Plugging into the Future: An Exploration of Electricity Consumption Patterns Using Tableau

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⚡ Plugging into the Future: Solution Architecture

Exploring Electricity Consumption Patterns Using Tableau
1️⃣ High-Level Architecture Overview
A robust solution architecture for analyzing electricity consumption patterns in Tableau typically follows this layered structure:
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Data Sources → Data Ingestion → Data Storage → Data Processing → Tableau → End Users
🏗️ 2️⃣ Architecture Layers Explained
🔹 A. Data Sources Layer
Possible Data Inputs:
Smart meter data (hourly/daily readings)
Utility billing systems
IoT sensors
Weather data (temperature, humidity)
Demographic data
Renewable energy production data
📌 Example Sources:
Smart Grid IoT Devices
Weather APIs
Energy Utility Databases
🔹 B. Data Ingestion Layer
Purpose: Extract and move data into centralized storage.
Tools Options:
ETL Tools (e.g., Talend, Informatica)
Python scripts
Cloud services (AWS Glue, Azure Data Factory)
Scheduled batch jobs or streaming ingestion (Kafka)
Processes:
Data extraction
Data cleaning
Data validation
Timestamp normalization
Unit standardization (kWh)
🔹 C. Data Storage Layer
Options:
Cloud Data Warehouse (Snowflake, BigQuery, Redshift)
On-premise SQL Server
Data Lake (Azure Data Lake, AWS S3)
Schema Design:
Star Schema (Recommended)
Example:
Fact Table:
Electricity Consumption (kWh)
Timestamp
Meter ID
Location ID

Dimension Tables:
Date
Location
Customer Type
Weather
Tariff Plan
🔹 D. Data Processing & Modeling Layer
Transformations:
Aggregations (hourly → daily → monthly)
Peak demand calculations
Time-series smoothing
Seasonal trend analysis
Anomaly detection
Calculated Fields for Tableau:
Average Daily Consumption
Peak Load Hour
Month-over-Month Growth %
Consumption per Capita
🔹 E. Tableau Analytics Layer
Components:
Data Source Connection (Live or Extract)
Interactive Dashboards
Filters (Date, Region, Customer Segment)
Drill-down Capabilities
Forecasting (Tableau built-in time series)
Heatmaps & Geo Maps
KPI Cards
Sample Dashboards:
📊 Time Series Consumption Trends
🌎 Regional Consumption Heatmap
⚡ Peak Load Analysis
📈 Forecasting Dashboard
🔹 F. User Layer
Stakeholders:
Energy Analysts
Utility Companies
Government Agencies
Sustainability Officers
Executive Leadership
Access:
Tableau Server
Tableau Online
Embedded dashboards in web portals
🔐 3️⃣ Non-Functional Architecture Considerations
Category
Considerations
Security
Role-based access, data encryption
Scalability
Cloud auto-scaling warehouse
Performance
Data extracts, indexing
Governance
Data lineage, audit logs
Availability
Backup & disaster recovery
Compliance
Energy regulations, GDPR
☁️ Example Cloud-Based Architecture

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Smart Meters → Azure Data Factory → Azure Data Lake → Azure Synapse → Tableau Server → End Users
OR
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IoT Devices → AWS Kinesis → S3 → Redshift → Tableau Online
📊 Advanced Enhancements
🔮 Machine Learning for demand forecasting
⚡ Real-time dashboards (Streaming data)
🌱 Renewable energy integration analysis
💡 Demand-response modeling
📉 Carbon emission tracking
🎯 Final Architecture Summary
A well-designed electricity consumption analytics solution using Tableau should:
✔ Centralize diverse data sources
✔ Use scalable storage (cloud preferred)
✔ Implement clean star-schema modeling
✔ Enable interactive, real-time dashboards
✔ Support forecasting and anomaly detection
✔ Ensure governance and security