Data and Visual Analytics 2026 (Capstone Project)

POWERING INDIA:

Analyzing the Gap Between Renewable Energy Potential and Actual Generation

Energy & Power Sector (Renewable Energy)

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CONTEXT & PROBLEM STATEMENT

Sector Context: India is rapidly expanding renewable energy to meet climate goals and rising electricity demand. However, renewable resources and infrastructure development are uneven across states.

Decision-makers: The decision-makers are Government energy planners, policy makers, and infrastructure investors.

Problem Statement: India has significant renewable energy potential, but the utilization of these resources varies widely across states. There is a noticeable gap between renewable energy potential, installed capacity, and actual generation in many regions. This leads to inefficient resource utilization and suboptimal investment decisions.
This project aims to identify these gaps across Indian states and renewable energy sources to support data-driven infrastructure planning and policy prioritization.

Objective: To support data-driven infrastructure investment and policy prioritization.

DATA ENGINEERING (SOURCE TO SINK)

Source

- Dataset: Potential, Generation, Capacity – Renewable
- Source: NDAP (Government of India)
- Size: 8,576 rows × 10 columns
- Time: State-wise, Year-wise

Cleaning

- Removed duplicate rows
- Standardized state names
- Handled missing values in potential & generation

Data Dictionary

- State
- Year
- Energy Source
- Renewable Potential (MW)
- Installed Capacity (MW)
- Generation (MU)

KPI & METRICS FRAMEWORK

What are we measuring?

01 Potential Utilization (%)

02 Capacity Utilization Factor (CUF %)

03 Potential–Capacity Gap (MW)

Why these KPIs?

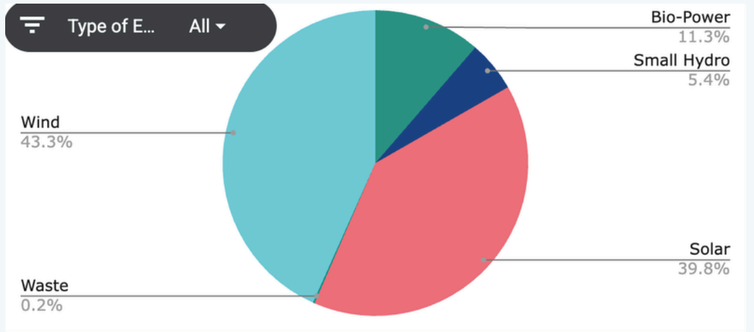
These directly measure:

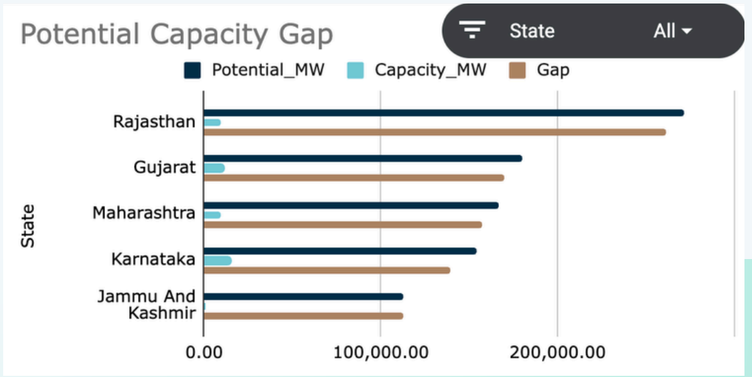
- Resource utilization
- Infrastructure efficiency
- Investment opportunity

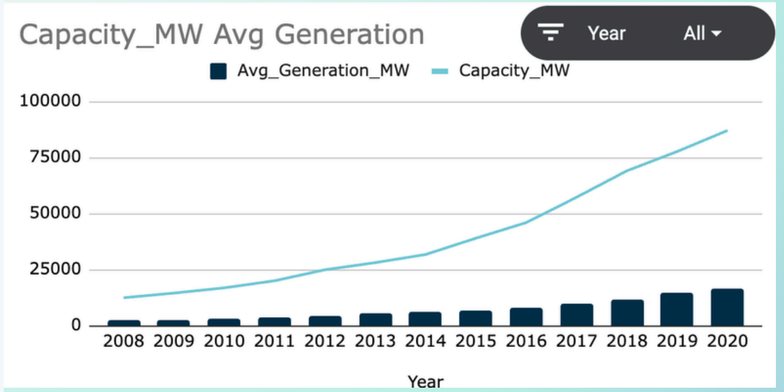
They link exactly to the problem of underperformance and misallocation.

KEY INSIGHTS (EDA)

- Renewable potential varies significantly across states.
- Several states show high potential but low installed capacity.
- Some states have large capacity but low actual generation.
- Solar shows strong growth compared to other sources.
- Renewable development is highly uneven across regions.







ADVANCED ANALYSIS

- High potential does not guarantee high generation.
- Infrastructure efficiency differs widely across states.
- Investment should focus on:
  - High-potential low-capacity regions
  - Low-efficiency high-capacity regions

This reveals root causes of underperformance.

Type of Analysis:

GAP

+

EFFICIENCY

+

TREND ANALYSIS

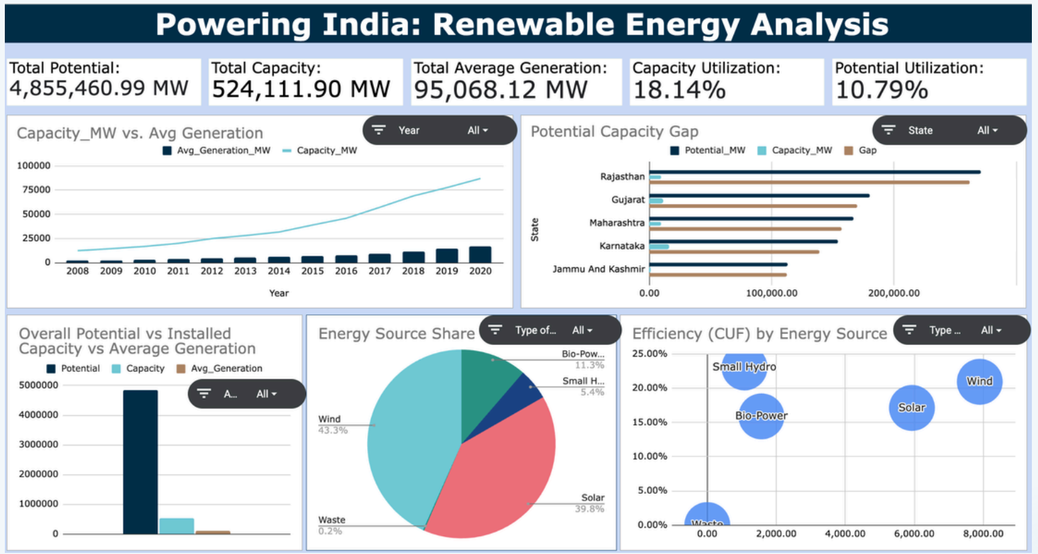
DASHBOARD WALKTHROUGH

Executive View

- Total renewable potential
- Total installed capacity
- Total average generation
- Capacity utilization %
- Potential utilization %

Operational View

- Energy source distribution (Wind, Solar, Bio-Power, Small Hydro, Waste)
- State-wise potential vs capacity gap
- Year-wise capacity vs average generation trend
- Efficiency (CUF) comparison by energy source



Renewable Energy Dashboard – Executive and Operational Overview

RECOMMENDATIONS

1

Prioritize investment in high-potential, low-capacity states

Focus on states showing large gaps between renewable potential and installed capacity to unlock untapped opportunities.

2

Improve operational efficiency in low-performing regions

Enhance plant performance and grid integration to increase overall capacity utilization (CUF).

3

Accelerate solar and wind expansion

Since these dominate the capacity mix, strategic expansion can significantly boost national renewable output.

4

Leverage data-driven monitoring systems

Use dashboards and periodic performance reviews to track progress and support evidence-based decision-making.

IMPACT & VALUE

- **Reduce inefficient investments**
  By identifying gaps between potential and installed capacity, resources can be allocated to high-impact regions instead of oversaturated areas.

- **Improve infrastructure utilization**
  Analysis of capacity utilization (CUF) highlights underperforming assets, enabling targeted efficiency improvements.

- **Support smarter policy decisions**
  State-wise and source-wise comparisons provide data-driven insights for renewable energy planning and regulatory focus.

- **Accelerate renewable energy adoption**
  By highlighting growth trends and untapped potential, the dashboard supports strategic expansion of wind, solar, and other clean energy sources.

LIMITATIONS & NEXT STEPS

Limitations

- Missing data for some states/years
- No cost or demand data included
- Does not include private sector constraints

Next Steps

- Add financial and demand datasets
- Forecast future renewable demand
- Build predictive models for investment planning

THANK YOU