CII: POWER PLANT SUBMIT 2024

Revitalizing Old Thermal Power Plants:
The Renewable Energy Renaissance

Presented By:

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Damodar Valley Corporation: Serving the Nation Since 1948

THERMAL

6540 MW

HYDEL

147.20 MW

SOLAR

13.92 MW

Water Supply & Irrigation

SUBSTATION

48

Transmission Line

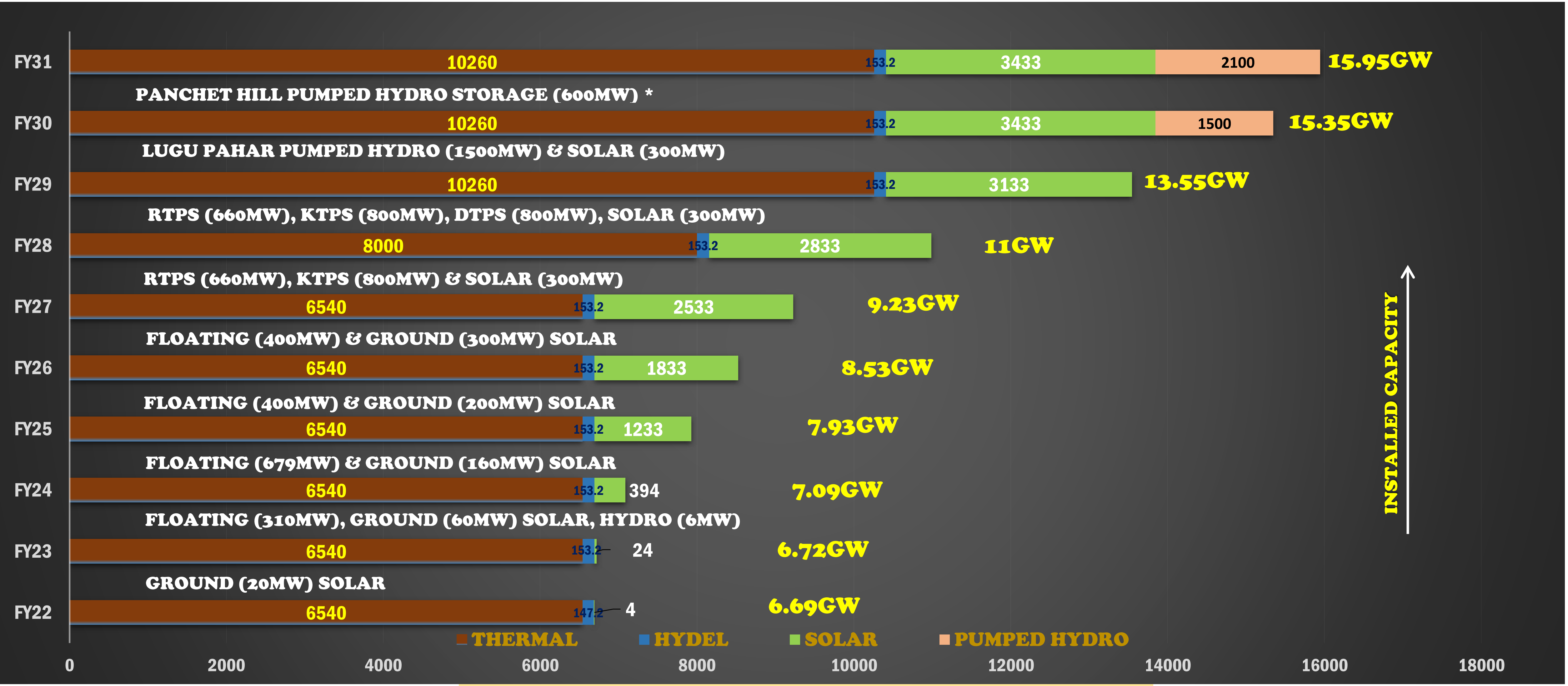
8633.65 CKm

Soil conservation and Afforestation

DAMODAR VALLEY CORPORATION

Riding on a crescendo

CAPACITY ADDITION PROGRAM



* Subject to allocation of site by WB Govt. in FY23
• RTPS: Supercritical, KTPS & DTPS: Ultra Supercritical Units

CLIMATE CHANGE & ITS IMPACT

- Human activity has caused the Earth to get warmer in the last 100 years.
- Climate change caused by our greenhouse gases is changing our weather patterns leading to rising temperatures and extremes of weather - both of which are damaging our natural environment.

WHY REPURPOSING

- **India's Energy Transition: Coal vs. Renewables**
- **Current Situation**:
  - **Coal Dominance**: 50-55% of installed capacity; >65% of electricity (MOP, 2020).
  - **Aging Coal Plants**: Low-capacity utilization, environmental issues, economically unviable (Forbes 2018).

- **Renewable Energy Targets**:
  - **500 GW** of RE capacity by 2022.
  - **50%** of generation from non-fossil fuels by 2030 (Shrimali 2020).

- **Trends**:
  - **Declining Utilization**: PLF dropped from 77.5% (2009) to 56.1% (2019) (MOP 2020).
  - **Reduced Coal Dependence**: Increased use of cheaper renewable sources (PWC 2019).

- **Economic & Environmental Impact**:
  - **Underutilized Plants**: Capacity factor fallen to below 60%, nearing 50%.
  - **Need for Decommissioning**: Economic and environmental concerns drive early retirement.

- **Opportunities**:
  - **Repurposing**: Potential value from stranded coal assets; exit strategy for utilities.

Challenges and Opportunities in Repurposing Old Thermal Power Plants

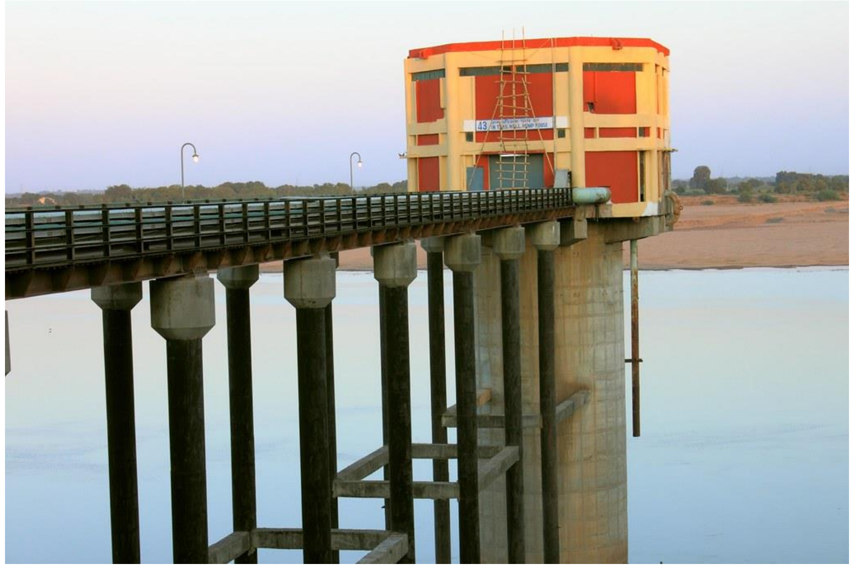
- **Land Constraints**: Limited space for new renewable energy (RE) projects.
- **Environmental & Social Management**: Address impacts of new developments and manage social resistance to plant closures.
- **Transmission Constraints:** Existing infrastructure may not support new RE projects efficiently.
- **Grid Stability**: Ensuring stability as coal plants are replaced by intermittent RE sources.
- **Opportunities**:
- **Public-Private Partnerships (PPP)**:
  - **Reduce CAPEX:** Lower capital expenditure through private investment.
  - **Debt Reduction**: Decrease overall debt for public utilities.
  - **Revenue Streams**: Create additional income sources.
- **Community Engagement**:
  - **Comprehensive Communication**: Develop extensive plans to involve local communities, staff, and labor.
  - **Address Sensitivities**: Consider the social impact of plant closures in local areas.
- **Benefits**:
- **Cost Savings**: Eliminate high operation and maintenance costs of old plants.
- **Financial Improvement**: Enhance the utility's financial position through efficient repurposing.

PHASES OF DEMOLITION OF OLD THERMAL POWER PLANTS

- The decommissioning process can be divided into three main stages:
- **Pre-Demolition Stage**:
  - **Shutdown**: Cease plant operations and modify power supply arrangements.
  - **Asset Management**: Valuate assets, transfer materials, and plan for manpower.
  - **Site Security**: Lock facilities and secure the premises.
  - **Costs**: Include employee expenses, station overheads, O&M costs post-retirement, and hazardous material remediation.
- **Demolition Stage**:
  - **Activities**: Safe demolition of chimneys, boilers, buildings, and other structures.
  - **Supervision**: Essential for safety and security.
  - **Costs**: Cover demolition, removal of scrap, and depend on plant size.
- **Post-Demolition Stage**:
  - **Remediation**: Environmental cleanup of ash disposal and coal storage areas.
  - **Site Restoration**: Prepare the site for future use.
  - **Expenditures**: Include environmental remediation and site preparation costs.

What we can Use in Old Utility Plants ?

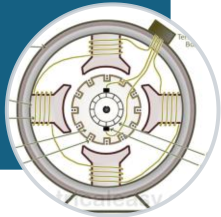
- **Intake Pump House**: For water supply to plant and colony
- **Switchyard / Power Evacuation System**: Infrastructure for power distribution
- **Demineralization Plant:** Water treatment facility
- **Compressor House**: Compressed air systems
- **Emulsifier System**: Equipment for mixing applications
- **Telephone Exchange**: Communication systems
- **DM Storage Tanks:** 4 tanks for demineralized water storage
- **DG Set**: Diesel generator for backup power
- **Machine Shop Equipment**: Tools and machinery for various applications



HOW TO REPURPOSE

- GREEN HYDROGEN

- SYNCON GENERATOR



- SOLAR & BESS

FIGURE ES.1: REPURPOSING BENEFITS (US$, MILLION)

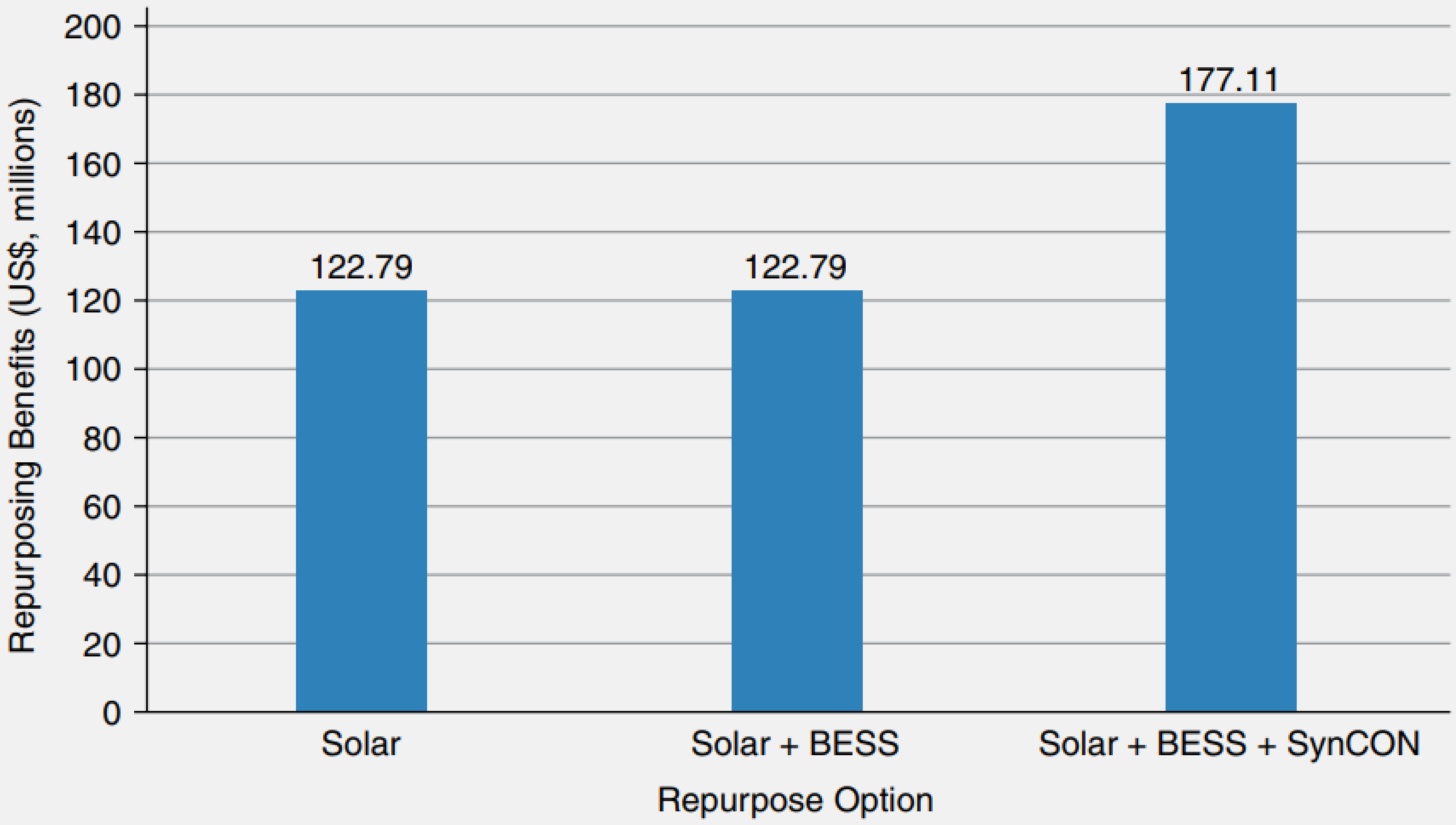
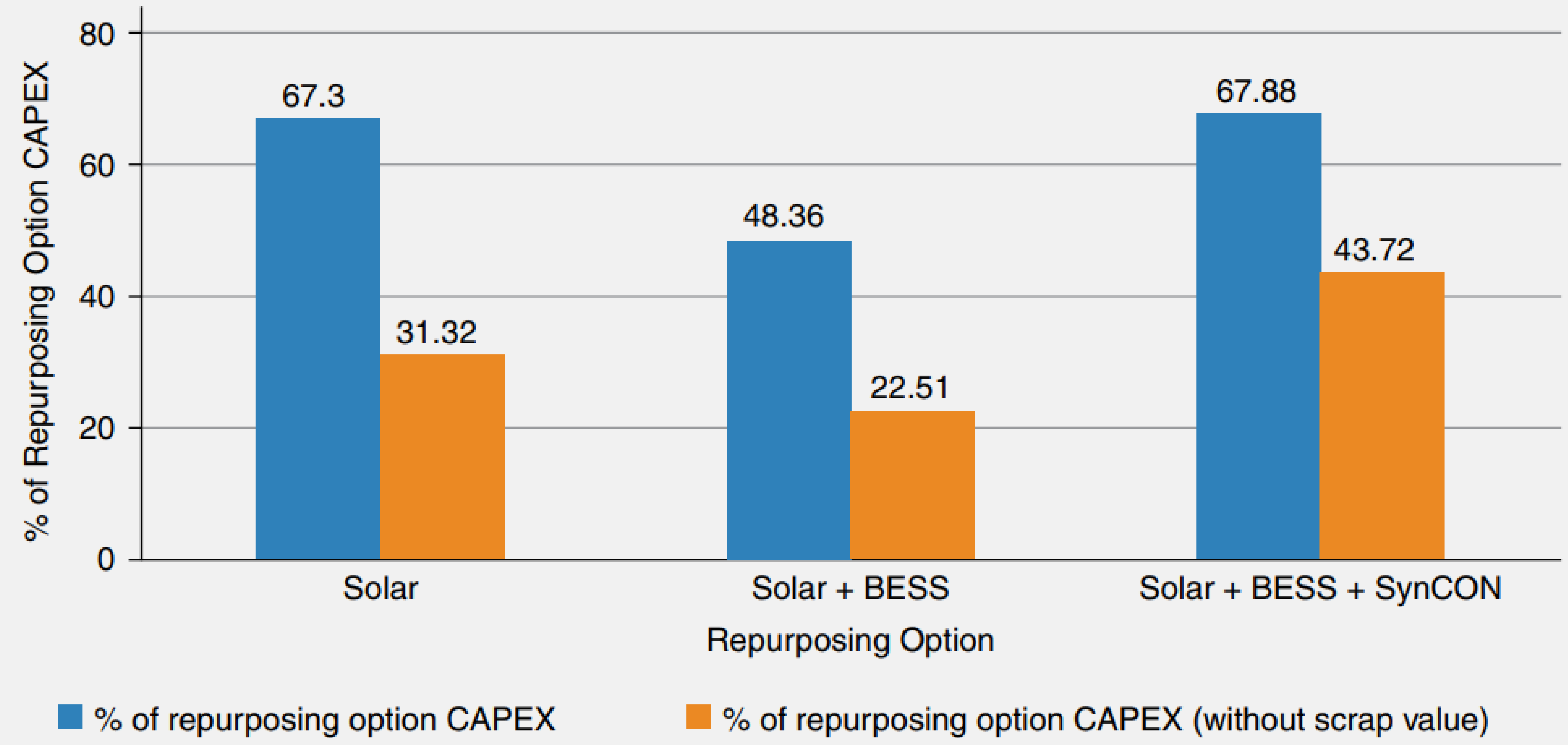


FIGURE ES.2: BENEFITS OF REPURPOSING (PERCENT OF REPURPOSING OPTION CAPEX)



Case Study of Repurposing of Old Thermal Plant of BTPS & CTPS

Financial Analysis

Sr No	Particulars	Renewable Energy Projects			BESS	Green Hydrogen Plant (MT)	
		BTPS Solar GM-1	BTPS Solar GM-2	BTPS Solar Rooftop		Without Banking	With Banking
1	Project Capacity (MW/MT)	1.96	2.77	2.15	100 MWh	30MT	30MT
2	Project Life Cycle (Years)	25	25	25	20	25	25
3	Project Capex (Investment)	90.09	127.32	96.02	2,593.96	9599.98	9599.98
	Debt	63.06	89.12	67.21	1,815.77	6,719.99	6719.986
	Equity	27.03	38.20	28.81	778.19	2,879.99	2879.994
4	Project Estimated Revenue	116.51	169.88	124.76	3,858.98	13,053.76	18,372.18
5	NPV of the Projects	26.42	42.56	28.74	1,265.02	3,453.78	8,772.20
6	Project IRR (Post Tax)	**9.08%**	**9.65%**	**9.16%**	**9.79%**	**9.36%**	**13.97%**
7	Equity IRR (Post Tax)	**8.75%**	**10.08%**	**8.94%**	**22.61%**	**11.23%**	**29.60%**
8	Project Payback Period	**15.28**	**14.54**	**15.14**	**14.94**	**15.16**	**8.22**
9	Desired Tariff Rate	**3.80**	**3.80**	**3.80**	**7.80**	**400.00***	**400.00***
10	LCOE without ROE	**2.99**	**2.84**	**2.97**	**NA**	**360.05#**	**288.44#**
11	LCOE with ROE	**4.21**	**4.06**	**4.19**	**NA**	**398.45#**	**326.84#**

* Net Selling Rate (Tariff)

Levelized Cost of Production

NA- Not Applicable

WHY GREEN HYDROGEN?

- **Global Position**: India ranks as the 3rd largest hydrogen consumer and producer, following China and the USA.

- **Future Demand**: Hydrogen demand in India is expected to increase by 2.5 to 3.5 times by 2040.

- **Energy Share**: Despite growth, hydrogen may account for less than 5% of India's total primary energy consumption by 2040.

- **Transportation Costs**: High transportation costs necessitate locating hydrogen production near demand centers and developing hydrogen hubs/valleys.

- **Market Opportunity**: Potential market size for clean hydrogen is ~$27 billion/year by 2030 and ~$40 billion/year by 2040.

Challenges:

- **Renewable Capacity**: 500 GW of renewable energy required to meet the 2030 target of 5 million tonnes per annum green hydrogen production (MNRE).

- **COP26 Commitment**: India aims for 500 GW of non-fossil fuel capacity by 2030, mainly replacing conventional power.

- **Economic Viability**: Green hydrogen may need fiscal incentives for demand growth; parity with conventional fuels expected by 2035 (~$2/kg).

HYDROGEN PRODUCTION AND TYPES OF ELECTROLYSERS

Hydrogen basically produced through water electrolysis

Alkaline electrolysis: 25%-35% wt. KOH is used as electrolyte, running at temperature between 40-90 degree C. The materials based on Ni or steel based electrodes are used.

Polymer electrolyte membrane (PEM) electrolysis: The acidic condition is provided by per flurosulphonic acid (PFSA) membrane. Metals based on iridium and platinum are used. The ions are passed through membrane.

Solid oxide electrolysis: Can operate at high temperature between 700-1000 degree C. The O^{2-} is transported across dense ionic conductor consisting of ZrO_2 doped with Y_2O_3.

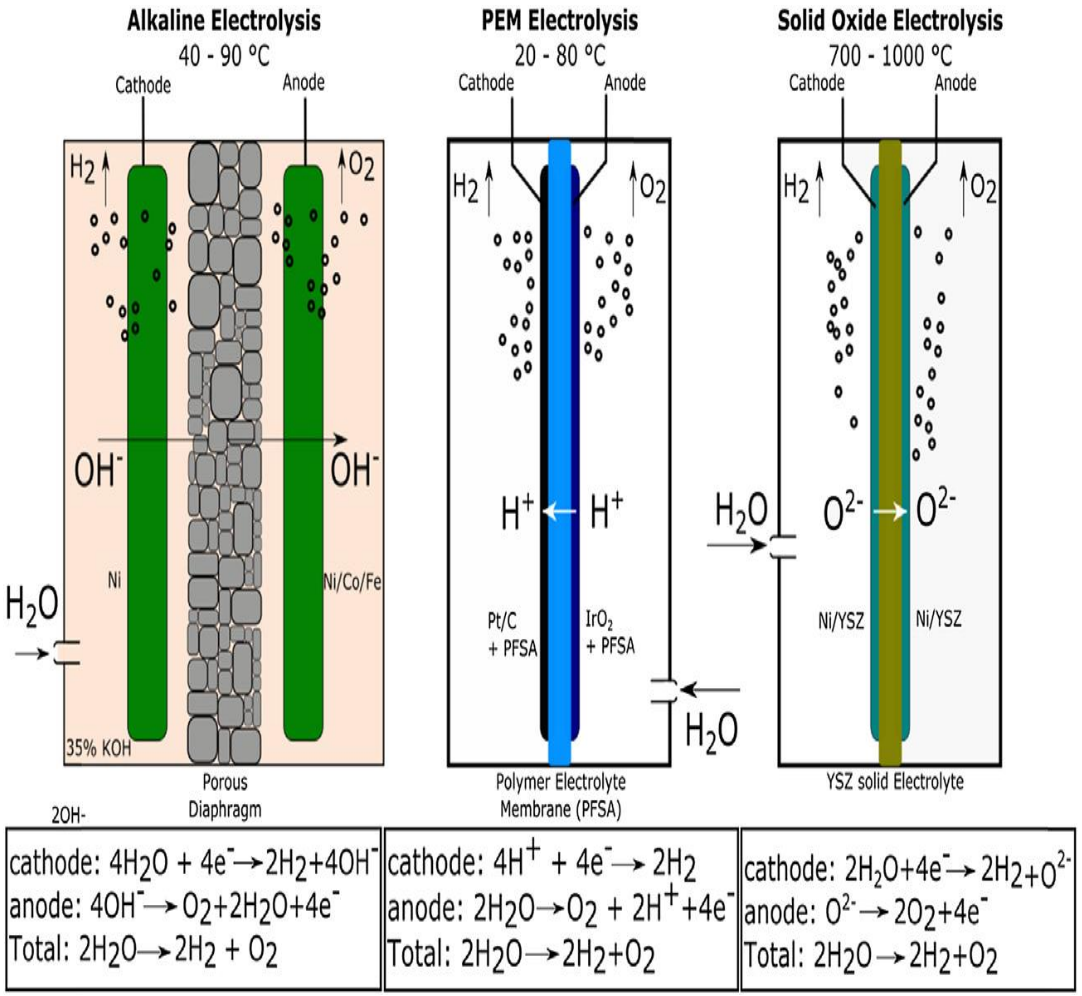
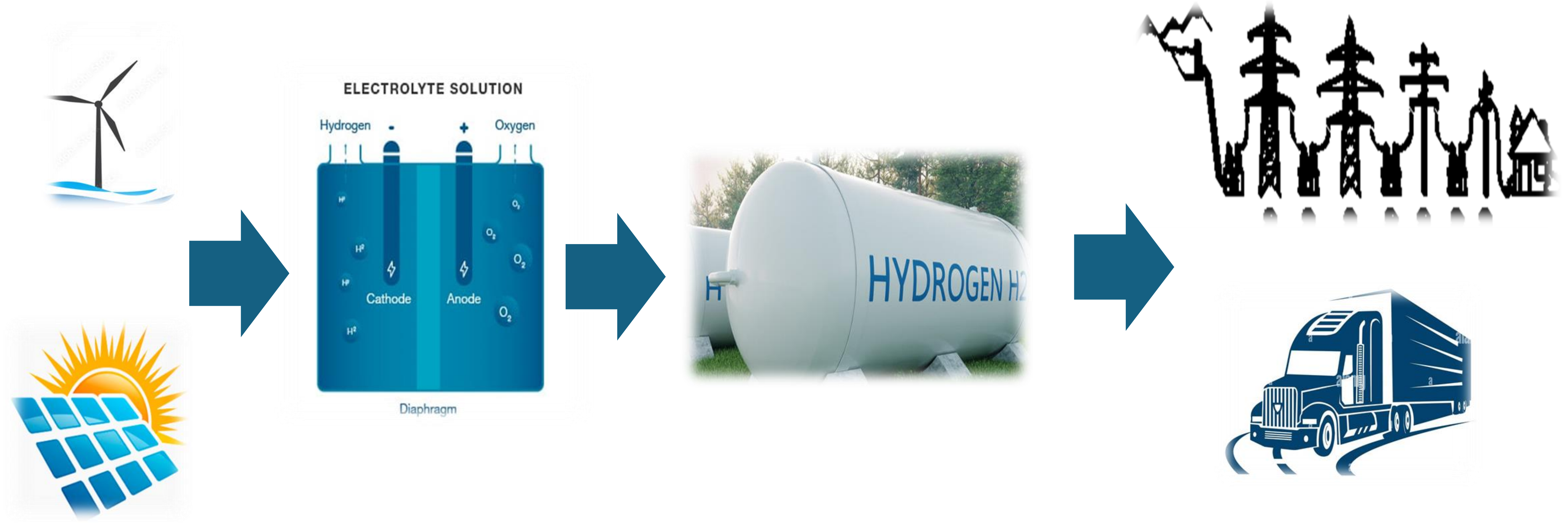


Fig.: Different types of electrolysis



Green Hydrogen and the process of Integration with Renewable sources of Energy

Timeline of the Green Hydrogen

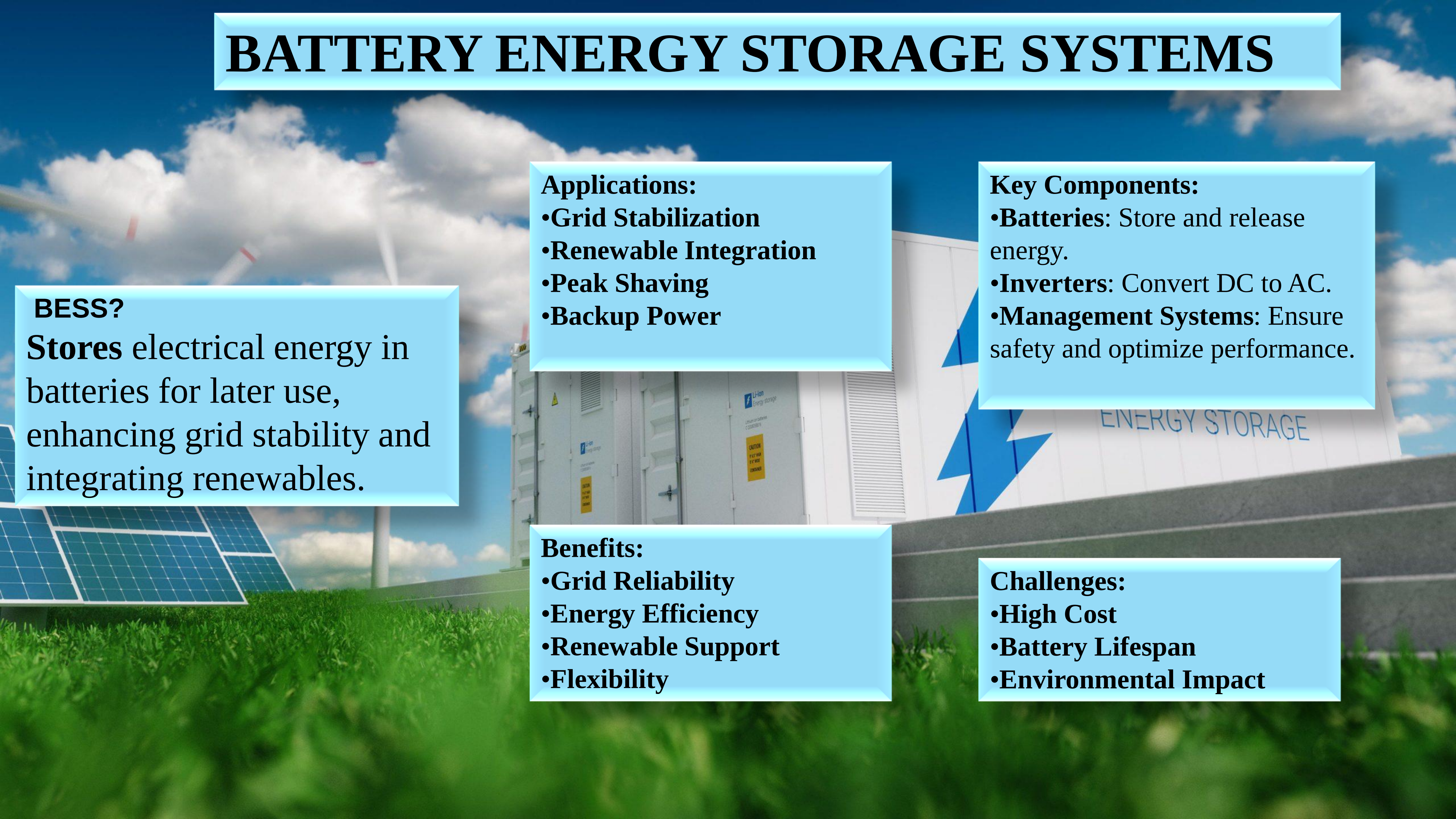
Source-:IRNEA First Meeting of the Collaborative Framework on Green Hydrogen

Indicator	Historical progress 2015-2018	Where we are heading (PES / 2030 and 2050)		Where we need to be (TES / 2030 and 2050)	
Blue H_2 (Mt and EJ)	0.6 Mt / 0.08 EJ (2015 - 2018)	10 Mt 1.25 EJ (2030)	40 Mt / 5 EJ (2050)	30 Mt 3.75 EJ (2030)	80 Mt / 10 EJ (2050)
Green H_2 (Mt and EJ)	1.2 Mt / 0.16 EJ (2015 - 2018)	9 Mt 1.1 EJ (2030)	25 Mt / 3 EJ (2050)	25 Mt / 3 EJ (2030)	160 Mt / 19 EJ (2050)
Green H_2 production costs (USD/kg)	4.0 - 8.0 USD/kg (2015 - 2018)	2.5 - 5.0 USD/kg (2030)	1.6 - 3.3 USD/kg (2050)	1.8 - 3.2 USD/kg (2030)	0.9 - 2.0 USD/kg (2050)
Electrolysers (GW)	0.04 GW (2016)	100 GW (2030)	270 GW (2050)	270 GW (2030)	1700 GW (2050)
Electricity demand to produce H_2 from renewables (GW)	0.26 TWh (2016)	450 TWh (2030)	1200 TWh (2050)	1200 TWh (2030)	7500 TWh (2050)

Case Study of Repurposing of Old Thermal Plant of BTPS & CTPS With Green Hydrogen

Green Hydrogen generation is feasible as BTPS and CTPS as there is existing steel and fertilizer plant are available nearby. The existing water supply and its related auxiliaries shall be used for the proposed Green Hydrogen plant. The export and infrastructures facility need to be developed.

Captive Consumption:	• **BTPS/CTPS Thermal Stations**: Utilize green hydrogen for internal use.
Fertilizer Plants:	• **Sindri & Barauni Fertilizer Plants**: Require 1,300 MT/day of hydrogen for ammonia (2,200 MT/day) and urea (3,850 MT/day) production.
Steel Industry:	• **Bokaro Steel Plant**: 5.6 million tons steel production (blast furnace) does not use hydrogen, but hydrogen is needed for the Cold Rolling Mill complex; existing hydrogen can be replaced by green hydrogen.
Refineries:	• **IOCL Barauni Refinery**: Potential customer for hydrogen, particularly for desulfurization processes, though refineries have their own hydrogen production programs.
Indian Railways:	• **Potential Market**: Explore opportunities for supplying green hydrogen for railway operations.



BATTERY ENERGY STORAGE SYSTEMS

BESS?

Stores electrical energy in batteries for later use, enhancing grid stability and integrating renewables.

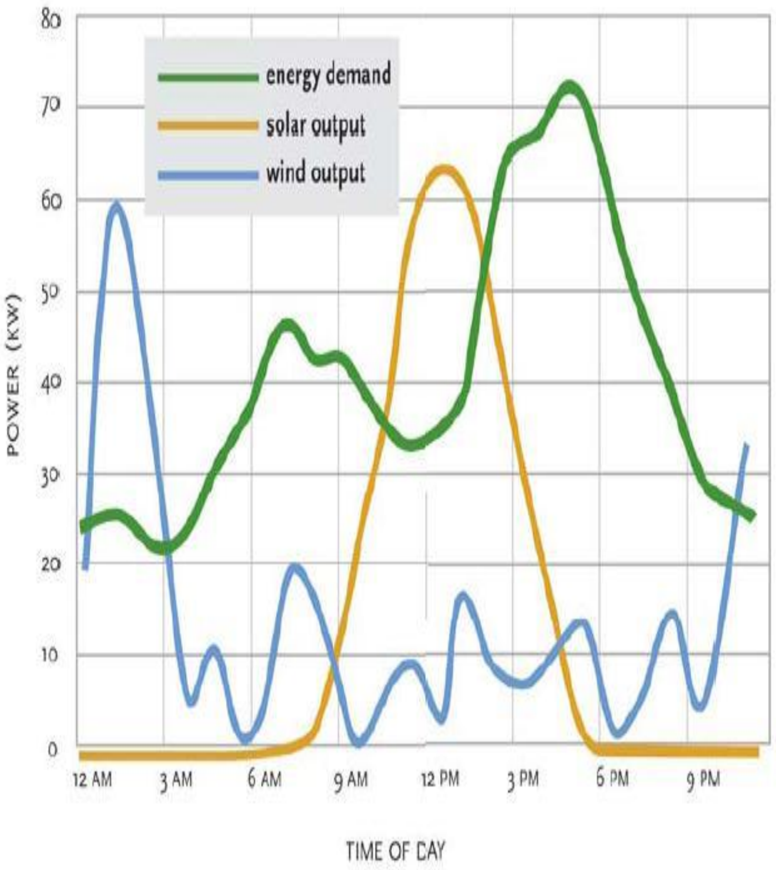
Applications:
- **Grid Stabilization**
- **Renewable Integration**
- **Peak Shaving**
- **Backup Power**

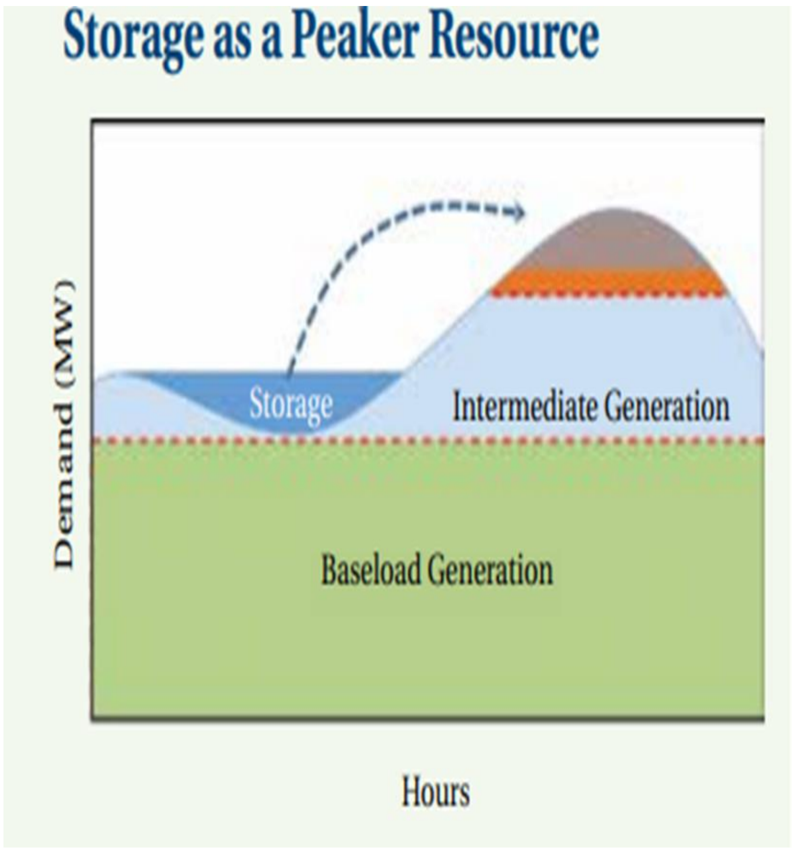
Key Components:
- **Batteries**: Store and release energy.
- **Inverters**: Convert DC to AC.
- **Management Systems**: Ensure safety and optimize performance.

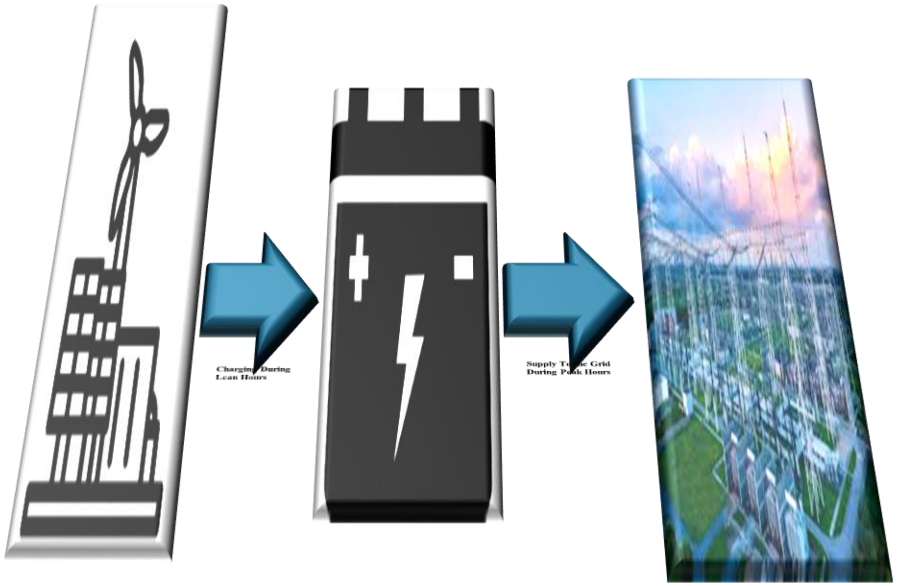
Benefits:
- **Grid Reliability**
- **Energy Efficiency**
- **Renewable Support**
- **Flexibility**

Challenges:
- **High Cost**
- **Battery Lifespan**
- **Environmental Impact**

NEED OF ENERGY STORAGE







MAJOR BATTERY STORAGE TECHNOLOGIES

Advanced Lead Acid/ Ultra Battery

Performance measure	Cycle Life	Energy Efficiency (%)
Market leader	1,200	80
Best in class	2,000	85

Sodium based Battery – NAS

Performance measure	Cycle Life	Energy Efficiency (%)
Market leader	4,000	70
Best in class	6,000	85

Li-Ion Battery Technology

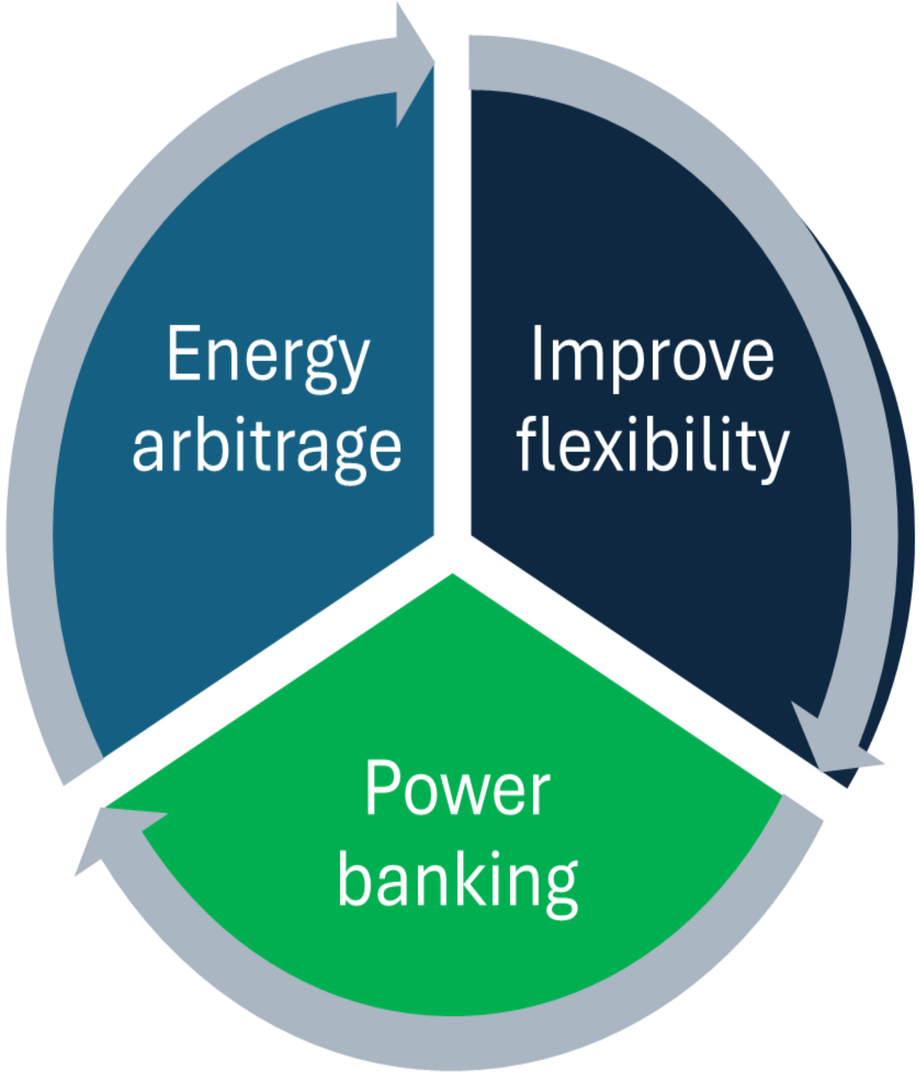
Performance measure	Cycle Life	Energy Efficiency (%)
Market leader	2,000	90
Best in class	10,00	95

Flow Battery Technology

Performance measure	Cycle Life	Energy Efficiency (%)
Market leader	5,000	60
Best in class	10,000+	70

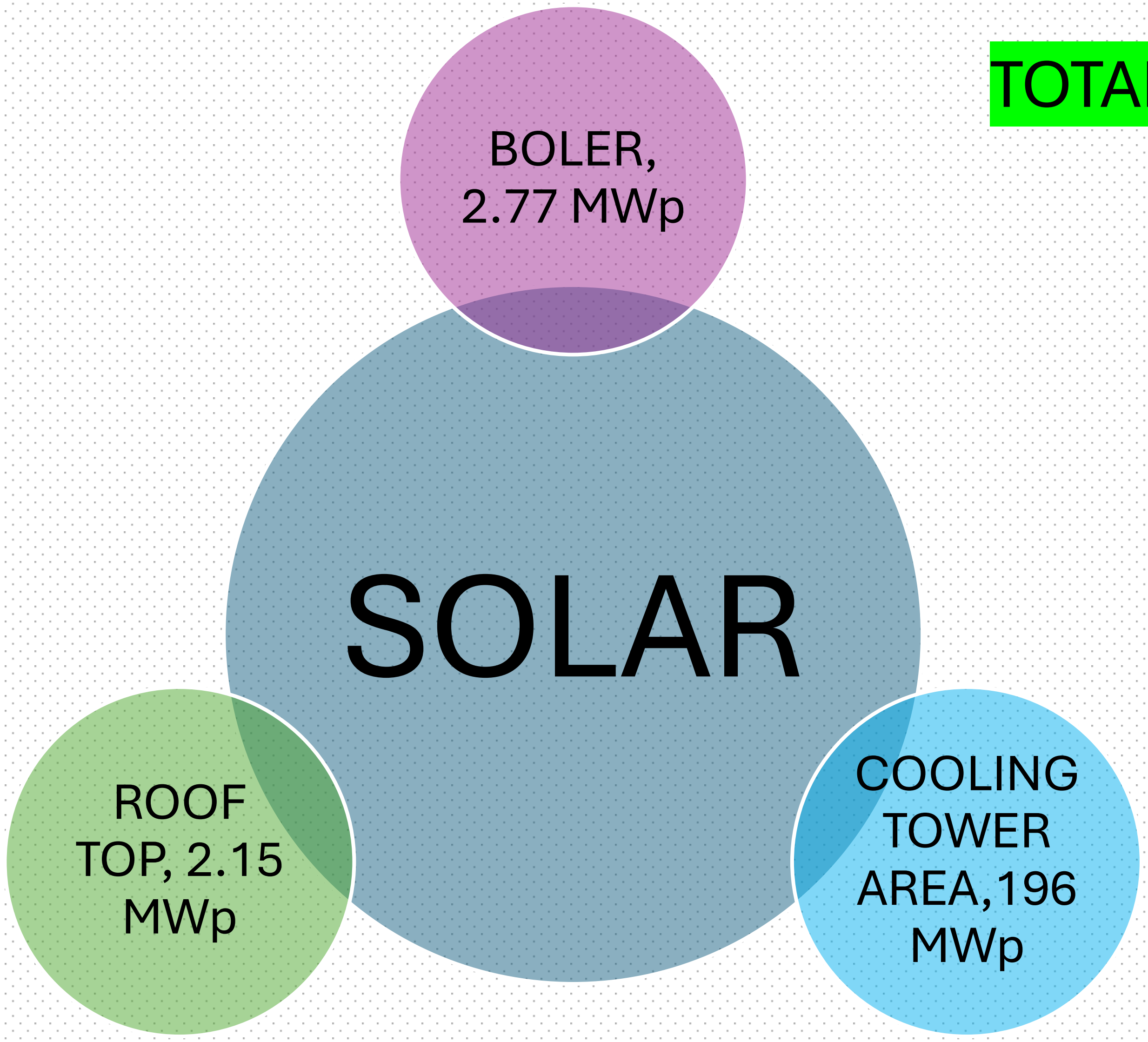
BESS TYPICAL CASE STUDY

- ❖ Estimated energy price for charging: 3.00 INR per KWH or less.
- ❖ Estimated selling price during morning / evening peak: 7.8 INR per KWH or higher.
- ❖ Proposed BESS can also support 500 MW BTPS generator in improving flexibility.
- ❖ Technical minimum of 500 MW generator @55%: 275 MW.
- ❖ Upper and Lower limits will be extended by 100 MW respectively – New Technical minimum can be 35%.
- ❖ Existing ramp rate: 50 MW / 15 min.
- ❖ Revised ramp rate: 50+100 MW / 15 min. with limit of 100 MWh /80 MWh for charging and discharging.



SOLAR PV OPPORTUNITY ANALYSIS

TOTAL 6.88 MWp



BOILER AREA, 19560 SQM

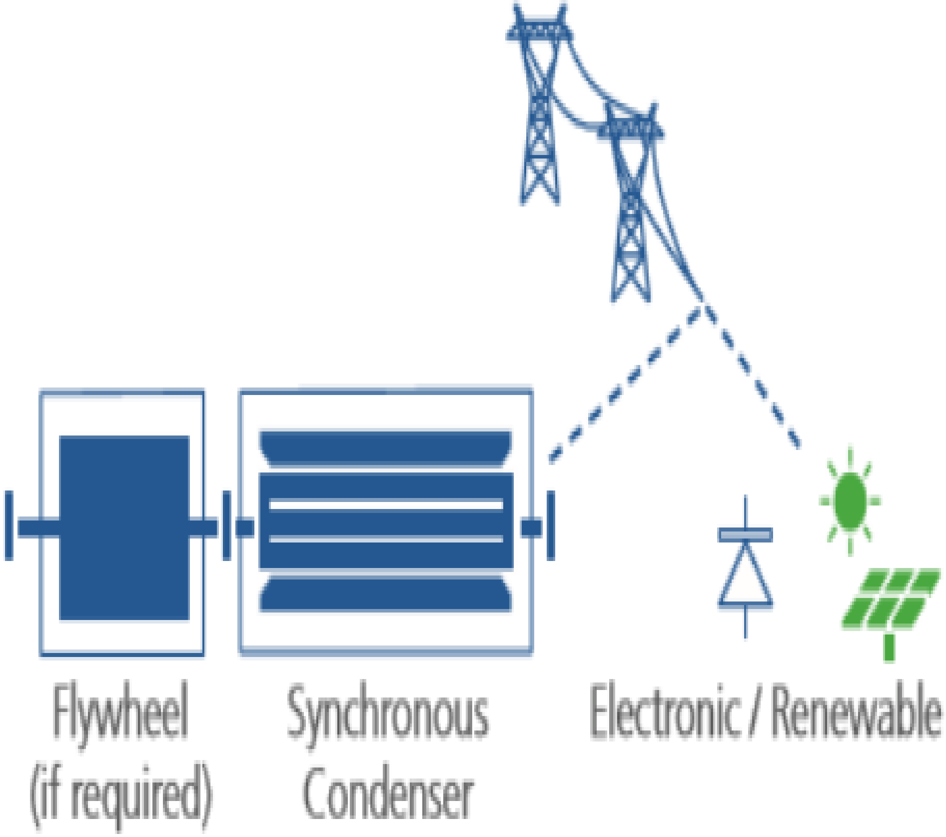
COOLING TOWER AREA, 45659 SQM

OLD GENERATORS AS SYNCON

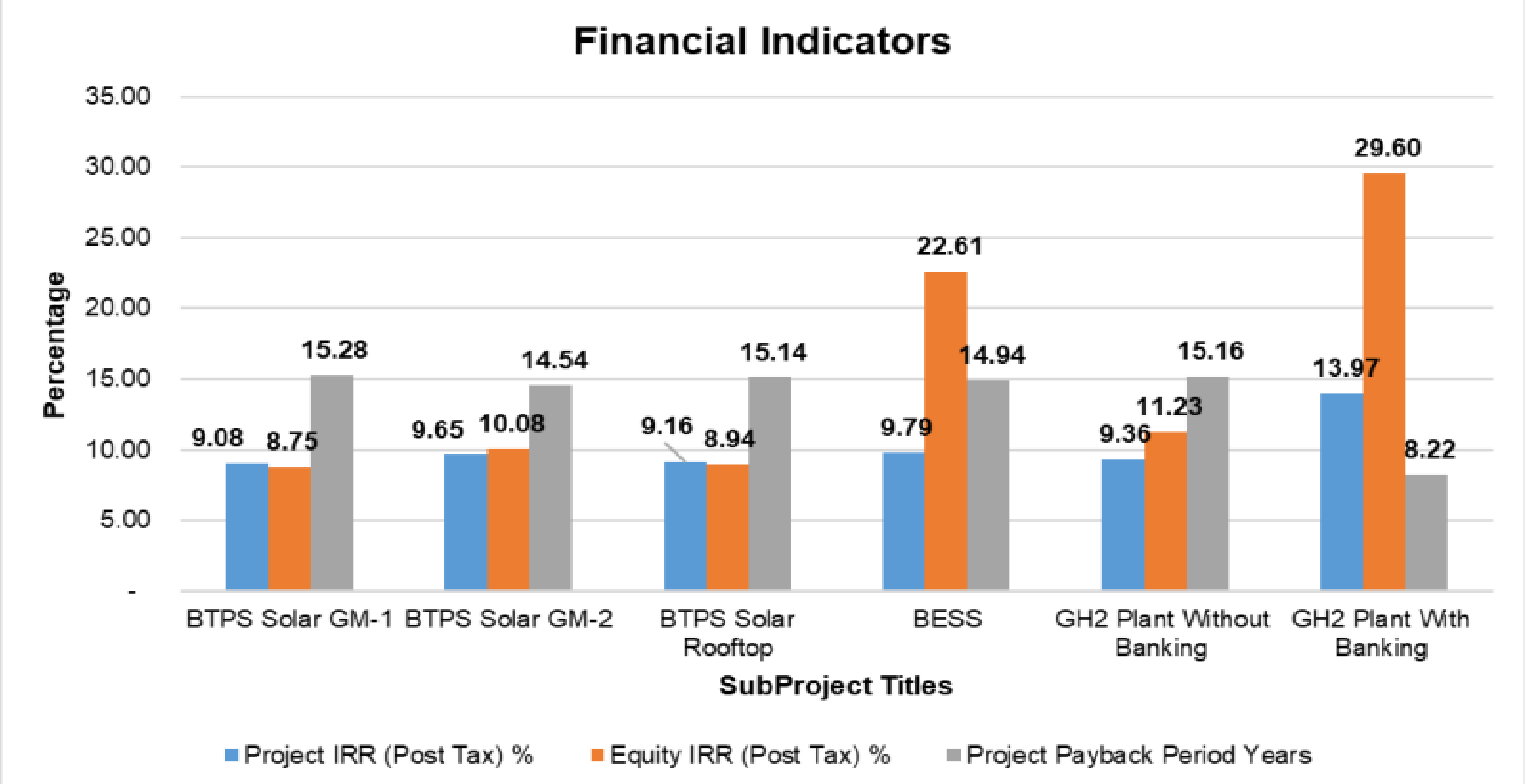
A synchronous condenser (also called a synchronous capacitor or synchronous compensator) is a DC-excited synchronous machine (large rotating generators) whose shaft is not attached to any driving equipment.

By providing grid services without burning fossil fuels we can enable more & more & more renewable energy surces like wind & solar to come to the grid & keeping the grid stable , Secure & at the correct frequency.

- Stator and rotor with solid integral pole tips
- Cooling system (hydrogen, air or water)
- Excitation system & Step-up transformer and auxiliary transformer.
- Lubrication oil supply



FINANCIAL PARAMETER AND FEASIBILITY



THANK YOU