

DATA VISUALIZATION: Indian Power Sector at a Glance



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Data Description and Analysis:

Installed_Power_Capacity_State_wise_MW.csv file with given data provides information on the monthly electricity generation and distribution statistics for the five regions of India from January 2019 to January 2022. The data is broken down by state and includes details on the amount of installed electricity generation capacity using different sources such as coal, gas, diesel, thermal, nuclear, hydro, and renewable energy (RES), as well as the total installed capacity by each state.

Power_Generation.csv file with daily power generation data in India region-wise for 2017-2020. This data could be used to perform more detailed analysis of electricity generation trends in India, and to compare the trends in different regions and states of the country. The daily data provides more granularity than the monthly data, allowing for more detailed analysis of energy demand and supply patterns. This data could be combined with the monthly data to provide a comprehensive picture of electricity generation and distribution in India over the past four years.

and Jammu and Kashmir was split into two UTs. This change in the political boundaries of states and UTs requires updating the data to ensure that it is consistent with the current geographic division of the country.

>Another challenge in dealing with power generation data is handling NaN values or missing data. NaN values can occur when data is not available or is incomplete. In the case of power generation data, it could be due to a power plant being shut down for maintenance, or due to a delay in data reporting. In such cases, it may be necessary to interpolate the data to estimate the missing values based on available data points. Interpolation can help fill in gaps in the data and make it more consistent, allowing for more accurate analysis.

>In particular, the Power_Generation.csv file may have missing data that requires interpolation to estimate the power generation during those periods accurately. Interpolation techniques such as linear interpolation, cubic interpolation, or spline interpolation can be used to fill in missing values.

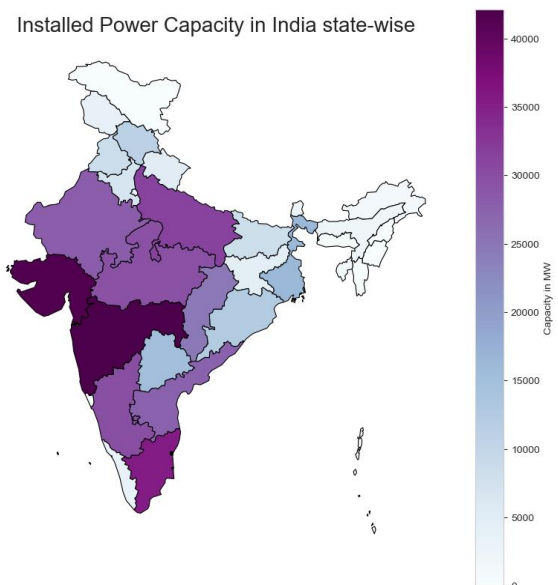
	id	month	region	state	coal	gas	diesel	thermal_total	nuclear	hydro	res	grand_total
0	1	Jan-2019	Northern	Chandigarh	0.0	0.00	0.0	0.00	0.0	0.00	32.40	32.40
1	2	Jan-2019	Northern	Delhi	135.0	2208.40	0.0	2343.40	0.0	0.00	176.21	2519.61
2	3	Jan-2019	Northern	Haryana	5540.0	431.59	0.0	5971.59	0.0	0.00	411.99	6383.58
3	4	Jan-2019	Northern	Himachal Pradesh	0.0	0.00	0.0	0.00	0.0	9809.02	864.50	10673.52
4	5	Jan-2019	Northern	Jammu and Kashmir	0.0	175.00	0.0	175.00	0.0	3449.00	188.88	3812.88

Data Anomalies and Data Cleaning:

> Data consistency is essential for accurate analysis and decision-making. When dealing with data on power generation in India, it is important to ensure that the state names are spelled correctly, and there are no duplications or discrepancies in the names. For example, 'Andhra Pradesh' and 'Andhra Pradesh.' may be the same state but with slightly different names. This inconsistency can lead to errors in analysis and should be corrected.

>In addition to spelling correction and removal of duplication in state names, data consistency may also involve handling newly formed or combined states or union territories (UTs). For example, in recent years, Telangana was formed by splitting Andhra Pradesh,

PLOT I: Choropleth Map - Installed Capacity State-wise



Plot I Description:

1. This is geographical plot, called 'Choropleth Map', I plotted using 'Geopandas' library.
2. This is used to show overall summary of Indian Power Sector at particular time point.
3. Unit of installed capacities is MW.
4. State-wise comparative study can be done through this plot and overall idea can be gained.

Plot I Observations:

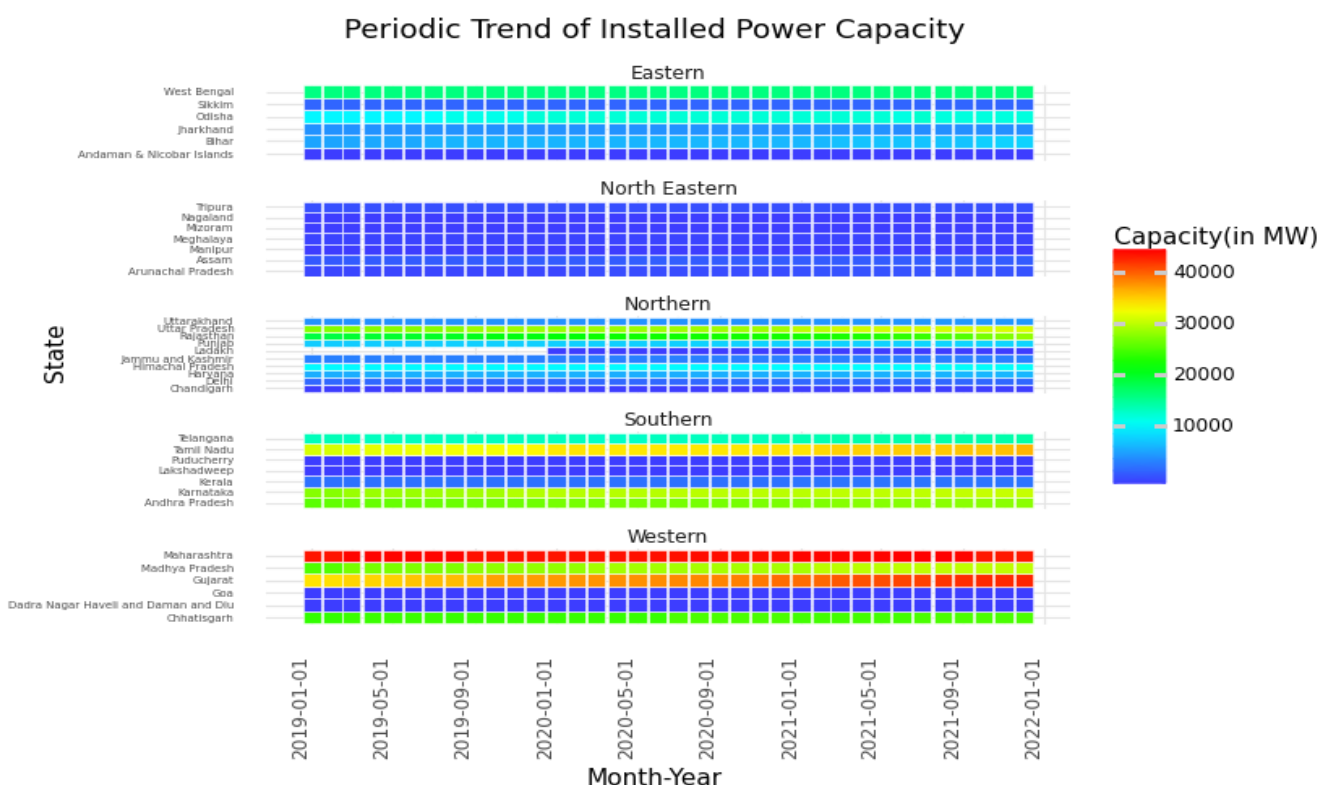
> A choropleth map is an effective way to visualize the distribution of data across geographic regions. A choropleth map showing the power installed capacity in India for the year 2022 would provide valuable insights into the regional distribution of power generation.

>The map would display the power installed capacity data for each state of India, with varying shades of colours indicating the level of installed capacity. The darker shades would represent higher installed capacity, while the lighter shades would represent lower installed capacity.

>Some of the states that would be highlighted with the highest installed capacity include Maharashtra, Tamil Nadu, Gujarat, and Rajasthan. These states have invested significantly in renewable energy sources such as wind and solar power plants. On the other hand, states such as Bihar, Jharkhand, and Chhattisgarh would display lower installed capacity due to several factors, including a lack of resources and limited infrastructure.

>Overall, the choropleth map would provide a clear visual representation of the power installed capacity across different states of India, indicating which regions are leading the way in power generation and which regions require more investment in the future.

PLOT II: Periodic Heat Map State-wise with Region-Wise facets



Plot II Description:

1. I have plotted this faceted heat-map for installed capacity data.
2. This is periodic plot, showing the trend of power generation capacity of states individually and facet comparison can give user idea about the region wise infrastructure development.

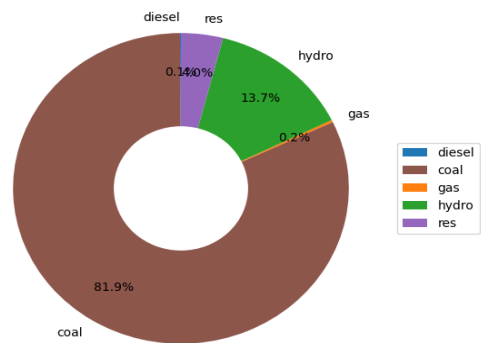
Plot II Observations:

1. Maharashtra is having consistently the highest installed capacity throughout the years.
2. Gujarat showed steepest increase in power infrastructure, followed by Tamil Nadu and Rajasthan

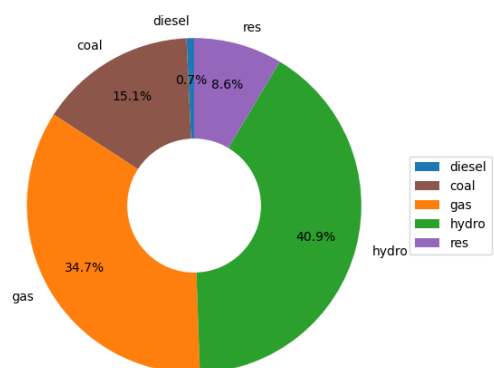
PLOT III: Donut Plots - Different Energy Sources Distribution

Details: Capacity installed during the given period can be seen from below visualizations and the highest three states having maximum capacity installed during this period are highlighted with different color.

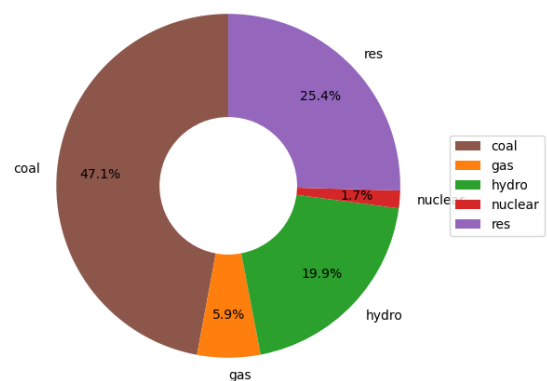
Share of each type of energy in Eastern



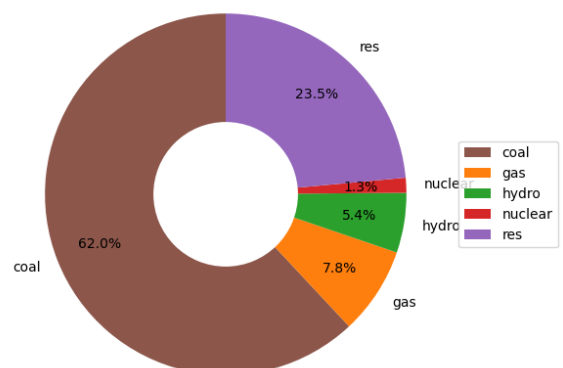
Share of each type of energy in North Eastern



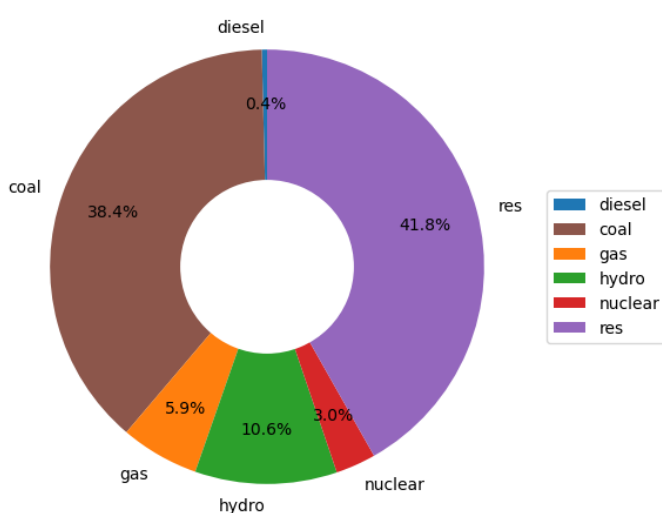
Share of each type of energy in Northern



Share of each type of energy in Western

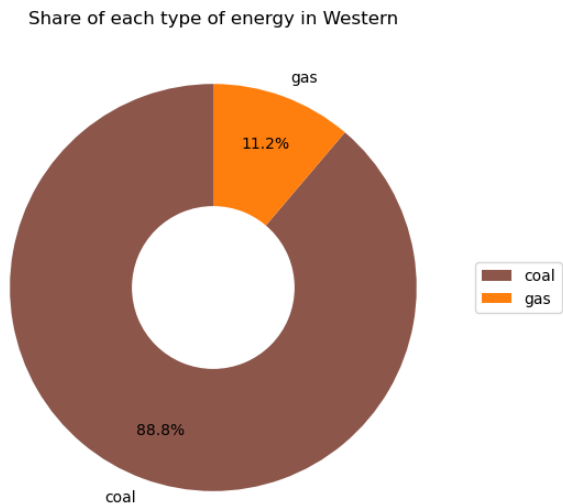
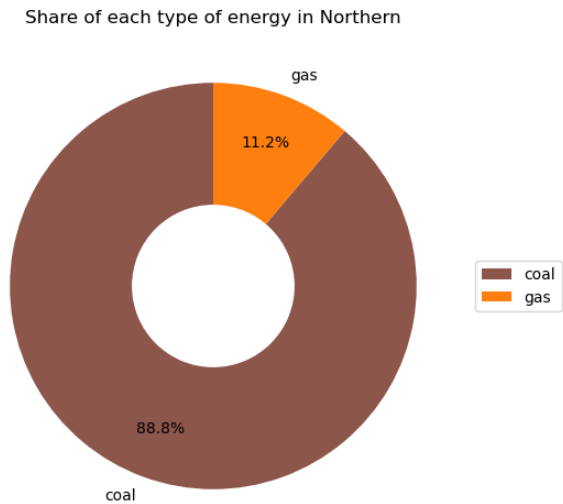
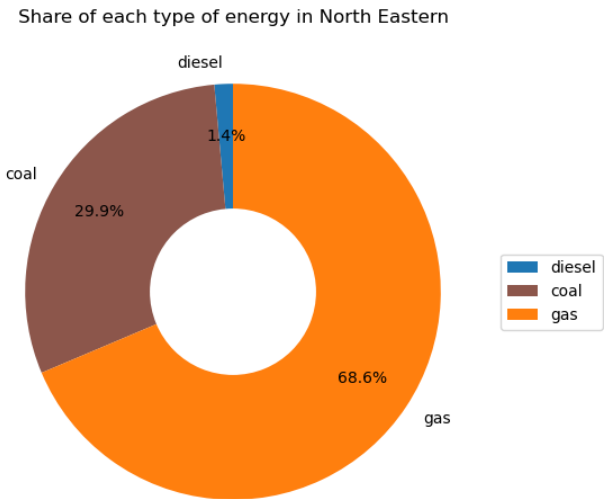
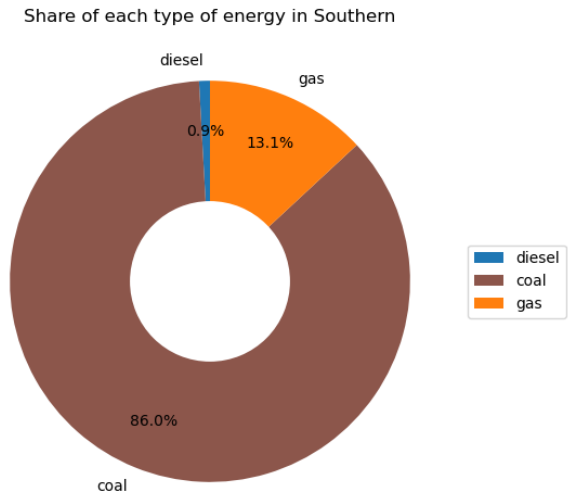
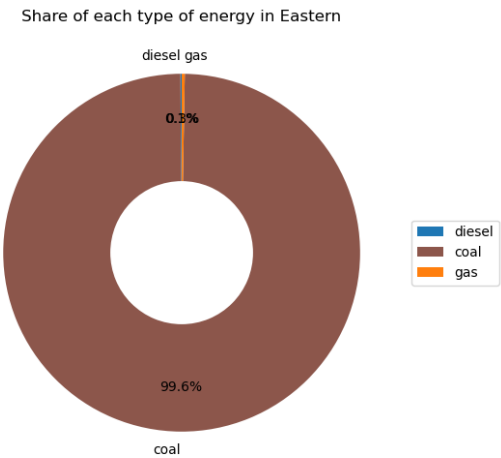


Share of each type of energy in Southern



PLOT IV: Different Thermal Energy Distribution

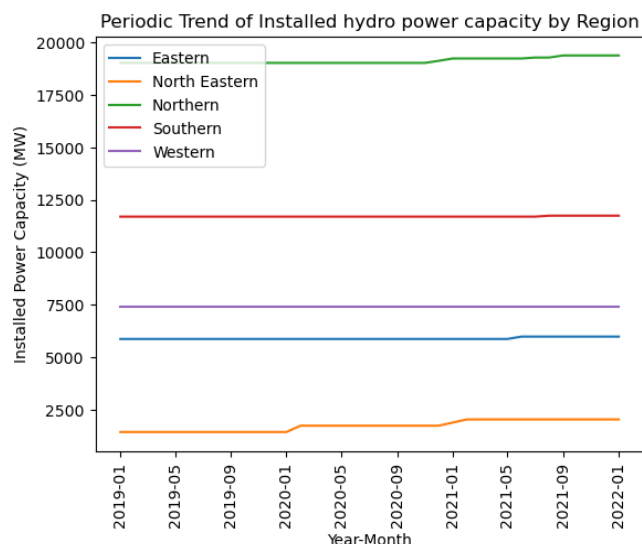
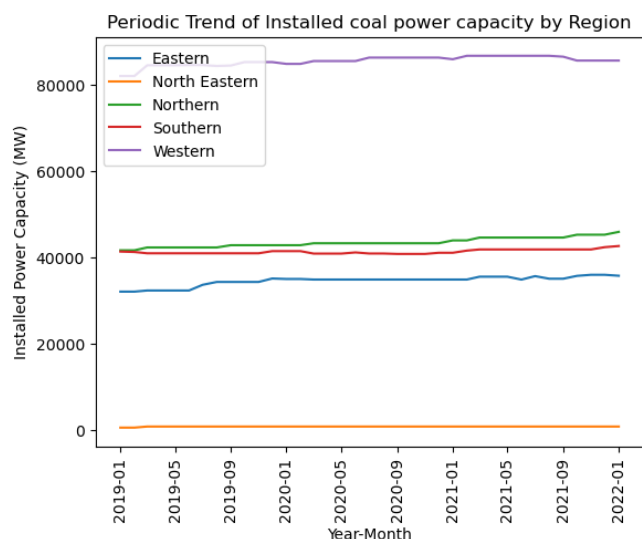
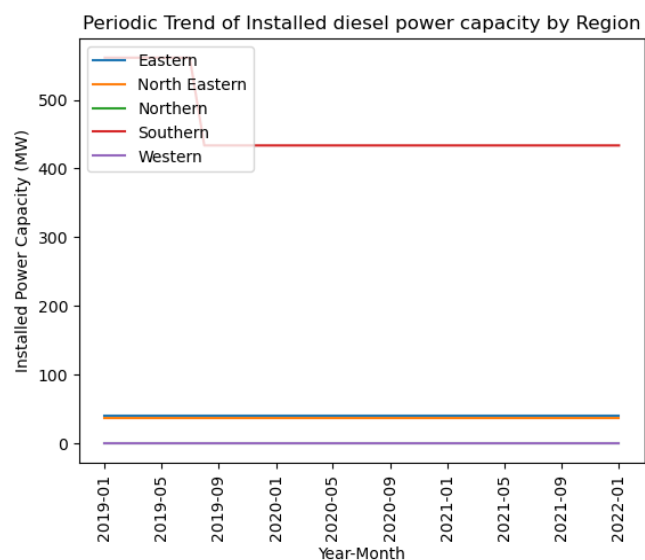
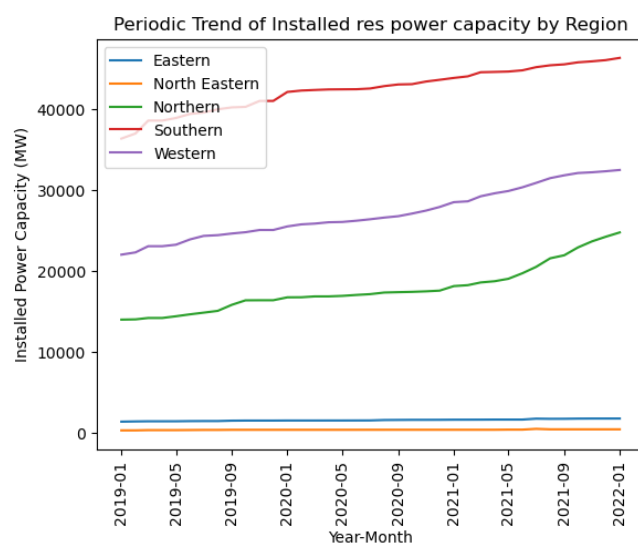
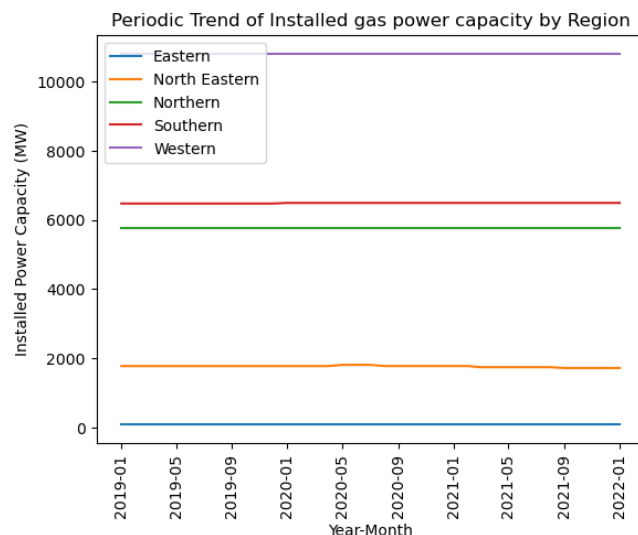
Details: Capacity installed during the given period can be seen from below visualizations and the highest three states having maximum capacity installed during this period are highlighted with different color.



PLOT V: Line Plots - Power Capacity Periodic trend over the period of 2019-2022

In India, power generation from various energy sources has been growing steadily over the years. To showcase the periodic trend of installed power capacity, five 'line plots' have been generated, each representing one energy source and displaying different coloured lines for the five regions of India.

Overall, these line plots demonstrate a positive trend in installed power capacity for various energy sources across different regions in India from 2019 to 2022.



PLOT VI: Stacked Bar Plot Region-Wise Facetted Stacked Bar Plot for 2019-2022

Details: Five facets each of a particular region makes it easy to compare data of installed capacity for period, moreover for different sources of energy gives idea that coal plants are the most dominant source of power generation facility installed in most of the regions.

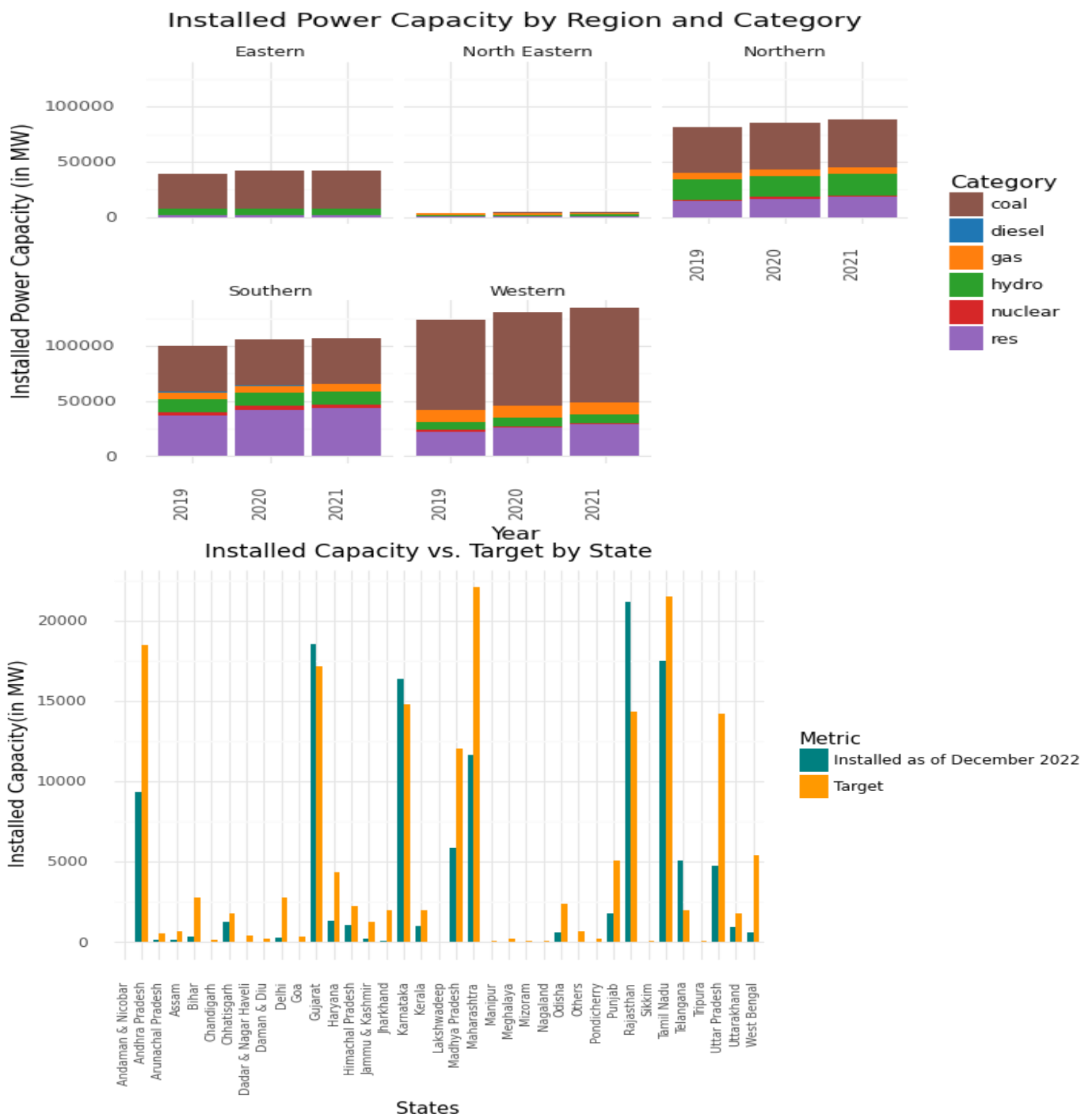
PLOT VII: Dodged Bar Plot- Renewable Installed Capacity Vs Development Target for States

Plot VII Description:

1. This bar plot is showing two statistical figures for each state, one is Installed Capacity as of December 2022 and Target.

Plot VII Observations:

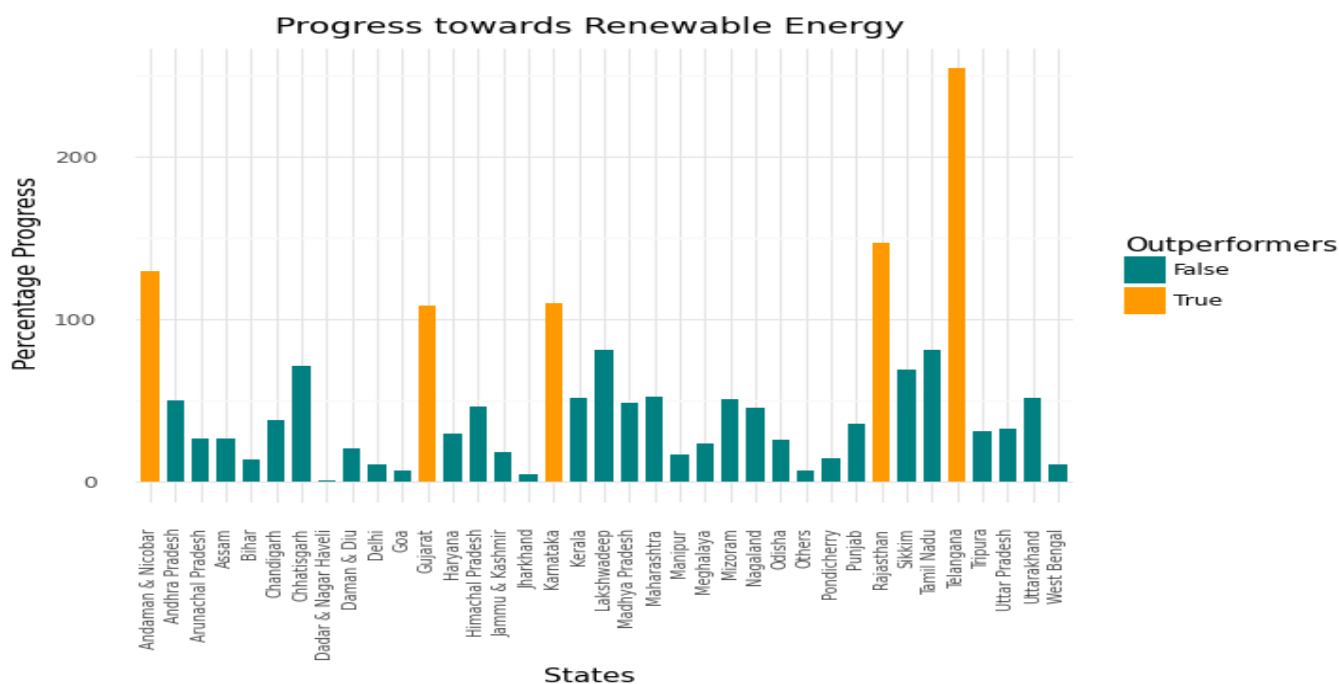
1. Few states are showing and extraordinary work in renewable power sector, ex. Karnataka, Gujarat, Telangana. They surpassed the target given to them for developing power infrastructure.



PLOT VIII: Bar Plots for Percentage Progress by States in Renewable Energy

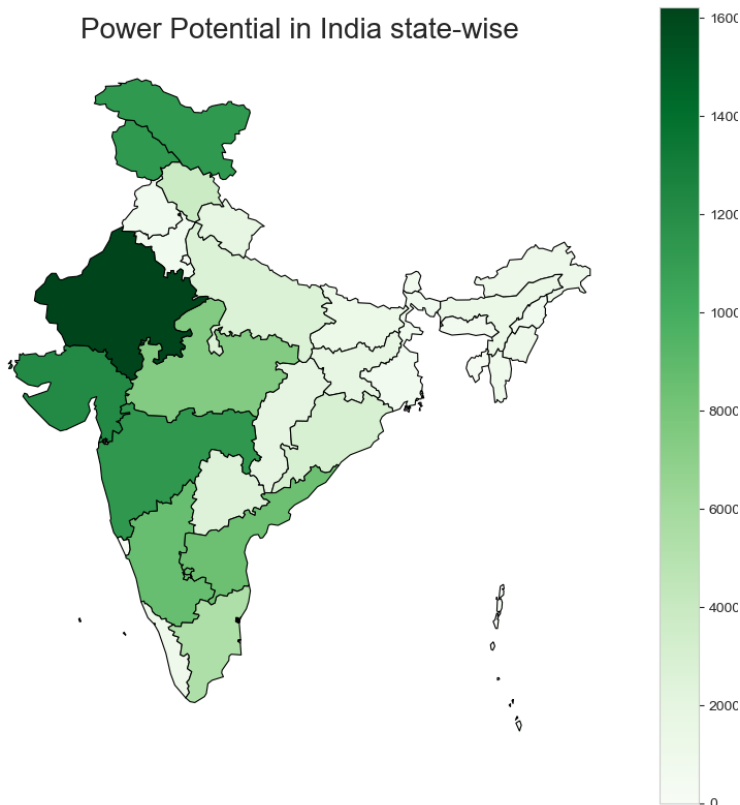
Plot Description:

1. This bar plot showing what percent of work is completed by every state in w.r.t Renewable energy Target given by administration.
2. Gujarat, Karnataka, Rajasthan Andaman and Nicobar have surpassed the mark of 100%.
3. Interesting insight that can be seen from this plot is the tallest orange bar of Telangana, it showed 254% progress, which is significantly high compared to other states.

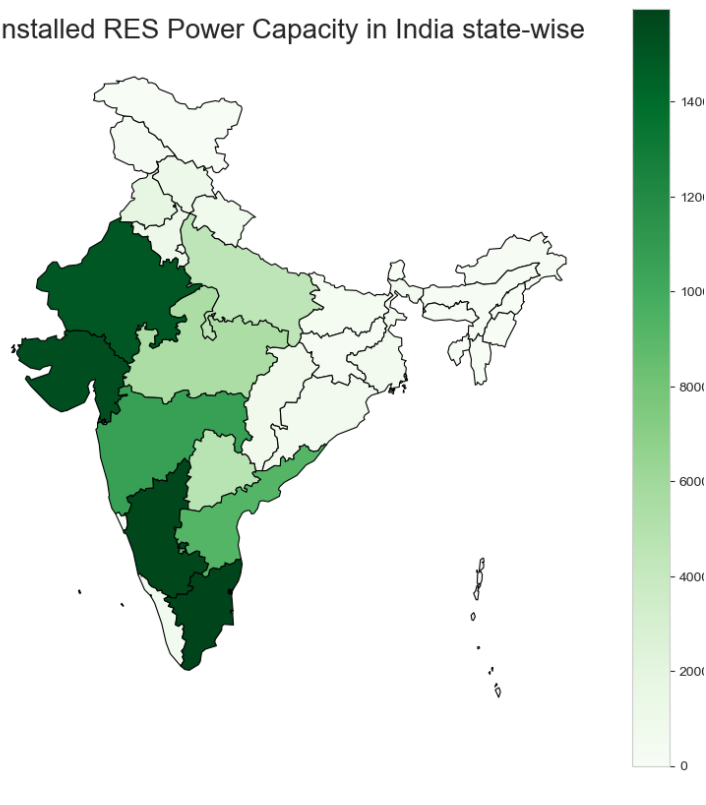


PLOT IX: Choropleth Maps: Potential of States compared with Current Installed Capacity

Power Potential in India state-wise



Installed RES Power Capacity in India state-wise



Plot IX Observations:

> A choropleth map is an effective way to visualize the distribution of data across geographic regions. A choropleth map showing the power installed capacity in India for the year 2022 would provide valuable insights into the regional distribution of power generation.

>The map would display the power installed capacity data for each state of India, with varying shades of colors indicating the level of installed capacity. The darker shades would represent higher installed capacity, while the lighter shades would represent lower installed capacity.

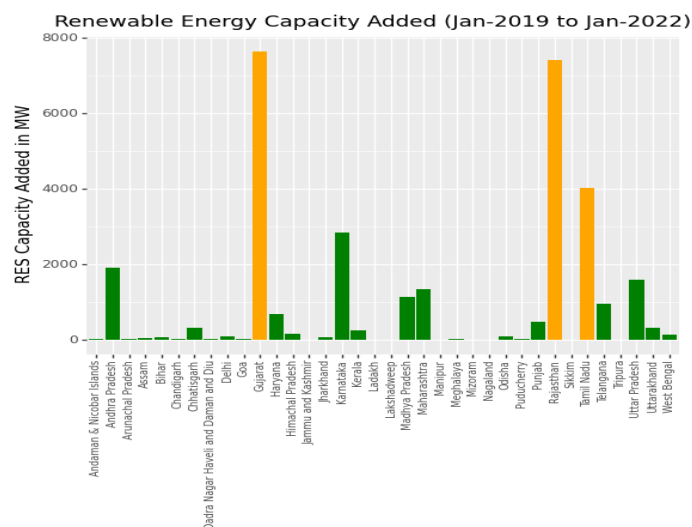
>Some of the states that would be highlighted with the highest installed capacity include Maharashtra, Tamil Nadu, Gujarat, and Rajasthan. These states have invested significantly in renewable energy sources such as wind and solar power plants. On the other hand, states such as Bihar, Jharkhand, and Chhattisgarh would display lower installed capacity due to several factors, including a lack of resources and limited infrastructure.

>Overall, the choropleth map would provide a clear visual representation of the power installed capacity across different states of India, indicating which regions are leading the way in power generation and which regions require more investment in the future.

PLOT X: Renewable Energy Plots

Details: Capacity installed during the given period can be seen from below visualizations and the highest

three states having maximum capacity installed during this period are highlighted with different color.

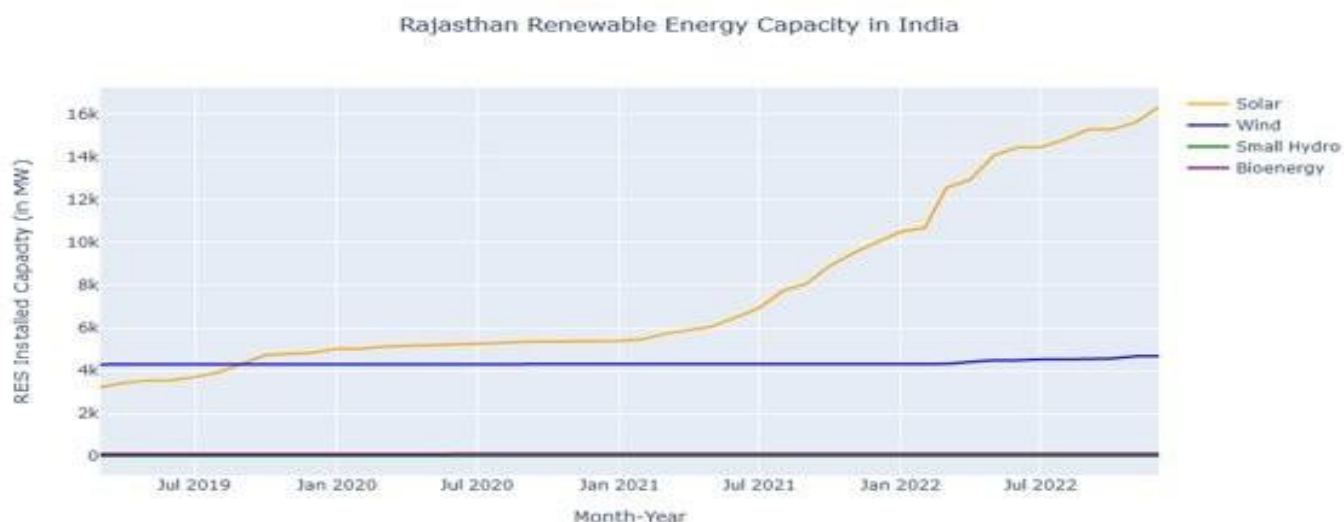


Plot XI: Interactive Line Charts Using Plotly - Solar, Wind, Bio-energy and Small Hydro growth over Top 3 Renewable Energy Leader States

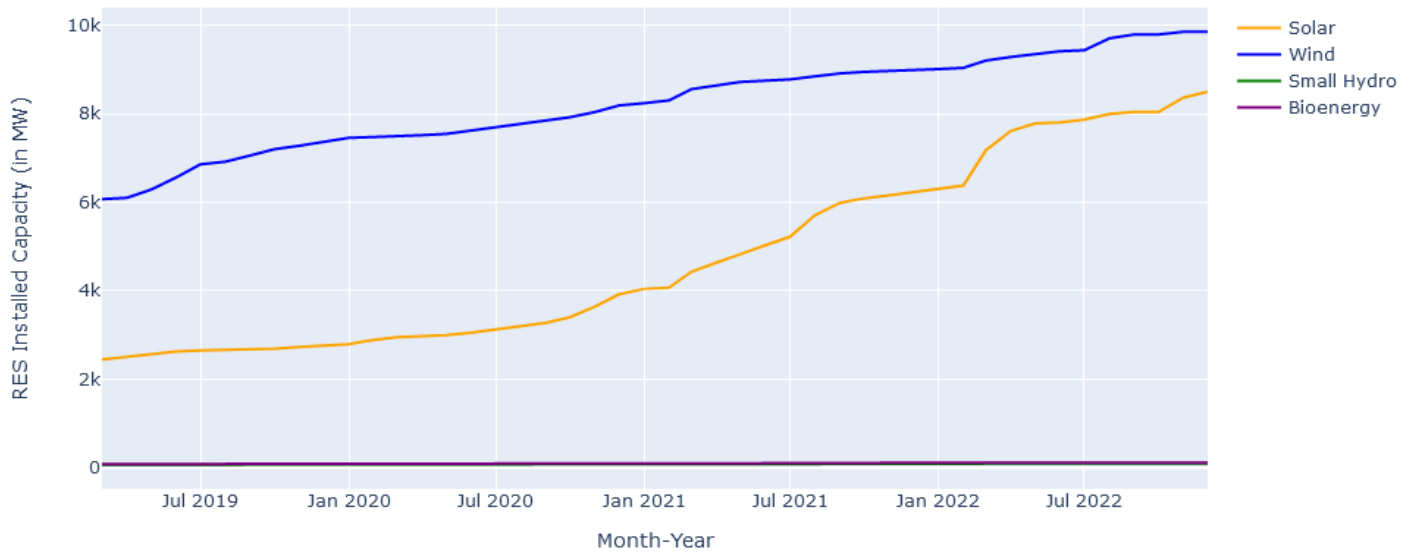
> A line chart can be used to visualize the growth of solar and wind energy capacity in Gujarat, Rajasthan, and Tamil Nadu over the past two years. The line chart would display each state as a separate line with the solar and wind energy capacity on the y-axis and time on the x-axis.

>The line chart would show the growth in solar and wind energy capacity in each state over the past two years. The line for each state would be color-coded to

Rajasthan Categorization in Renewable Energy Generation: [Solar -Wind-Small Hydro-BioEnergy]



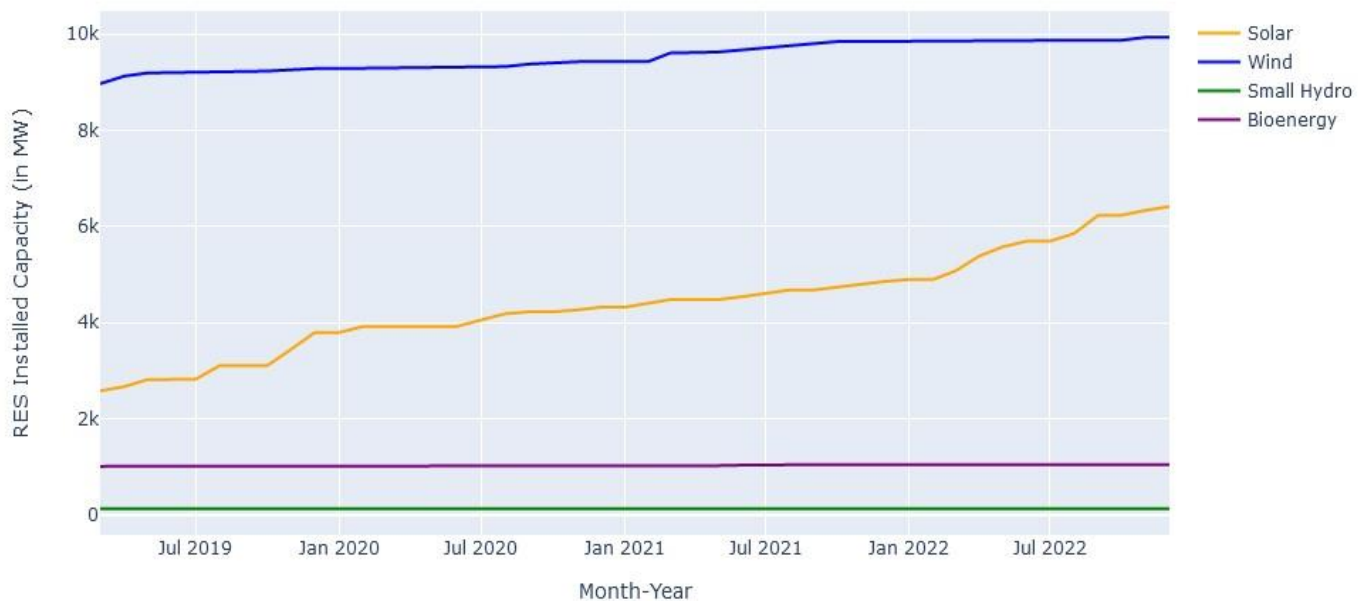
Gujarat Renewable Energy Capacity in India



make it easy to distinguish between them. The chart

Tamil Nadu Categorization in Renewable Energy Generation: [Solar -Wind-Small Hydro-BioEnergy]

Tamil Nadu Renewable Energy Capacity in India



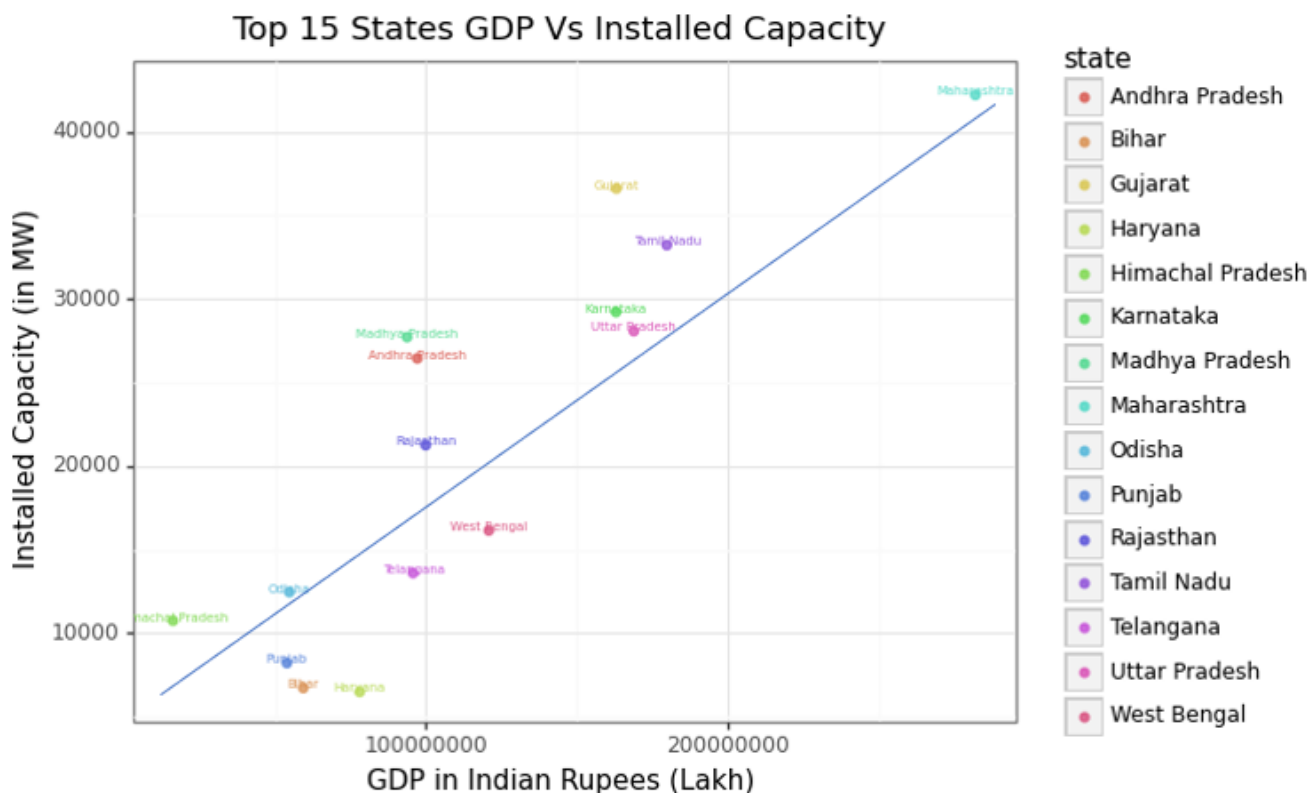
would also include a legend to identify the different lines.

PLOT XII: Scatter Plot showing correlation between GDP and Power Infrastructure in States

> A scatter plot can be used to visualize the relationship between installed capacity and GDP of states in India. A positive correlation between the two variables suggests that as the installed capacity increases, so does the GDP.

>The plot would display each state as a point with the installed capacity on the y-axis and GDP on the x-axis. The size of the point would represent the population of the state, and each point would be color-coded according to the region of the country in which it is located.

>A positive correlation between installed capacity and GDP would be evident if the points on the scatter plot tend to cluster around a line that slopes upward from left to right. A line of best fit could be drawn to visualize this trend, making it easy to see how the two variables are related.



Plot XIII: Line Charts Showing Periodic Trend of Hydro Energy Generation in different regions.

