Hybrid Plant Simulation Report

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Mixed End-Use Hybrid Plant with Renewable Energy Integration

Executive Summary

Total Renewable Capacity: 270,000 MW
Total Storage Capacity: 250,000 MWh
Total Capital Cost: 8,007,050 Rs./kW (720,634,500 Rs./kW)

System Overview

Wind: 150,000 kW
Pv: 120,000 kW
Battery: 50,000 kW
Large Energy Storage: 200,000 kW
Electrolyzer: 80,000 kW
Fuel Cell: 60,000 kW
Hydrogen Storage: 10,000 kW

Load Profiles

electric_load_hybrid.csv: Peak Electricity Demand = 33,000 kW
heat_load_hybrid.csv: Peak Heat Demand = 22,000 kW
hydrogen_demand_hybrid.csv: Peak Hydrogen Demand = 1,700 kg/h

Production Data Sources

Solar Data Sources: 2
Wind Data Sources: 8
SS01-KAT_H1: Max=232.49 A/m², Avg=52.22 A/m²
SS01-KAT_H2: Max=217.48 A/m², Avg=42.12 A/m²
WS01-OTT_Q01: Max=3569.47 kW, Avg=1510.63 kW

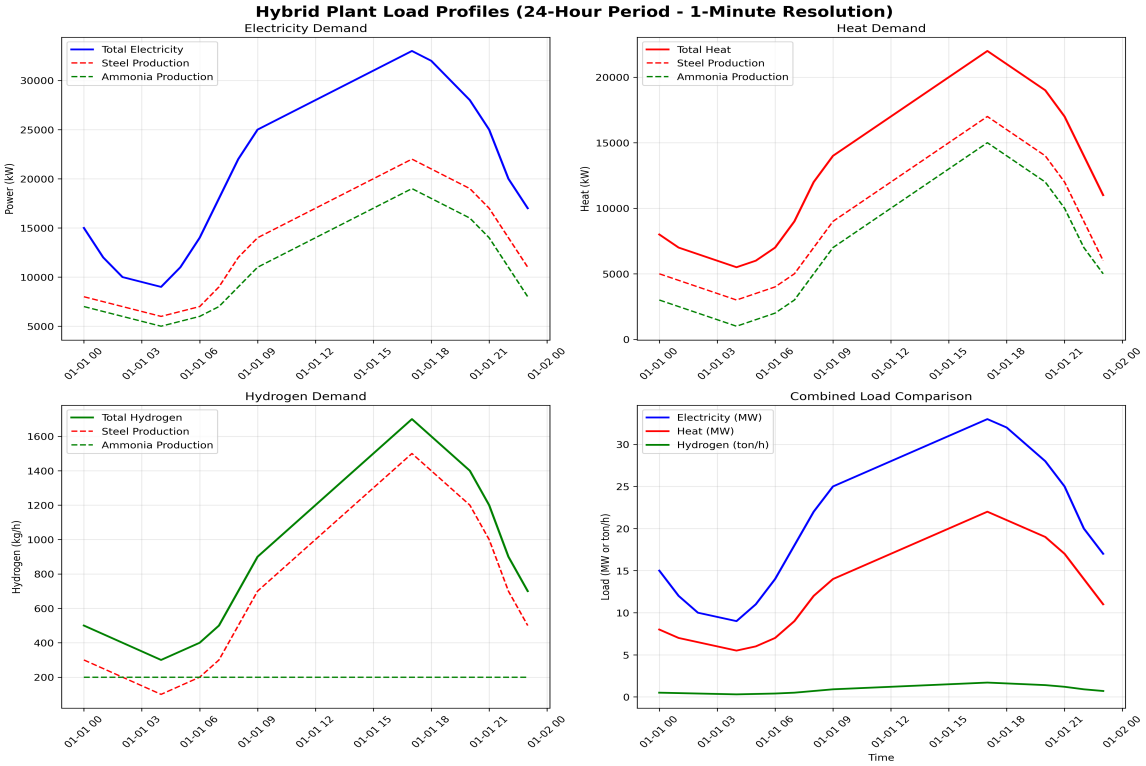
Technology Costs

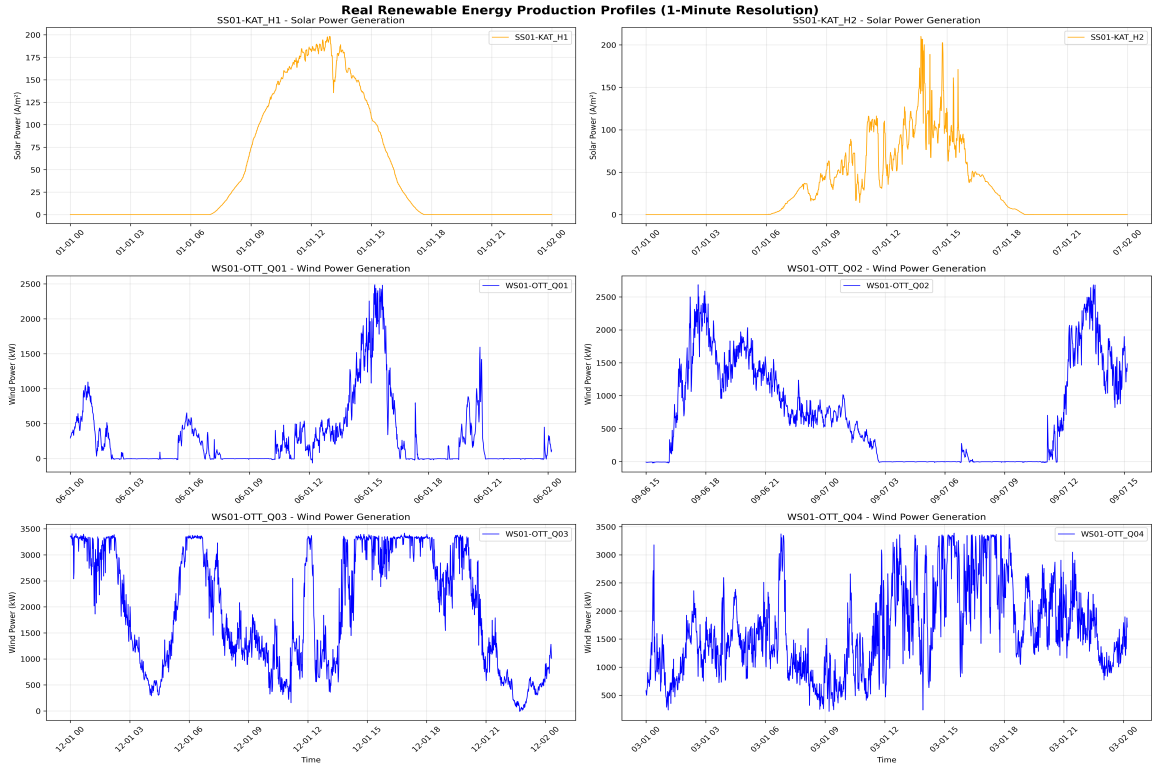
PV: 1,000 Rs./kW (90,000 Rs./kW)
wind: 1,200 Rs./kW (108,000 Rs./kW)
battery: 800 Rs./kW (72,000 Rs./kW)
large_energy_storage: 600 Rs./kW (54,000 Rs./kW)
fuel cell: 3,000 Rs./kW (270,000 Rs./kW)
hydrogen_storage: 450 Rs./kW (40,500 Rs./kW)
steel_production: 5,000,000 Rs./kW (450,000,000 Rs./kW)
ammonia_production: 3,000,000 Rs./kW (270,000,000 Rs./kW)

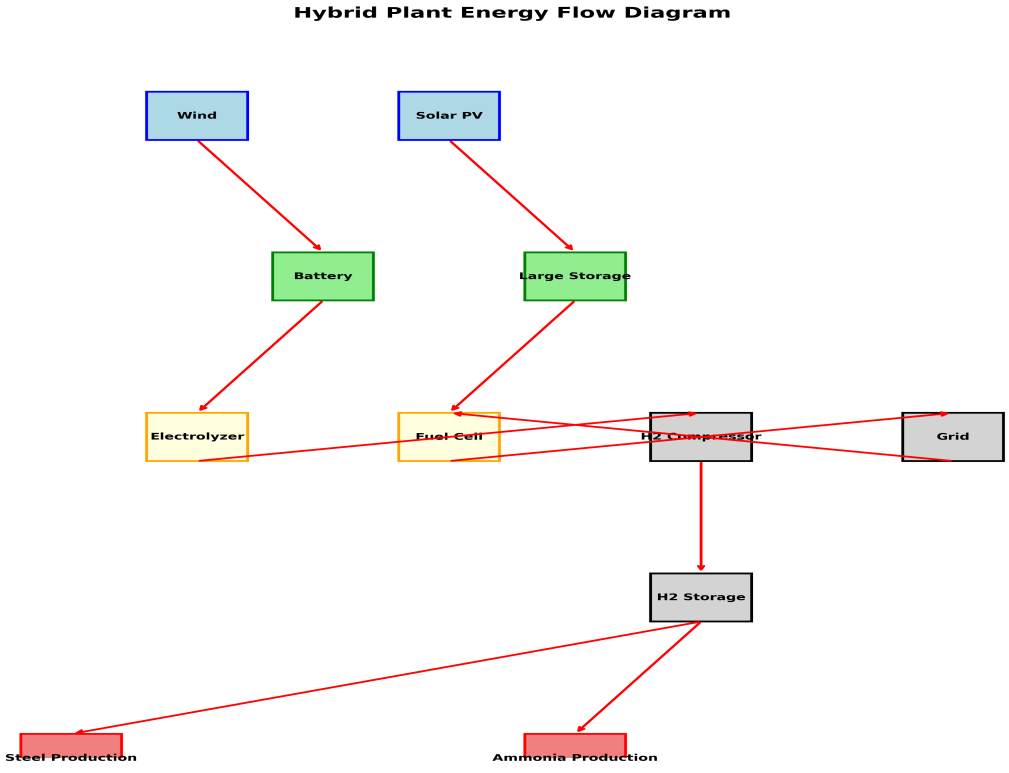
Energy Market

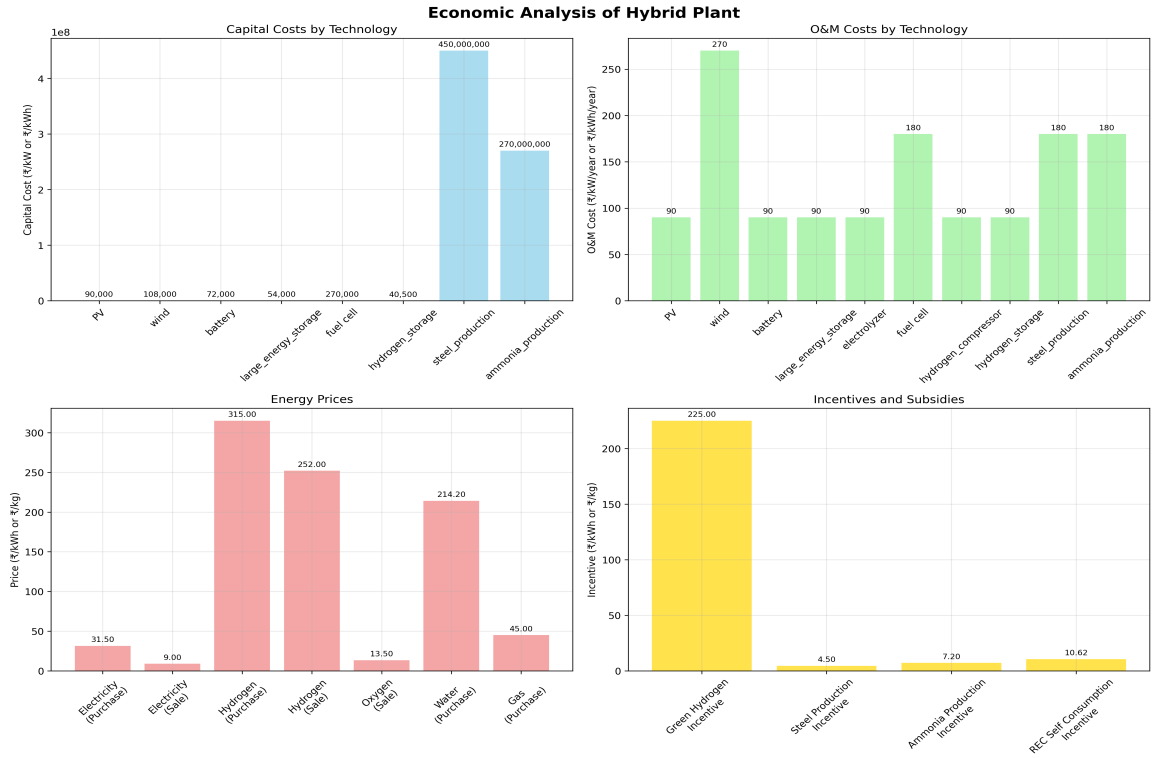
Electricity Purchase Price: 0.35 Rs./kWh
Electricity Sale Price: 0.10 Rs./kWh
Hydrogen Purchase Price: 3.50 Rs./kg
Hydrogen Sale Price: 2.80 Rs./kg

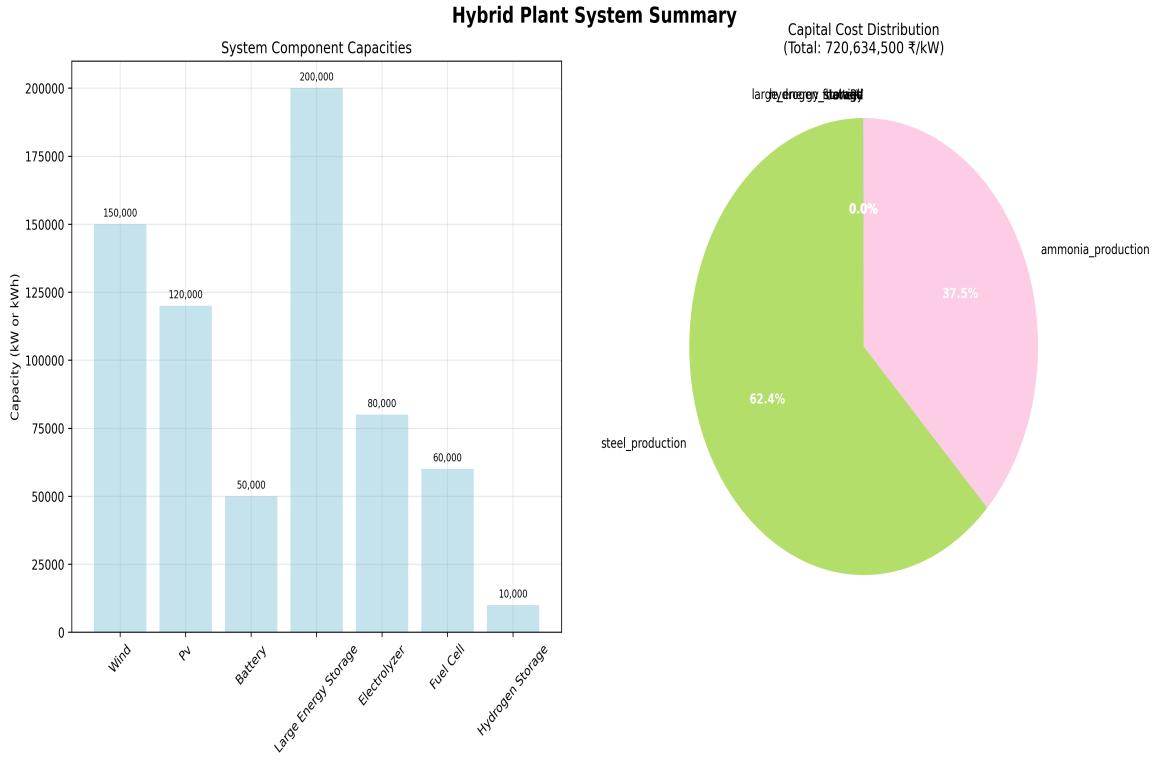
Generated Analysis Plots




Real Renewable Energy Production Profiles (1-Minute Resolution)
SS01-KAT_H1 - Solar Power Generation
SS01-KAT_H1
Solar Power (A/m²)
SS01-KAT_H2 - Solar Power Generation
SS01-KAT_H2
Solar Power (A/m²)
WS01-OTT_Q01 - Wind Power Generation
WS01-OTT_Q01
Wind Power (kW)
WS01-OTT_Q02 - Wind Power Generation
WS01-OTT_Q02
Wind Power (kW)
WS01-OTT_Q03 - Wind Power Generation
WS01-OTT_Q03
Wind Power (kW)
Time
WS01-OTT_Q04 - Wind Power Generation
WS01-OTT_Q04
Wind Power (kW)
Time


Hybrid Plant Energy Flow Diagram
Wind
Solar PV
Battery
Large Storage
Electrolyzer
Fuel Cell
H2 Compressor
Grid
H2 Storage
Steel Production
Ammonia Production


Economic Analysis of Hybrid Plant
Capital Costs by Technology
1e8
Capital Cost (₹/kW or ₹/kWh)
90,000
108,000
72,000
54,000
270,000
40,500
450,000,000
270,000,000
PV
wind
battery
large_energy_storage
fuel cell
hydrogen_storage
steel_production
ammonia_production
O&M Costs by Technology
O&M Cost (₹/kW/year or ₹/kWh/year)
90
270
90
90
90
180
90
90
180
180
PV
wind
battery
large_energy_storage
electrolyzer
fuel cell
hydrogen_compressor
hydrogen_storage
steel_production
ammonia_production
Energy Prices
Price (₹/kWh or ₹/kg)
31.50
9.00
315.00
252.00
13.50
214.20
45.00
Electricity (Purchase)
Electricity (Sale)
Hydrogen (Purchase)
Hydrogen (Sale)
Oxygen (Sale)
Water (Purchase)
Gas (Purchase)
Incentives and Subsidies
Incentive (₹/kWh or ₹/kg)
225.00
4.50
7.20
10.62
Green Hydrogen Incentive
Steel Production Incentive
Ammonia Production Incentive
REC Self Consumption Incentive


Hybrid Plant System Summary
System Component Capacities
Capacity (kW or kWh)
150,000
120,000
50,000
200,000
80,000
60,000
10,000
Wind
Pv
Battery
Large Energy Storage
Electrolyzer
Fuel Cell
Hydrogen Storage
Capital Cost Distribution
(Total: 720,634,500 ₹/kW)
0.0%
37.5%
62.4%
ammonia_production
steel_production