REDWOOD COAST ENERGY AUTHORITY
TITLE - ENERGY CONSUMPTION ANALYSIS

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HUMBOLDT CUSTOMER DATA (QUESTION 1) AND REDWOOD COAST DATA (QUESTION 2)

OVERVIEW OF THE DATASET

The Humboldt dataset and Redwood Coast dataset contains 15-minute interval energy consumption data for a given customer over a specific period. The key columns include:

1. DATE: Timestamp marking the start of the day at 00:00:00.
2. 00:00:00 to 23:45:00: 15-minute interval columns representing energy consumption.
3. Exceed kW Threshold (kWh): Energy consumption exceeding a certain kW threshold for the entire day.
4. Exceed kW Threshold during peak hours (kWh): Energy consumption exceeding the kW threshold during peak hours.
5. Exceed kW Threshold during part-peak hours (kWh): Energy consumption exceeding the kW threshold during part-peak hours.
6. On Peak kW: Maximum power demand during peak hours.
7. Off Peak kW: Maximum power demand during off-peak hours.
8. Super Off-Peak kW: Maximum power demand during super off-peak hours.
9. Park Peak: A special category of peak hours requiring domain expert clarification.
10. Max kW Demand: Maximum power demand recorded during the day.

15-minute Intervals: The core of the dataset consists of 15-minute interval readings of energy consumption. These intervals provide a detailed view of the customer's energy usage patterns throughout the day.
Peak and Off-Peak Hours: Energy consumption and demand are often categorized into peak, part-peak, and off-peak hours to manage and optimize energy usage and costs. Peak hours are typically times of the day when energy demand is highest, while off-peak hours are when the demand is lowest.
Threshold Exceedances: The columns related to threshold exceedances indicate how much the customer's energy consumption exceeded predefined thresholds. These thresholds might be set by the energy provider to encourage efficient energy usage or to impose limits on maximum allowable consumption.

STEPS FOR ANALYSIS

Trend Analysis: Identify daily, weekly, and seasonal trends in energy consumption.
Peak Usage Times: Determine the times of day with the highest energy consumption.
Seasonal Variations: Analyze how energy consumption varies across different seasons.
Energy Reduction Strategies: Propose strategies for reducing energy consumption, particularly during peak periods.

GRAPHS

1. **Identify Trends:**
   This graph shows the overall trend of energy consumption over the entire period. Seasonal patterns are evident, with noticeable peaks during the winter and summer months, likely due to heating and cooling needs. There are also regular weekly cycles indicating higher consumption during certain periods of the week.
2. **Average Energy Consumption by Hour of Day:**
   This graph illustrates the daily pattern of energy consumption, highlighting peak usage times throughout a typical day. It often shows higher consumption during morning and evening hours, times due to activities like cooking, heating, or cooling, and general household or business operations.

3. **Average Energy consumption by day of the week:** This graph shows the average energy consumption for each day of the week, indicating if there are any significant differences in usage between weekdays and weekends.

4. **Seasonal Trends:** This graph highlights the seasonal variations in energy consumption, with potential peaks during certain months which may correspond to heating or cooling needs in winter or summer.

PERFORMING ANALYSIS

1.Trends Over Time:

Seasonal Trends: By visualizing the data over an extended period, you can identify seasonal patterns, such as higher consumption during winter or summer months due to heating or cooling.

2.Daily and Weekly Patterns:

Daily Consumption: Regular spikes and troughs in the graph indicate typical daily consumption patterns, such as higher usage during the day and lower usage at night.

Weekly Trends: Patterns keep repeating on a weekly basis, during weekdays compared to weekends.

3.Peak Usage Periods:

Identifying Peaks: The graph shows the times of the day or specific days when energy consumption is at peak. This can help in identifying high-demand periods.

Consumption Variability: You can observe the variability in energy consumption and identify any irregular peaks that might need further investigation.

4.Anomalies and Outliers:

Unusual Spikes: Any unexpected spikes in the graph indicates unusual consumption patterns that may need to be explored, such as equipment malfunctions or unusual activities.

Drops in Consumption: Significant drops might indicate power outages, system shutdowns, or other disruptions.

REDWOOD CUSTOMER DATA ANALYSIS (QUESTION 2)

GRAPHS

1. **Daily Energy Consumption Trends**: This analysis shows how energy consumption fluctuates throughout each day, helping identify peak usage times. The data reveals that energy usage typically peaks in the early morning and late afternoon/evening hours, likely corresponding to household or business activities starting and ending.
2. **Exponential Smoothing Forecast:** Exponential smoothing was used to forecast future energy consumption based on historical data, providing a smooth curve that represents the general trend. This forecast helps in planning future energy needs by indicating expected consumption patterns. The confidence bounds (upper and lower) show the range within which future consumption is likely to fall, aiding in risk management.
3. **Moving Average Analysis:** The moving average analysis smoothens out short-term fluctuations and highlights longer-term trends in energy consumption. This approach is useful for identifying consistent patterns and seasonal variations, helping to plan for predictable changes in energy demand.

GRAPHS

1.Daily Energy Consumption Trends:

This graph plots energy consumption for each 15-minute interval over multiple days, highlighting the daily patterns.

Peaks in the early morning and late afternoon/evening indicate times of high energy usage, possibly due to routine activities like starting the day and returning home.

2.Exponential Smoothing Forecast:

This graph uses exponential smoothing to forecast future energy consumption based on historical data. The confidence bounds (upper and lower) indicate the range within which future consumption is likely to fall.

The forecast helps in planning future energy needs and managing risks associated with energy consumption variability.

3.Moving Average Analysis:

This graph applies a moving average to smooth out the short-term fluctuations, highlighting longer-term trends in energy consumption.

The moving average reveals consistent patterns and seasonal variations, aiding in planning for predictable changes in energy demand.

PRESENTATION OF ANALYSIS USING EXCEL

Excel was chosen for this analysis due to its robust functionalities in data manipulation, cleaning, and preparation. Features like filtering, sorting, and conditional formatting made it easy to read the dataset. Coming to Excel’s extensive chart options, including line graphs, area charts, and bar charts, helped to effectively visualize the energy consumption trends. Its user-friendly interface and widespread use ensure accessibility and ease of review for stakeholders. Excel's capability to handle time-series data with functions like moving averages and exponential smoothing was crucial for identifying trends. Pivot tables and charts provided powerful tools for summarizing and analyzing large datasets, enabling quick aggregation and detailed breakdowns. Advanced analytical tools such as Solver and the Data Analysis Toolpak facilitated detailed statistical analysis and optimization, while the grid structure allowed swift examination of 15-minute interval data. Excel's forecasting functions, including exponential smoothing, has helped for the project’s future consumption, making it a comprehensive tool for both detailed analysis and effective presentation.

WHY EXCEL OVER OTHER TOOLS

1.Power BI: Despite its advanced visualization and real-time data connectivity, Power BI lacks the flexibility for detailed data manipulation and cleaning that Excel offers, which was crucial for this analysis.

2.Python: While Python is highly effective for data analysis and machine learning, its complexity can be a barrier for stakeholders who are not familiar with programming. Excel’s user-friendly interface makes the analysis more accessible, and it can still integrate with Python for more complex tasks if necessary.

3.Tableau: Although Tableau is excellent for creating interactive dashboards, its data manipulation capabilities are not as robust as Excel’s. Excel’s familiarity and strength in detailed, iterative analysis make it a more suitable choice for immediate insights and comprehensive data examination.