Expanding the PV possibilities for India's renewable future, floating PV and Solar Plus Storage

Future PV Roundtable – Renewable Energy India Expo 2019

solaredge DSM ET Solar

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Agenda

Part I

14:00	**Welcome and introductions**
14:05	**LOCAL FOCUS Challenges and opportunities for floating PV in India: Is this a viable option within India's clean energy future?**
14:15	**PANEL DISCUSSION Enabling high performance and quality floating installations in India, including MLPE module level power electronics**

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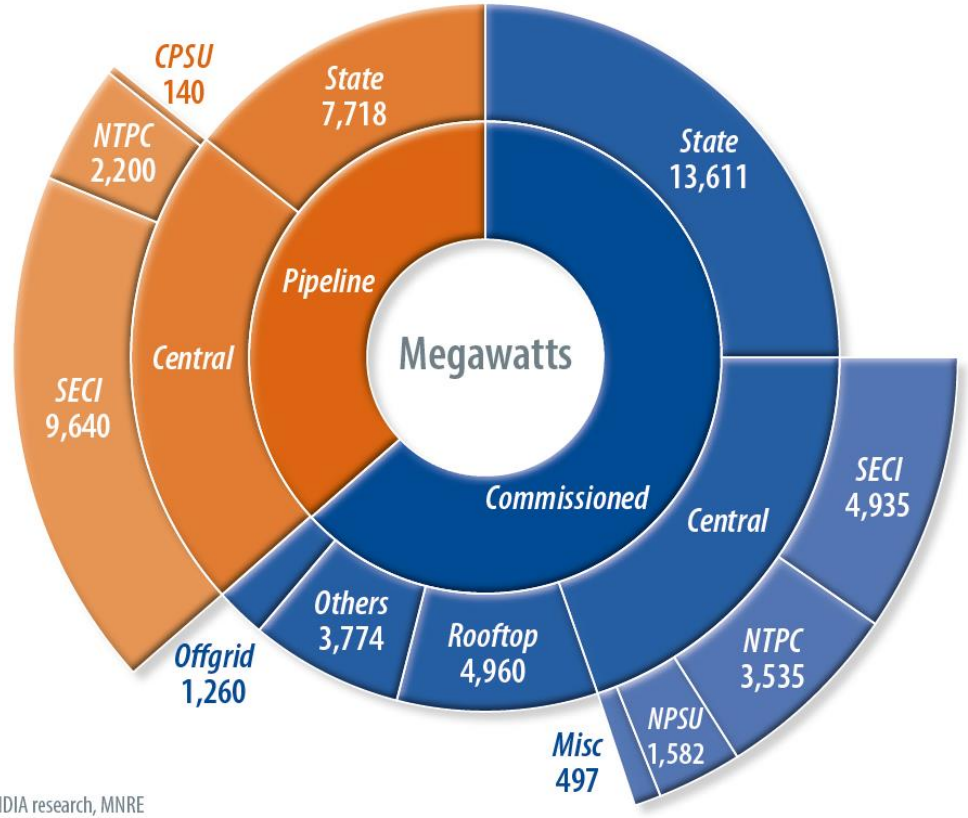
Agenda

Part II

14:45	pv magazine Editor Analysis: Global Solar Plus Storage (energy storage) trends
14:55	PANEL DISCUSSION Solar Plus Storage in India: in front of, and behind the meter. Evaluating energy storage opportunities in India, battery storage deployment, regulatory policy, market growth, manufacturing, power electronics and large-scale implementation
15:25	Closing remarks

Networking

Total installed and pipeline capacity at the end of June 2019



Source: BRIDGE TO INDIA research, MNRE

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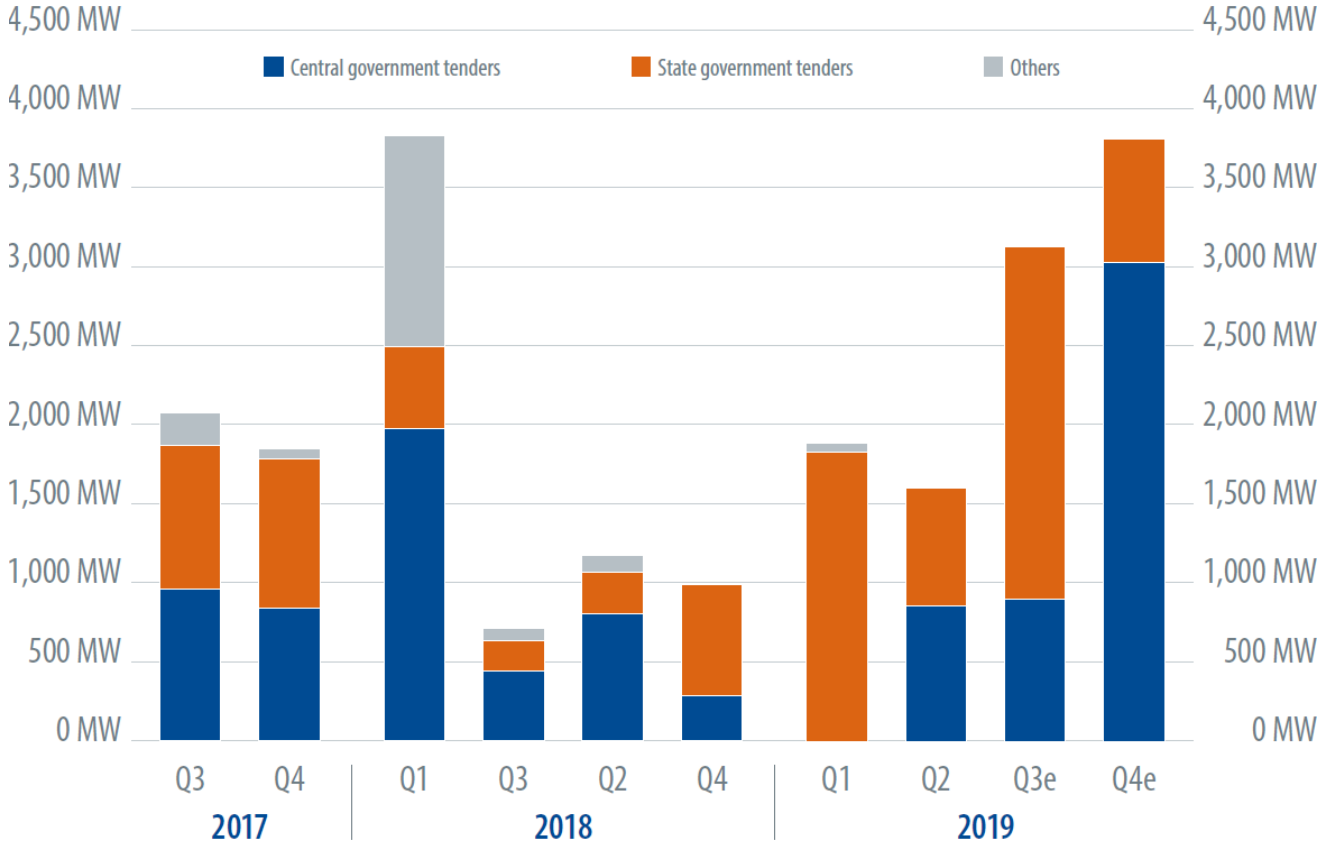
Utility scale solar capacity addition

Source: BRIDGE TO INDIA research



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Local focus

Challenges and opportunities for floating PV in India: Is this a viable option within India's clean energy future?

Parag Sharma

Chief Operating Office,
Renew Power

Rishabh Jain

Manager – Market Intelligence
Centre for Energy Finance,
CEEW Centre for Energy
Finance

Amresh Mahajan

VP technology,
Acme Cleantech

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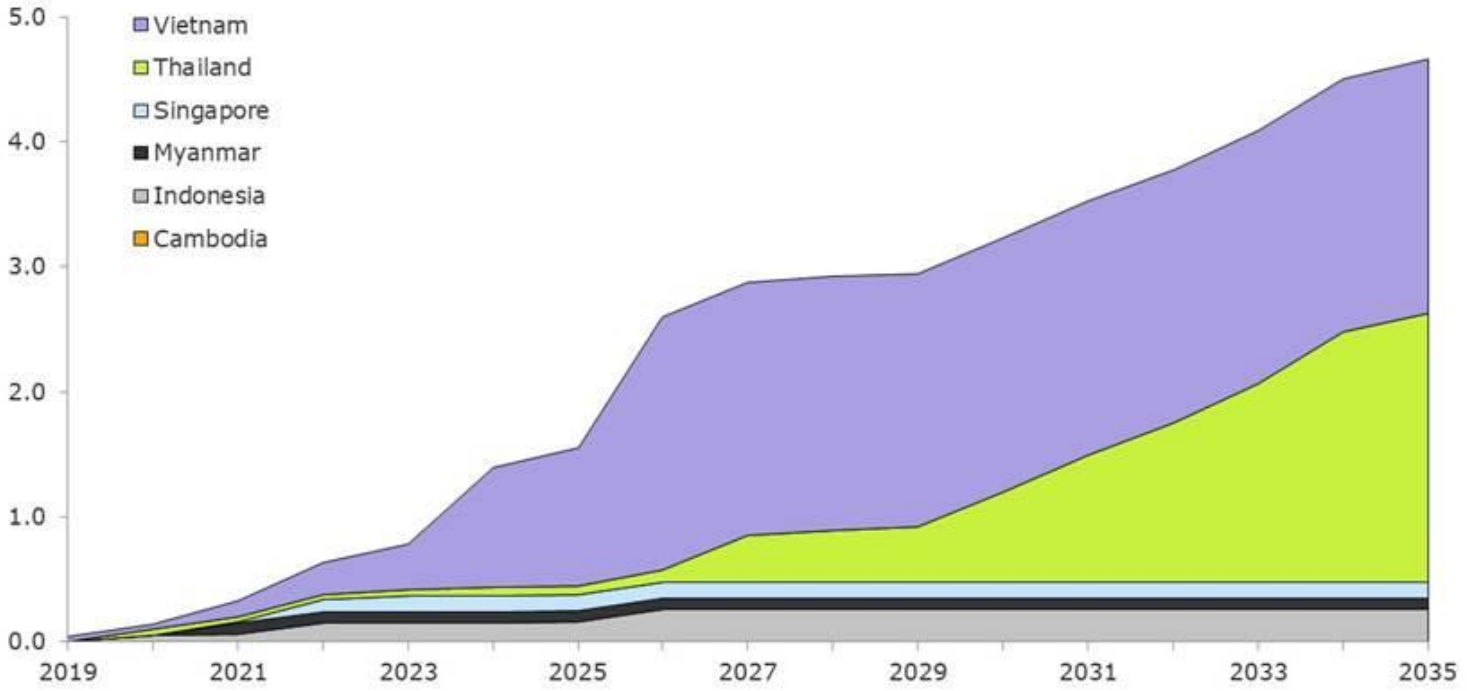
Floating PV growth in South East Asia

GW_{AC}



Source: Rystad Energy RenwableCube, August 2019

RYSTAD ENERGY

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Manager – Market Intelligence
Centre for Energy Finance,
CEEW Centre for Energy
Finance

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VP technology,
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Panel discussion

Enabling high performance and quality floating installations in India, including MLPE module level power electronics

Ivan Saha

BU Head of Manufacturing and CTO,
Vikram Solar

Julia Serebro

Senior Marketing Manager Asia

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Vivek Chaturvedi

Regional Business Director – Solar

DSM

Arjun Raaj

Sales Director

ET Solar

Shreenidhi Sharma

Manager (PE-Solar),
NTPC

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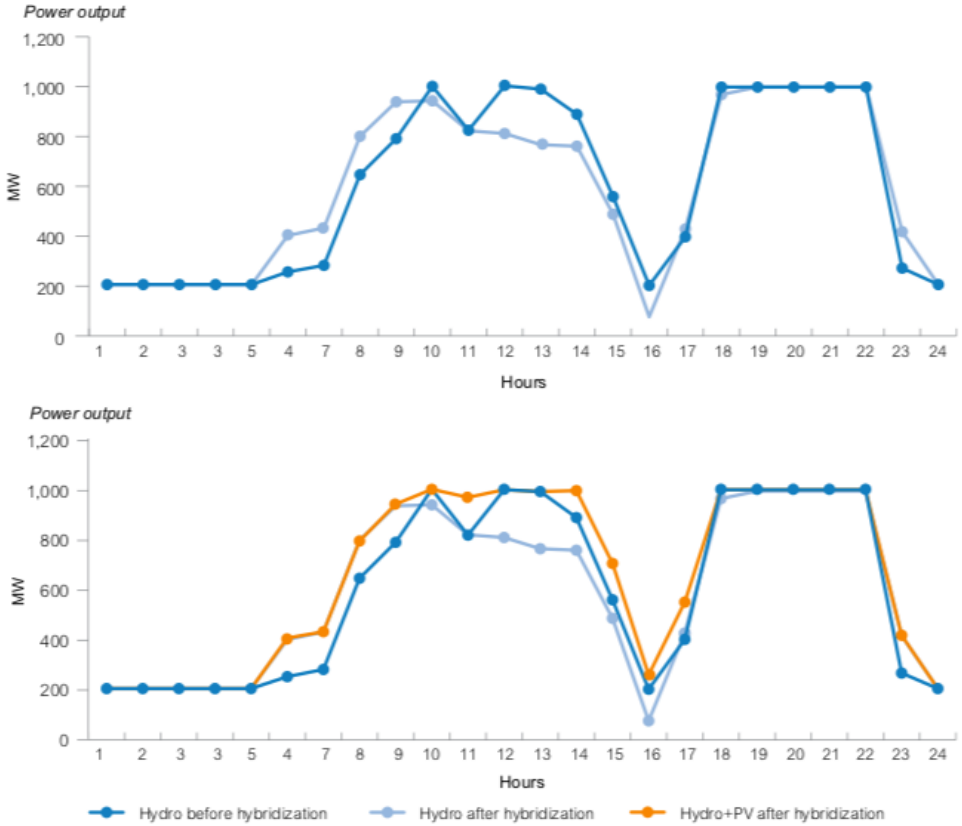
Advantages of floating PV (FPV)

- Expanding available space for PV
- Increased power output due to lower operating temperature
- Evaporation reduction from water bodies
- Hybridization with hydro generation

FIGURE 2.26. Before and after hybridization operation on a day in December in a dry year: hydropower output (top) and total system output (bottom).



Source: SERIS based on Qi 2014.

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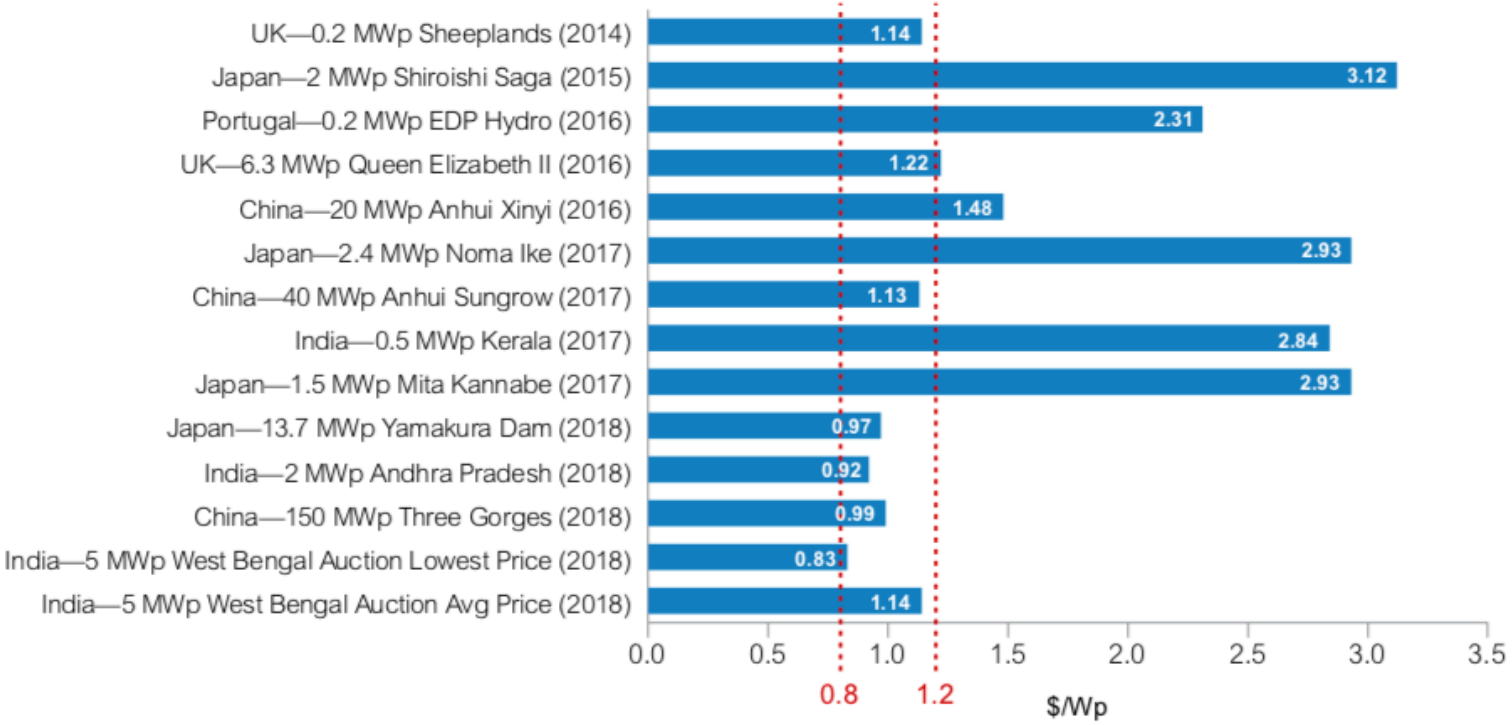
FIGURE E.6 Investment costs of FPV in 2014–2018 (realized and auction results)



Challenges of FPV

- Environmental assessments and impacts (including floaters)
- Energy assessments, including bifacial impacts
- Anchoring and float design constraints
- Construction challenges
- O&M costs and complications
- Bankability (0.2% global PV market is FPV)

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pv magazine Editor Analysis

Global Solar Plus Storage (energy storage) trends

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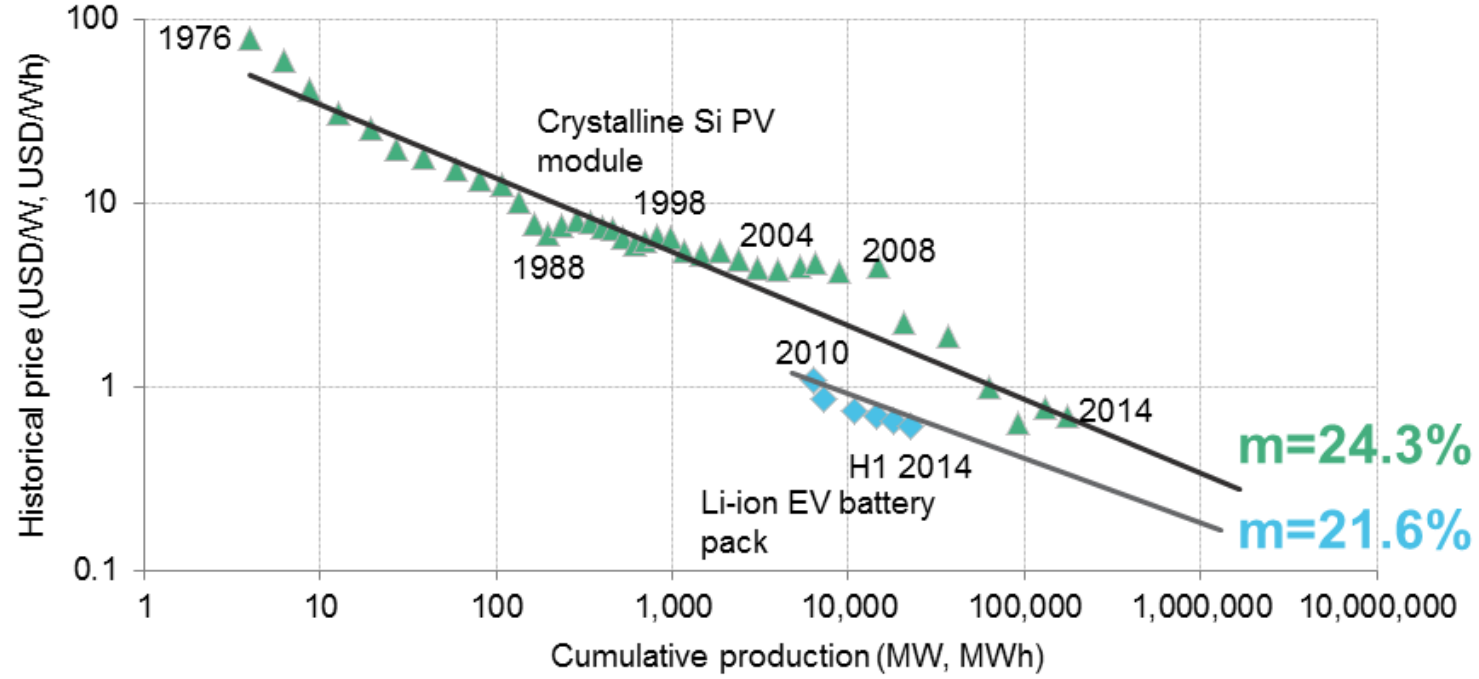
LITHIUM-ION EV BATTERY EXPERIENCE CURVE COMPARED WITH SOLAR PV EXPERIENCE CURVE

Bloomberg NEW ENERGY FINANCE



Note: Prices are in real (2014) USD.

Source: Bloomberg New Energy Finance, Maycock, Battery University, MIT

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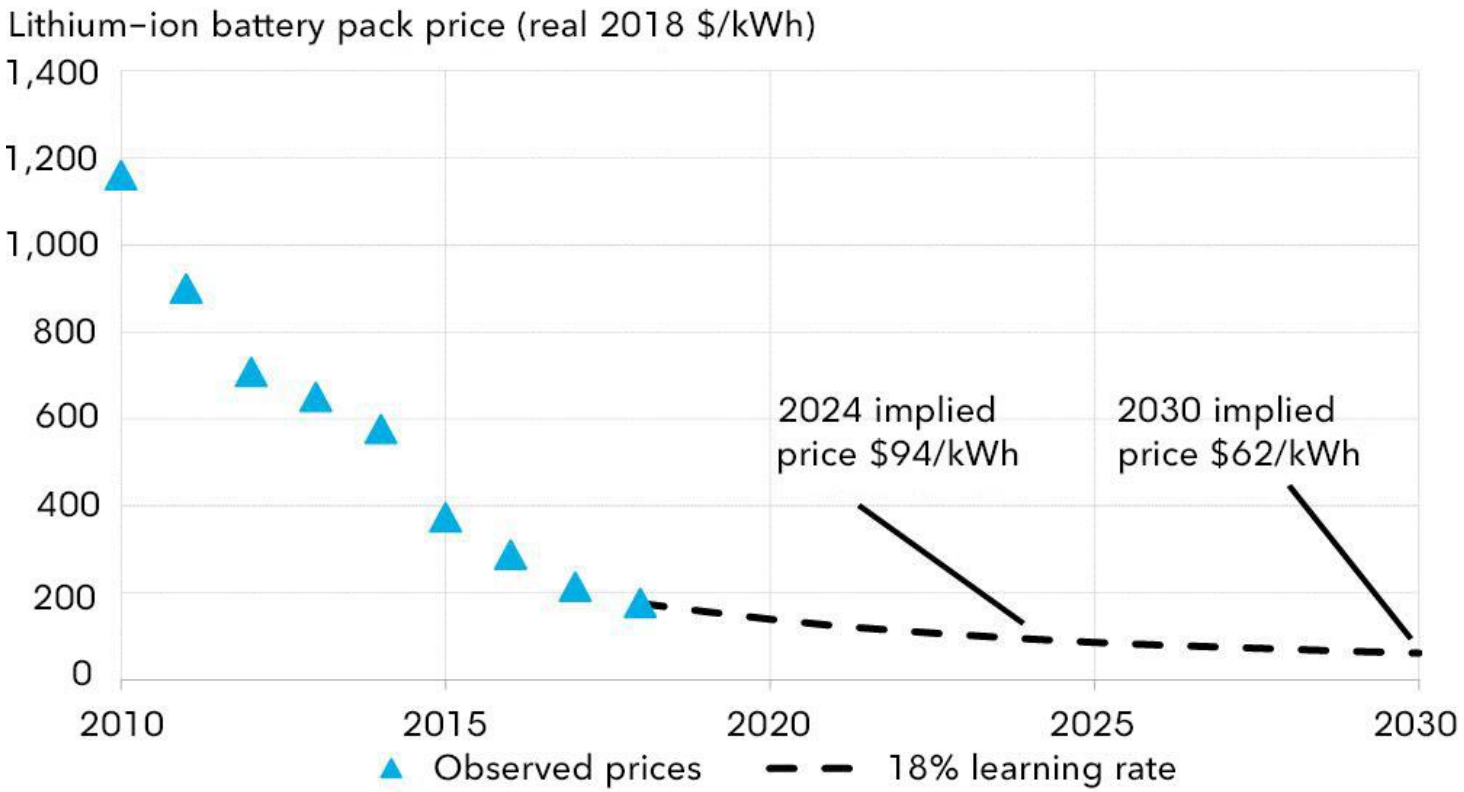
Lithium-ion battery price outlook



Source: BloombergNEF

NEW4.0 - Speicherregelkraftwerk Hamburg-Curslack

Innovative Research for System Integration of Renewable Energy

Key Figures Battery Storage System

- 24 Lithium-Ion HV Batteries
- Power: 720 kW
- Energy Content: 792 kWh

Key Figures Wind Farm

- 5 Wind Turbines, Nordex N117
- Types: 1xN117 / 3 MW, 4x N117 / 2,4 MW
- Overall power: 12,6 MW

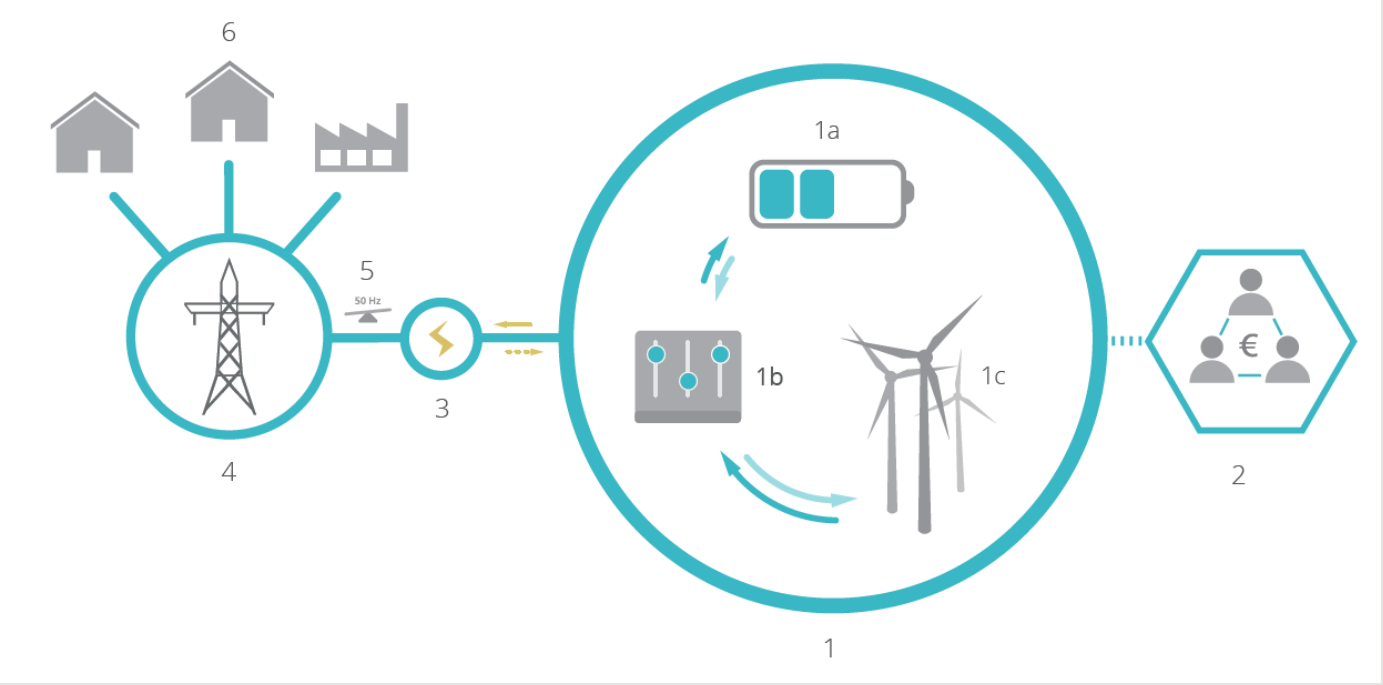
Research Applications

- Virtual Inertia
- Frequency Containment Reserve
- Reactive Power Mgmt.
- Voltage Control
- Stacking of Applications

Battery storage in combination with wind farm

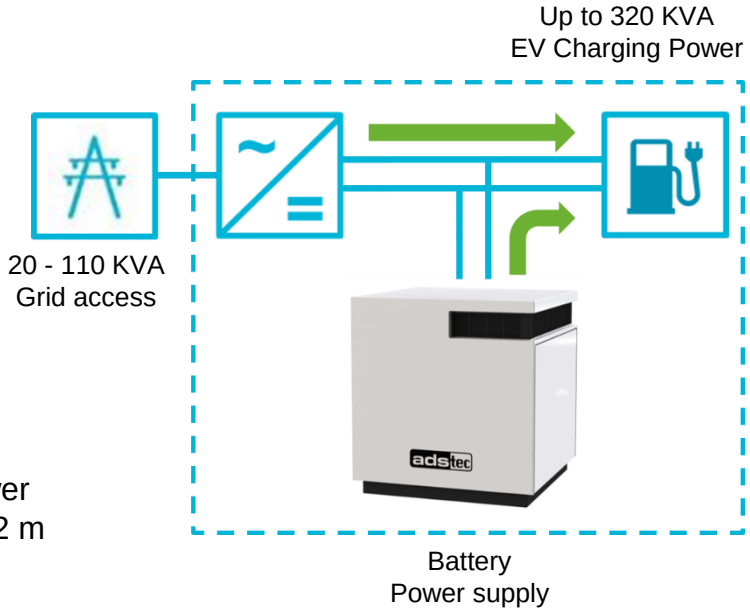
NEW4.0 - Speicherregelkraftwerk Hamburg-Curslack

Innovative Research for System Integration of Renewable Energy



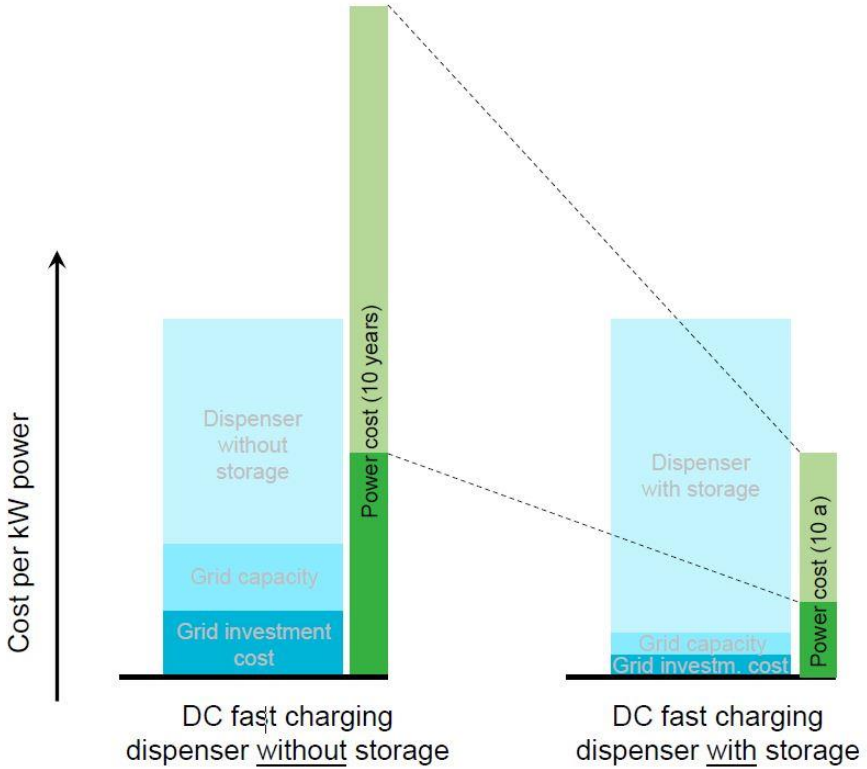
1. Speicherregelkraftwerk
   1a. Battery Storage System
   1b. Control Unit
   1c. Windfarm Curslack
2. Business Model Development
3. Grid Entry Point
4. General Electricity Grid
5. Ancillary Services
6. Households / Consumers

High Power Charging @ limited grid capacity



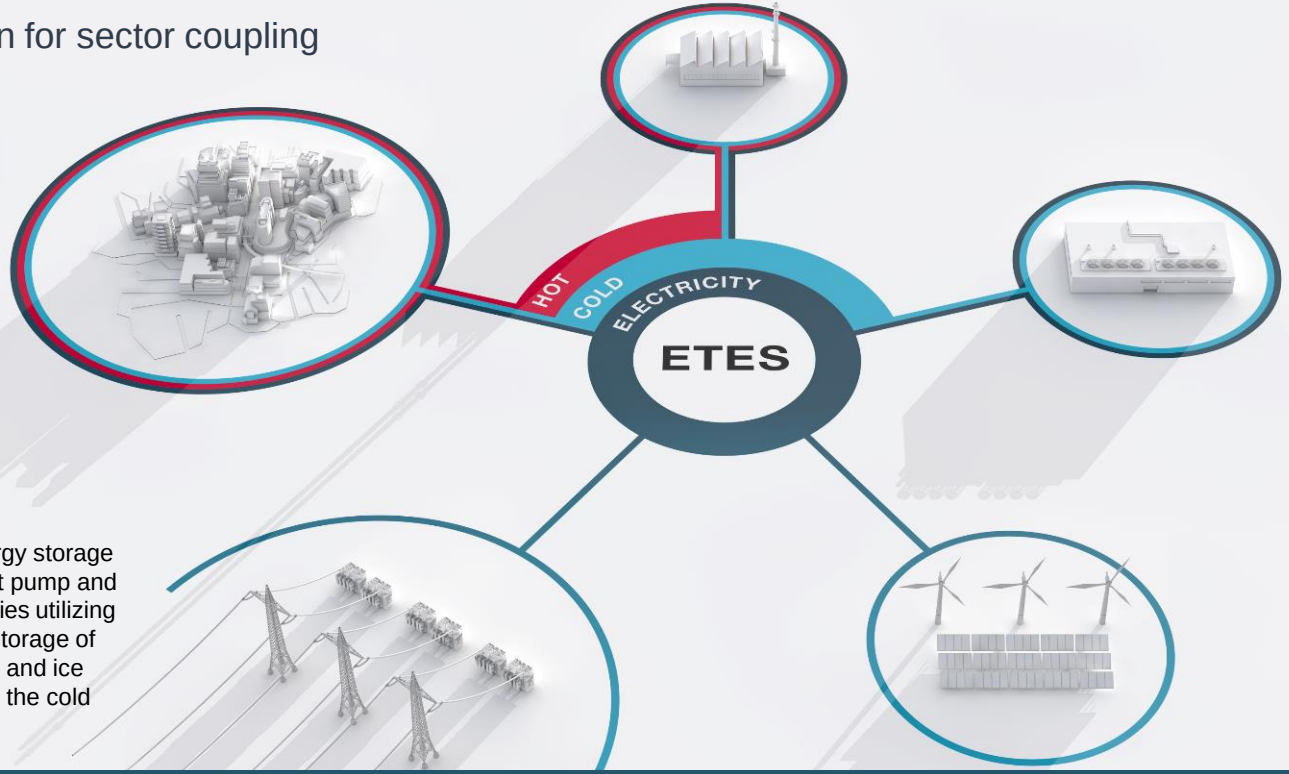
- One or two HPC Dispenser
- 20 - 110 KVA Grid Power
- 2 x 160 kW / 1 x 320 kW Charging Power
- Smallest footprint worldwide 1.2 m x 1.2 m
- 140 KWh Lithium-Ion battery included
- Low noise
- No grid investment
- CCS1 / CCS2 / GBT

Savings due to low power grid access



MAN ETES – Electro Thermal Energy Storage

The ideal solution for sector coupling



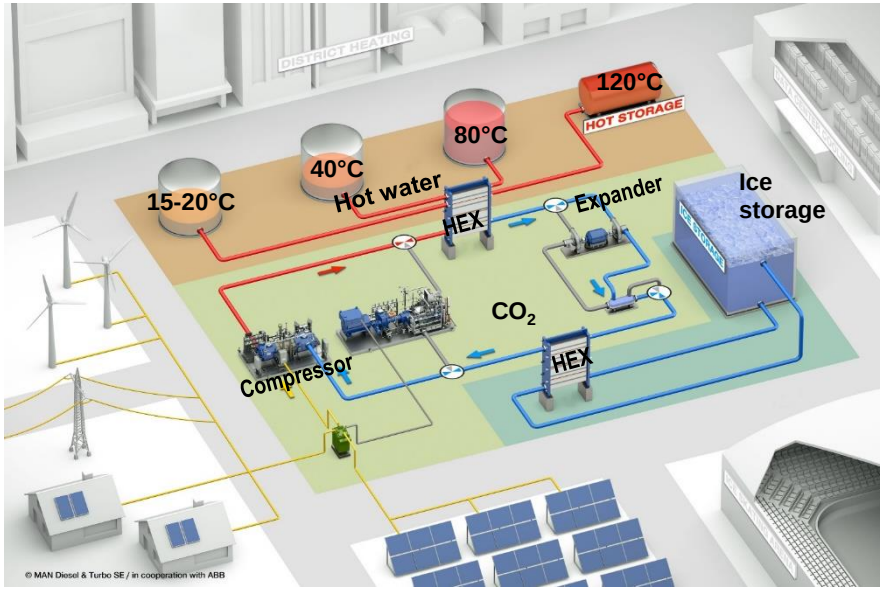
MAN ETES is a bulk energy storage technology based on heat pump and thermal engine technologies utilizing transcritical CO_2 cycles, storage of pumped heat in hot water and ice generation and melting at the cold end of the cycles.

MAN ETES is a tri-generation energy management system:
Providing heat & cold & electricity at large scale on demand to numerous industries

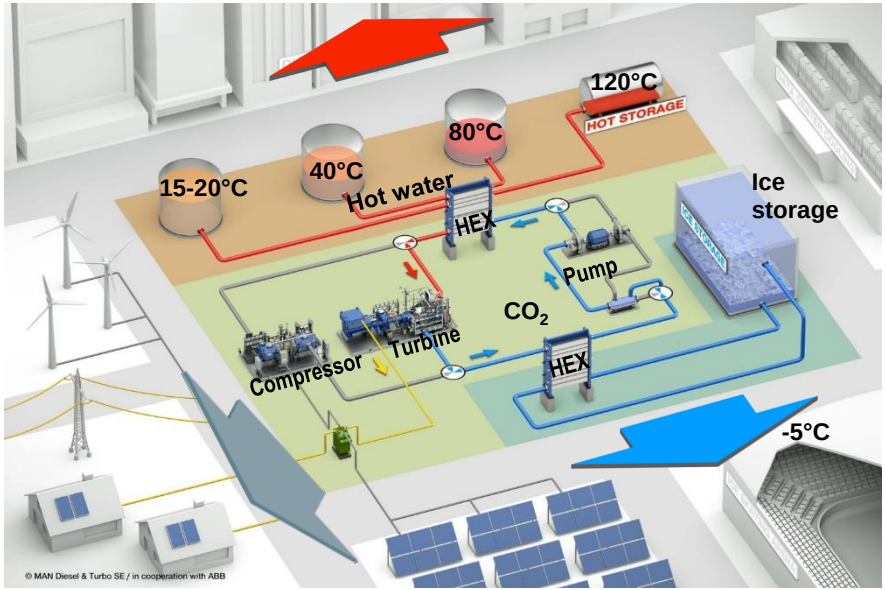
MAN ETES – Charging and Discharging Cycle

Conversion of electricity in thermal energy – heat pump operation

Charging cycle



Discharging cycle



Schematic is not to scale, only for demonstration purposes

Link to animation

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Panel discussion

Solar Plus Storage in India: in front of, and behind the meter. Evaluating energy storage opportunities in India, battery storage deployment, regulatory policy, market growth, manufacturing, power electronics and large-scale implementation

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Networking session

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