Chapter-01

Introduction

In an increasingly electrified world, understanding how we generate, distribute, and consume electricity has never been more important. From powering homes and industries to enabling digital transformation and electric mobility, electricity lies at the heart of modern life. As global demand continues to rise, analyzing consumption patterns is critical for improving efficiency, reducing costs, and advancing sustainability goals.

This project, **"Plugging into the Future,"** leverages the powerful data visualization capabilities of Tableau to explore electricity consumption trends across regions, sectors, and time. By transforming raw energy data into interactive dashboards and insightful visual stories, the analysis aims to uncover meaningful patterns, seasonal variations, peak demand periods, and long-term growth trajectories.

"Plugging into the Future" is a data analytics and visualization project that examines electricity consumption patterns using Tableau. The project focuses on transforming raw electricity usage data into meaningful visual insights that reveal trends, seasonal variations, and sector-wise consumption behavior. As global energy demand continues to rise due to population growth, urbanization, and industrial expansion, understanding electricity consumption patterns has become essential for sustainable planning and efficient resource management.

This project analyzes historical electricity consumption data across different regions and sectors such as residential, commercial, and industrial. By leveraging Tableau's interactive dashboards, time-series visualizations, and forecasting tools, the project identifies peak demand periods, growth trends, and regional disparities in electricity usage. It also highlights how consumption fluctuates across months and seasons, helping stakeholders better understand usage behavior and energy requirements.

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Chapter – 2

2.1Problem Statement

In today's rapidly evolving energy landscape, electricity consumption is increasing due to urbanization, industrial growth, technological advancement, and population expansion. However, despite the availability of large volumes of energy data, many organizations struggle to transform this raw information into meaningful insights that support efficient planning and sustainable decision-making. Without clear visibility into consumption trends, peak demand periods, and sector-wise usage patterns, it becomes challenging to optimize resource allocation, reduce energy waste, and plan for future infrastructure needs.

This project, **"Plugging into the Future: An Exploration of Electricity Consumption Patterns Using Tableau,"** addresses this challenge by leveraging interactive data visualization tools to analyze and interpret electricity usage data. By identifying trends, seasonal variations, regional disparities, and consumption behaviors across different sectors, the study aims to uncover actionable insights that can guide policymakers, utility providers, and energy planners toward more efficient and sustainable energy management strategies.

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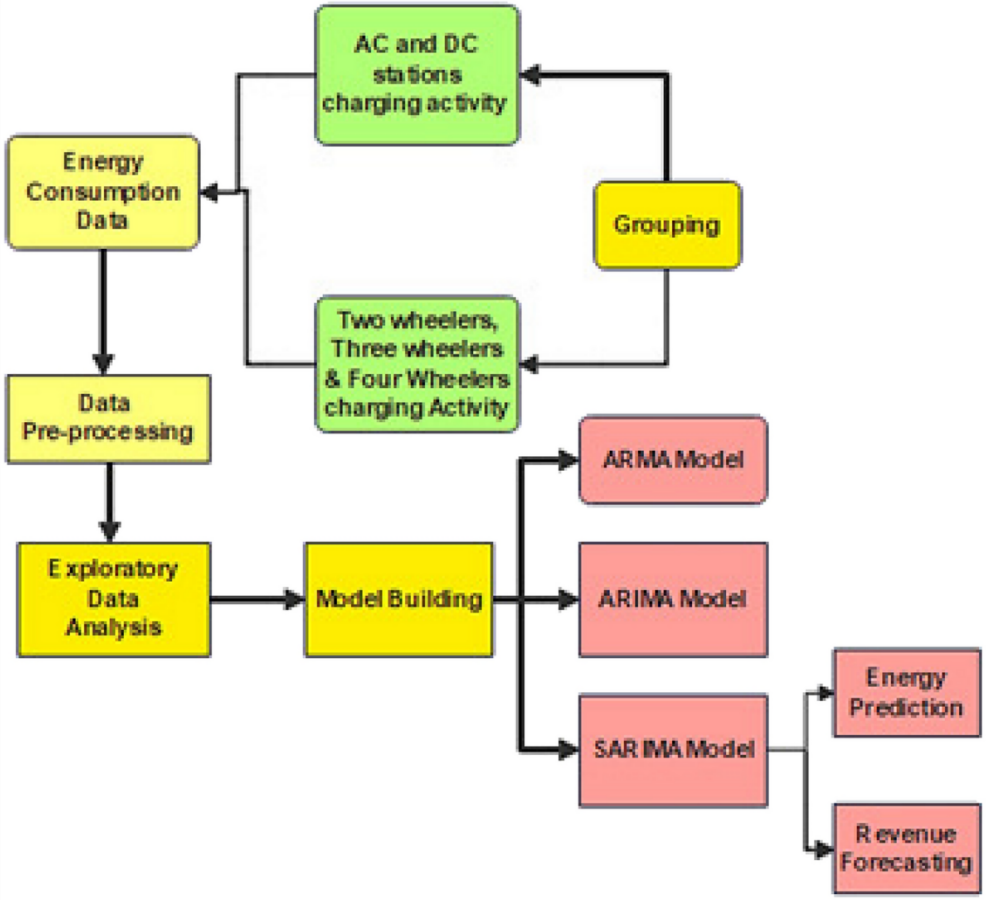

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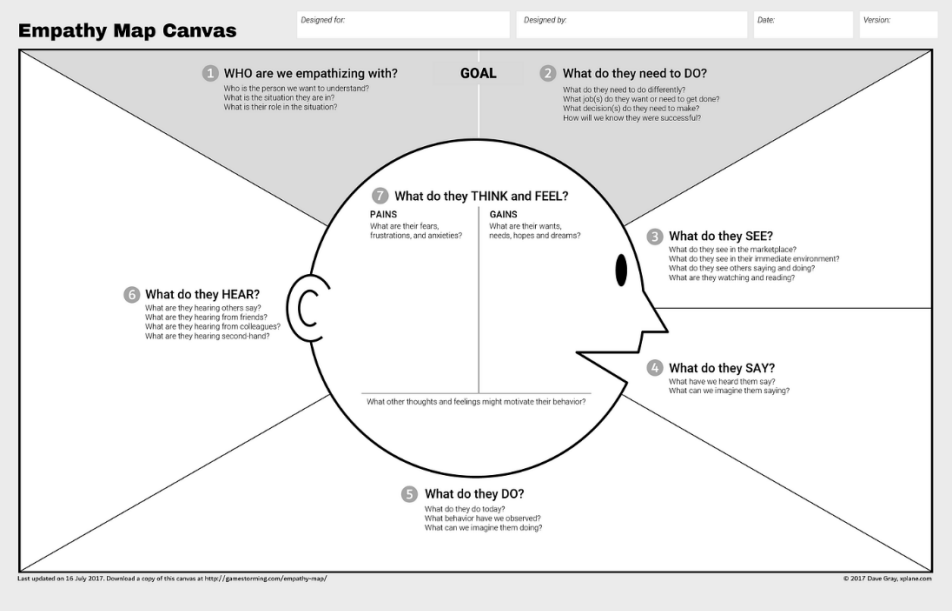
2.2 EMPATHY MAP CANVAS:

The Empathy Map Canvas further emphasizes the importance of aligning data insights with stakeholder expectations and real-world challenges. Decision-makers not only require accurate consumption figures but also intuitive visual representations that simplify complex patterns and support strategic discussions. By incorporating interactive dashboards, trend analyses, and comparative visual tools in Tableau, the project ensures that users can explore data dynamically, ask deeper questions, and uncover hidden correlations. This user-centered approach strengthens engagement, enhances clarity, and ultimately supports more informed, proactive energy management decisions.



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2.3 – Brainstorming:

When brainstorming this project, the main idea is to understand how different housing features influence sale prices and how market trends change over time. The housing market generates a large amount of data, including property details, pricing information, and location-based factors. The goal is to transform this raw data into meaningful visual insights using Tableau.

The first step in brainstorming is identifying key questions. For example: What factors most strongly affect house prices? Does a larger house always mean a higher sale price? How does location impact pricing? Are newer houses more expensive than older ones? Are there seasonal trends in housing sales? By defining these questions, the analysis becomes focused and purposeful.

Next, we identify important variables for the dataset. These may include sale price, number of bedrooms, number of bathrooms, square footage, lot size, year built, neighborhood, property type, and condition of the house. Each of these features may influence pricing differently. For instance, location might have a greater impact than the number of bedrooms in high-demand areas.

Reference: https://www.mural.co/templates/brainstorm-and-idea-prioritization

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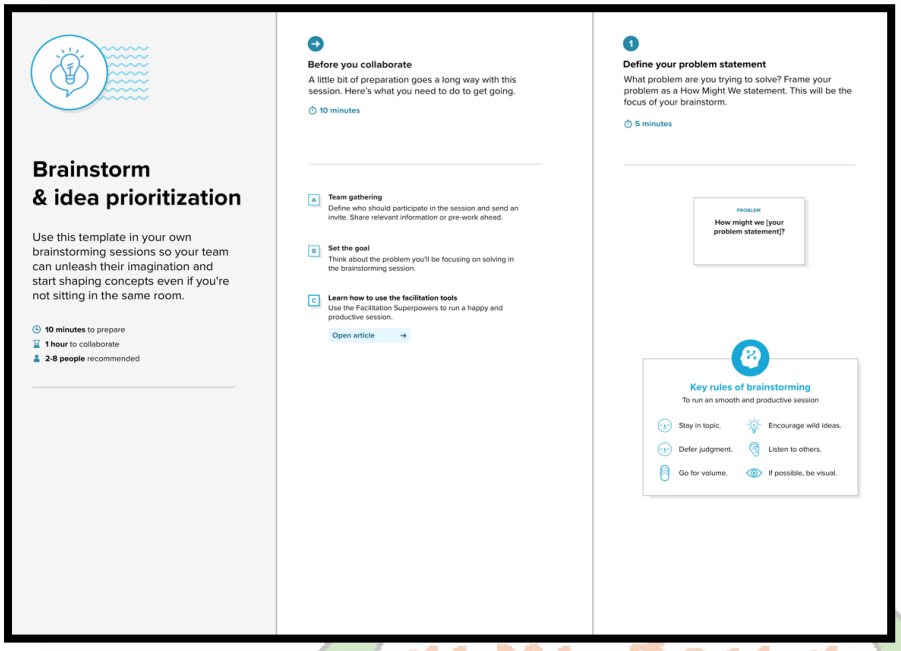
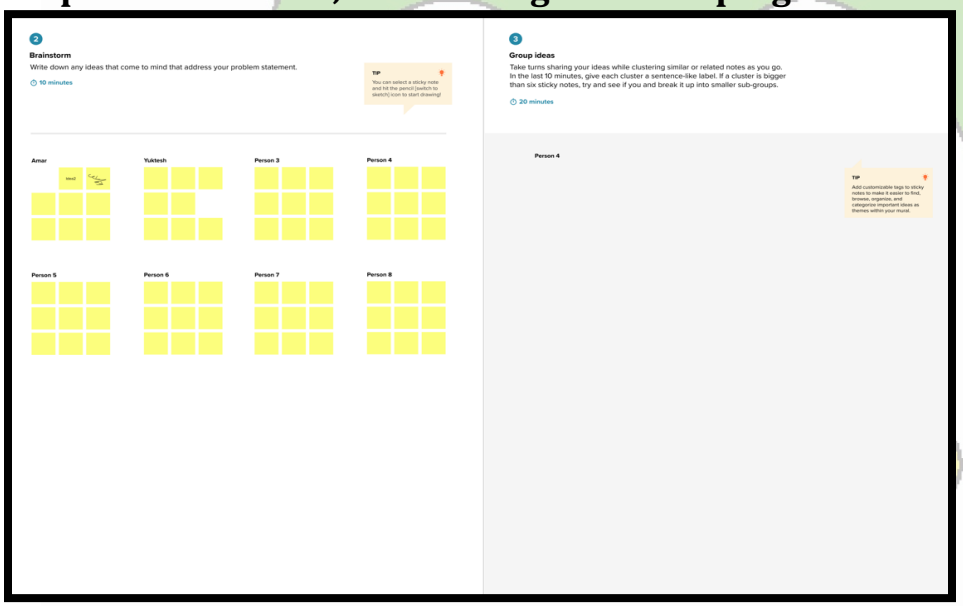
Step-1: Team Gathering, Collaboration and Select the Problem Statement:



Step-2: Brainstorm, Idea Listing and Grouping:



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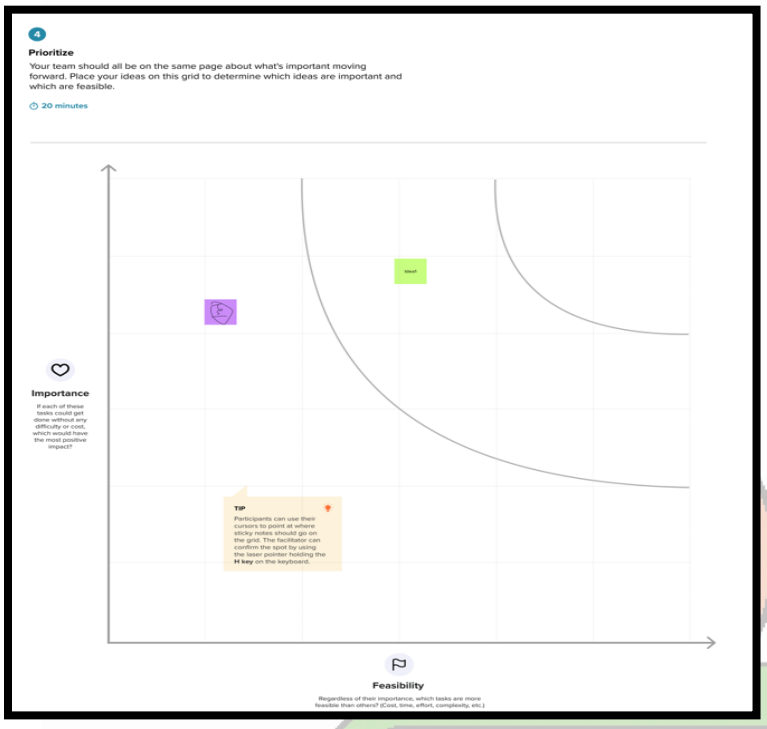
Step-3: Idea Prioritization:



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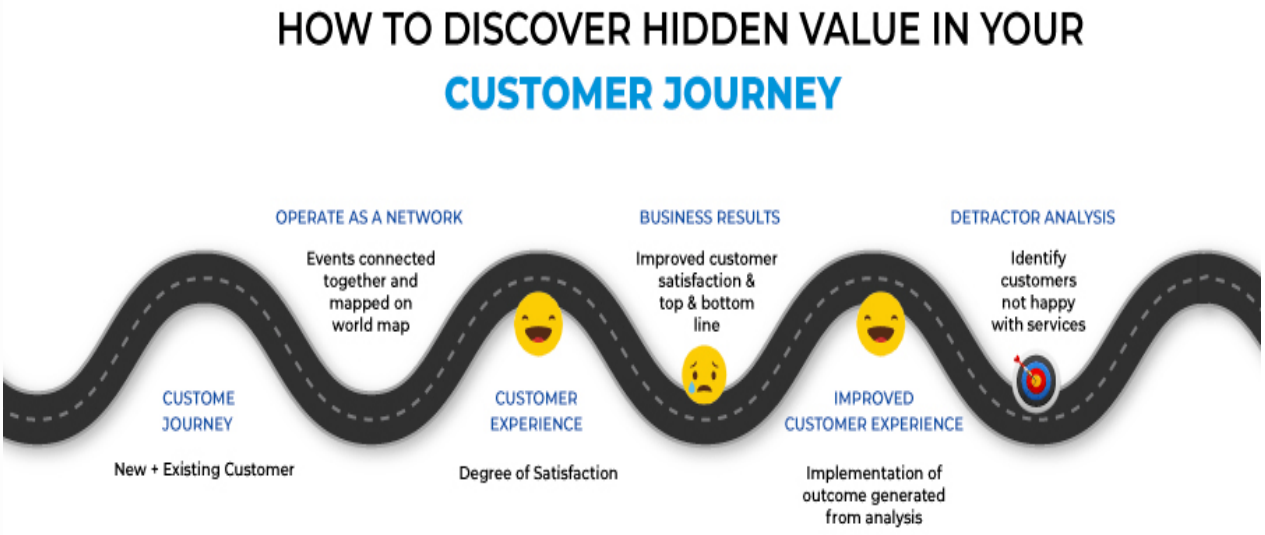
Chapter-3

3.1 Customer journey Map

The Customer Journey Map also emphasizes the emotional and strategic progression of the user throughout the project lifecycle. Initially, users may feel overwhelmed by fragmented datasets and uncertain forecasts, but as they engage with interactive dashboards built in Tableau, their confidence gradually increases. Clear visualizations, intuitive filters, and real-time insights reduce complexity and enhance understanding. Over time, this positive experience fosters trust in data-driven decision-making, encourages collaboration among departments, and strengthens long-term planning for sustainable electricity management.



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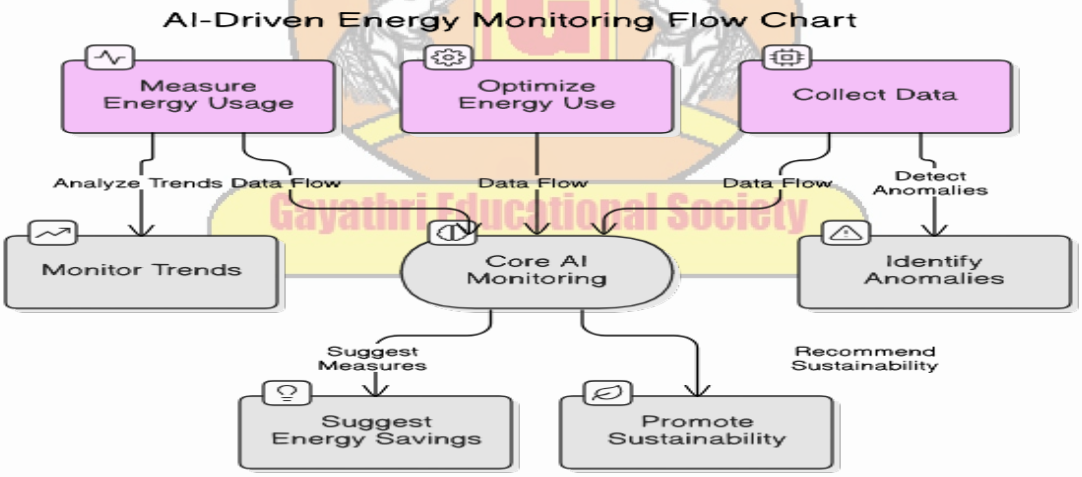
3.2 Solution Requirements

Data Requirements

- **Comprehensive Consumption Data:** Historical electricity usage data across residential, commercial, and industrial sectors.
- **Regional and Temporal Granularity:** Data segmented by regions, states, cities, and time intervals (daily, monthly, yearly).
- **Energy Source Information:** Breakdown of consumption by renewable and non-renewable sources.
- **Demographic & Economic Indicators:** Population, urbanization rate, industrial growth, and economic activity for correlation analysis.
- **Data Quality:** Accurate, complete, and consistent datasets, preferably in CSV, Excel, or database formats compatible with Tableau.

By meeting these solution requirements, the project aims to transform complex electricity consumption data into actionable insights, enabling stakeholders to make informed, strategic, and sustainable energy management decisions using Tableau.



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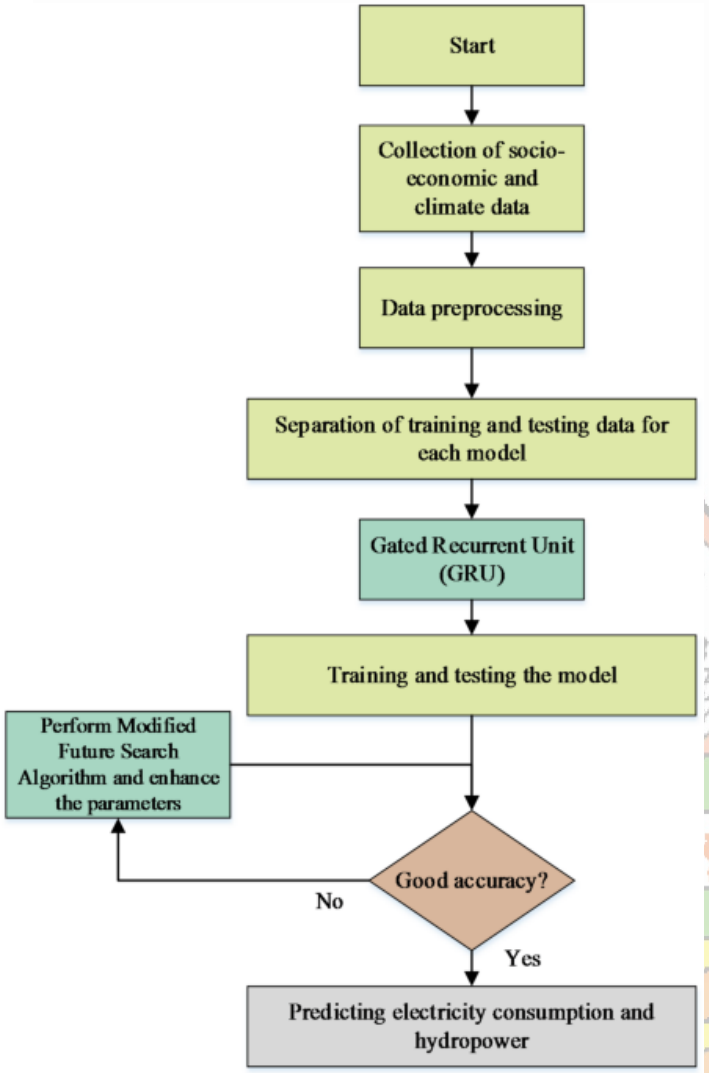
3.3 Data Flow Diagram

In the project *Plugging into the Future: An Exploration of Electricity Consumption Patterns Using* Tableau, the data flow begins with collection from multiple sources. Electricity consumption data is sourced from utility companies, smart meters, government energy reports, and open datasets. This raw data often comes in varied formats such as CSV files, Excel spreadsheets, or SQL databases, containing information about time-stamped usage, regional distribution, sector-wise consumption, and energy sources.

Once collected, the data enters the data preprocessing stage, where it is cleaned, validated, and standardized. Missing values are handled, inconsistent entries are corrected, and datasets are transformed into a structured format suitable for analysis. During this stage, additional demographic and economic indicators—like population density, industrial output, and urbanization rates—are integrated to enrich the dataset and enable correlation analyses.

The prepared data is then imported into Tableau, which acts as the central processing and visualization engine. Here, the data is connected through live connections or extracts, depending on the need for real-time updates or historical analysis. Within Tableau, interactive dashboards are designed to allow users to filter by region, sector, or time period, visualize seasonal trends, perform comparative analyses, and forecast future consumption patterns using built-in analytical and predictive tools.



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3.4 Technology Stack

The “Plugging into the Future” project relies on a robust and integrated technology stack to collect, process, analyze, and visualize electricity consumption patterns efficiently. At the core of the stack is Tableau, which provides advanced capabilities for creating interactive dashboards, visual analytics, and predictive insights. Tableau serves as the front-end visualization layer, enabling stakeholders to explore complex electricity data dynamically, filter by region, sector, or time, and identify trends and anomalies without deep technical expertise.

On the data management side, the project leverages relational databases (such as MySQL or PostgreSQL) and cloud storage solutions (like AWS S3 or Google Cloud Storage) to store large volumes of structured and semi-structured electricity consumption data. These databases maintain historical records from utility companies, smart meters, and government datasets, ensuring scalability and reliability. Data extraction and transformation are handled using ETL (Extract, Transform, Load) tools or scripting languages such as Python or R, which clean, normalize, and enrich the data by integrating demographic, economic, and environmental indicators.

For analytics and forecasting, the stack incorporates Python libraries like pandas, NumPy, and scikit-learn, enabling statistical analysis, trend identification, and predictive modeling for future electricity demand. Where real-time monitoring is required, API integrations allow live connections from smart meters or utility data systems directly into Tableau, providing near real-time insights. Visualization enhancements may include Tableau extensions or JavaScript APIs, allowing custom interactivity and embedding dashboards into internal platforms for stakeholders.

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4.1 Problem-Solution Fit

The central problem addressed in *Plugging into the Future: An Exploration of Electricity Consumption Patterns Using* Tableau revolves around the difficulty of understanding complex electricity consumption patterns and converting raw energy data into actionable insights. Utility managers, policymakers, and energy analysts often face fragmented datasets, static reports, and limited analytical tools, making it challenging to identify trends, forecast demand, and plan for efficient energy usage. Seasonal spikes, regional disparities, and sector-wise consumption differences further complicate decision-making, while the lack of interactive visualization reduces clarity and slows response to changing energy needs.

The solution provided by this project directly addresses these challenges through a combination of data integration, preprocessing, visualization, and predictive analytics. By consolidating electricity consumption data from multiple sources—utility databases, smart meters, government reports, and demographic indicators—into a structured format, the project ensures data accuracy, completeness, and consistency. Tableau then enables the creation of interactive dashboards, allowing users to filter data by region, sector, and time period, explore trends, and perform comparative analyses easily. Advanced forecasting features allow stakeholders to predict future demand, while drill-down capabilities help uncover sector-specific or region-specific insights that were previously hidden in static reports.

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4.2 Proposed Solution

The proposed solution for *Plugging into the Future: An Exploration of Electricity Consumption Patterns Using* Tableau focuses on transforming complex electricity consumption data into actionable insights through an integrated, interactive, and user-friendly analytics platform. The solution begins with the collection and consolidation of diverse datasets from utility companies, smart meters, government energy reports, and open-source databases. These datasets include historical electricity usage, sector-wise consumption (residential, commercial, industrial), regional distribution, energy source types, and demographic or economic indicators, which are essential for understanding patterns and correlations.

Once the data is gathered, it undergoes a robust preprocessing and ETL (Extract, Transform, Load) process. This step ensures data accuracy, handles missing or inconsistent entries, and standardizes formats to make the data compatible with Tableau. Additional enrichment, such as population density, industrial growth, and seasonal weather data, allows the system to deliver deeper insights into the factors driving electricity demand.

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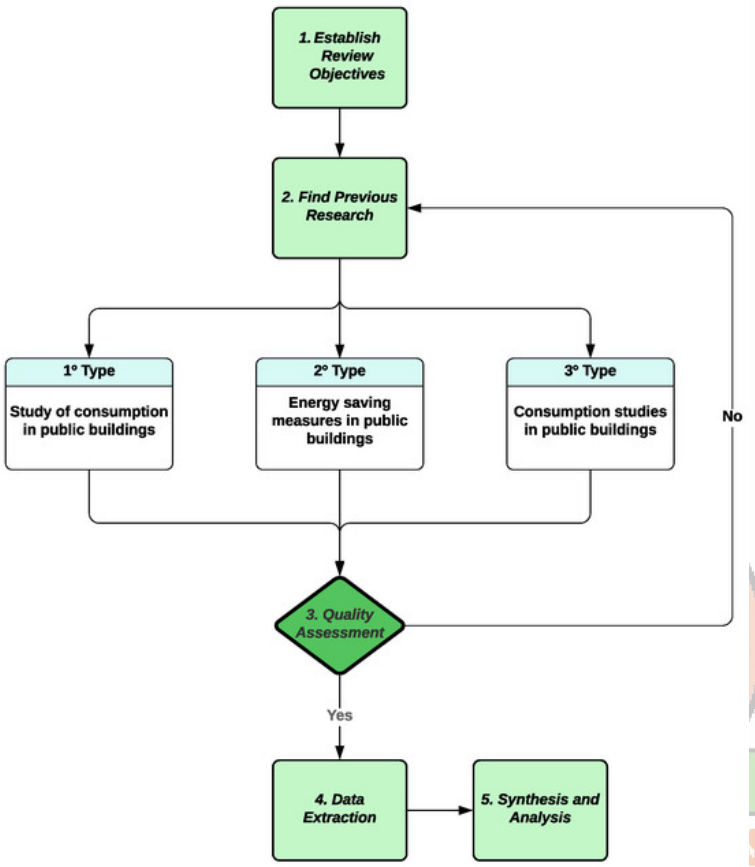
4.3 Solution Architecture

The solution architecture for *Plugging into the Future: An Exploration of Electricity Consumption Patterns Using* Tableau is designed as a multi-layered, end-to-end system that transforms raw electricity consumption data into actionable insights for energy stakeholders. At the foundation is the data layer, which aggregates electricity usage data from multiple sources, including utility providers, smart meters, government energy reports, and open datasets. This layer also incorporates supplementary data such as population statistics, industrial output, and urbanization metrics, which are essential for contextual analysis. Data is stored in structured formats within relational databases (like MySQL or PostgreSQL) or cloud storage solutions (such as AWS S3 or Google Cloud Storage), ensuring scalability, reliability, and secure access.

Above the data layer is the data processing and integration layer, where raw datasets are cleaned, validated, and transformed through ETL pipelines or scripting languages like Python and R. This step handles missing values, resolves inconsistencies, and standardizes data formats to ensure compatibility with Tableau. Preprocessing also includes data enrichment to provide correlations between electricity consumption and demographic or economic indicators, enabling more comprehensive analysis.



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Chapter – 5

5.1 - Project Milestones & Tasks

Data Collection

Objective: Gather high-quality, relevant data required for the project.

Tasks:

- Identify reliable data sources (databases, APIs, web scraping, surveys, etc.)
- Collect structured and unstructured data
- Ensure data relevance and completeness
- Store data in a centralized database or storage system
- Maintain data documentation for reference

Deliverables:

- Raw dataset
- Data source documentation
- Data storage setup

Data Pre-Processing

Objective: Clean and prepare the data for model training and analysis.

Tasks:

- Remove duplicates and handle missing values
- Handle outliers and inconsistent data
- Data normalization or scaling
- Feature engineering and selection

- Encode categorical variables
- Split dataset into training and testing sets

Deliverables:

- Cleaned dataset
- Feature-engineered dataset
- Preprocessing scripts

Model Building

Objective: Develop and train a machine learning model.

Tasks:

- Select appropriate algorithm(s)
- Train model using training dataset
- Hyperparameter tuning
- Model validation and evaluation
- Compare performance metrics
- Finalize best-performing model

Deliverables:

- Trained model
- Evaluation report (Accuracy, Precision, Recall, F1-score, etc.)
- Saved model file
- Test API responses
- Secure API (authentication if required)

Web Integration

Objective: Integrate API into a web-based user interface.

Tasks:

- Design user-friendly frontend interface
- Connect frontend to backend API

- Display model predictions dynamically
- Implement input validation
- Perform end-to-end testing
- Deploy web application

Deliverables:

- Fully functional web application
- User interface design
- Live deployment link (if applicable)

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5.2 - Sprint Delivery Plan

Phase 1: Live Sessions (Week 1–6)

Objective: Build strong foundational knowledge and prepare interns for real-time project development.

Sprint 1 (Week 1–2): Fundamentals & Tools

Focus Areas:

- Introduction to Internship Program
- Programming Fundamentals (Python / Relevant Tech Stack)
- Git & GitHub
- Development Environment Setup
- Basics of Databases

Deliverables:

- Setup development environment
- GitHub repository creation
- Mini practice assignments

Sprint 2 (Week 3–4): Data & Backend Foundations

Focus Areas:

- Data Handling (Pandas / Data Structures)
- Data Cleaning Techniques

- Introduction to APIs
- Backend Basics (Flask / FastAPI)
- SQL & Database Integration

Deliverables:

- Data preprocessing assignment
- Basic API development task
- Database connectivity demo

Sprint 3 (Week 5–6): Machine Learning & Deployment Basics

Focus Areas:

- Machine Learning Fundamentals
- Model Training & Evaluation
- REST API Integration with Model
- Introduction to Web Integration
- Deployment Overview

Deliverables:

- Simple ML Model
- Model evaluation report
- API with working prediction endpoint

◇ Phase 2: Project Work (Week 7–15)

Objective: Apply learned skills to build a complete end-to-end project.

Sprint 4 (Week 7–8): Project Planning & Data Collection

Activities:

- Finalize project topic

- Define problem statement
- Collect dataset
- Perform initial data analysis (EDA)

Deliverables:

- Project proposal document
- Dataset documentation
- EDA report

Sprint 5 (Week 9–10): Data Preprocessing & Feature Engineering

Activities:

- Clean dataset
- Handle missing values & outliers
- Feature engineering
- Data transformation
- Train-test split

Deliverables:

- Cleaned dataset
- Preprocessing pipeline
- Feature documentation

Sprint 6 (Week 11–12): Model Development & Optimization

Activities:

- Train multiple models
- Hyperparameter tuning
- Model comparison

- Performance evaluation

Deliverables:

- Best performing model
- Evaluation metrics report
- Saved model artifact

Sprint 7 (Week 13–14): API Development & Integration

Activities:

- Develop REST API
- Integrate trained model
- Implement validation & error handling
- Test API endpoints

Deliverables:

- Functional API
- API documentation
- Backend deployment

Sprint 8 (Week 15): Web Integration & Final Deployment

Activities:

- Develop frontend interface
- Connect frontend with API
- End-to-end testing
- Deployment & final presentation

Deliverables:

- Fully functional web application

- Deployment link
- Final project presentation
- Internship completion report

Final Outcome

By the end of 15 weeks, interns will have:

- Strong technical foundation
- Real-time project experience
- A complete end-to-end deployed project
- Industry-ready portfolio project

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5.3 - Project Progress Tracking

1. Zoho Cliq Workspace Structure

Channels Setup

Create the following channels for organized communication:

1. #announcements
   - Official updates
   - Sprint start/end notifications
   - Deadlines & evaluation updates
   - Meeting schedules
2. #project-discussion
   - Technical queries
   - Implementation discussions
   - Code review discussions
   - Issue troubleshooting
3. #daily-updates
   - Daily progress reports
   - Blockers
   - Completed tasks
4. #resources

- Shared datasets
- Documentation links
- Recorded session links
- API documentation

5. #team-specific-channels (if multiple teams)

Example:

- #team-alpha
- #team-beta

2. Sprint-Based Tracking Method

Each sprint will follow a structured reporting cycle.

Daily Progress Update Format (Posted in #daily-updates)

Every intern must post:

Format:

Date:

Sprint:

Tasks Completed:

Tasks In Progress:

Blockers (if any):

Plan for Tomorrow:

Weekly Sprint Review (Every Weekend)

Mentor will post:

- Sprint Goals
- Completed Milestones
- Pending Tasks

- Risk Areas
- Next Week Targets

3. Task Tracking System

Option 1: Zoho Cliq Tasks Feature

Use built-in task management in Zoho Cliq:

- Assign tasks to interns
- Set deadlines
- Track completion status
- Add task priority (High / Medium / Low)

Task Status Workflow:

- 🔘 To Do
- 🔘 In Progress
- 🔘 Completed
- 🔘 Blocked

Option 2: Zoho Projects Integration (Optional)

For advanced tracking, integrate with:

- Zoho Projects

Use:

- Kanban Board
- Gantt Chart
- Milestone tracking
- Automated reminders

📊 4. Sprint Progress Monitoring Dashboard

Track the following metrics weekly:

- % Tasks Completed
- API Development Progress
- Model Accuracy Improvement
- Deployment Readiness
- Bug Count
- Attendance in Live Sessions

Mentor shares a weekly progress summary in:

👉 #announcements channel

5. Milestone Tracking Structure

Milestone	Week	Status	Owner	Remarks
Data Collection	Week 7–8	☐	Team	
Data Preprocessing	Week 9–10	☐	Team	
Model Building	Week 11–12	☐	Team	
API Integration	Week 13–14	☐	Team	
Web Integration	Week 15	☐	Team	

6. Escalation Process

If blocker > 24 hours:

- Post in #project-discussion
- Tag mentor
- If unresolved → Schedule quick call via Zoho Cliq
- Update resolution summary in channel

7. Performance Evaluation Criteria

Evaluation will be based on:

- Daily update consistency
- Sprint milestone completion
- Code quality
- Participation in discussions
- Final project delivery
- Timely submissions

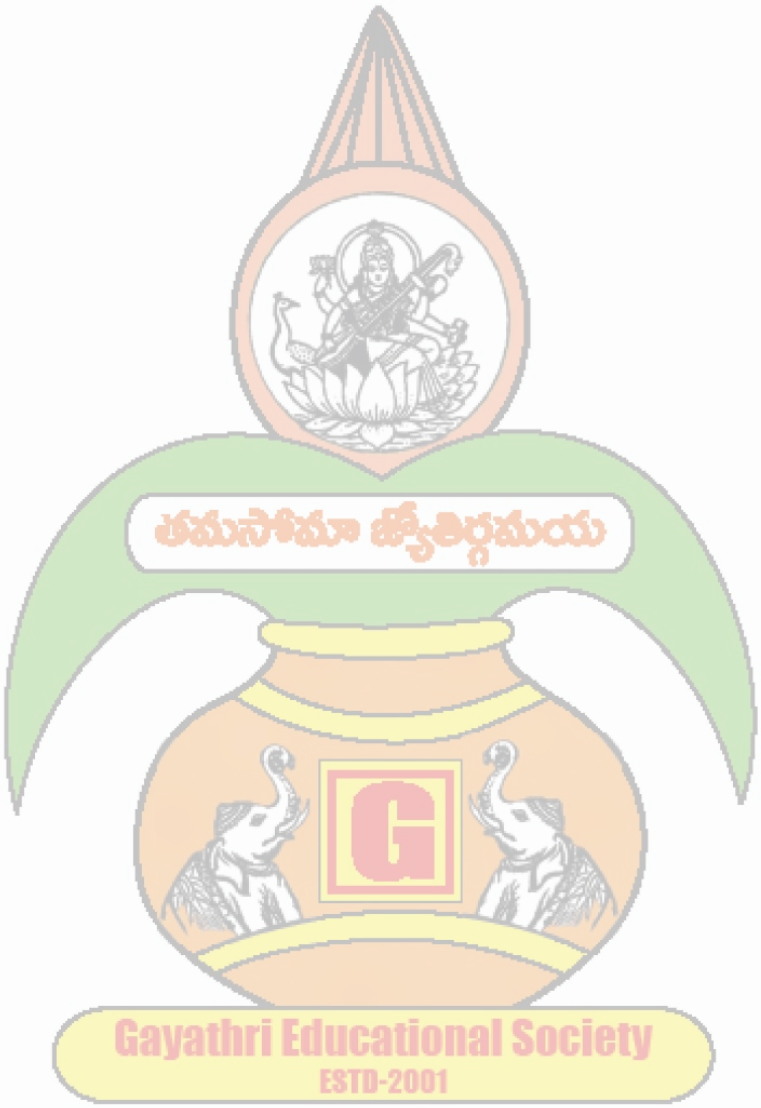
Weekly Workflow Summary

Day	Activity
Monday	Sprint planning post
Tue–Thu	Development & daily updates
Friday	Progress review
Saturday	Sprint demo
Sunday	Feedback & planning

Final Outcome

Using Zoho Cliq ensures:

- Clear communication
- Accountability
- Structured sprint tracking
- Real-time problem resolution
- Professional workflow management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5.4 - Team Management Tools for Agile Planning

What is Jira?

Jira is an Agile project management and issue-tracking tool developed by Atlassian. It supports Scrum and Kanban methodologies, helping teams plan, track, and release software efficiently.

Jira Project Structure for Internship

Project Creation

Create a project with:

- Project Name: Internship Capstone Project
- Template: Scrum (Recommended)
- Project Type: Software Development

Issue Types Configuration

Define standard issue types:

- Epic – Major project phases
- Story – Feature or functionality
- Task – Smaller implementation steps
- Bug – Errors or defects
- Sub-task – Breakdown of tasks

Suggested Epics (Based on Your Milestones)

Epic	Description
Data Collection	Dataset gathering & validation
Data Preprocessing	Cleaning & feature engineering
Model Development	ML training & evaluation
API Integration	Backend & model API
Web Integration	Frontend & deployment

Sprint Planning Structure

Sprint Duration

- 2 Weeks per Sprint
- Total: 4–5 Sprints (Project Phase)

Sprint Workflow

1. Create Sprint in Backlog
2. Add Stories/Tasks to Sprint
3. Assign Tasks to Interns
4. Set Priority (High/Medium/Low)
5. Estimate Story Points
6. Start Sprint

Workflow Status Configuration

Customize workflow:

- To Do
- In Progress
- In Review

- Done
- Blocked

This ensures transparent tracking of task movement.

Agile Boards in Jira

Scrum Board

Used for:

- Sprint planning
- Daily standups
- Tracking sprint progress

Kanban Board (Optional)

Used for:

- Continuous workflow
- API & bug tracking

Agile Reports for Monitoring

Jira provides built-in reports:

- Burndown Chart – Sprint progress tracking
- Velocity Chart – Team performance
- Sprint Report – Completed vs pending work
- Bug Report – Defect tracking

Mentors can review reports weekly to evaluate progress.

Role-Based Access

Define permissions:

Role	Responsibilities

Project Admin	Configure board & workflow
Scrum Master	Sprint planning & review
Developer (Intern)	Task implementation
Reviewer	Code & feature review

Daily Standup Format (Using Jira Board)

Each intern updates:

- What was completed yesterday
- What will be done today
- Any blockers

Tasks must be moved across workflow stages accordingly.

Integration Capabilities

Jira can integrate with:

- GitHub (code tracking)
- CI/CD tools
- Slack or Zoho Cliq (notifications)
- Confluence (documentation)

Example Sprint Breakdown (2 Weeks)

Sprint Goal: Complete Data Preprocessing

Planned Stories:

- Clean missing values
- Outlier detection
- Feature scaling
- Train-test split

Expected Outcome:
Clean dataset ready for model training.

Benefits of Using Jira

- Structured Agile Planning
- Clear Accountability
- Transparent Sprint Tracking
- Performance Analytics
- Real-time Status Visibility
- Industry-standard project management tool

Final Outcome

By implementing Jira for Agile planning, the internship project will follow:

- Scrum-based sprint execution
- Organized backlog management
- Efficient task delegation
- Measurable progress tracking
- Professional software development workflow

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Chapter – 6

6.1 - Pre-Requisites

Tableau Installation Guide:

Tableau is a useful data visualization and business intelligence tool that helps us turn raw data into easy-to-understand charts, dashboards and interactive reports. It is widely used for businesses, analysts and researchers to make sense of complex information and support better decision-making.

Installation:

Let's install Tableau in our local machines.

Step 1: Tableau Website

Go to the official website of Tableau and find the "Products" menu.

Step 2: Tableau Products

Tableau provides various ways to use its features which includes:

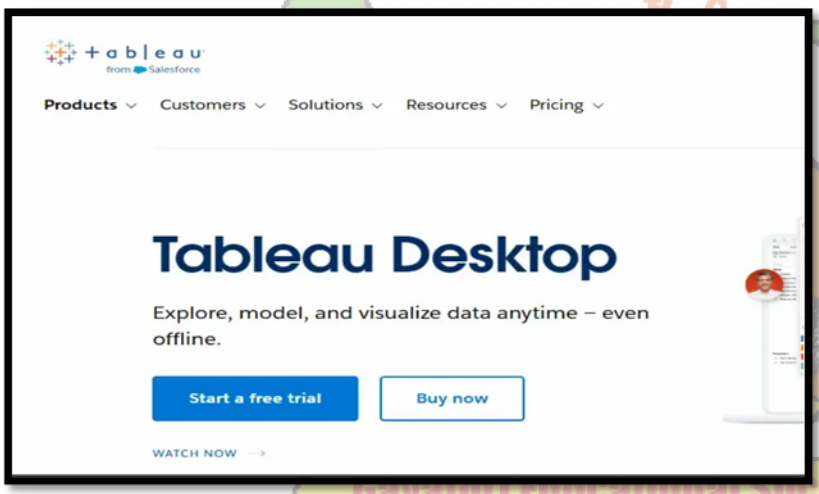
- Tableau Cloud: Cloud-based analytics platform, fully hosted without server management, for data analysis and secure sharing.
- Tableau Server: Self-hosted platform for on-premises or cloud deployment, giving full control over data and analytics environment.
- Tableau Desktop: Authoring tool used to create visualizations and dashboards, supporting offline and deep data exploration.
- Tableau Next: Future-focused AI and modular analytics platform integrating smart workflows and quicker insights.
- Other Products: Tableau Prep (data cleaning), Tableau Public (free public visualizations), Tableau Mobile (mobile access).

We will download the desktop version.

Step 3: Select the Tableau Desktop

We will select the Tableau Desktop option and then there we can have two option:

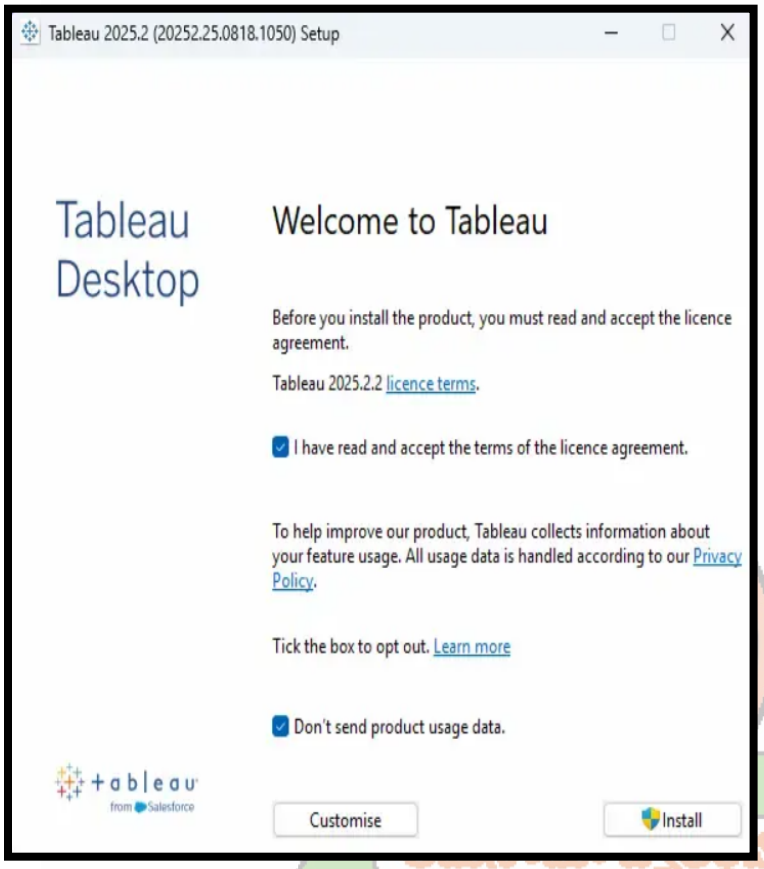
- Start Free Trial
- Buy Now



Select the one which suits you.

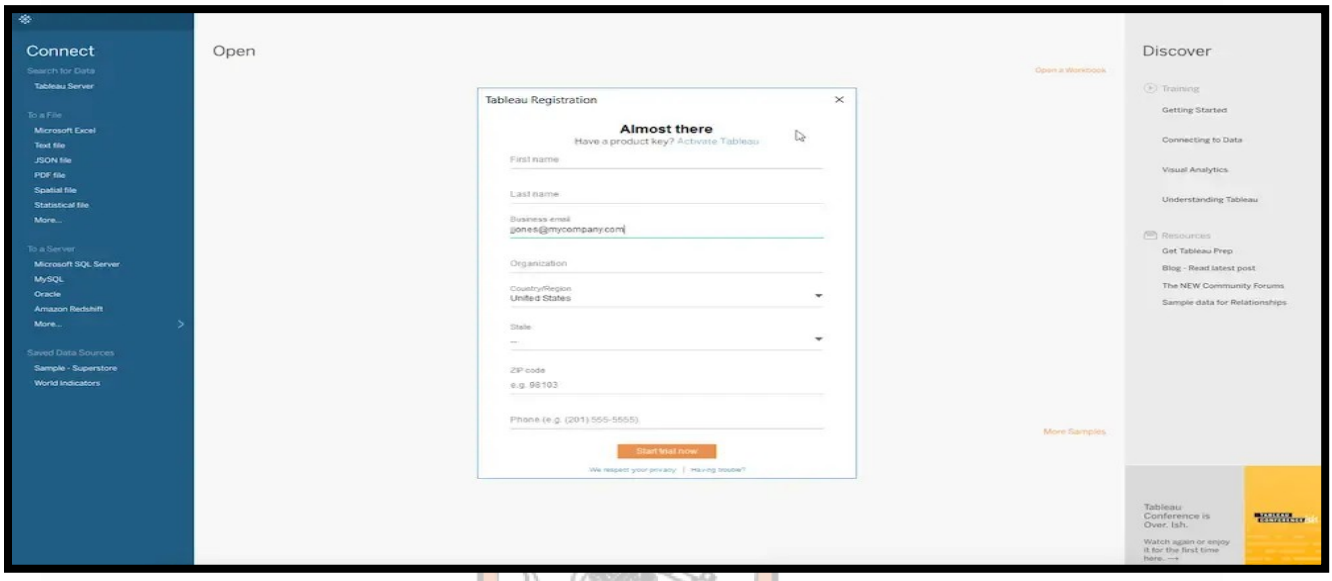
Step 4: Installation

After selecting the option, the setup will get downloaded. After downloading the setup, we need to install it. Open the setup file and proceed with the setup.



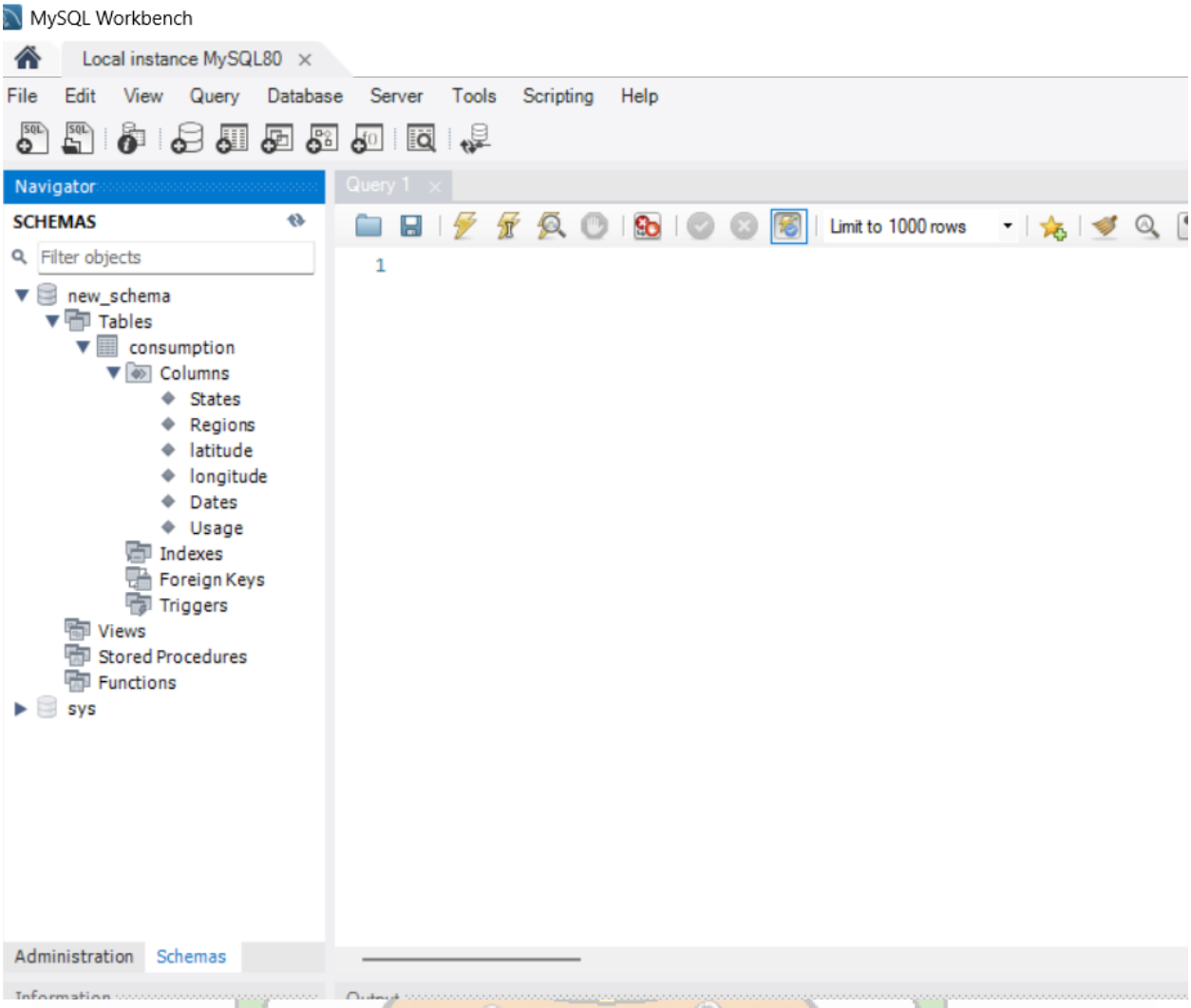
Step 5: Setup

After successful installation, open the Tableau Desktop application and complete the registration.



Step 6: Tableau Desktop

After completing the registration, Tableau is ready to be used.



plugging into the future: an exploration of electricity consumption patterns using tableau

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PROJECT NAME	plugging into the future: an exploration of electricity consumption patterns using tableau
MAXIMUM MARKS	4 MARKS

Step 1: Create / Login to Kaggle Account

1. Go to: https://www.kaggle.com
2. Click Sign Up (if new user) or Sign In
3. Complete email verification

Step 2: Search for Electricity Dataset

1. In the search bar, type:
   "Electricity Consumption Dataset"
2. Choose a dataset such as:
   - Household electricity consumption
   - Global power consumption
   - Energy usage by country
3. Click on the dataset you prefer

Step 3: Download the Dataset

1. Click the Download button
2. The file will download as a ZIP file
3. Extract the ZIP file
4. You will get files like:
   - .csv
   - .xlsx

For Tableau, CSV format is recommended.

PART 2: Connect Kaggle Dataset to Tableau Desktop

Tableau Desktop is developed by Salesforce.

Step 1: Open Tableau Desktop

1. Launch Tableau Desktop
2. On the left side under Connect, choose:
   → To a File
   → Click Text File (for CSV)
   OR
   → Click Microsoft Excel (for .xlsx)

Step 2: Select Dataset File

1. Browse to the folder where you extracted the Kaggle dataset
2. Select the .csv file
3. Click Open

Step 3: Load Data into Tableau

1. Tableau will open the Data Source page
2. Drag the sheet/table into the canvas (if needed)
3. Click Sheet 1

Now your dataset is successfully connected

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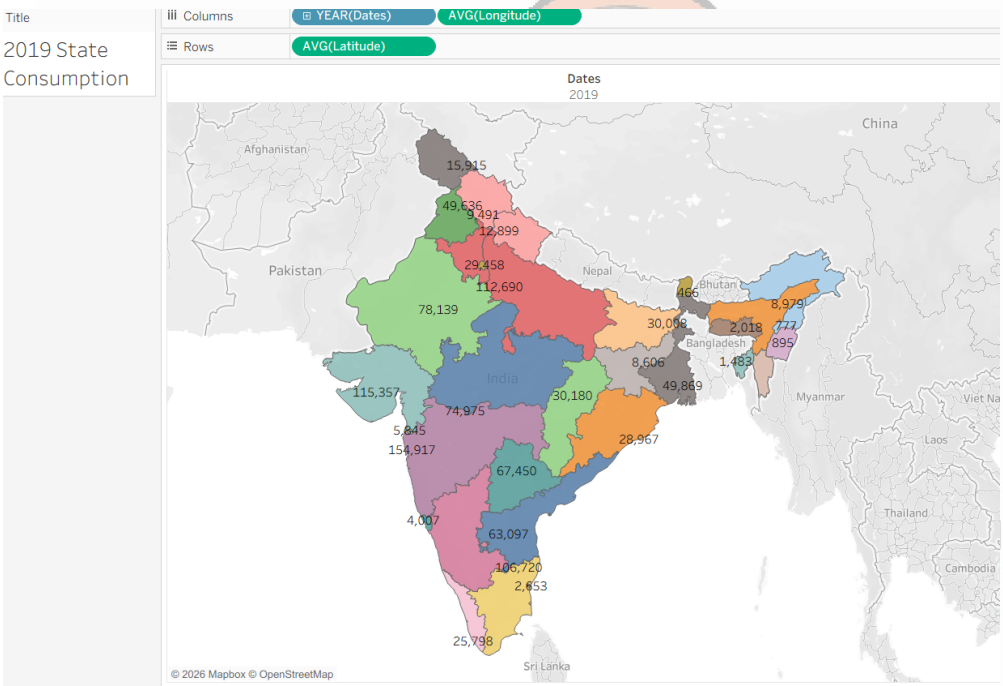
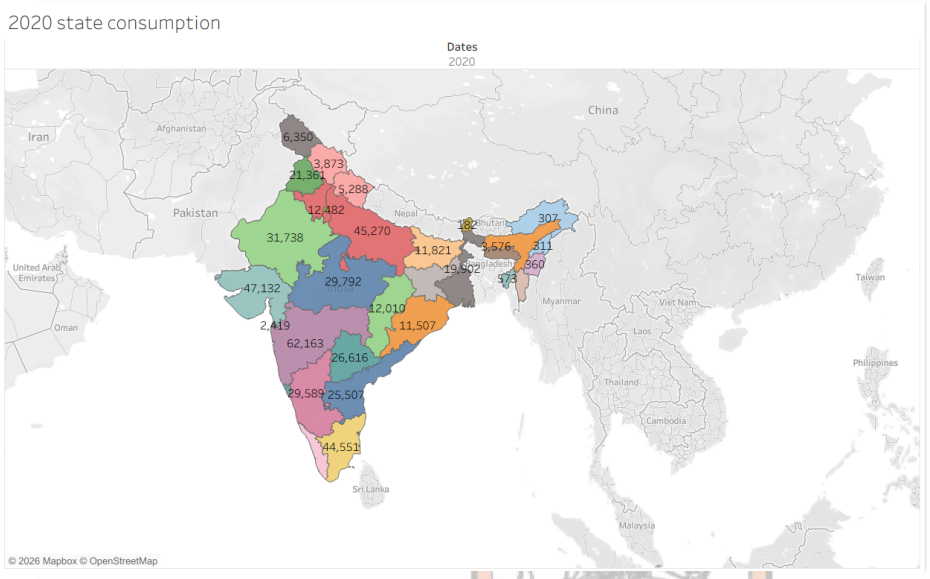
6.3 Data Preparation

Visualizing:

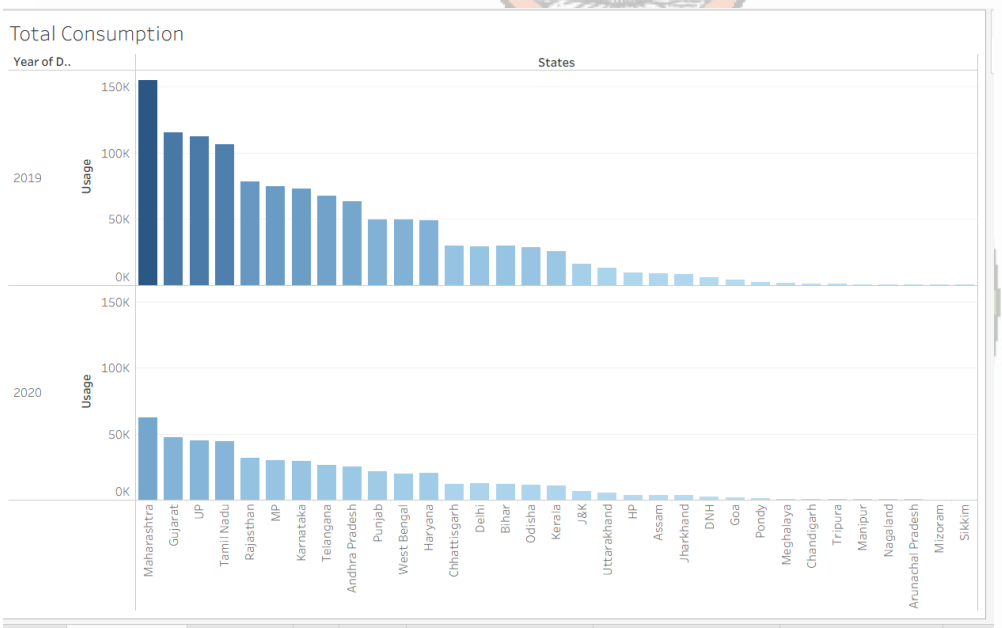
2019 State Consumption:



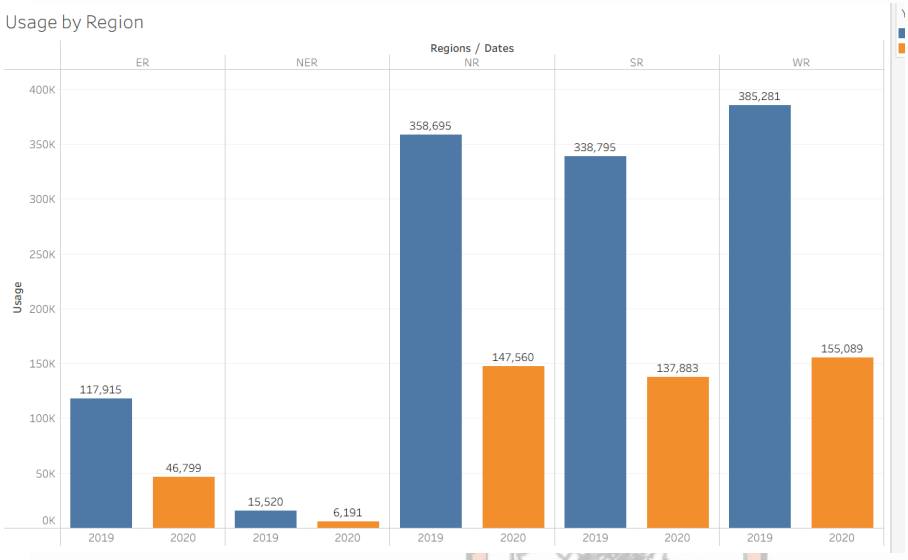
2020 State Consumption:



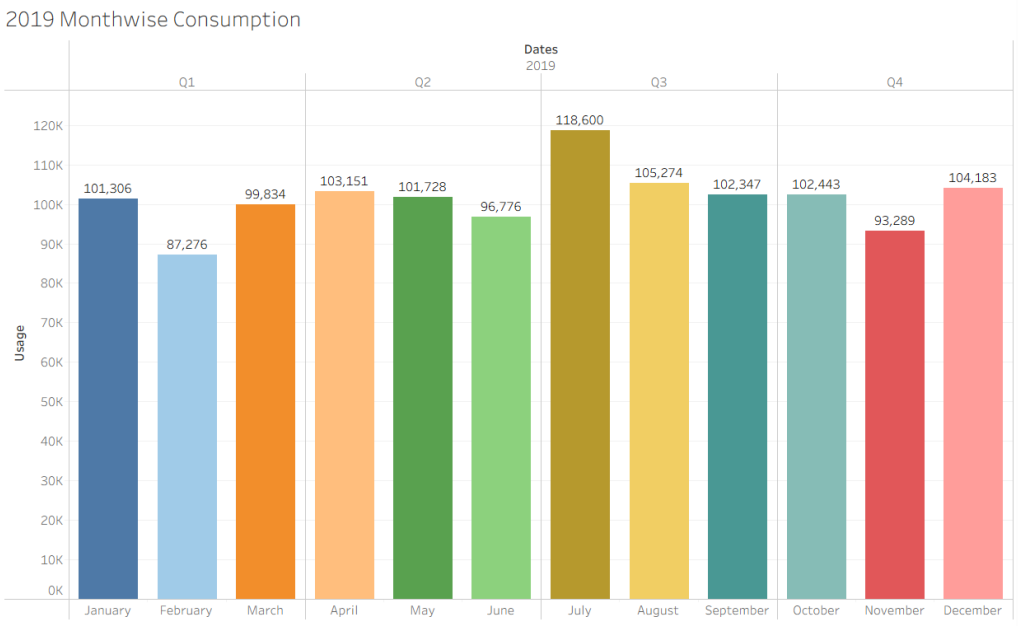
Total Consumption:



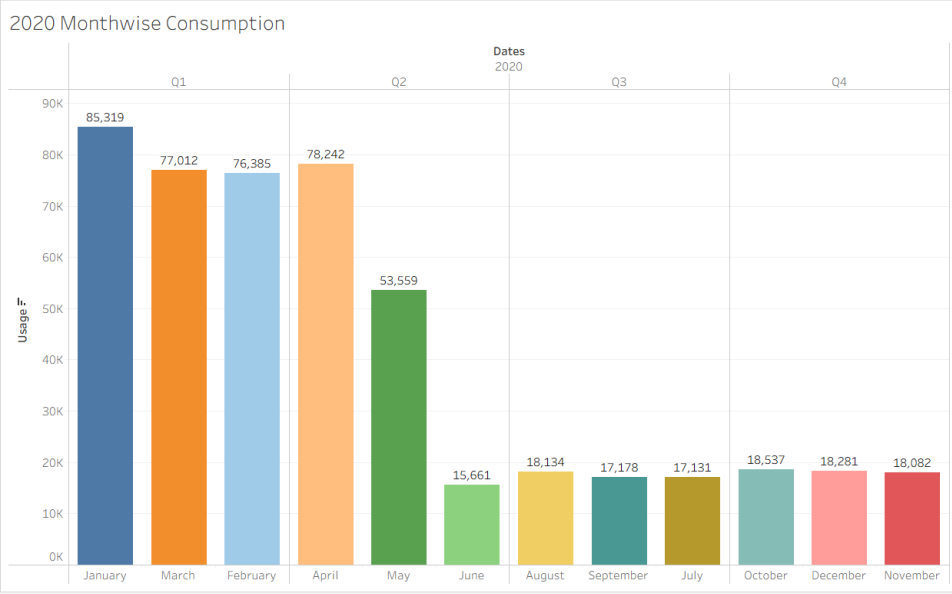
Usage by Region:



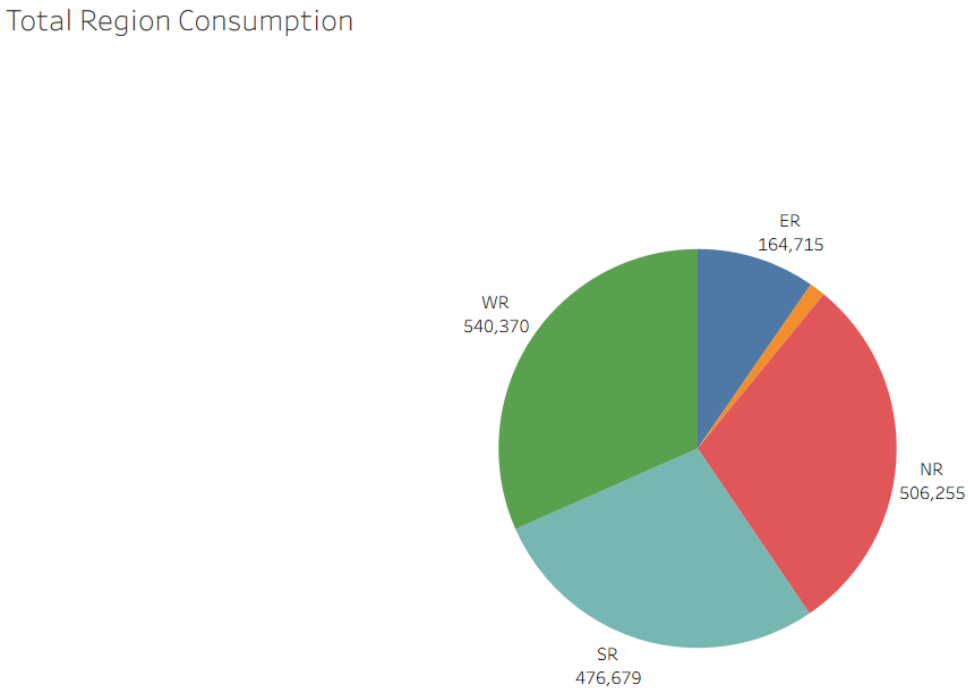
2019 Month wise Consumption:



2020 Month wise Consumption:



Total Region Consumption:



plugging into the future: an exploration of electricity consumption patterns using tableau

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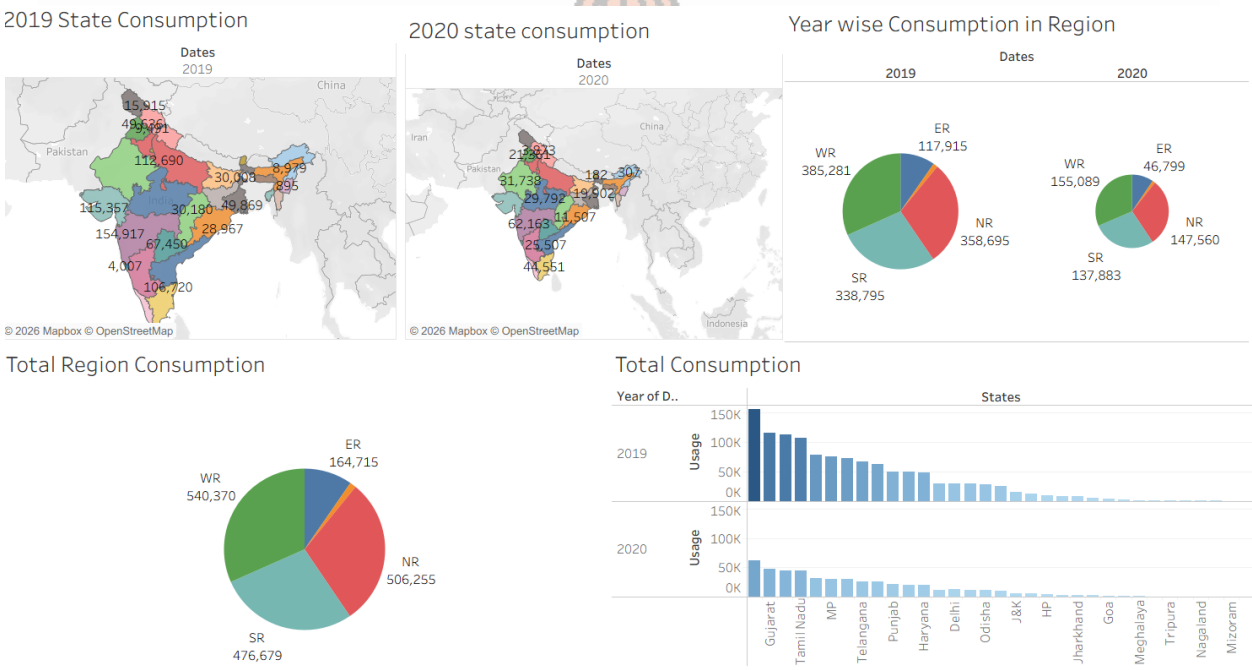
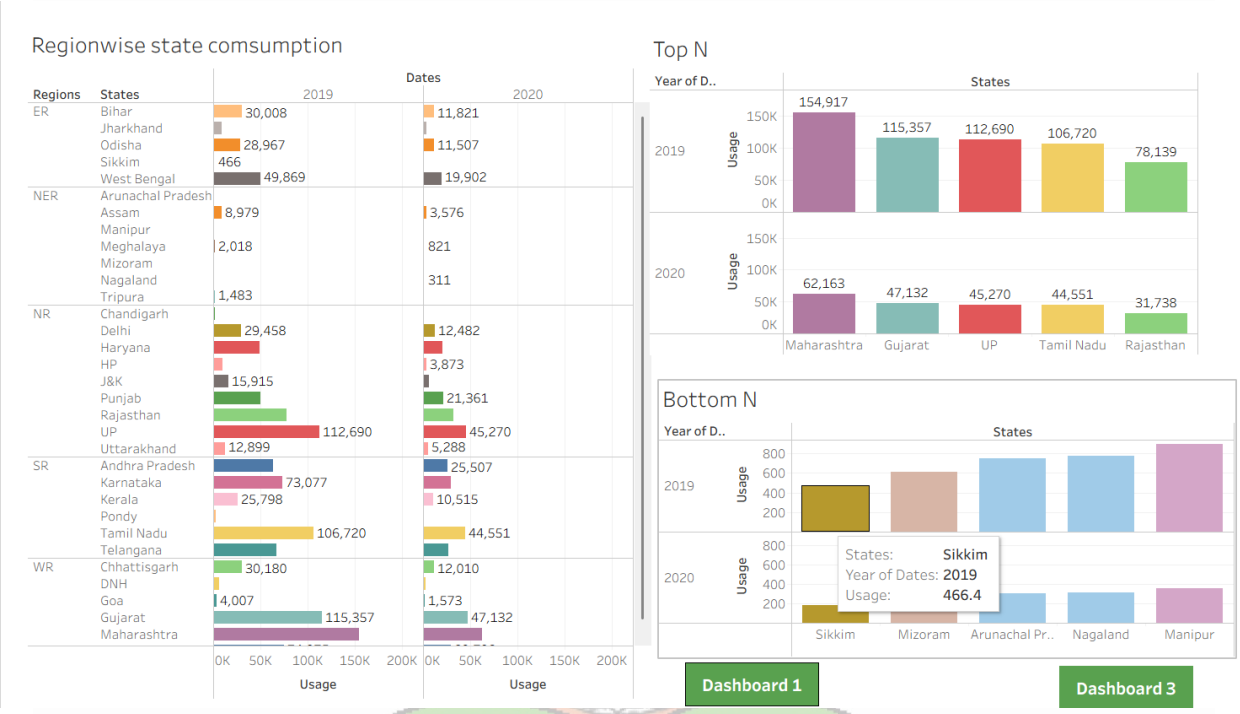
6.4 DASHBOARDS

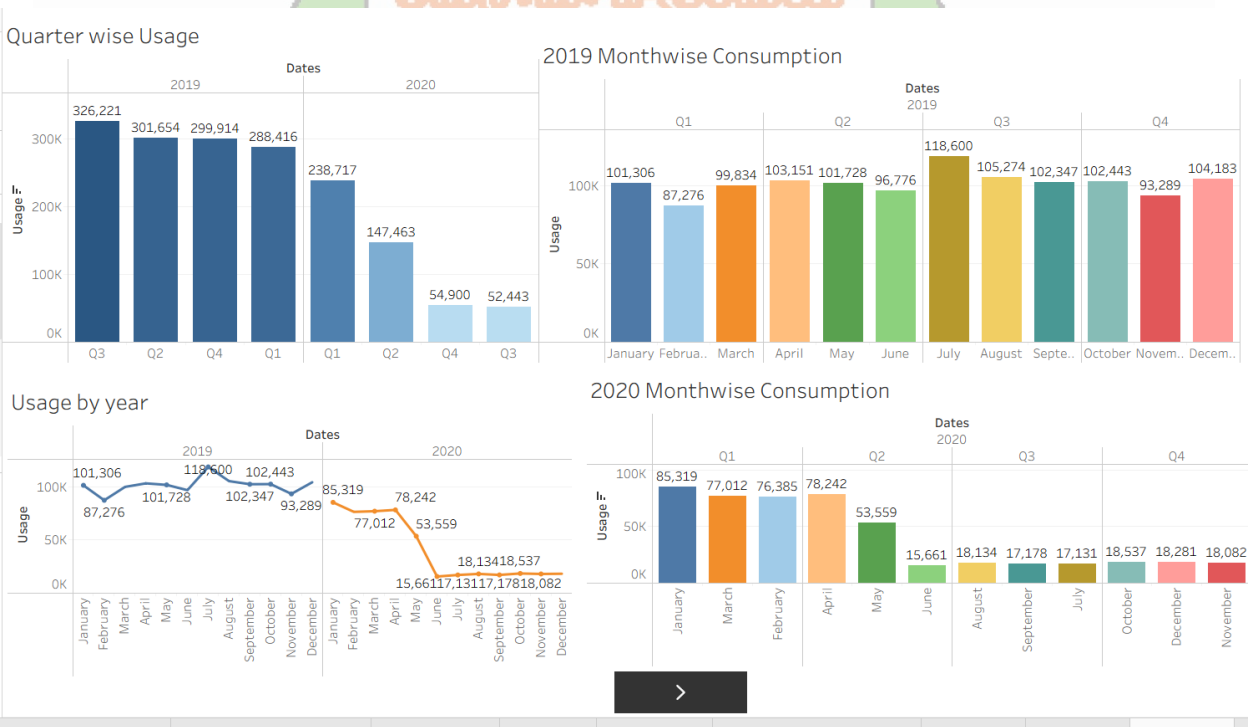
Dashboard1:



Dashboard2:



Dashboard3:



DATE	28-02-2026
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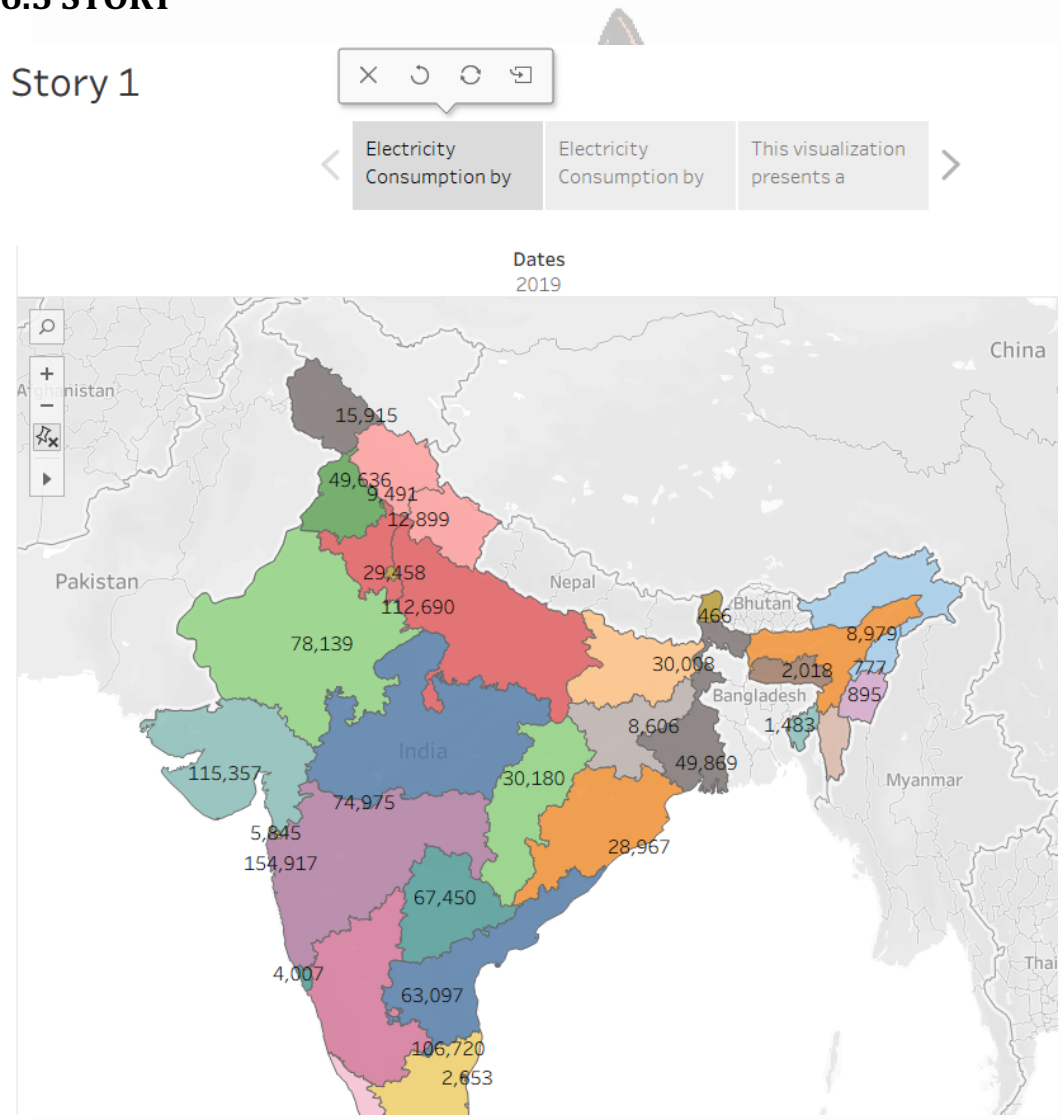
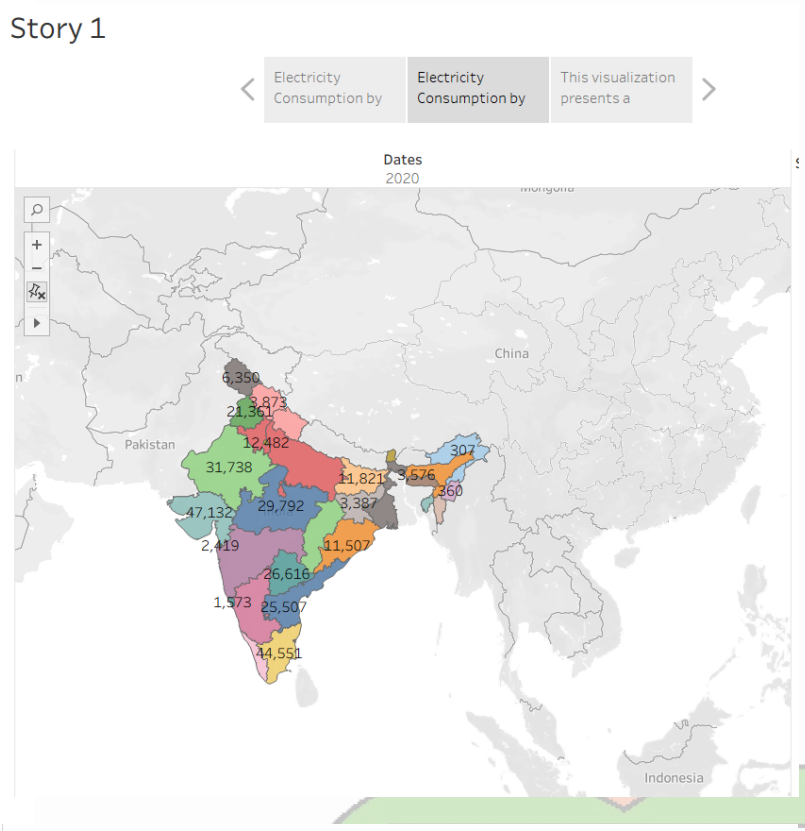
6.5 STORY




Story 1
Electricity Consumption by
Electricity Consumption by
This visualization presents a
Dates
2020
China
Pakistan
Indonesia
6,350
3,873
21,361
12,482
31,738
11,821
3,676
307
360
3,387
47,132
29,792
2,419
11,507
26,616
1,573
25,507
14,551


Story 1
Electricity Consumption by
Electricity Consumption by
This visualization presents a
Year of D..
States
2019
2020
Usage
150K
100K
50K
0K
Delhi
J&K
HP
Goa

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6.6 CREATIVITY (FONT AND STYLE)

1. Overall Visual Theme

Theme Idea: Futuristic & Tech-Savvy

- **Color Palette:** Electric blues, neon greens, and dark backgrounds to mimic energy grids.
- **Accent Colors:** Orange or yellow for peaks/alerts, subtle gray for baseline data.
- **Layout Style:** Modular panels, clean lines, and dynamic spacing to highlight different sections.

Why: Conveys energy, modernity, and high-tech analytics—perfect for electricity consumption exploration.

2. Fonts

Choose fonts that are readable but convey innovation:

- **Title & Headings:**
  - **Futuristic fonts:** *Orbitron*, *Exo 2*, *Rajdhani*
  - **Style:** Bold or semi-bold, uppercase for titles
- **Subtitles & KPIs:**
  - **Clean sans-serif:** *Roboto*, *Montserrat*, *Lato*
  - Use semi-bold for numbers to stand out
- **Body Text / Descriptions:**
  - Neutral, readable sans-serif: *Open Sans*, *Noto Sans*, *Source Sans Pro*

Tip: Avoid overly decorative fonts—they reduce readability for dense data dashboards.

3. Styling for Charts & Visuals

- **Line Charts / Time Series:** Neon-colored lines on a dark background for energy trends.
- **Heatmaps:** Gradient from cool blue (low usage) to hot orange/red (high usage).
- **Maps:** Dark basemap with vibrant highlights for high consumption regions.
- **Bar & Stacked Charts:** Semi-transparent bars with glowing edges for a modern energy vibe.
- **KPIs / Numbers:** Large, centered, neon or glowing text for instant visual impact.

4. Creative Dashboard Elements

- **Electric Pulse Animation:** Use subtle glow or motion effects for peak hours on charts.
- **Interactive Sliders:** For time periods or scenarios, designed like futuristic switches.
- **Icons & Symbols:**
    - Lightning bolts for peaks
    - Solar panels or wind turbines for renewable energy comparison
    - Smart meters for household-level data
- **Story Panels:** Treat each Tableau Story "point" as a futuristic info card, with a semi-transparent overlay over a dark energy-grid background.

5. Suggested Layout

1. **Cover Slide / Dashboard Intro:**
    - Large futuristic font for the title
    - Neon glowing line representing electricity flow across the screen
2. **Time Trends & Daily Patterns:**
    - Animated line charts and heatmaps
    - Glowing hour markers for peaks
3. **Regional & Sector Analysis:**
    - Map with neon highlights

- Interactive toggle for sectors

plugging into the future: an exploration of electricity consumption patterns using tableau

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7.1 FUNCTIONAL AND PERFORMANCE TESTING

1. Functional Testing

Goal: Verify that all Tableau dashboards, charts, filters, and interactions work correctly.

Key Areas to Test:

1. **Data Accuracy & Validation**
   - Check that electricity consumption values match the source data.
   - Verify calculations: peak vs off-peak, per capita usage, percentage changes.
   - Test aggregations across time periods (hourly, daily, monthly).
2. **Filters and Parameters**
   - Time filters: Selecting specific dates or months should update all visuals consistently.
   - Sector or region filters: Dashboard should refresh correctly when changing sectors (residential, commercial, industrial) or regions.
   - Scenario parameters: E.g., temperature changes or forecast projections must update charts properly.
3. **Interactive Elements**
   - Tooltips display correct data and context.
   - Hover or highlight actions work across charts (e.g., selecting a day in heatmap highlights line chart points).
   - Legends update dynamically when filters are applied.
4. **Dashboard Navigation**
   - Story points follow correct sequence in Tableau Story.
   - Navigation buttons or sheet tabs work correctly without broken links.

5. **User Interface & Layout**
    - Titles, KPIs, and charts are correctly aligned and readable.
    - Colors and fonts match the design guidelines (e.g., futuristic neon theme).
    - Visuals remain legible on different screen sizes and resolutions.

2. Performance Testing

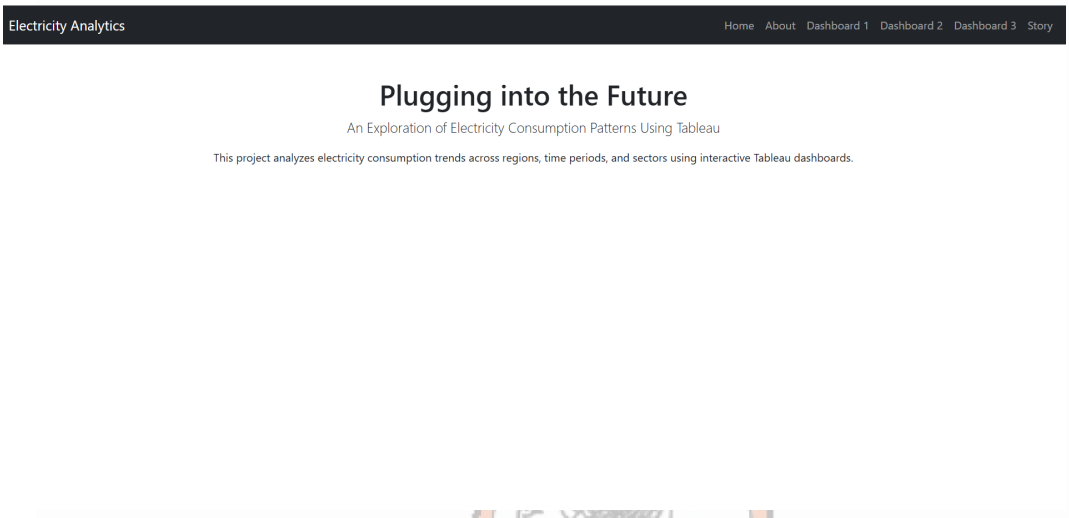
Goal: Ensure dashboards load quickly, respond smoothly, and scale with large datasets.

Key Areas to Test:

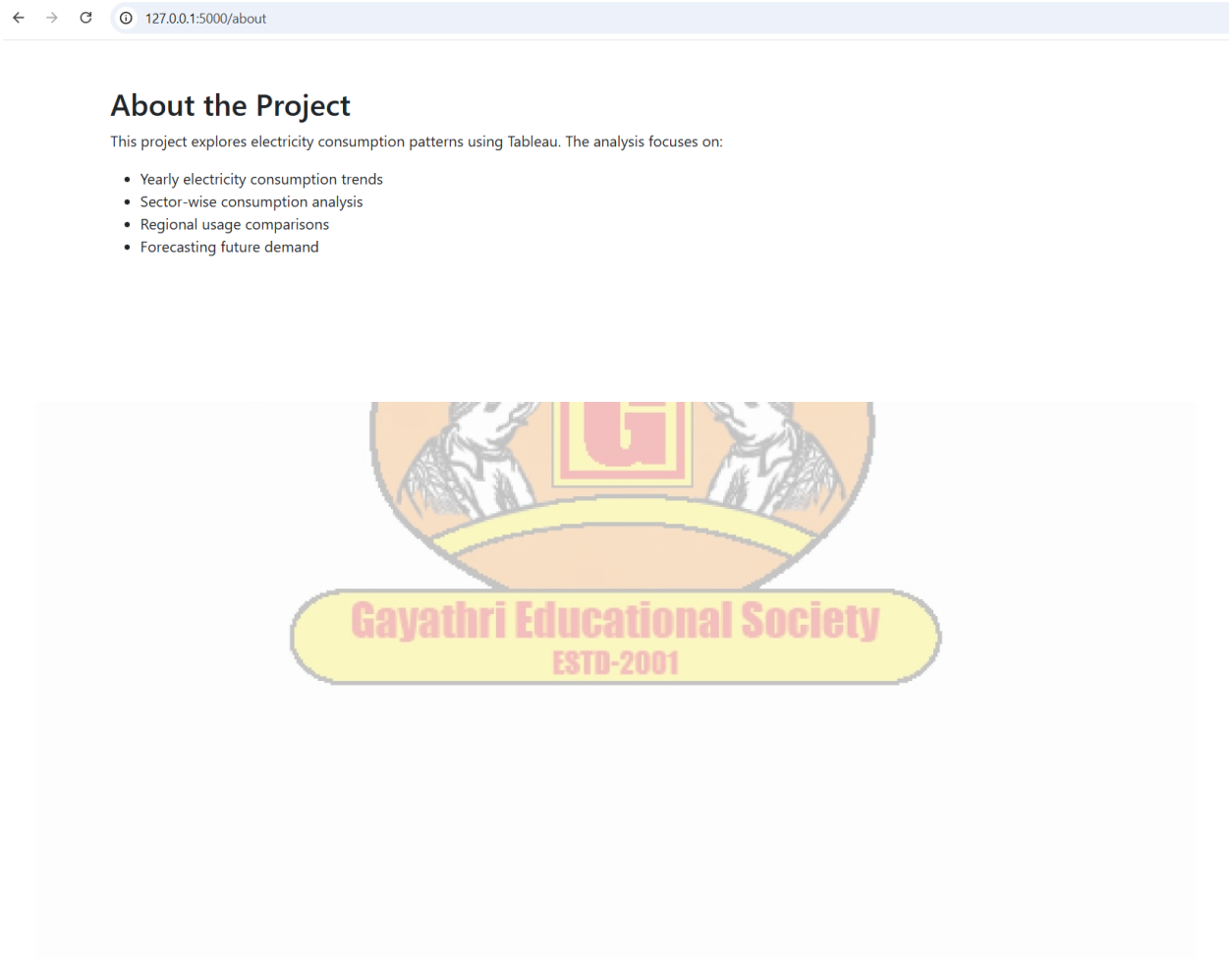
1. **Data Volume Handling**
    - Test with full electricity datasets (e.g., multiple years of hourly smart meter data).
    - Verify dashboard response when aggregating millions of rows.
2. **Load Times**
    - Target: dashboards should load in ≤5 seconds for main visuals.
    - Time filters or parameter changes should refresh charts in ≤2 seconds.
3. **Concurrency / Multi-User Testing**
    - If hosted on Tableau Server or Tableau Online, test multiple simultaneous users.
    - Verify there's no performance degradation under load.
4. **Query Optimization**
    - Ensure calculated fields, table calculations, and data blending don't cause delays.
    - Optimize data extracts instead of live connections when possible.
    - Reduce complex nested calculations on high-volume datasets.
5. **Responsive Performance**
    - Test dashboards on different devices: desktop, tablet, and mobile.
    - Ensure interactive elements remain usable and responsive.

8.1 OUTPUT SCREENS

Index:

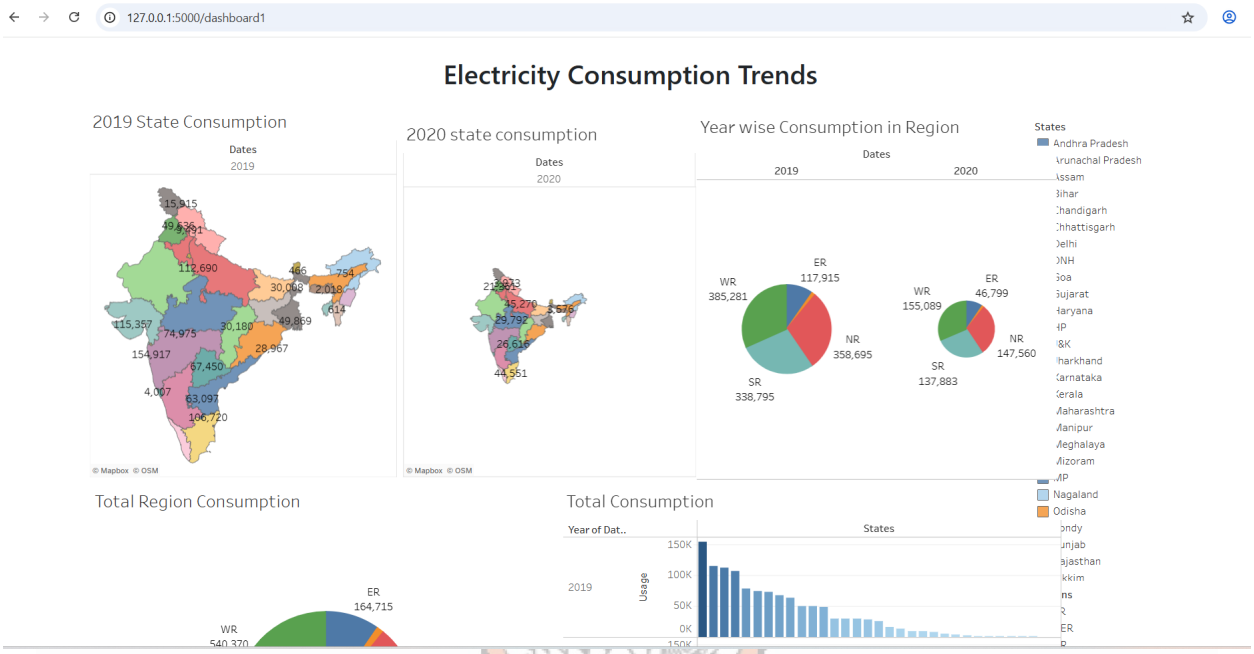


About:

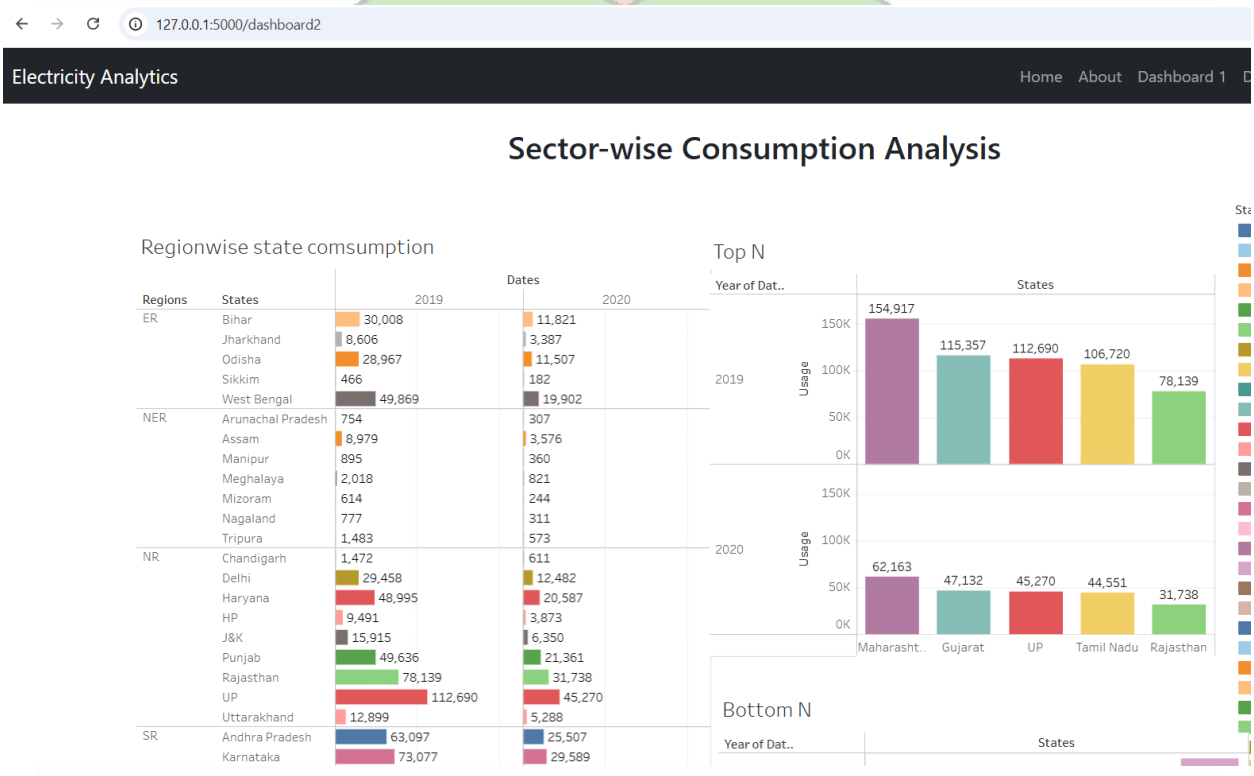


plugging into the future: an exploration of electricity consumption patterns using tableau

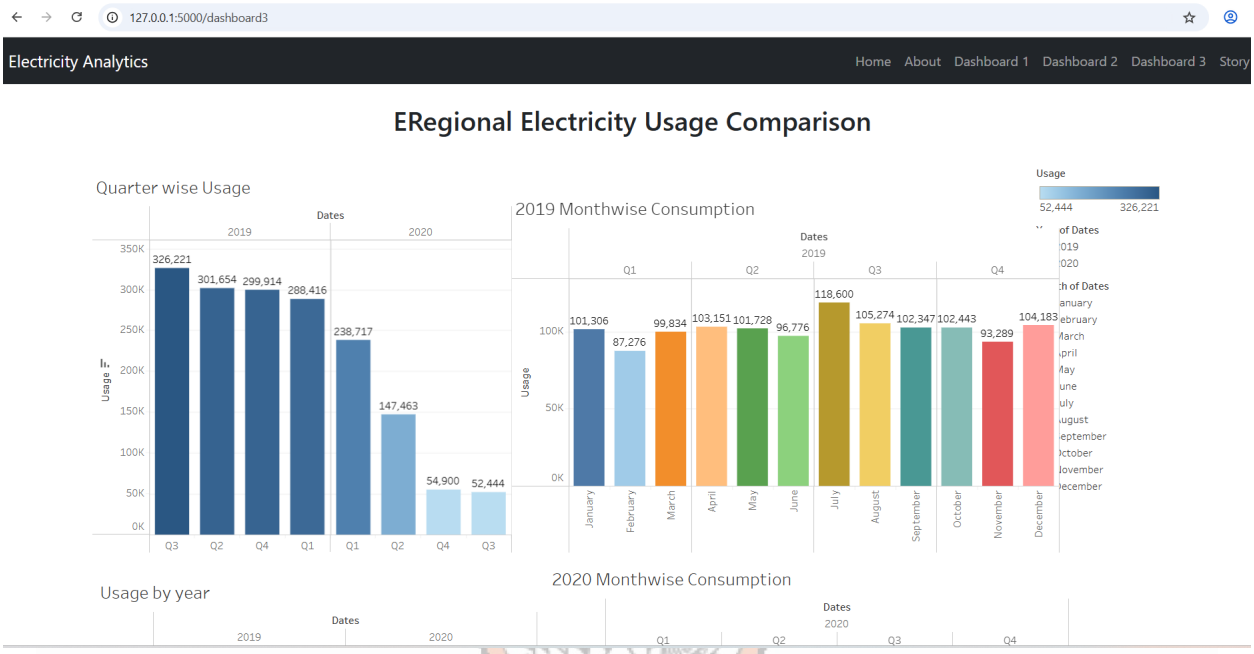
Dashboard1:



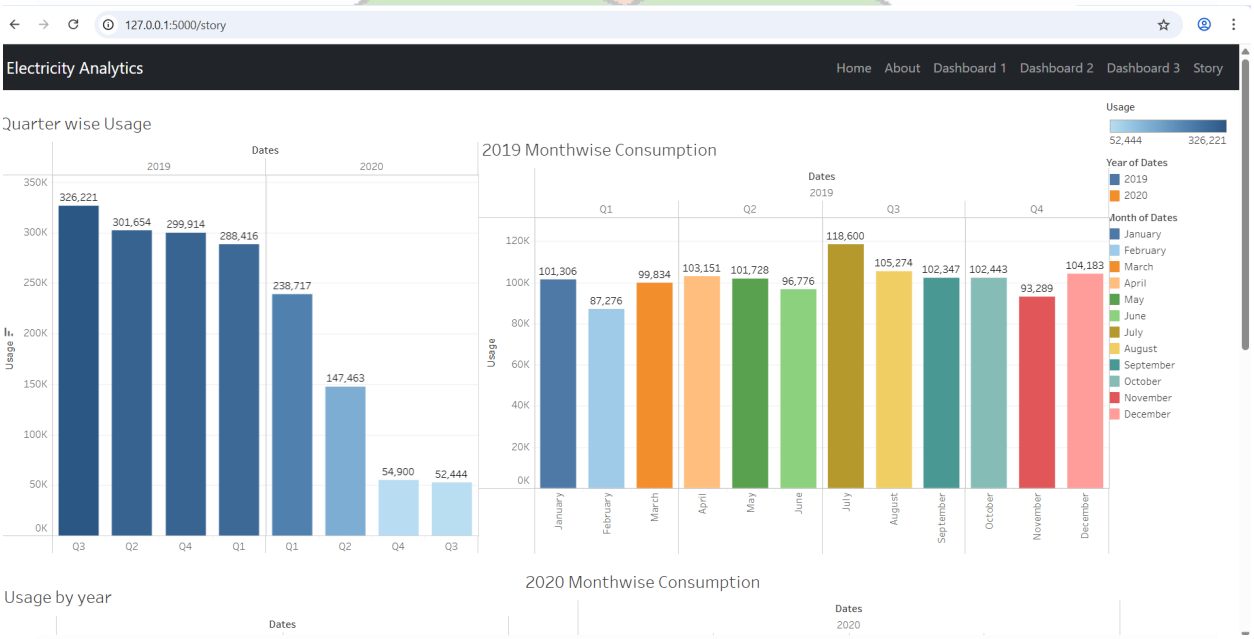
Dashboard2:



Dashboard3:



Story:



9.1ADVANTAGES

1. Clear Visualization of Complex Data

Electricity consumption datasets are often large and complex (hourly readings, regional data, sector-wise usage). Tableau transforms raw data into:

- Interactive dashboards
- Heatmaps
- Time-series graphs
- Geographical maps

This makes trends, peaks, and patterns easy to understand even for non-technical users.

2. Real-Time & Dynamic Analysis

Tableau allows:

- Live data connections
- Automatic refresh of dashboards
- Real-time monitoring of electricity usage

This is highly beneficial for utilities and grid operators who need immediate insights into demand fluctuations.

3. Identification of Peak Demand Periods

Using heatmaps and hourly trend charts, the dashboard helps:

- Identify peak load hours
- Detect seasonal demand variations
- Understand off-peak consumption

This supports better load balancing and energy distribution planning.

4. Improved Decision-Making

By analyzing:

- Regional consumption patterns
- Sector-wise electricity usage
- Weather impact on demand

Policymakers and energy providers can:

- Plan infrastructure upgrades
- Promote energy-saving programs
- Implement demand response strategies

5. Forecasting Capabilities

Tableau's built-in forecasting tools allow:

- Predicting future electricity demand
- Scenario-based analysis
- Anticipating supply shortages

This helps in long-term planning and sustainable energy management.

6. Enhanced Data Interactivity

Interactive filters and parameters allow users to:

- Select time periods
- Compare regions
- Switch between sectors

This provides customized insights without rebuilding reports.

9.2 DISADVANTAGES

1. High Licensing Cost

Tableau (especially Tableau Creator / Explorer / Server) requires paid licenses.
For large organizations or academic institutions, this can become expensive compared to free tools like Excel or open-source BI platforms.

2. Performance Issues with Large Datasets

Electricity consumption data (e.g., hourly smart meter readings) can include millions of records.
Without proper optimization:

- Dashboards may load slowly
- Filters may take time to respond
- Complex calculations may reduce performance

Performance tuning (extracts, indexing, aggregation) becomes necessary.

3. Limited Advanced Statistical Capabilities

While Tableau supports basic forecasting and trend analysis:

- Advanced predictive modeling
- Machine learning algorithms
- Deep statistical analysis

Often require integration with tools like Python, R, or specialized analytics software.

4. Data Preparation Complexity

Electricity datasets may include:

- Missing values
- Time zone inconsistencies
- Multiple data sources (weather, region, sector)

Significant preprocessing is often required before importing into Tableau.

5. Dependency on Data Quality

The accuracy of insights depends entirely on:

- Clean and reliable input data

- Proper aggregation methods
- Correct calculated fields

Incorrect data can lead to misleading conclusions about consumption patterns.

6. Limited Customization for Highly Complex Dashboards

Although Tableau is flexible:

- Extremely customized UI designs may be restricted
- Advanced animations are limited
- Highly technical interfaces may require external embedding

7. Server & Infrastructure Requirements

If deployed on Tableau Server or Cloud:

- Requires server setup and maintenance
- Needs proper configuration for multi-user access
- Performance depends on hardware resources

10.1 Conclusion

The exploration of electricity consumption patterns through Tableau has revealed meaningful insights into how energy is produced, distributed, and consumed across regions and time periods. By transforming raw data into interactive visualizations, complex consumption trends became clearer, enabling deeper understanding of seasonal demand fluctuations, peak usage periods, regional disparities, and long-term growth patterns.

The analysis highlighted the significant influence of factors such as population growth, urbanization, industrial activity, and climate variations on electricity demand. Temporal visualizations showed predictable seasonal spikes, while regional comparisons revealed uneven distribution of consumption, often linked to economic development and infrastructure availability.

Using Tableau's dynamic dashboards and filtering capabilities enhanced the analytical process by allowing real-time comparisons and multi-dimensional exploration. The visual storytelling approach not only improved interpretability but also supported data-driven decision-making for policymakers, utility providers, and sustainability planners.

Most importantly, this study underscores the growing need for efficient energy management and sustainable planning. As global electricity demand continues to rise, leveraging data visualization tools like Tableau becomes essential in forecasting future consumption, optimizing grid performance, and supporting the transition toward renewable energy sources.

In conclusion, this project demonstrates that when data analytics and visualization are effectively combined, they provide powerful insights that can drive smarter energy strategies and help society "plug into the future" with greater efficiency and sustainability.

11.1 Future Scope

The analysis of electricity consumption patterns using Tableau lays a strong foundation for deeper, more advanced energy analytics. While the current study focuses on historical trends and visual exploration, future work can significantly expand both the scope and impact of this research.

One major direction is the integration of real-time smart meter data to enable live dashboards. By incorporating streaming data, utilities and policymakers could monitor consumption dynamically, detect anomalies instantly, and respond proactively to demand fluctuations.

Another promising extension is the application of predictive analytics and machine learning models alongside Tableau. Forecasting future electricity demand based on historical usage, weather patterns, population growth, and economic indicators would enhance planning accuracy and grid reliability.

The project can also be expanded to include renewable energy integration analysis, comparing conventional electricity consumption with solar, wind, and other sustainable sources. This would support strategic planning for energy transition and carbon footprint reduction.

Additionally, incorporating geospatial analytics can provide deeper insights into regional consumption disparities, infrastructure gaps, and urban–rural energy distribution patterns. Combining Tableau with GIS tools would strengthen spatial decision-making capabilities.

Future research may also explore:

- Energy efficiency benchmarking across industries
- Demand-side management strategies
- Impact analysis of government energy policies
- Carbon emission correlation with electricity consumption

12.1 Source File

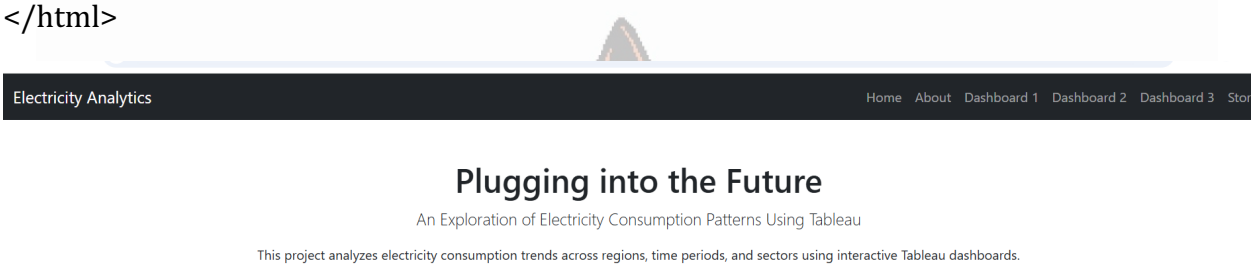
Index.html

```
<!DOCTYPE html>
<html>
<head>
  <title>Plugging into the Future</title>
  <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.3.2/dist/css/bootstrap.min.css"
rel="stylesheet">
</head>
<body>
<nav class="navbar navbar-expand-lg navbar-dark bg-dark">
 <div class="container-fluid">
  <a class="navbar-brand" href="/">Electricity Analytics</a>
  <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-
target="#navbarNav">
    <span class="navbar-toggler-icon"></span>
  </button>
  <div class="collapse navbar-collapse" id="navbarNav">
   <ul class="navbar-nav ms-auto">
    <li class="nav-item"><a class="nav-link" href="/">Home</a></li>
    <li class="nav-item"><a class="nav-link" href="/about">About</a></li>
    <li class="nav-item"><a class="nav-link" href="/dashboard1">Dashboard 1</a></li>
    <li class="nav-item"><a class="nav-link" href="/dashboard2">Dashboard 2</a></li>
    <li class="nav-item"><a class="nav-link" href="/dashboard3">Dashboard 3</a></li>
    <li class="nav-item"><a class="nav-link" href="/story">Story</a></li>
   </ul>
  </div>
 </div>
</nav>


<div class="container mt-5">
  <div class="text-center">
    <h1>Plugging into the Future</h1>
    <p class="lead">An Exploration of Electricity Consumption Patterns Using
Tableau</p>
    <p>
```

```
        This project analyzes electricity consumption trends across regions,
        time periods, and sectors using interactive Tableau dashboards.
      </p>
    </div>
</div>

</body>
</html>
```



About.html

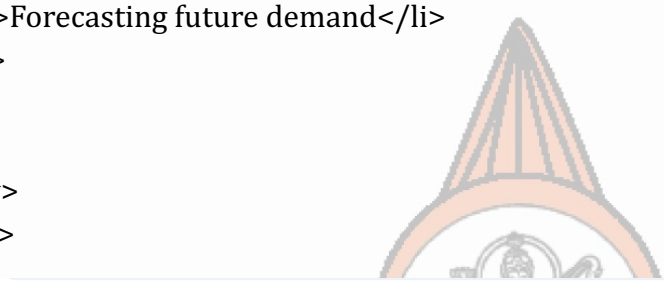
```
<!DOCTYPE html>
<html>
<head>
  <title>About Project</title>
  <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.3.2/dist/css/bootstrap.min.css"
rel="stylesheet">
</head>
<body>

<!-- Navbar Here -->

<div class="container mt-5">
  <h2>About the Project</h2>
  <p>
```

```
    This project explores electricity consumption patterns using Tableau.
    The analysis focuses on:
  </p>
  <ul>
    <li>Yearly electricity consumption trends</li>
    <li>Sector-wise consumption analysis</li>
    <li>Regional usage comparisons</li>
    <li>Forecasting future demand</li>
  </ul>
</div>

</body>
</html>
```



Dashboard1.html

```
<!DOCTYPE html>
<html>
<head>
  <title>Dashboard 1</title>
  <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.3.2/dist/css/bootstrap.min.css"
rel="stylesheet">
```

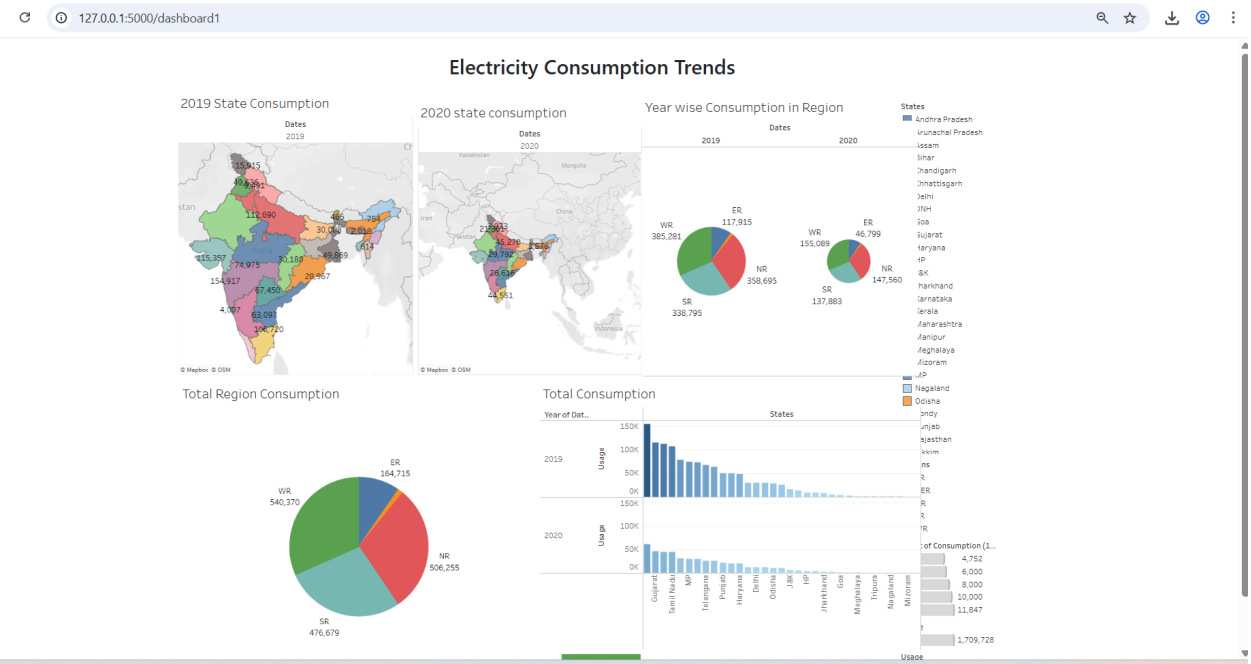
```
</head>
<body>

<!-- Navbar Here -->

<div class="container mt-4">
  <h2 class="text-center">Electricity Consumption Trends</h2>

  <div class="mt-4">
    <!-- Tableau Embed -->
    <div class='tableauPlaceholder' id='viz1771054036972' style='position:
relative'><noscript><a href='#'><img alt='Dashboard 1 '
src='https:&#47;&#47;public.tableau.com&#47;static&#47;images&#47;Bh&#47;Bharaths
imha-Dashboard1&#47;Dashboard1&#47;1_rss.png' style='border: none'
/></a></noscript><object class='tableauViz'  style='display:none;'><param
name='host_url' value='https%3A%2F%2Fpublic.tableau.com%2F' /> <param
name='embed_code_version' value='3' /> <param name='site_root' value='' /><param
name='name' value='Bharathsimha-Dashboard1&#47;Dashboard1' /><param name='tabs'
value='no' /><param name='toolbar' value='yes' /><param name='static_image'
value='https:&#47;&#47;public.tableau.com&#47;static&#47;images&#47;Bh&#47;Bhara
thsimha-Dashboard1&#47;Dashboard1&#47;1.png' /> <param name='animate_transition'
value='yes' /><param name='display_static_image' value='yes' /><param
name='display_spinner' value='yes' /><param name='display_overlay' value='yes'
/><param name='display_count' value='yes' /><param name='language' value='en-US'
/><param name='filter' value='publish=yes' /></object></div>                <script
type='text/javascript'>                var divElement =
document.getElementById('viz1771054036972');                var vizElement =
divElement.getElementsByTagName('object')[0];                if ( divElement.offsetWidth >
800 ) {
vizElement.style.width='100%';vizElement.style.height=(divElement.offsetWidth*0.75)+'px';
} else if ( divElement.offsetWidth > 500 ) {
vizElement.style.width='100%';vizElement.style.height=(divElement.offsetWidth*0.75)+'px';
} else { vizElement.style.width='100%';vizElement.style.height='1877px';}                var
scriptElement = document.createElement('script');                scriptElement.src =
'https://public.tableau.com/javascripts/api/viz_v1.js';
vizElement.parentNode.insertBefore(scriptElement, vizElement);            </script>
  </div>
</div>
```

```
</body>
</html>
```



Dashboard2.html

```
<!DOCTYPE html>
<html>
<head>
  <title>Dashboard 1</title>
  <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.3.2/dist/css/bootstrap.min.css" rel="stylesheet">
</head>
<body>

<nav class="navbar navbar-expand-lg navbar-dark bg-dark">
 <div class="container-fluid">
  <a class="navbar-brand" href="/">Electricity Analytics</a>
  <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-target="#navbarNav">
    <span class="navbar-toggler-icon"></span>
  </button>
  <div class="collapse navbar-collapse" id="navbarNav">
```

```
    <ul class="navbar-nav ms-auto">
      <li class="nav-item"><a class="nav-link" href="/">Home</a></li>
      <li class="nav-item"><a class="nav-link" href="/about">About</a></li>
      <li class="nav-item"><a class="nav-link" href="/dashboard1">Dashboard 1</a></li>
      <li class="nav-item"><a class="nav-link" href="/dashboard2">Dashboard 2</a></li>
      <li class="nav-item"><a class="nav-link" href="/dashboard3">Dashboard 3</a></li>
      <li class="nav-item"><a class="nav-link" href="/story">Story</a></li>
    </ul>
  </div>
 </div>
</nav>


<div class="container mt-4">
  <h2 class="text-center">Sector-wise Consumption Analysis</h2>

  <div class="mt-4">
    <!-- Tableau Embed -->
    <div class='tableauPlaceholder' id='viz1771054281028' style='position:
relative'><noscript><a href='#'><img alt='Dashboard 2 '
src='https:&#47;&#47;public.tableau.com&#47;static&#47;images&#47;Bh&#47;Bharaths
imha-Dashboard2&#47;Dashboard2&#47;1_rss.png' style='border: none'
/></a></noscript><object class='tableauViz'  style='display:none;'><param
name='host_url' value='https%3A%2F%2Fpublic.tableau.com%2F' /> <param
name='embed_code_version' value='3' /> <param name='site_root' value='' /><param
name='name' value='Bharathsimha-Dashboard2&#47;Dashboard2' /><param name='tabs'
value='no' /><param name='toolbar' value='yes' /><param name='static_image'
value='https:&#47;&#47;public.tableau.com&#47;static&#47;images&#47;Bh&#47;Bhara
thsimha-Dashboard2&#47;Dashboard2&#47;1.png' /> <param name='animate_transition'
value='yes' /><param name='display_static_image' value='yes' /><param
name='display_spinner' value='yes' /><param name='display_overlay' value='yes'
/><param name='display_count' value='yes' /><param name='language' value='en-US'
/><param name='filter' value='publish=yes' /></object></div>                <script
type='text/javascript'>                var divElement =
document.getElementById('viz1771054281028');                var vizElement =
divElement.getElementsByTagName('object')[0];                if ( divElement.offsetWidth >
800 ) {
vizElement.style.width='100%';vizElement.style.height=(divElement.offsetWidth*0.75)+'px';
```

```
} else if ( divElement.offsetWidth > 500 ) {
vizElement.style.width='100%';vizElement.style.height=(divElement.offsetWidth*0.75)+'px';
} else { vizElement.style.width='100%';vizElement.style.height='1277px';}                    var
scriptElement = document.createElement('script');                    scriptElement.src =
'https://public.tableau.com/javascripts/api/viz_v1.js';
vizElement.parentNode.insertBefore(scriptElement, vizElement);                    </script>
  </div>
</div>

</body>
</html>
```

Story.html

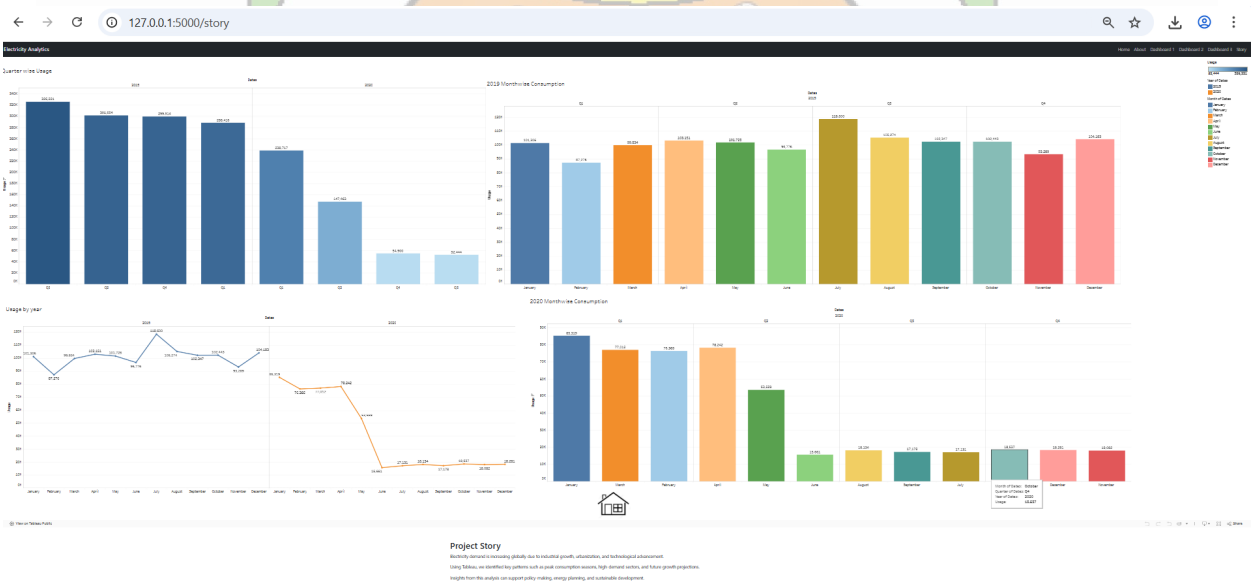
```
<!DOCTYPE html>
<html>
<head>
  <title>Story</title>
  <link href="https://cdn.jsdelivr.net/npm/bootstrap@5.3.2/dist/css/bootstrap.min.css"
rel="stylesheet">
</head>
<body>
<nav class="navbar navbar-expand-lg navbar-dark bg-dark">
 <div class="container-fluid">
```

```
  <a class="navbar-brand" href="/">Electricity Analytics</a>
  <button class="navbar-toggler" type="button" data-bs-toggle="collapse" data-bs-
target="#navbarNav">
    <span class="navbar-toggler-icon"></span>
  </button>
  <div class="collapse navbar-collapse" id="navbarNav">
    <ul class="navbar-nav ms-auto">
      <li class="nav-item"><a class="nav-link" href="/">Home</a></li>
      <li class="nav-item"><a class="nav-link" href="/about">About</a></li>
      <li class="nav-item"><a class="nav-link" href="/dashboard1">Dashboard 1</a></li>
      <li class="nav-item"><a class="nav-link" href="/dashboard2">Dashboard 2</a></li>
      <li class="nav-item"><a class="nav-link" href="/dashboard3">Dashboard 3</a></li>
      <li class="nav-item"><a class="nav-link" href="/story">Story</a></li>
    </ul>
  </div>
 </div>
</nav>
<div class='tableauPlaceholder' id='viz1771054001081' style='position:
relative'><noscript><a href='#'><img alt='Dashboard 3 '
src='https:&#47;&#47;public.tableau.com&#47;static&#47;images&#47;Bh&#47;Bharaths
imha-Dashboard3&#47;Dashboard3&#47;1_rss.png' style='border: none'
/></a></noscript><object class='tableauViz'  style='display:none;'><param
name='host_url' value='https%3A%2F%2Fpublic.tableau.com%2F' /> <param
name='embed_code_version' value='3' /> <param name='site_root' value='' /><param
name='name' value='Bharathsimha-Dashboard3&#47;Dashboard3' /><param name='tabs'
value='no' /><param name='toolbar' value='yes' /><param name='static_image'
value='https:&#47;&#47;public.tableau.com&#47;static&#47;images&#47;Bh&#47;Bhara
thsimha-Dashboard3&#47;Dashboard3&#47;1.png' /> <param name='animate_transition'
value='yes' /><param name='display_static_image' value='yes' /><param
name='display_spinner' value='yes' /><param name='display_overlay' value='yes'
/><param name='display_count' value='yes' /><param name='language' value='en-US'
/><param name='filter' value='publish=yes' /></object></div>                <script
type='text/javascript'>                    var divElement =
document.getElementById('viz1771054001081');                    var vizElement =
divElement.getElementsByTagName('object')[0];                    if ( divElement.offsetWidth >
800 ) {
vizElement.style.width='100%';vizElement.style.height=(divElement.offsetWidth*0.75)+'px';
} else if ( divElement.offsetWidth > 500 ) {
```

```
vizElement.style.width='100%';vizElement.style.height=(divElement.offsetWidth*0.75)+'px';
} else { vizElement.style.width='100%';vizElement.style.height='1477px';}                    var
scriptElement = document.createElement('script');                    scriptElement.src =
'https://public.tableau.com/javascripts/api/viz_v1.js';
vizElement.parentNode.insertBefore(scriptElement, vizElement);                    </script>

<div class="container mt-5">
  <h2>Project Story</h2>
  <p>
    Electricity demand is increasing globally due to industrial growth,
    urbanization, and technological advancement.
  </p>
  <p>
    Using Tableau, we identified key patterns such as peak consumption
    seasons, high-demand sectors, and future growth projections.
  </p>
  <p>
    Insights from this analysis can support policy-making,
    energy planning, and sustainable development.
  </p>
</div>

</body>
</html>
```




తమసోమా జ్యోతిర్గమయ
G
Gayathri Educational Society
ESTD-2001

12.2 Data Set Link

https://drive.google.com/file/d/1JxIkHNwXxjFztKq7ad0_KtkukCqTckNy/view

12.3 - GitHub and Project Demo Link:

Github:

https://drive.google.com/file/d/1BSpnaRdHM42BxqiLH0jP_wAQ3CGUA82B/view?usp=drivesdk

Demo video:

https://drive.google.com/file/d/1BSpnaRdHM42BxqiLH0jP_wAQ3CGUA82B/view?usp=drivesdk