LAB MANUAL

Case Study: Energy Usage of a Family and Its Carbon Footprint

Energy Usage of a Family and Its Carbon Footprint

Let us zoom in on one household's energy use and its carbon output. Like the consumption patterns of a city, families receive their energy from a combination of renewable sources: solar panels, wind energy, and hydroelectric power. Although renewable sources are part of the mix, households still generate carbon due to their total energy consumption. Ultimately, it is about understanding the data and taking steps toward energy efficiency and reducing carbon output.

The Dataset: Monthly Energy Usage and Carbon Emissions

The following table shows the summary of the household's solar, wind, and hydro generations. In addition, there is the total energy consumption of the household coupled with the corresponding carbon emissions, with a view to considering the emission factor of 0.475 kg of CO_2 per kWh.

Month	Solar (kWh)	Wind (kWh)	Hydro (kWh)	Total Energy Consumption (kWh)	Carbon Emissions (kg)
January	600	500	400	1500	712.5
February	550	450	400	1400	665
March	700	500	400	1600	760
April	750	550	400	1700	807.5
May	800	600	400	1800	855
June	850	650	400	1900	902.5
July	900	700	400	2000	950
August	950	750	400	2100	997.5
September	800	600	400	1800	855
October	750	550	400	1700	807.5
November	700	500	400	1600	760
December	600	500	400	1500	712.5

Line Plot: Visualizing Total Energy Consumption Over the Year

Objective: Study the change of family electricity consumption during the different seasons to be able to know which time of the year would have the maximum variations.

The family uses more energy during the warmer months of the year. This is higher in July and August. It is probably due to air conditioning and cooling systems. It decreases in winter possibly because heating systems are being used more efficiently, or they rely on other ways of heat like gas.

Month	Total Energy Consumption (kWh)
January	1500
February	1400
March	1600

April	1700
May	1800
June	1900
July	2000
August	2100
September	1800
October	1700
November	1600
December	1500

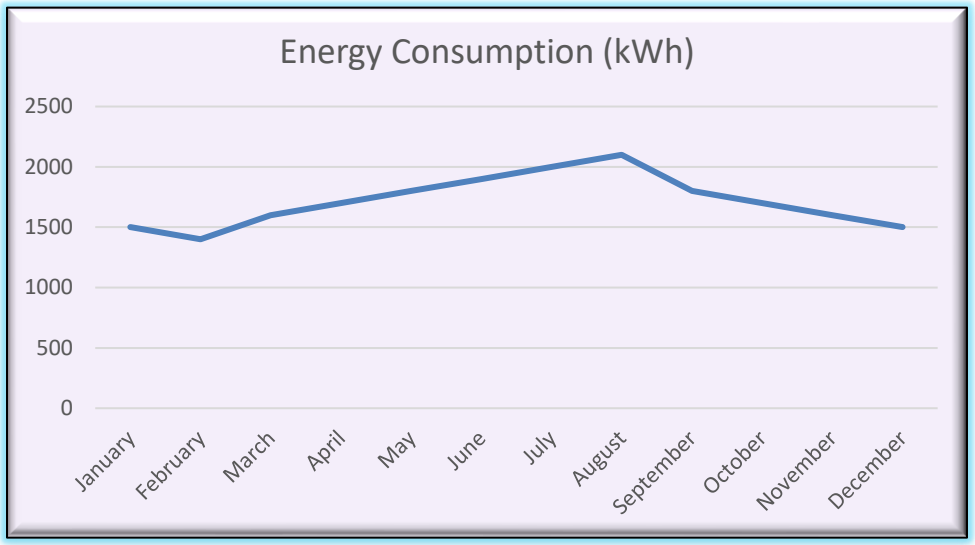

Fig: Visualizing Total Energy Consumption Over the Year

Bar Chart: Comparing Energy Generation from Solar, Wind, and Hydro Sources

Objective: Compare the energy generation coming from solar, wind, and hydro throughout the year for the household.

Production of solar energy is highest during summer since it finds long daily hours of the sun's being in the sky. The production of wind energy also coincides with the harshest months of the year when wind speed appears to be high. In contrast to this, hydro energy is constant during the entire year and thus the steady source of energy supply to the house.

Month	Solar (kWh)	Wind (kWh)	Hydro (kWh)
January	600	500	400
February	550	450	400
March	700	500	400
April	750	550	400
May	800	600	400
June	850	650	400
July	900	700	400

August	950	750	400
September	800	600	400
October	750	550	400
November	700	500	400
December	600	500	400

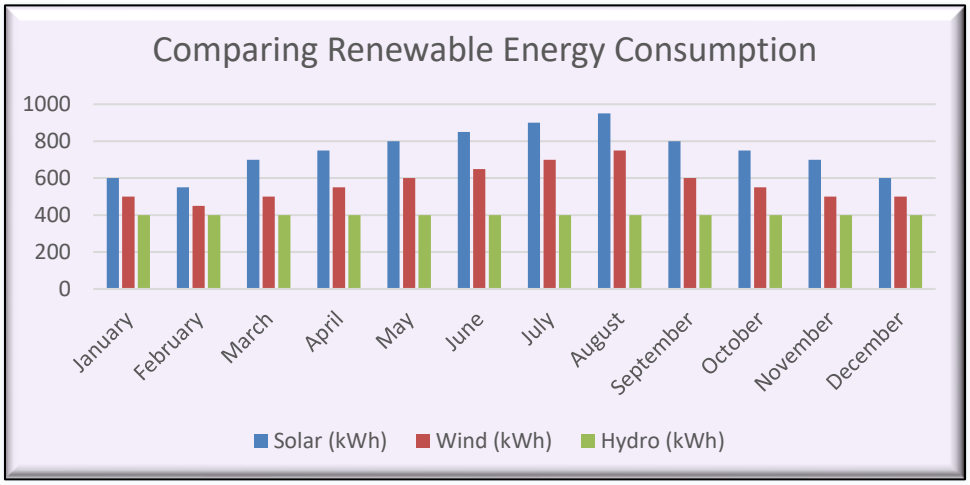

Fig: Comparing Energy Generation from Solar, Wind, and Hydro Sources

Pie Chart: Contribution of Each Renewable Energy Source to Annual Energy Generation

Objective: To demonstrate the proportion of solar, wind, and hydro power in the annual energy mix for the household.

Solar energy is the leading source for domestic renewable energy generation, producing 38.2% of the total amounts. It is followed by wind energy, which was at 33.8%, and hydro at 28%. These renewables will cut down the usage of electricity from non-renewable forms for the family.

Energy Source	Total kWh (Annual)	Percentage
Solar	9200	38.2%
Wind	8150	33.8%
Hydro	4800	28%

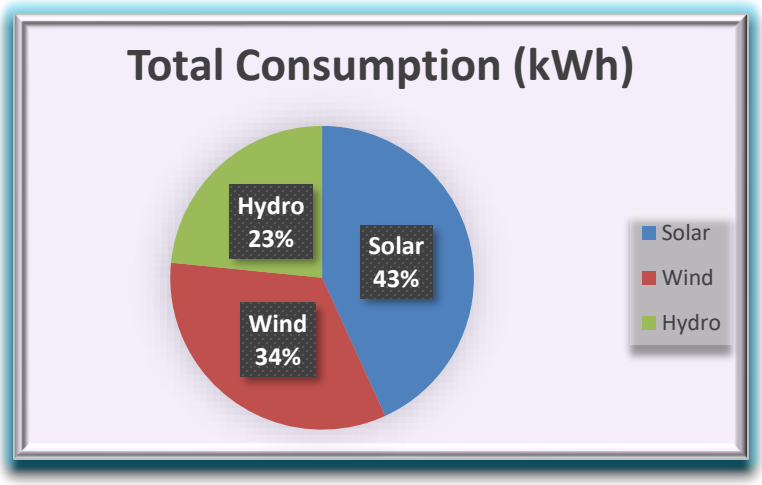

Fig: Contribution of Each Renewable Energy Source to Annual Energy Generation

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Scatter Plot: Correlation Between Energy Consumption and Carbon Emissions

Objective: To understand the relationship between the household energy consumption and carbon emissions.

As would be expected, there is a clear energy consumption-carbon emissions link. Because the family consumes more energy during the hot summer months, their carbon emissions increase during that period of the year. This means that if the family can reduce energy use during peak consuming months, its carbon footprint would decrease remarkably.

Month	Total Energy Consumption (kWh)	Carbon Emissions (kg)
January	1500	712.5
February	1400	665
March	1600	760
April	1700	807.5
May	1800	855
June	1900	902.5
July	2000	950
August	2100	997.5
September	1800	855
October	1700	807.5
November	1600	760
December	1500	712.5

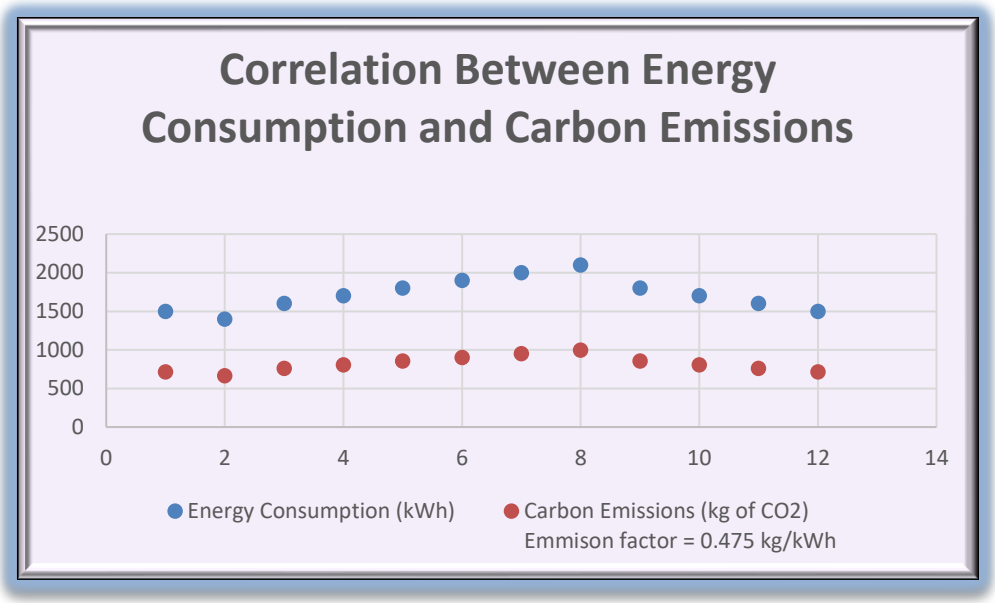

Fig: Correlation Between Energy Consumption and Carbon Emissions

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Customization: Customizing a Bar Chart Using Titles, Labels, Legends, and Adjusting Styles

From the previously created bar chart that was comparing energy generated from solar, wind, and hydro sources, making customizations really spice up clarity and presentation; apply the following customizations in Excel so you could make your chart so much more informative and visually effective:

Step-by-Step Customization:

1. **Add a Chart Title:**

- Navigate to the **Chart Elements** button (the plus icon next to the chart).
- Check the **Chart Title** box.
- Edit the title to something meaningful, like **"Monthly Renewable Energy Generation (kWh)"** to clearly indicate what the chart represents.

2. **Label the Axes:**

- From the same **Chart Elements** menu, check the box for **Axis Titles**.
- Label the **X-axis** as **"Months"** to indicate the time period and the **Y-axis** as **"Energy Generated (kWh)"** to indicate the energy values.

3. **Add Data Labels:**

- Select the chart and then click the **Chart Elements** button again.
- Check **Data Labels** to display the actual energy generation values on top of each bar. This will make it easy for the viewer to see exact values for each month.

4. **Legend Placement:**

- Ensure the **Legend** is present and properly labeled (e.g., Solar, Wind, Hydro) by checking the **Legend** box under **Chart Elements**.
- To adjust the position, right-click on the legend and choose **Format Legend**. Place it at the **bottom** or **right** for better readability.

5. **Adjust Styles:**

- To change the chart style, select the chart and go to the **Chart Styles** option in the toolbar.
- You can experiment with different styles, such as **Style 4** for a cleaner look or **Style 6** for a more modern design.
- You may also adjust the **color scheme** by selecting the **Change Colors** option in the **Chart Styles** menu. For example, using a color palette that differentiates solar, wind, and hydro more clearly (e.g., solar = orange, wind = blue, hydro = green).

6. **Additional Customizations:**

- **Gridlines**: You can remove or lighten the gridlines by going to the **Chart Elements** menu and unchecking **Gridlines** or modifying them under **Format Gridlines**.
- **Borders**: Add a border to the chart by selecting the chart, going to **Format**, and adding a solid border to make the chart stand out.

Conclusion

This family can make some informed choices about energy efficiency by analysing their energy usage and associated carbon emissions. Proper investment in better energy management tools, a higher proportion of renewable energy use, or reducing the overall consumption during peak months could all significantly cut their carbon footprint.

This allows the family to perceive and visualize the charts generated with respect to energy and environmental impact as they strive toward a greener, more sustainable way of life.