

Implementation Details :

The implementation of the energy consumption analysis project was divided into three major modules to systematically transform raw datasets into interactive dashboards using Microsoft Power BI. Each module represents a phase in the data lifecycle—starting with data preparation, followed by dashboard design for household and industrial sectors

Module 1: Data Preparation

This foundational module involved collecting, cleaning, transforming, and modeling data from two primary Excel files:

- Household_energy_data.xls
- Industrial_energy_data.xls

4.1.1 Importing Data

- The “Get Data” function in Power BI was used to load the two Excel files.
- Sheets were individually reviewed and loaded as separate tables.
- Both datasets had distinct structures, so no merging was performed at this stage.

4.1.2 Data Cleaning in Power Query

Once loaded, the data underwent preprocessing in Power Query:

- Null and Blank Values:
- Removed rows with missing or corrupted entries.
- Replaced null energy values with 0 to avoid calculation errors in visuals.

Column Renaming:

- Ambiguous column names (e.g., “H_Eng”, “Reg”) were renamed to full descriptive forms such as “HeatingEnergy” and “Region” for clarity.

Data Types and Formatting:

- Ensured numerical columns (e.g., EnergyConsumption, Appliances) were assigned correct data types (e.g., Decimal Number).
- Date fields were formatted properly to support time-based analysis.

4.1.3 Relationships and Data Modeling

- Created one-to-many relationships where applicable (e.g., between Region and entries).
- Established calculated columns and DAX measures such as:
- $\text{TotalEnergy} = \text{SUM}([\text{HeatingEnergy}] + [\text{CoolingEnergy}] + [\text{Appliances}] + [\text{Lighting}])$
 $\text{EfficiencyScore} = [\text{OutputEnergy}] / [\text{InputEnergy}]$

This preparation ensured data consistency and made downstream visualization more robust and flexible.

Module 2: Household Dashboard

This module focused on visualizing energy usage in residential properties across various dimensions such as region, occupancy, and energy type.

4.2.1 Filters and Slicers

Interactive slicers were implemented to allow user-driven exploration:

- Date Range: Analyze usage over time (e.g., year-by-year trend).
- House Type: Apartment, Detached, Semi-detached.
- Occupancy: Full-time, Part-time, Seasonal.
- Region: North, South, East, West (or defined zones from dataset).
- These filters allow users to dynamically slice the data and compare patterns.

4.2.2 Visual Elements

The following visuals were designed for effective interpretation:

Line Chart – Yearly Trend

- Shows energy usage over time (by year/month).
- Helps detect seasonal spikes (e.g., heating in winter, cooling in summer).

Stacked Bar Chart – Energy Type Breakdown

- Represents the contribution of heating, cooling, appliances, and lighting.
- Useful for identifying dominant consumption sources.

KPI Tiles

Display:

- Maximum Energy Use (e.g., 4.8kWh – heating peak)
- Minimum Energy Use (e.g., 0.2kWh – lighting)
- Total Consumption (e.g., 6.10K kWh)

KPIs update dynamically with slicer selections.

4.2.3 Key Findings

- Apartments consume more cooling energy than detached homes.
- Northern regions show peak usage during winter due to heating demands.

- Appliance usage remains relatively consistent year-round but spikes during holidays.

Module 3: Industrial Energy Consumption Dashboard

The industrial dashboard visualizes energy use by different industry sectors, tracks technology adoption, and provides efficiency insights.

4.3.1 Filters and Parameters

The dashboard includes the following filters:

Region: West, East, South, North zones.

Industry Sector: Metals, Construction, Food, Textile, etc.

Technology Used: CNC Machines, Manual, IoT-enabled, Legacy equipment.

These allow industry-specific benchmarking and trend observation.

4.3.2 Visual Components

Monthly Line Chart – Energy Trend

- Plots industrial energy consumption over time.
- Detects monthly usage patterns, highlighting operational peaks.

Sector-wise Bar Chart

- Shows total energy consumption by sector.
- Allows quick comparison of energy-intensive industries.

Pie Chart – Technology Adoption

- Represents percentage distribution of technology types.
- Highlights gaps in adoption of modern, energy-efficient tools.

KPI Cards

- Total Industries Analyzed: 255
- Total Industrial Energy Use: 519.51K kWh
- Average Efficiency Score: 0.45 (on a scale from 0 to 1)

4.3.3 Analytical Insights

- Metals and Construction sectors lead in energy use due to continuous operations and heavy machinery.
- Industries using CNC or IoT-enabled systems show significantly better energy efficiency.
- Older industries still rely on manual or legacy equipment, contributing to higher energy waste.

4.3.4 User Experience and Interactivity

Both dashboards were designed with usability in mind:

- Dynamic Filters: All visuals respond instantly to filter changes.
- Responsive Layouts: Visuals adjust based on selection scope.

- Color Themes: Consistent color coding for each energy type and sector improves readability.
- Tooltips: Hover-over explanations provide data context without cluttering visuals.

4.3.5 Challenges and Resolutions

Challenge	Solution
Inconsistent column naming in Excel	Standardized during Power Query transformation
Null or missing energy values	Replaced with 0 or removed row after validation
High variance in industrial data	Normalized consumption values for fair comparison
Overlapping visuals in dashboard	Used grid layout and grouping features in Power BI