# 1. Introduction :

**1.1 Project Overview:** In today's data-driven world, electricity consumption analysis plays a vital role in energy planning and policy-making. Government agencies and electricity boards collect vast amounts of consumption data, but without proper visualization tools, extracting meaningful insights becomes difficult.

The project titled "Plugging into the Future – Electricity Consumption Analysis Using Tableau" focuses on analyzing electricity usage across states, regions, months, quarters, and years (2019 & 2020).

Using Tableau, raw electricity datasets are transformed into interactive dashboards that help answer key questions:

- Which states consume the most electricity?
- How did lockdown impact electricity demand?
- What are the seasonal and regional trends?
- Which regions dominate overall power usage?

The dashboard enables interactive filtering and drill-down, providing a complete analytical view for energy stakeholders.

**1.2 Purpose:** The purpose of this project is to support data-driven energy planning by visualizing electricity consumption patterns across:

- State-wise usage
- Region-wise comparison
- Monthly and quarterly trends
- Lockdown impact analysis
- Top and Bottom consuming states

The solution simplifies complex datasets into intuitive dashboards that allow policymakers and energy officials to make faster, evidence-based decisions.

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# 2. IDEATION PHASE :

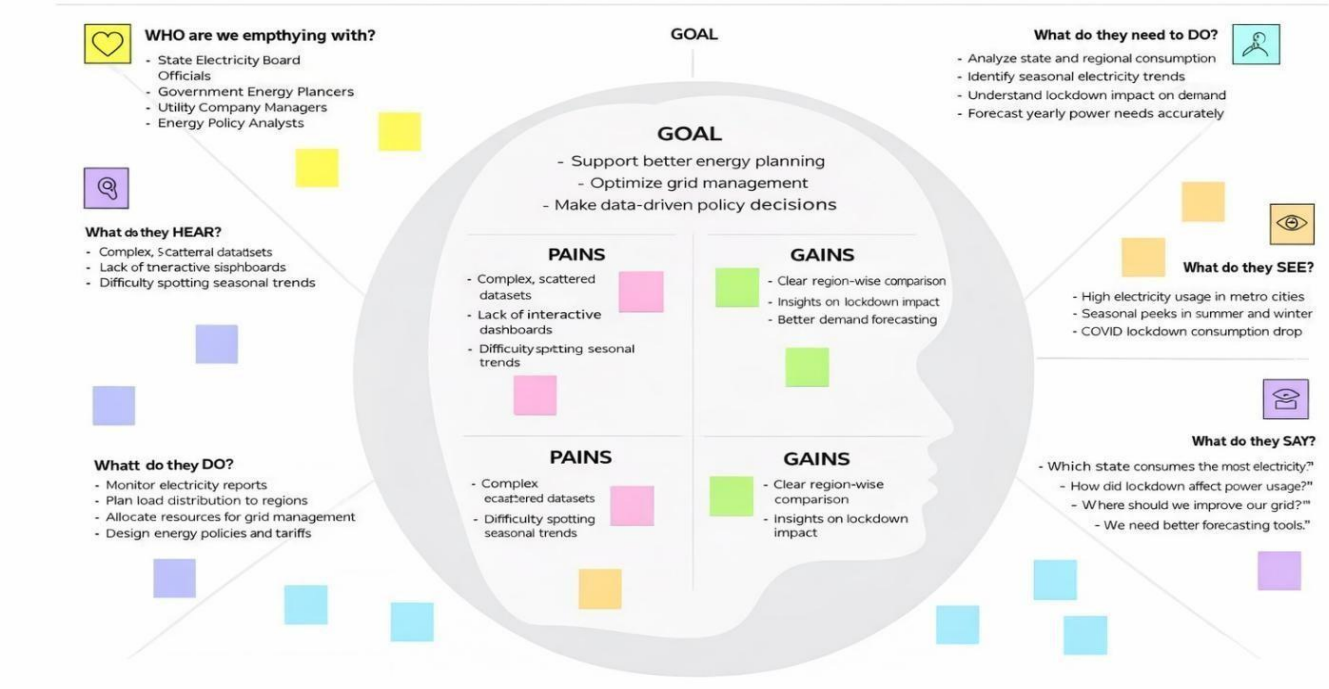
**2.1 Problem Statement**: Electricity boards struggle to analyze large state-wise and time-based datasets using static spreadsheets.

Challenges include:

- Difficulty identifying peak demand periods
- Lack of regional comparison tools
- No interactive filtering capability
- Limited visibility of lockdown impact

There is a need for an interactive visualization solution that connects stakeholders directly to their data.

## 2.2 Empathy Map Canvas :




## 2.3 Brainstorming :

**2.3.1. Team Collaboration and Approach:** Our team began the project with a brainstorming session to analyze the electricity consumption dataset and identify key variables such as State, Region, Year, Quarter, and Usage.

We discussed suitable visualizations like maps, bar charts, and line charts to effectively present insights. Responsibilities were divided among data cleaning, calculated field creation, dashboard design, and story development.

We followed an Agile approach with regular reviews to ensure clear visuals, proper interactivity, and timely project completion.

**2.3.2. Ideas Generated and Grouped by Category:**

# 3. Key Ideas Generated:

| Idea | Category |
|---|---|
| State-wise comparison map | Geographic Analysis |
| Quarter-wise usage trend | Seasonal Analysis |
| Lockdown impact comparison | Event Impact Analysis |

| | |
|---|---|
| Top N & Bottom N states | Ranking Analysis |
| Region-wise pie chart | Regional Distribution |
| Interactive filters | User Interactivity |
| Tableau Story feature | Presentation |
| | |
| **2.3.3. Prioritization:** | |

| **Priority** | **Idea** | **Reason** |
|---|---|---|
| High | Bar Chart for Product Position vs Sales | Core to solving the project's main problem |
| High | Donut Chart for Promotion Impact | Simple and clear to stakeholders |

| **Priority** | **Idea** | **Reason** |
|---|---|---|
| High | Highlight Table for Demographics | Helps target customer segments more precisely |
| High | Filters for Category, Traffic, and Promotion | Essential for interactivity |
| Medium | Funnel and Waterfall Charts | Adds depth to financial and behavioral insight |
| Low | Word Cloud and Storyboard | Adds polish and storytelling but not critical to logic |

# 4. REQUIREMENT ANALYSIS :

**4.1 Customer Journey map :** The Customer Journey Map helps visualize the enduser's experience from problem identification to solution adoption. For this project, our primary

users are retail managers, marketing analysts, and store planners who want to improve sales using data-driven product placement.

Customer Journey Map

| Stage | User Action | Pain Point | Dashboard Solution |
|---|---|---|---|
| Awareness | Notices inconsistent power demand | Static reports | Interactive dashboard |
| Analysis | Tries manual Excel analysis | Time-consuming | Filters & charts |
| Insight | Identifies peak demand | Hard to compare data | Quarter & Month charts |
| Action | Plans resource allocation | Needs presentation support | Tableau Story & Export |

### 3.2 Solution Requirement:

**Functional Requirements**

- Upload electricity dataset
- Clean and preprocess data
- Create state map and charts
- Add filters (Year, Region, Quarter, State)
- Build Top N & Lockdown analysis
- Enable export functionality

**Non-Functional Requirements**

- Usability – Easy to navigate • Performance – Load within 5 seconds
- Reliability – Accurate filter results
- Scalability – Support future years
- Availability – Accessible via Tableau Public

**3.3 Data Flow Diagram:** A **Data Flow Diagram (DFD)** shows how data moves through your system — from input to final output — across different components. This project processes a CSV dataset through Tableau to produce interactive dashboards for business decision-making.

**Level 1 DFD – Detailed Process Flow:**

| | Process Component | Description |
|---|---|---|
| 1 | Data Input | User uploads Product Positioning.csv to Tableau |
| 2 | Data Cleaning & Formatting | Missing value check, column type conversion, column renaming |
| 3 | Calculated Fields | Fields like Price Gap, Sales Category, % Difference |
| 4 | Visualization Engine | Tableau sheets and dashboards created using multiple chart types |
| | Process Component | Description |
| 5 | Filters | Applied on Promotion, Traffic, Demographics, Product Category |
| 6 | Dashboard Assembly | All sheets combined into one interactive dashboard |
| 7 | Storytelling Mode | Tableau story created to walk stakeholders through key insights |
| 8 | Output | Users view or export dashboard results (PDF, image, or shareable link) |

**3.4 Technology Stack:** This section outlines the tools, technologies, and components used to build and deploy the solution. It includes both the architecture layers and the technology choices for your project.

**A. Technical Architecture (3-Tier Design)**

| Layer | Component Description |
|---|---|
| Presentation Layer | The final Tableau Dashboard UI, visible to users. Includes interactive filters and visuals |
| Application Layer | Tableau Engine responsible for creating calculations, visual logic, and rendering visuals |

| | |
|---|---|
| Data Layer | Raw dataset: Product Positioning.csv stored locally or on Google Drive |

**B. Components & Technologies Used**

| S. No | Component | Description | Technology Used |
|---|---|---|---|
| 1 | User Interface | Tableau Dashboard with visual and filter components | Tableau Public / Desktop |
| 2 | Data Processing | Data cleaning, type conversion, and calculated fields | Tableau, Optional: Python/Pandas |
| 3 | File Storage | Dataset stored and imported into Tableau | Local File System / Google Drive |
| 4 | Visualization Engine | Chart rendering and interactivity | Tableau Visualization Engine |
| 5 | Story Presentation | Tableau Story feature for sequential insights | Tableau |
| 6 | Export & Sharing | Export reports in PDF/Image formats; public dashboard access | Tableau Public / PDF Export |

**C. Application Characteristics**

| Feature | Description | Technology Used |
|---|---|---|
| Open Source Frameworks | Tableau Public is freely accessible, optional use of Python (Pandas) | Tableau Public, Pandas |

| | | |
|---|---|---|
| Security | Controlled data sharing via Tableau Public permissions and Google Drive | Tableau Share Settings |
| Scalability | Can support more data rows, product lines, or new categories easily | Tableau Extract Engine |
| **Feature** | **Description** | **Technology Used** |
| Availability | Hosted via Tableau Public or downloadable as a file for 24/7 access | Tableau Public |
| Performance | Fast loading for up to 1000+ rows with live filters and dashboard response | Tableau (Live / Extract) |

# 4. PROJECT DESIGN:

## 4.1 Problem Solution Fit:

**The Problem**

Our product is an interactive Tableau dashboard that analyzes electricity consumption across states and regions for 2019 and 2020.

It provides insights into monthly trends, quarterly usage, lockdown impact, and Top/Bottom consuming states using dynamic filters and visual storytelling for better energy planning decisions.

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**The Solution**

This project proposes a fully interactive Tableau dashboard that transforms raw, static electricity consumption data into dynamic and meaningful visual insights. The dashboard allows users to:

- View and compare state-wise electricity consumption for 2019 and 2020
- Analyze regional distribution and identify high-demand areas
- Examine monthly and quarterly trends, including lockdown impact
- Identify Top and Bottom consuming states
- Explore metro city usage and seasonal variations

By integrating filters, calculated fields, drill-down features, and multiple chart types, this solution enables energy officials and policymakers to understand consumption patterns clearly and make faster, data-driven planning decisions.

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| **Challenge** | **How the Solution Solves It** |
|---|---|
| Static, unfilterable spreadsheets | Tableau dashboard allows dynamic filtering and exploration |

| | |
|---|---|
| | Users can interactively combine factors like traffic |
| No correlation between multiple variables | + promo + demographics |
| | Visuals offer instant insights, reducing dependency on Excel |
| Manual analysis is timeconsuming | |
| Poor placement decisions | Dashboard shows which placements drive the |
| Difficulty sharing insights | Tableau stories present clear, step-by-step visual narratives |

most sales **Why This Solution Fits the Problem** with

teams

**4.2 Proposed Solution:** To address the challenges faced by electricity boards and policymakers in analyzing complex consumption datasets, we propose a Tableau-based interactive dashboard solution that enables deep exploration of electricity usage patterns across states and regions. The proposed solution transforms flat, tabular electricity consumption data into a dynamic visual analytics environment where users can interact with the data, apply filters, and gain real-time insights into how state distribution, regional trends, seasonal variations, quarterly changes, and lockdown impact influence overall electricity demand.

**Key Features of the Proposed Solution**

| Feature | Description |
|---|---|
| State-wise Map | Visualize electricity consumption across different states for 2019 and 2020 |
| Bar Charts | regions, and Top/Bottom N rankings |
| Line Charts | Analyze yearly and monthly consumption trends |
| Quarter Charts | Study seasonal variations and lockdown impact (Q2 2020) |
| Pie Charts | Show region-wise contribution to total electricity usage |
| KPI Cards | Display total consumption and key summary metrics |
| Drill-Down Feature | Enable Region → State level detailed analysis |
| Interactive Filters | Slice data by Year, Region, State, and Quarter |
| **Feature** | **Description** |
| Calculated Fields | Add Growth %, Lockdown Impact classification, and ranking logic |
| Dashboard | Present insights step-by-step for |

| | |
|---|---|
| Story | policymakers and stakeholders |
| Export Options | Allow dashboards to be exported as PDF or image for reporting |

.

Compare electricity usage across states,

**How the Solution Will Be Implemented**

1. **Data Upload & Preparation**: Import the electricity consumption dataset (CSV) into Tableau o Clean and format data fields (State, Region, Year, Month, Quarter, Usage) o Remove null or duplicate entries o Create calculated fields such as Growth % and Lockdown Impact classification
2. **Dashboard Design**: Develop individual visualizations (State Map, Bar Charts, Line Charts, Quarter Charts, KPI Cards) o Implement Top N and Bottom N analysis o Apply global filters (Year, Region, State, Quarter) across all dashboards o Use consistent color coding and labels for better readability

3. **Storytelling and Output**: Use Tableau Story feature to present insights step-by-step
   - o Highlight key findings such as regional dominance and lockdown impact
   - o Export dashboards as PDF or images for reporting and presentations

## 4.3 Solution Architecture A.

**Technology Stack:**

| Component | Technology Used |
|---|---|
| Data Storage | Local CSV File (Electricity Consumption Dataset) / Google Drive |
| Data Processing | Tableau Desktop / Tableau Public |
| Visualization Engine | Tableau Visualization Engine |
| Calculated Logic | Tableau Calculated Fields (Growth %, Lockdown Impact) |
| Storytelling & Output | Tableau Story Feature |
| Sharing & Export | Tableau Public, PDF/Image Export |
| Optional Enhancements | Python + Pandas (for advanced data cleaning and future forecasting) |

4.

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## B. Key Functional Features Enabled by Architecture:

• Calculated Fields like:

o **Growth %** = (2020 Usage – 2019 Usage) / 2019 Usage o **Lockdown Impact Classification** = IF Year = 2020 AND Quarter = "Q2" THEN "Post-Lockdown" ELSE "Normal

Period" o **Region Ranking** to identify highest and lowest electricity-consuming regions o **Top N / Bottom N Logic** to dynamically rank states based on total electricity usage

- **Dashboard Filters for:** o Year (2019 / 2020) o Region (NR, SR, ER, WR, NER) o State o Quarter (Q1–Q4)

- **Charts & Visuals:** o Filled Map for state-wise electricity consumption o Bar Chart for Top N & Bottom N states o Line Chart for yearly and monthly trend analysis o Quarter Chart for lockdown impact analysis o Pie Chart for region-wise contribution o KPI Card for total electricity consumption summary

# 5 PROJECT PLANNING & SCHEDULING:

a **Project Planning:** Project planning was essential to ensure the systematic development of the electricity consumption dashboard. Our approach followed the Agile methodology with three focused sprints, each targeting core functional elements of the solution — from data preparation and visualization design to story creation and final presentation.

This structured approach helped ensure timely completion, clear task distribution, and continuous improvement throughout the dashboard development process.

# PERFORMANCE TESTING :

**Product Backlog, Sprint Schedule, and Estimation (4 Marks)**

| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task | Story Points | Priority | Team Members |
|---|---|---|---|---|---|---|
| Sprint-1 | Data Setup & Cleaning | USN-1 | As an analyst, I want to uploda and clean the electricity dataset so it is ready for visualization | 2 | High | You |
| Sprint-1 | Basic Visualization Design | USN-2 | As a user, I want to create state maps and bar charts to compare electricity consumption | 3 | High | You |
| Sprint-1 | Dashboard Filtering | USN-3 | As a user, I want to add filters (Year, Region, State, Quarter) to interact with dashboards | 2 | Medium | You |
| Sprint-2 | Advanced Visualizations | USN-4 | As a user, I want to build Top N, Bottom N, and Quarter analysis charts | 4 | High | You |
| Sprint-2 | Lockdown & Growth Analysis | USN-5 | As a user, I want calculated fields (Growth %, Lockdown Impact) to analyze trends | 3 | Medium | You |
| Sprint-3 | Story Building | USN-6 | As a presenter, I want to create a Tableau Story to communicate insights step-by-step | 2 | Medium | You |
| Sprint-3 | Export & Presentation | USN-7 | As a user, I want to export visuals and present the final dashboard to stakeholders | 2 | High | You |

**Project Tracker, Velocity & Burndown Chart (4 Marks)**

| Sprint | Total Story Points | Total Story Points | Duration | Sprint Start Date | Sprint End Date (Planned) | Story Points Completed | Sprint Release Date (Actual) |
|---|---|---|---|---|---|---|---|
| Sprint-1 | 7 | 7 | 6 Days | 01 Feb 2026 | 06 Feb 2026 | 7 | 06 Feb 2026 |
| Sprint-2 | 7 | 7 | 6 Days | 07 Feb 2026 | 12 Feb 2026 | 7 | 12 Feb 2026 |
| Sprint-3 | 4 | 4 | 6 Days | 13 Feb 2026 | 18 Feb 2026 | 4 | 18 Feb 2026 |

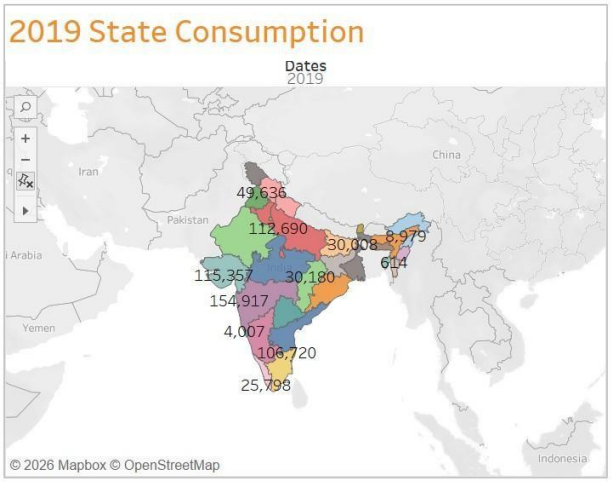
Velocity Calculation = 18 Number of Sprints = 3 Velocity 6 story points per sprint

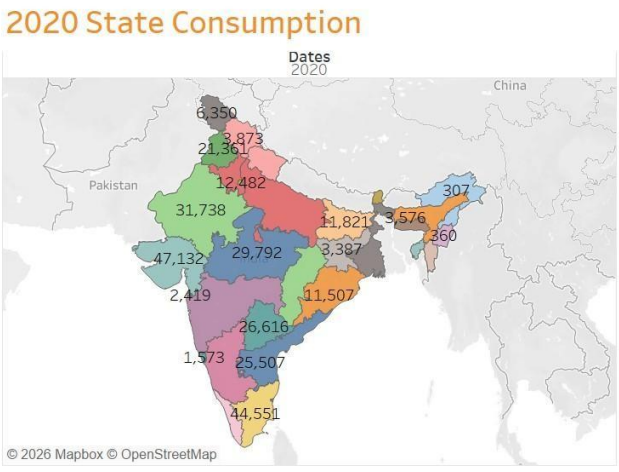
## Model Performance Testing

| S.No. | Parameter | Screenshot / Values |
|---|---|---|
| 1. | **Data Rendered** | The dataset used contains **1000 entries** related to product placement, pricing, traffic, demographics, **promotions,** and **sales volume**. Key fields include:<br>• Product_Position<br>• Traffic<br>• Foot Traffic<br>• Promotion (Yes/No)<br>• Customer Demographics<br>• Sales Volume |
| 2. | **Data Preprocessing** | • Cleaning and computed **column types**<br>• Removed missing/null entries (none in :his dataset)<br>• Data preprocessed for easy visualization in |
| 3. | Utilization of Filters | Global filters used in the dashboard:<br>• Promotion (Yes/No)<br>• Demographics (Segment/Age)<br>• Foot Traffic (Low/Medium/High)<br>• Seasonal (Q1–Q4)<br>All filters **applied** across all visualizations to enable dashboard interactivity: |
| 4. | Calculation fields Used | • Price Gap = (Price) – (Competitor's Price)<br>• Promotion Impact = IF Promotion = "Yes" THEN Sales Volume<br>• **% Price Difference** =[[Price) – (Competitor's Price]] / (Competitor's |
| 5. | Dashboard design | • Bar Chart – Avg Sales by Product Category<br>• Donut Chart – Promotion-wise Sales<br>• Funnel Chart – Traffic Drop-off Zones<br>• Quarter Chart – Traffic vs. Sales **Post-Lockdown** Impact. |
| 6. | Story Design | • **Bar** Chart – Avg Sales by Product Category<br>• **Key Findings**.<br>• **Regional** Traffic Impact<br>• Promotion Effectiveness<br>• Sales Optimization Insights<br>**Story fiiges:**<br>• Key Findings<br>• Regioval Traffic<br>• Sales Optimiz Insights |

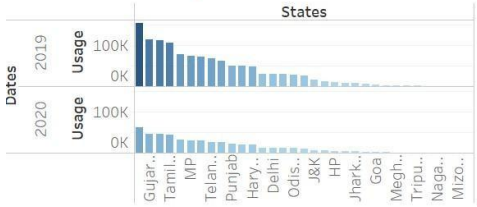
# 6 RESULTS :

## a Output Screenshots:

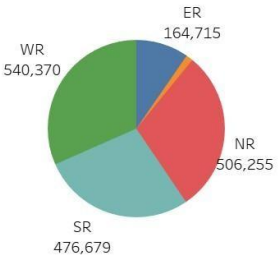


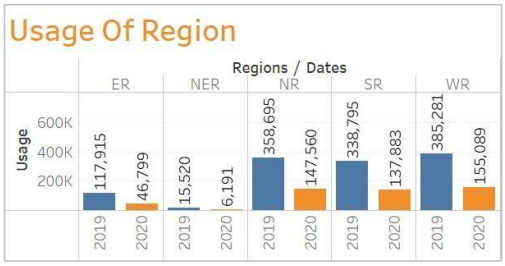
## Total Consumption




## Total Consumption Region Wise

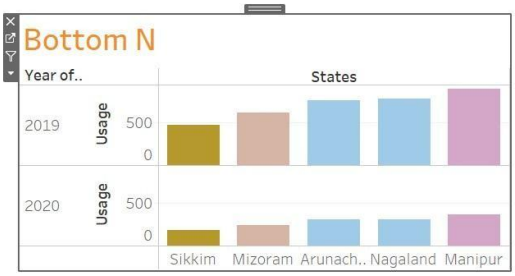



## Usage Of Region

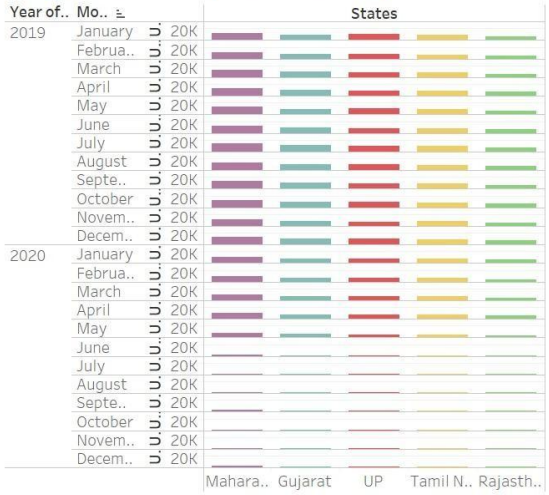



## Top N

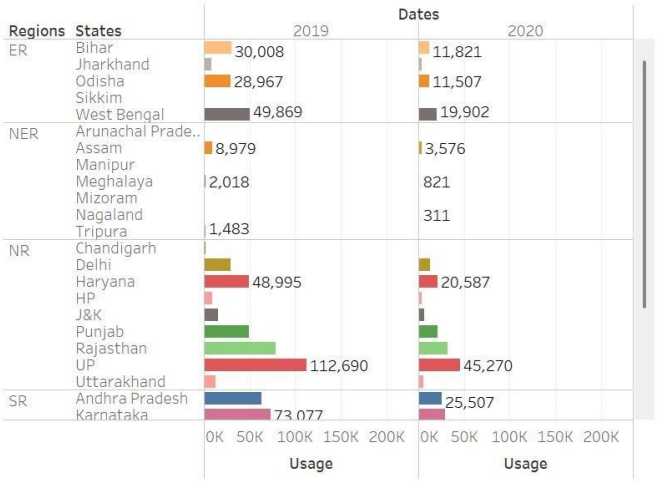

## Bottom N




## Regionwise Top N Consumption




## Regionwise State Usage

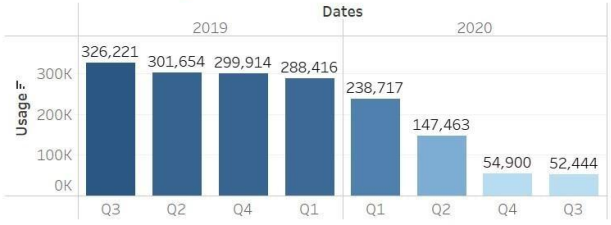


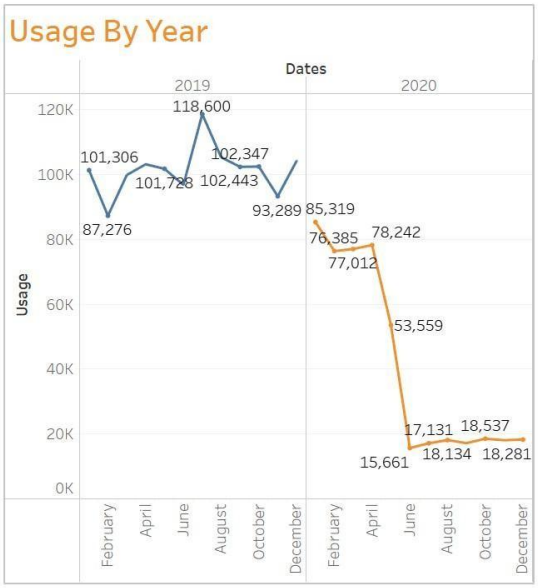

## 2019 Monthwise Consumption

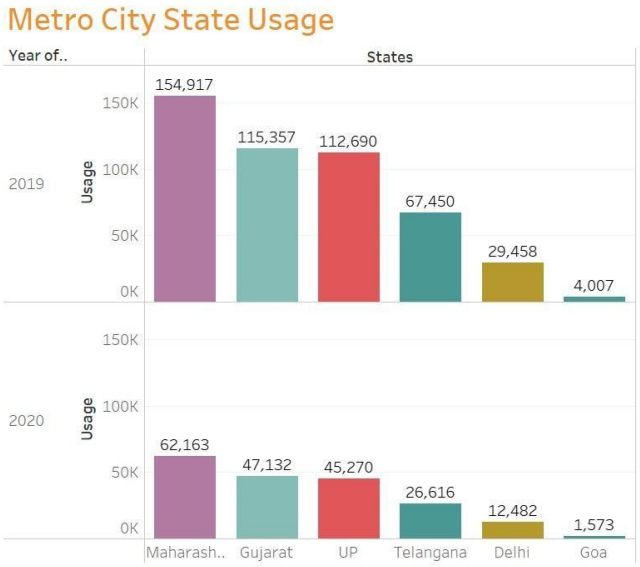

## 2020 Monthwise Consumption


## Usage Before And After Lockdown


## Quarter Usage






| Disadvantage | Description |
|---|---|
| **1. Static Data Source** | Since the dataset is CSV-based, it lacks real-time data updates. Manual uploads are required for each update cycle. |
| **2. No Predictive Capabilities** | The current solution is descriptive, not predictive. It identifies patterns but doesn't forecast future trends. |
| **3. Limited Automation** | Without integration to live data sources (e.g., APIs, databases), it cannot support automated, continuous data refresh. |
| **4. Requires Tableau Familiarity for Editing** | While the dashboard is easy to use, editing charts or building new visuals requires knowledge of Tableau. |
| **5. No Backend Storage for Historical Dashboards** | Tableau Public does not support complex versioning or change-tracking unless hosted in Tableau Cloud/Server. |

# CONCLUSION:

This project, **"Plugging into the Future – Electricity Consumption Analysis Using Tableau,"** successfully demonstrates how electricity consumption data — when visualized effectively — can uncover meaningful insights that directly support energy planning and policy decisions. By transforming a static electricity consumption dataset into a fully interactive and filterable Tableau dashboard, the project empowers energy stakeholders to:

- Identify which states and regions have the highest electricity demand.
- Understand the impact of seasonal variations and lockdown periods on power consumption.
- Compare yearly and quarterly trends to detect growth patterns and demand shifts.
- Highlight hidden insights that were previously difficult to interpret using traditional spreadsheets or static reports.

The dashboard offers a user-friendly and visually intuitive interface that supports real-time filtering, multiple chart types (e.g., maps, bar charts, line charts, pie charts), and a structured story presentation to communicate findings clearly. It serves as a valuable decision-support tool for:

- Energy department officials planning infrastructure development
- Policymakers designing efficient power distribution strategies

• Analysts monitoring consumption patterns and regional demand

Through structured project planning, sprint-based execution, and iterative dashboard design, the solution achieved its key objectives:

• Enhanced data visibility

• Faster and evidence-based decision-making

• Reduced dependence on manual analysis

Although there are limitations — such as reliance on historical data and absence of predictive forecasting — the project establishes a strong and scalable foundation for future enhancements, including real-time integration and advanced analytics.

In conclusion, this project validates that visual data storytelling using Tableau is a powerful tool for improving transparency, efficiency, and strategic decision-making in electricity consumption management.

# FUTURE SCOPE:

### 1. Real-Time Data Integration

Integrate live electricity consumption feeds from smart meters, energy grids, or government databases.

• Use Tableau live data connections or APIs to automatically update dashboards without manual uploads.

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### 2. Predictive Analytics and Machine Learning

Incorporate machine learning models (using Python or R) to: o
Forecast future electricity demand based on historical trends. o Predict
peak load periods and seasonal demand spikes.

• Apply clustering techniques to group regions with similar consumption patterns for optimized distribution planning.

---

### 2. Cloud Deployment for Collaboration

Deploy the dashboard on Tableau Cloud or Tableau Server for centralized access.

• Enable energy departments, policymakers, and analysts to collaborate using a unified data source.

---

### 3. Deeper Segmentation and Personalization

• Extend analysis to sector-wise consumption (Residential, Commercial, Industrial).

• Add deeper time-based filters such as weekday vs. weekend or hourly demand patterns.

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### 5. Historical Data Versioning

Implement year-over-year and quarter-over-quarter comparison features.

Add toggle options to compare pre-lockdown, lockdown, and post-lockdown electricity usage.

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### 6. Dashboard-as-a-Service Model

Offer the dashboard as an analytics solution for electricity boards or smart city projects. Provide customizable versions for different states or energy departments with integrated realtime data.

## APPENDIX:

Dataset Link - https://drive.google.com/file/d/1XDxHSKwHBM-VNf-6sz_406Y0e7MJRrAd/view?usp=drivesdk

GitHub - https://github.com/Nx316/Electricity-_Consumption_Patterns_Using_Tableau/tree/main Project Demo Link- https://drive.google.com/file/d/1N7IOkm_RljOG1cDrDgdEclCPF6UXRcT5/view?usp=drivesdk