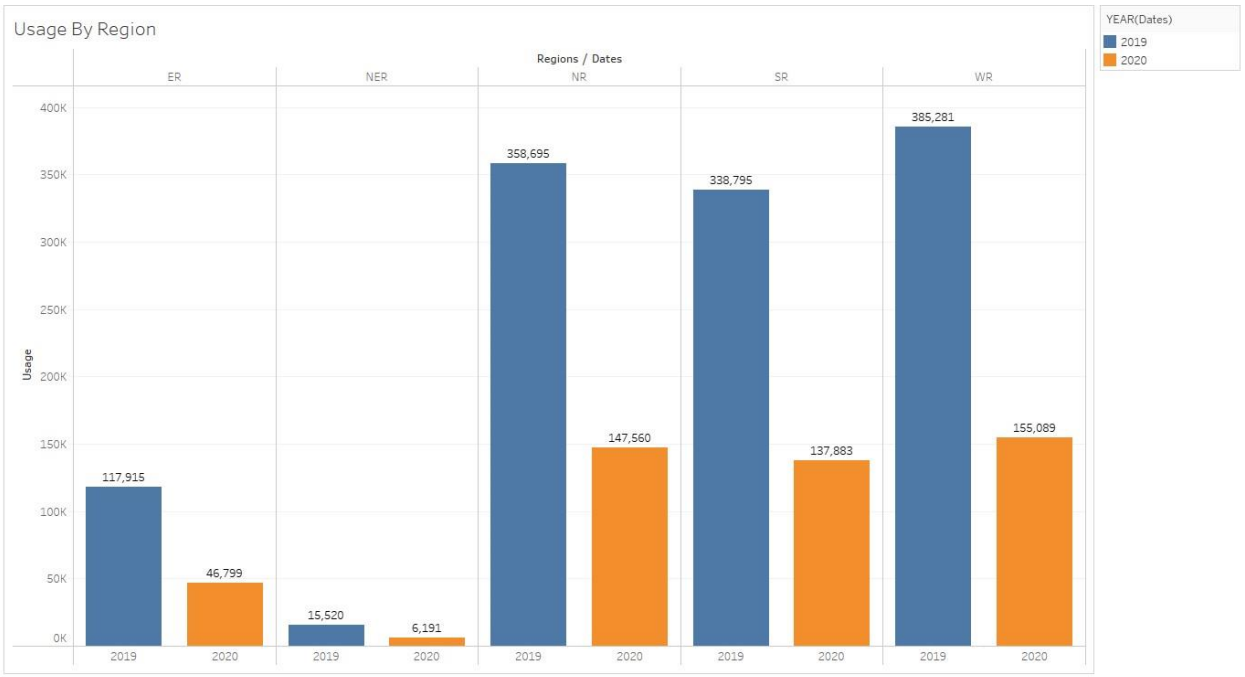
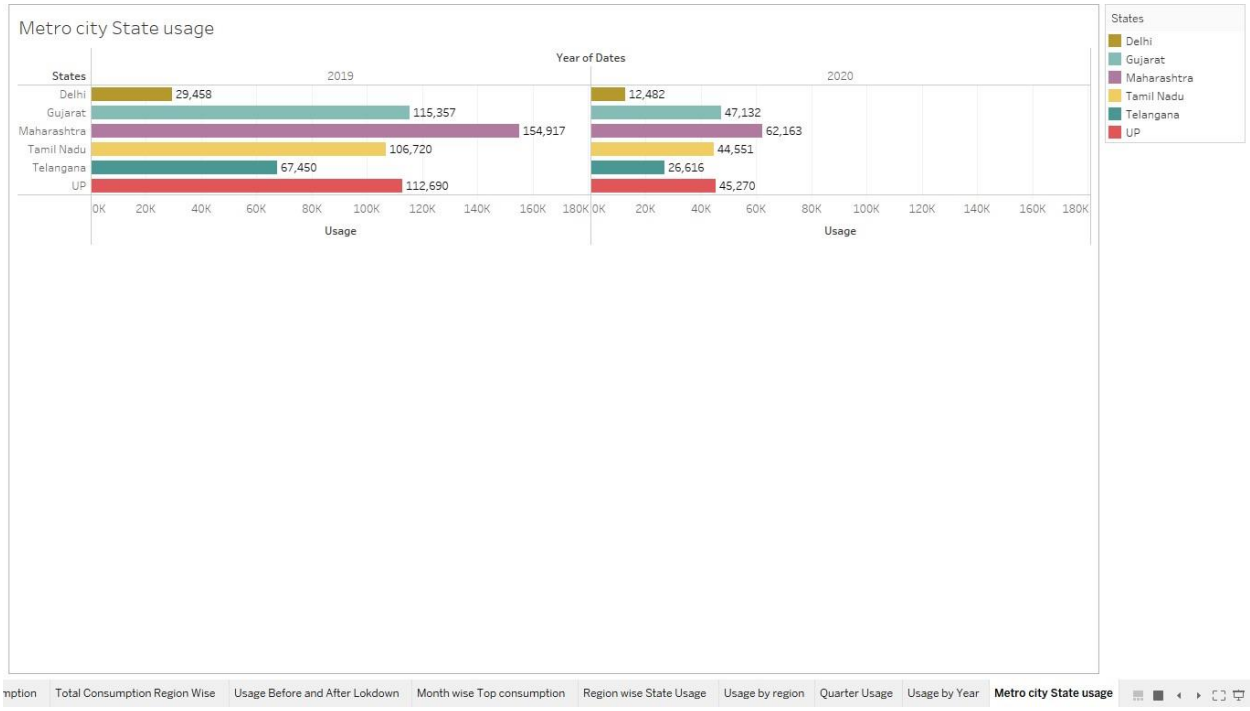


Top N | Bottom N | 2019 Monthwise Consumption | 2020 Monthwise Consumption | Total Consumption Region Wise | Usage Before and After Lokdown | Month wise Top consumption | **Region wise State Usage**



2019 State Consumption | 2020 State Consumption | Total Consumption | **Usage By Region** | Top N | Bottom N | 2019 Monthwise Consumption | 2020 Monthwise Consumption | Total Consumption Region Wise


Metro city State usage
Year of Dates
2019
2020
States
Delhi
Gujarat
Maharashtra
Tamil Nadu
Telangana
UP
29,458
115,357
154,917
106,720
67,450
112,690
12,482
47,132
62,163
44,551
26,616
45,270
Usage
Total Consumption Region Wise
Usage Before and After Lokdown
Month wise Top consumption
Region wise State Usage
Usage by region
Quarter Usage
Usage by Year
Metro city State usage

DASHBOARD:

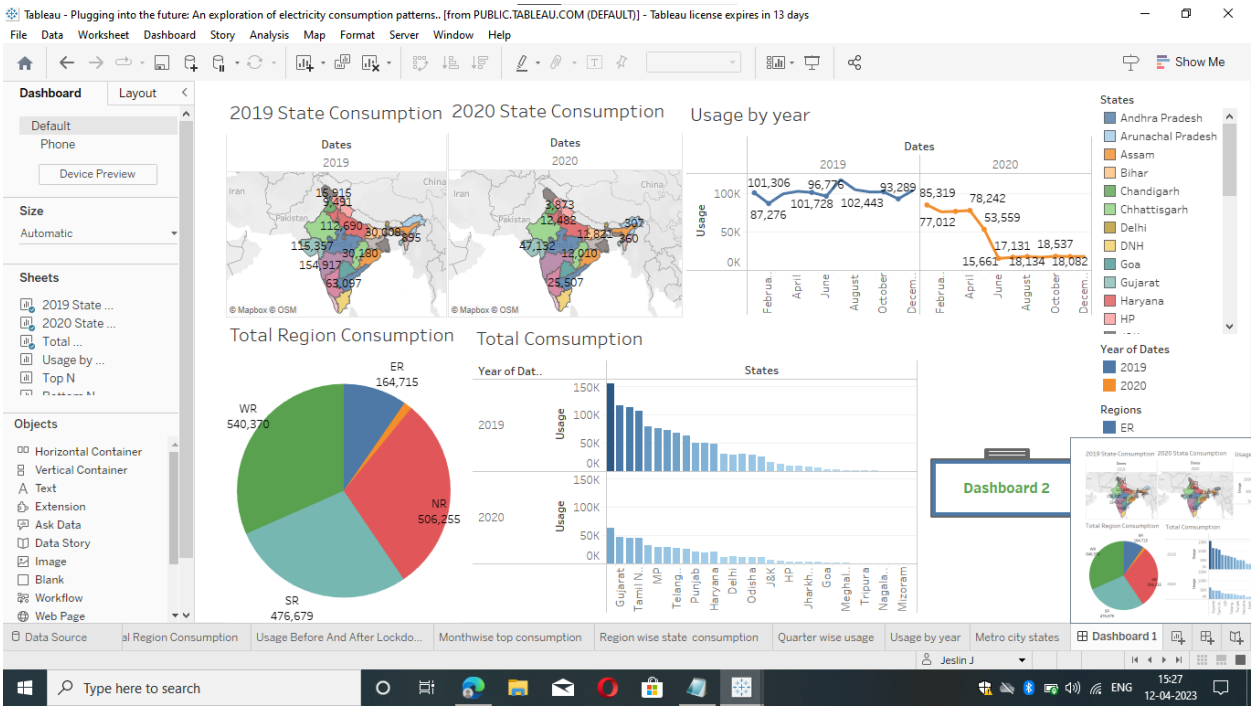


Tableau - Plugging into the future: An exploration of electricity consumption patterns.. [from PUBLIC.TABLEAU.COM (DEFAULT)] - Tableau license expires in 13 days
2019 State Consumption
2020 State Consumption
Usage by year
Total Region Consumption
Total Comsumption
ER 164,715
WR 540,370
NR 506,255
SR 476,679
Dashboard 2
Dashboard 1
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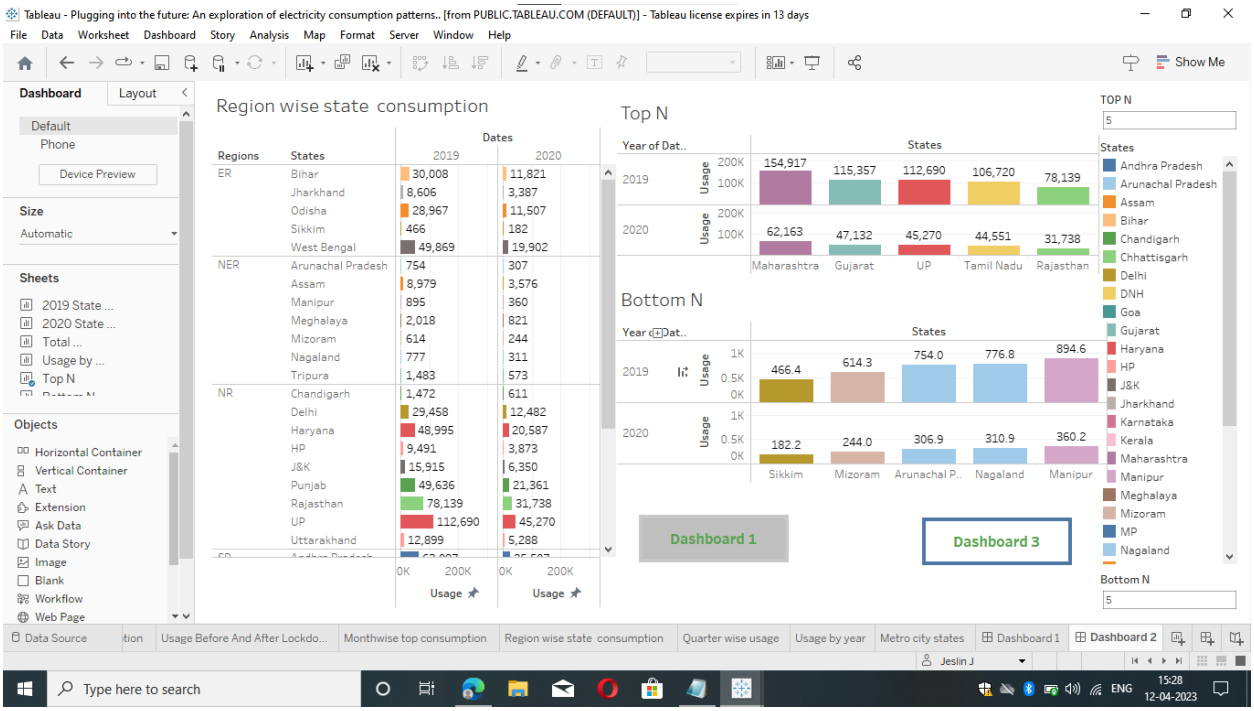
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File Data Worksheet Dashboard Story Analysis Map Format Server Window Help
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Size
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2019 State ...
2020 State ...
Total ...
Usage by ...
Top N
Objects
Horizontal Container
Vertical Container
Text
Extension
Ask Data
Data Story
Image
Blank
Workflow
Web Page
Region wise state consumption
Dates
Regions States 2019 2020
ER Bihar 30,008 11,821
Jharkhand 8,606 3,387
Odisha 28,967 11,507
Sikkim 466 182
West Bengal 49,869 19,902
NER Arunachal Pradesh 754 307
Assam 8,979 3,576
Manipur 895 360
Meghalaya 2,018 821
Mizoram 614 244
Nagaland 777 311
Tripura 1,483 573
NR Chandigarh 1,472 611
Delhi 29,458 12,482
Haryana 48,995 20,587
HP 9,491 3,873
J&K 15,915 6,350
Punjab 49,636 21,361
Rajasthan 78,139 31,738
UP 112,690 45,270
Uttarakhand 12,899 5,288
Usage
Top N
Year of Dat..
States
2019
2020
Usage
154,917
115,357
112,690
106,720
78,139
62,163
47,132
45,270
44,551
31,738
Maharashtra
Gujarat
UP
Tamil Nadu
Rajasthan
Bottom N
466.4
614.3
754.0
776.8
894.6
182.2
244.0
306.9
310.9
360.2
Sikkim
Mizoram
Arunachal P..
Nagaland
Manipur
Dashboard 1
Dashboard 3
TOP N
5
Andhra Pradesh
Arunachal Pradesh
Assam
Bihar
Chandigarh
Chhattisgarh
Delhi
DNH
Goa
Gujarat
Haryana
HP
J&K
Jharkhand
Karnataka
Kerala
Maharashtra
Manipur
Meghalaya
Mizoram
MP
Nagaland
Bottom N
5
Data Source
Usage Before And After Lockdo...
Monthwise top consumption
Region wise state consumption
Quarter wise usage
Usage by year
Metro city states
Dashboard 1
Dashboard 2
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ENG
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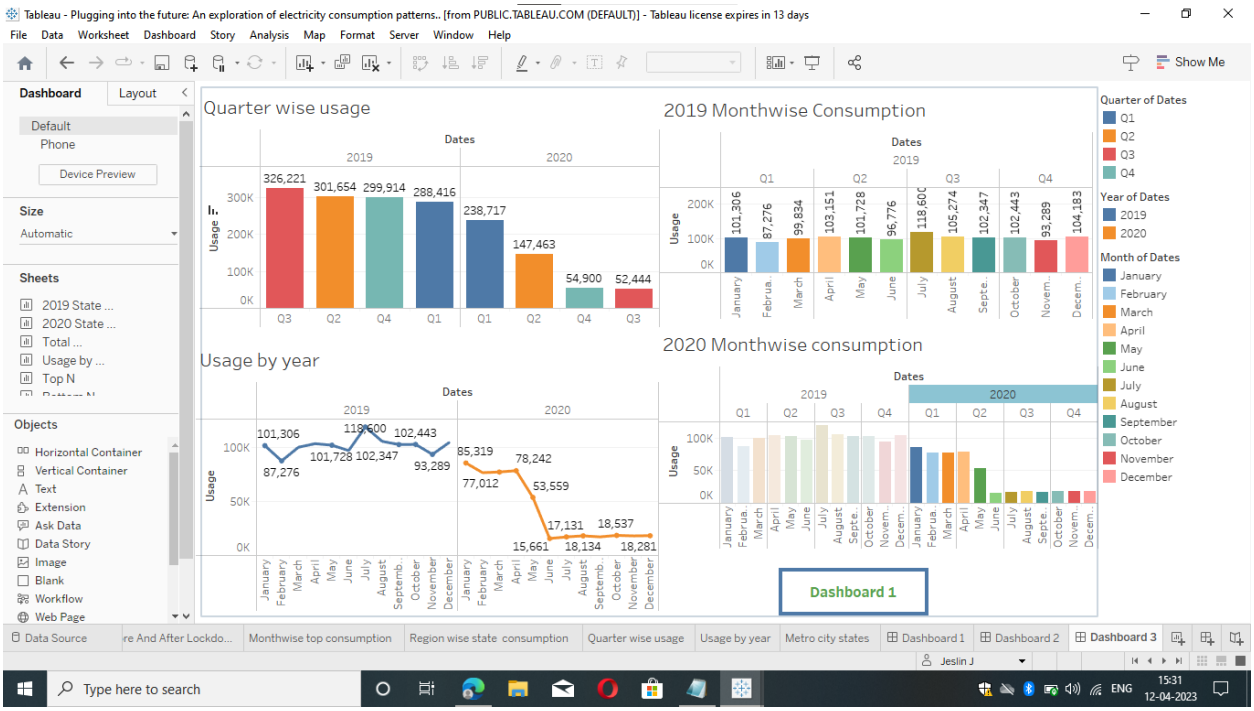
12-04-2023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Show Me
Dashboard Layout
Default
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Size
Automatic
Sheets
2019 State ...
2020 State ...
Total ...
Usage by ...
Top N
Objects
Horizontal Container
Vertical Container
Text
Extension
Ask Data
Data Story
Image
Blank
Workflow
Web Page
Quarter wise usage
Dates
2019
2020
Usage
326,221
301,654
299,914
288,416
238,717
147,463
54,900
52,444
Q3 Q2 Q4 Q1 Q1 Q2 Q4 Q3
2019 Monthwise Consumption
Q1 Q2 Q3 Q4
101,306
87,276
99,834
103,151
101,728
96,776
118,600
105,274
102,347
102,443
93,289
104,183
January Februa.. March April May June July August Septe.. October Novem.. Decem..
Usage by year
101,306
87,276
118,600
101,728
102,347
102,443
93,289
85,319
77,012
78,242
53,559
17,131
15,661
18,134
18,537
18,281
2020 Monthwise consumption
Dashboard 1
Quarter of Dates
Q1
Q2
Q3
Q4
Year of Dates
2019
2020
Month of Dates
January
February
March
April
May
June
July
August
September
October
November
December
Data Source
Monthwise top consumption
Region wise state consumption
Quarter wise usage
Usage by year
Metro city states
Dashboard 1
Dashboard 2
Dashboard 3
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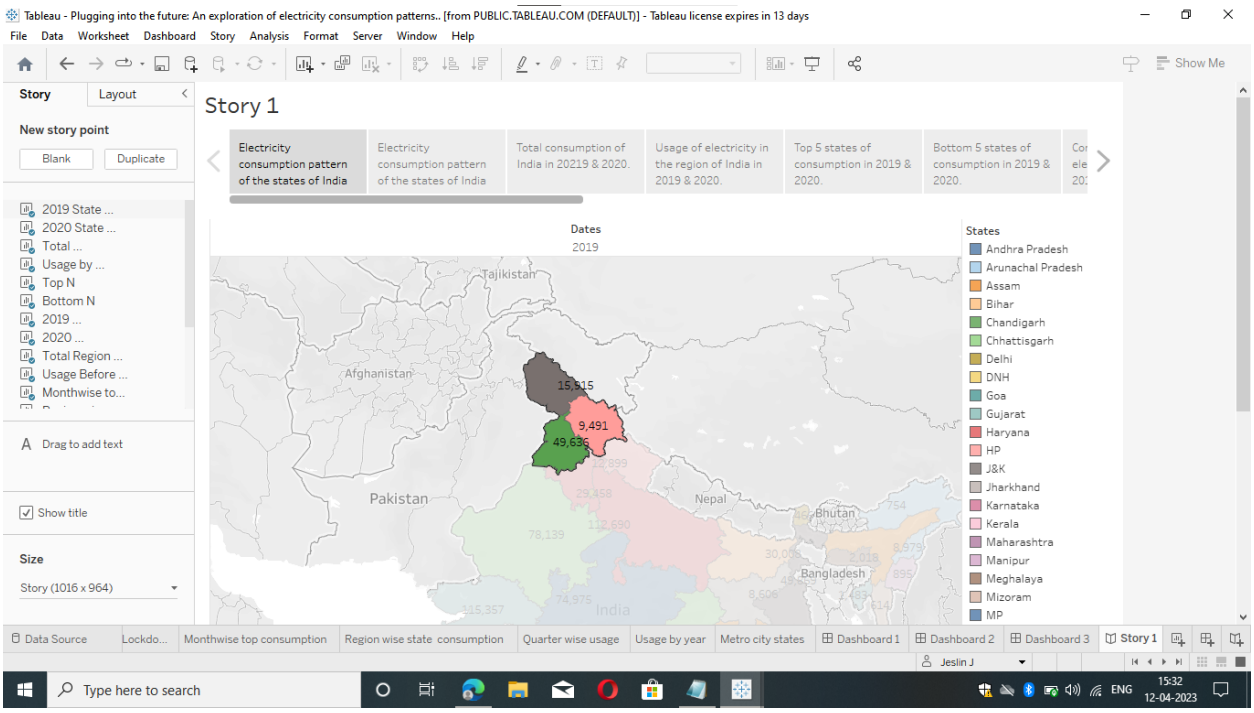
STORY:



4. ADVANTAGES & DISADVANTAGES:

ADVANTAGES:

Cost savings: By analysing electricity consumption patterns, businesses and individuals can identify areas of excessive energy use and make changes to reduce their energy consumption, which can lead to significant cost savings on electricity bills.

Increased efficiency: Analysing electricity consumption can help businesses and individuals identify inefficiencies in their energy usage and make changes to increase efficiency, such as upgrading to more energy-efficient appliances or lighting systems.

Environmental benefits: Reducing electricity consumption can help to reduce carbon emissions and environmental impact, making it an important part of sustainability efforts.

Predictive maintenance: Analysis of electricity consumption can help identify potential equipment failures or maintenance needs, allowing for proactive maintenance that can prevent downtime and improve equipment lifespan.

Improved load management: By analysing electricity consumption patterns, businesses can better manage their energy demand, potentially avoiding peak pricing and reducing strain on the power grid.

Energy planning: Analysis of electricity consumption data can help businesses and individuals make informed decisions about energy investments, such as installing solar panels or upgrading to energy-efficient HVAC systems.

DISADVANTAGES:

Limited scope: Analysis of electricity consumption patterns may only provide information on a particular aspect of energy usage, such as the amount of electricity consumed over a specific time period or the usage pattern of a particular appliance. It may not provide a complete picture of overall energy usage or factors that contribute to it.

Lack of context: Analysis of electricity consumption patterns may not provide sufficient context to fully understand the reasons behind energy consumption patterns. For example, a spike in energy usage during a particular time of day may be due to a specific event or circumstance, but without additional context, it may be difficult to determine the cause.

Data accuracy: The accuracy of the data used to analyze electricity consumption patterns is critical. Any errors or inconsistencies in the data can significantly impact the validity of the analysis and the resulting insights.

Cost and complexity: Conducting a detailed analysis of electricity consumption patterns can be complex and expensive, requiring specialized equipment and expertise. This may make it difficult for individuals or organizations with limited resources to conduct such an analysis.

Privacy concerns: Analysing electricity consumption patterns may raise privacy concerns, as it involves collecting and analysing data on individuals' energy usage patterns. This could potentially reveal personal information or habits that some people may prefer to keep private.

5. APPLICATIONS:

There are many applications of analysing electricity consumption patterns, including:

Energy Efficiency: Understanding how and when electricity is used can help identify opportunities for energy efficiency improvements. By analysing consumption patterns, it is possible to identify areas of wastage and take steps to reduce energy consumption.

Demand Response: Electricity consumption patterns can be used to predict peak demand periods, which can be used to implement demand response programs. These programs can incentivize consumers to shift their electricity consumption to off-peak periods, reducing strain on the grid during peak demand periods.

Load Forecasting: Electricity consumption patterns can be used to forecast future electricity demand. Load forecasting is important for energy suppliers to ensure they can meet demand and avoid blackouts or brownouts.

Smart Grid Optimization: Analysing electricity consumption patterns can help optimize the operation of a smart grid. By collecting and analysing data on electricity consumption, it is possible to identify areas of inefficiency and take steps to improve the efficiency of the grid.

Carbon Emissions Reduction: Understanding electricity consumption patterns can help identify opportunities to reduce carbon emissions. For example, by identifying times when renewable energy sources are most abundant, it is possible to shift electricity consumption to those times, reducing the need for fossil fuel-powered electricity generation.

Overall, analysing electricity consumption patterns is a key tool for improving energy efficiency, reducing carbon emissions, and ensuring a reliable supply of electricity.

6. CONCLUSION:

Electricity consumption patterns vary widely depending on several factors such as geographical location, climate, population density, economic development, and lifestyle choices. However, some general trends can be observed.

In developed countries, electricity consumption is typically higher due to higher levels of economic activity, larger homes, and greater reliance on appliances and electronic devices. In contrast, developing countries tend to have lower levels of electricity consumption, often due to lower levels of economic development and less widespread access to electricity.

In terms of seasonality, electricity consumption tends to be higher in the summer and winter months due to increased demand for air conditioning and heating, respectively. There are also daily fluctuations in electricity demand, with peak consumption occurring during daytime hours and lower demand during overnight hours.

Renewable energy sources such as solar and wind power are becoming increasingly popular as a way to reduce reliance on fossil fuels and decrease carbon emissions. However, the intermittent nature of these sources means that energy storage and backup systems are needed to ensure reliable electricity supply.

Overall, understanding electricity consumption patterns is important for policymakers, utility companies, and individuals looking to reduce energy use and decrease environmental impact.

7. FUTURE SCOPE:

The future scope of electricity consumption patterns is expected to be shaped by various factors such as technological advancements, climate change, policy and regulatory changes, and consumer behaviour.

One significant trend is the increasing adoption of renewable energy sources such as solar and wind power, which are expected to account for a larger share of the electricity mix in the future. This shift towards renewable energy is likely to change the way electricity is generated, transmitted, and consumed.

Another trend is the development of energy-efficient technologies and smart grid infrastructure, which can help reduce electricity demand and optimize energy usage. With the rise of the Internet of Things (IoT), homes and businesses can be connected to a network of sensors and devices, allowing for more efficient energy use and management.

Consumer behaviour is also expected to play a role in shaping electricity consumption patterns. As consumers become more aware of the environmental impact of their energy use, they may seek out energy-efficient appliances and adopt behaviours that reduce their energy consumption.

Overall, the future of electricity consumption patterns is likely to be more sustainable and efficient, driven by technological advancements, policy changes, and consumer behaviour.