

Problem Statement

- No centralized system to monitor hourly energy consumption across PJM and its sub-regions.
- Difficulty in comparing regional load data (e.g., AEP, COMED, DAYTON, DOM).
- Inability to easily identify peak load and minimum load periods.
- Lack of historical trend analysis from 1990 to 2018.
- High data granularity (hourly) made it difficult to extract quick insights.
- No base for forecasting future electricity demand.
- Manual reporting methods were inefficient and error-prone.

Tools Used

1. Power Query Editor (Data Transformation)

- Used for cleaning and preparing raw load data (PJM, AEP, COMED, etc.).
- Replaced missing/null values and ensured proper data types (e.g., Date-Time, Numeric).
- Merged and appended regional datasets for unified analysis.
- Created new calculated columns (e.g., Hour, Year, Month) for grouping.

2. DAX (Data Analysis Expressions)

- **Measures created for:**
 - Total Load (MW) = SUM(Load_MW)
 - Peak Load = MAX(Load_MW)
 - Min Load = MIN(Load_MW)
 - Avg Hourly Load = AVERAGE(Load_MW)
 - Year-wise and region-wise aggregations.
- Used DAX for **custom time intelligence** (e.g., yearly trends, comparison).

- Created **dynamic % calculations** for pie charts (e.g., % share by region).

3. Visualizations Used

- **KPI Cards** for summary values:
 - Total Load, Peak Load, Min Load, Avg. Hourly Load, Total Hours Recorded.
- **Line Charts** for trend analysis over years (e.g., AEP_MW, PJMW_MW).
- **Donut & Pie Charts** to show regional contributions (e.g., AEP vs COMED vs DOM).
- **Bar Charts** to compare values across regions in a simple way.
- **Funnel Chart** for hierarchical load contribution breakdown.

4. Filters & Slicers

- Year-wise slicer to view specific periods (1990–2018).
- Region-based filters to isolate and analyse load by PJM sub-areas.
- Enabled interactivity between visuals for better drill-down.

5. Calculated Columns

- Created columns for:
 - **Year** from Date-Time field.
 - **Hour** to analyse hourly trends.
 - Region classifications from source data.

Dashboard Overview

Main Objectives of the Dashboard

- Monitor **total and average hourly load** across regions.
- Identify **peak and minimum load** times for demand management.
- Compare **regional performance** within PJM's network.
- Understand **seasonal and yearly consumption trends**.
- Enable **interactive filtering** by year, region, and hour.

Key Components

1. KPI Cards

- Show high-level metrics like:
 - Total Energy Load (MW)
 - Peak Hour Load
 - Minimum Load
 - Total Records Analyse
 - Average Hourly Load

2. Line Charts

- Visualize **hourly or yearly load trends**.
- Separate charts for PJM and each sub-region.
- Allows easy detection of **load spikes or drops**.

3. Bar Charts

- Compare load data across different regions or years.
- Helps identify which region has the highest/lowest contribution.

4. Pie/Donut Charts

- Represent **percentage share** of each region's consumption.
- Quick visual for identifying **major energy consumers**.

5. Funnel Chart

- Show hierarchical **load contribution** (e.g., Total → Region → Sub-region).
- Useful for tracing how load distributes from top-level to local areas.

6. Slicers and Filters

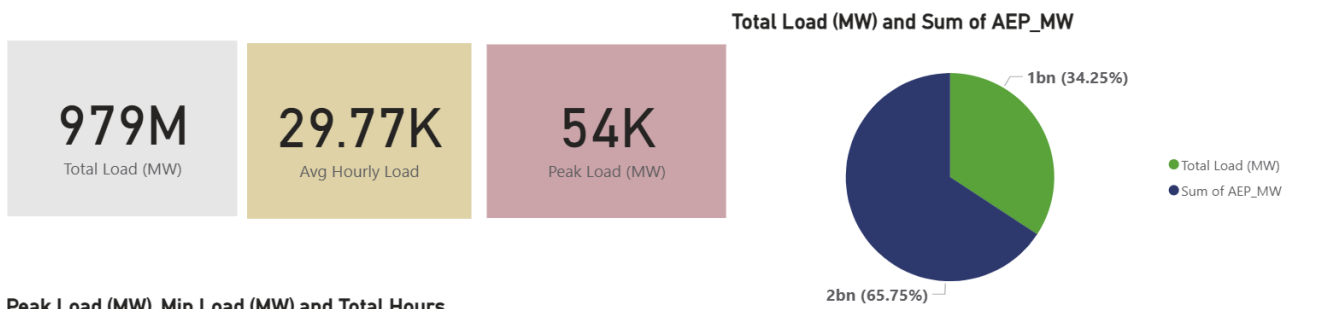
- Year-wise slicer to focus on a specific period (1990–2018).
- Region slicer to drill down into a particular PJM sub-region.
- Enhances interactivity and **customized exploration**.

User-Friendly Layout

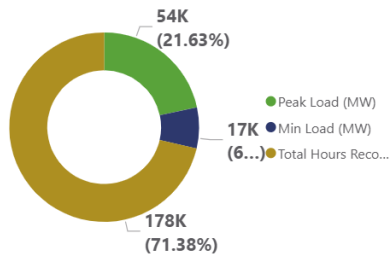
- Logical flow from **summary KPIs** → **detailed visual comparisons**.
- **Dark or themed background** for enhanced readability.
- Visuals grouped to reduce clutter and increase clarity.

Purpose & Value

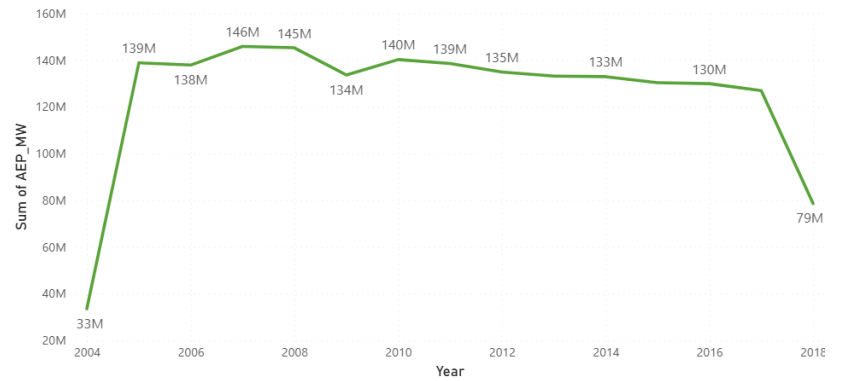
- Enables real-time and historical analysis of energy demand.
- Helps identify **efficiency gaps** and **optimization opportunities**.
- Supports **energy planning and forecasting** for stakeholders.



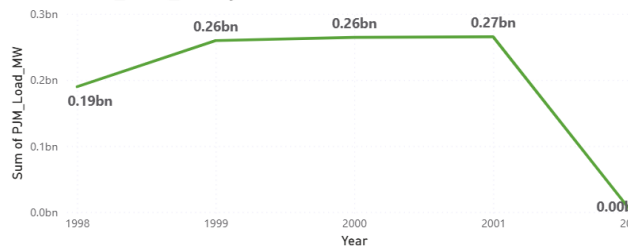
Peak Load (MW), Min Load (MW) and Total Hours Recorded



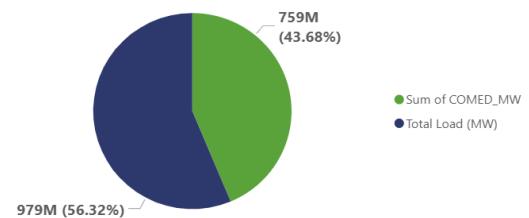
Sum of AEP_MW by Year



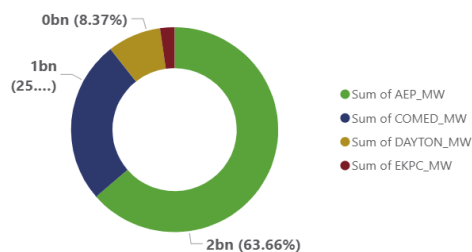
Sum of PJM_Load_MW by Year



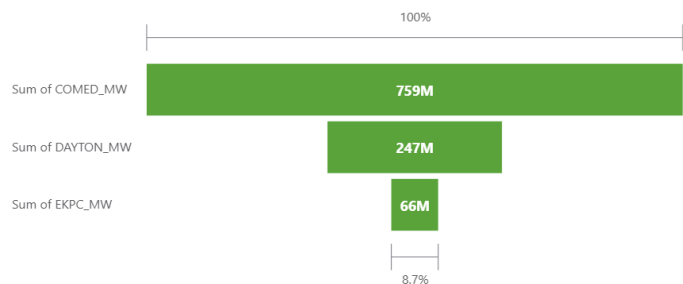
Sum of COMED_MW and Total Load (MW)

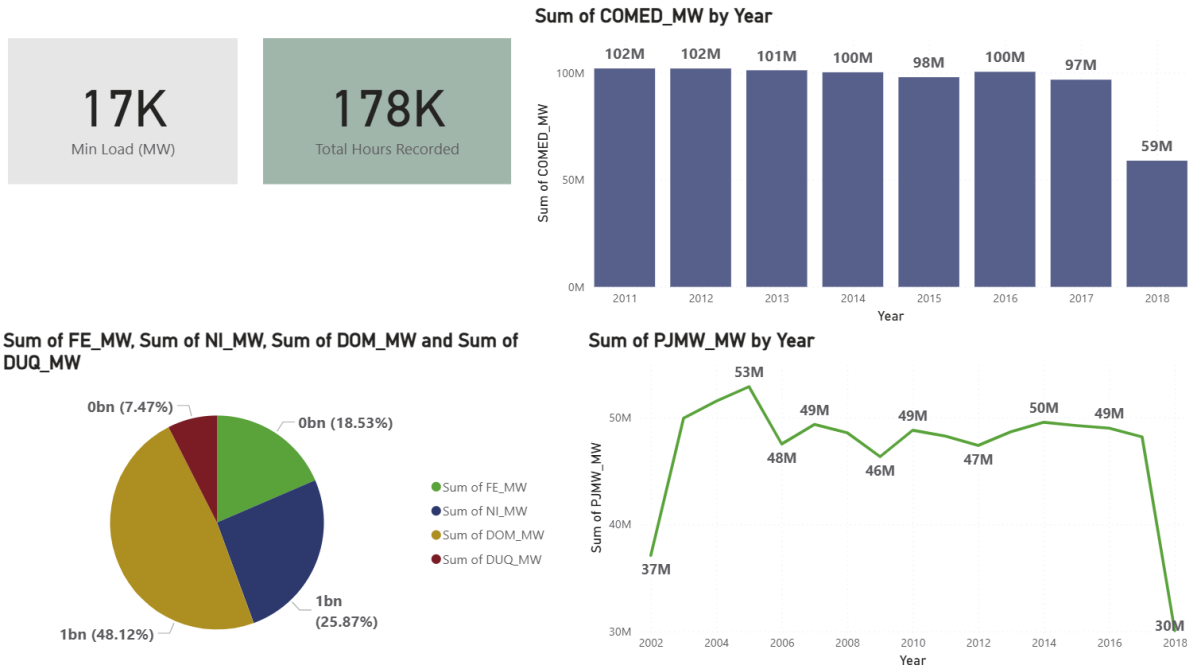


Sum of AEP_MW, Sum of COMED_MW, Sum of DAYTON_MW and Sum of EKPC_MW



Sum of COMED_MW, Sum of DAYTON_MW and Sum of EKPC_MW





Problem Faced

- **Missing or Incomplete Data:** Some hourly load records were missing, requiring data cleaning and imputation.
- **Data Inconsistency:** Regional datasets had varying formats and column structures that needed normalization.
- **Date-Time Parsing Issues:** Converting timestamp formats and extracting hourly/yearly information posed challenges in Power Query.
- **Performance Lag:** Visuals took longer to load due to the large volume of data spanning multiple years and regions.

- **Difficult Relationship Modeling:** Combining PJM and sub-regional datasets required careful linking for accurate aggregations.
- **Visual Overcrowding:** Displaying multiple KPIs and regional comparisons without cluttering the layout was a design challenge.
- **Filter Conflicts:** Interactions between slicers sometimes created unexpected filtering behaviour in visualizations.
- **Time Intelligence Complexity:** Building accurate year-over-year and trend calculations using DAX involved advanced logic.

Key Insights

- **Total Load** reached **979M MW**; Peak Load stood at **54K MW**.
- **AEP_MW** has the highest share (~33.66%) among all sub-regions.
- **COMED_MW** showed a gradual decline from 102M (2011) to 59M (2018).
- Load distribution is highly uneven—some sub-regions have zero or negligible data post-2002.
- **PJM_Load_MW** saw growth from 0.19bn to 0.27bn till 2001, then a sharp drop.