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Maximising business sustainability

20 June 2023



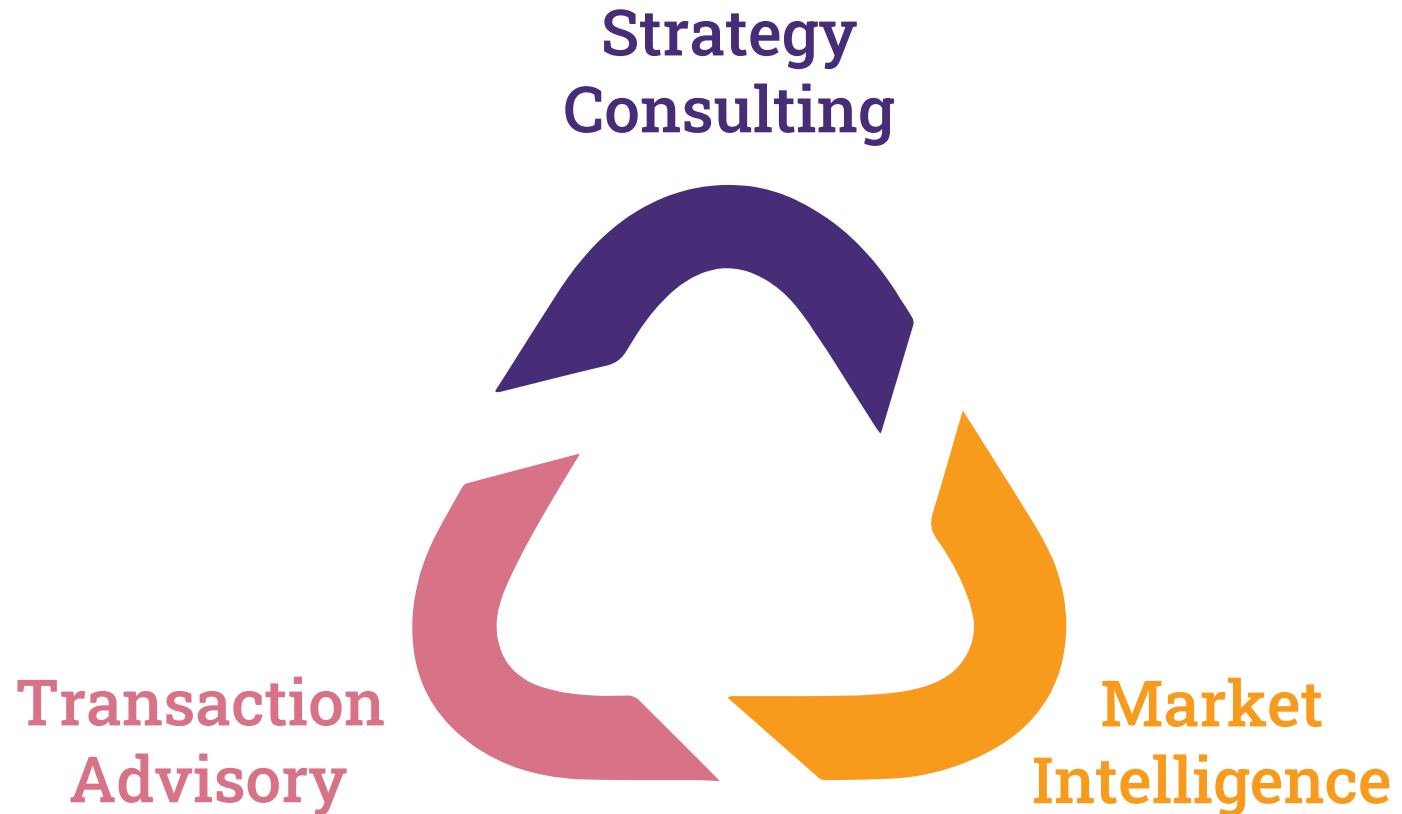
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BRIDGE TO INDIA is a clean energy-focused consulting and research services company



Deep sector insights

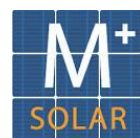
A 360 degree view of market dynamics

An unrivalled network of industry stake holders

Cross-functional team

We work with clients across the sector

Select clientele



We have built strong expertise in the corporate renewable market

Select consulting assignments



Renewable power roadmap

Logistics company

Evaluation of various renewable power procurement options; policy and financial feasibility



Policy advocacy

Global technology major

Renewable sector policy and market analysis for select states; preparation of policy advocacy briefs



RE 100 roadmap

Power electronics manufacturer

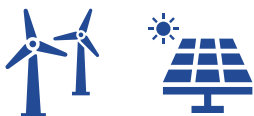
Development of RE100 roadmap; detailed policy and cost analysis of different procurement options



Market sizing

Leading C&I developers

Detailed assessment of C&I renewable market including market sizing and growth prospects



RE 100 roadmap

Automobile manufacturer

Development of an RE100 roadmap for manufacturing facilities in multiple states



Policy advocacy

International think tank

Development of an RE100 roadmap for manufacturing facilities in multiple states



RE procurement

Industrial consumer

Operational and financial feasibility assessment of a 10 MW rooftop solar plant for an industrial consumer



Transaction advisory

Multiple international PE firms

Commercial and market due diligence for investment in renewable project developers

We have built strong expertise in the corporate renewable market

Select research assignments

INDIA CORPORATE RENEWABLE BRIEF Q1 2023

Contents

- 1 Capacity addition | 1
- 2 Pricing update | 3
- 3 Policy developments | 6
- 4 Other market developments | 15

Executive summary

India added 1,635 MW corporate renewable capacity in Q1 2023, up 50% QOQ and the highest since Q1 2018. Total corporate renewable capacity is estimated to have reached 30,098 MW with OA solar, wind and rooftop solar capacity estimated at 9,856 MW, 10,605 MW and 9,637 MW respectively.

Figure: Total corporate renewable capacity by March 2023,

Category	Capacity (MW)
OA wind	10,605
OA solar	9,856
Rooftop solar	9,637
Total	30,098

Source: BRIDGE TO INDIA research
Note: OA wind capacity includes 2.7 GW projects allocated originally under FIT regime in Maharashtra for which PPAs have expired and not been renewed.

The increase in quarterly capacity addition came despite module availability constraints partly because of the rush to complete projects before end of the financial year.

This report provides an update on key trends and developments in the C&I renewable market including capacity addition, key players, policy issuances, financing, equipment prices and other market trends in the last quarter.

RE100 CLIMATE GROUP | CDP

The potential of corporate renewable electricity demand to influence India's renewables growth

RE100 CLIMATE GROUP | CDP

A business case for Renewable Energy Certificates for Indian companies to meet RE100 targets

WWF REPORT 2019

Global Corporate Renewable Power Procurement Models Lessons for India

Accelerating corporate procurement of **RENEWABLE ENERGY IN INDIA**

RE100 CLIMATE GROUP | CDP

A business case for rationalisation of Green Tariffs in India

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INDIA CORPORATE RENEWABLE MARKET 2023

75th Anniversary Report

Facilitating Growth of Corporate Renewable Market May 2023

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INDIA SOLAR ROOFTOP MARKET



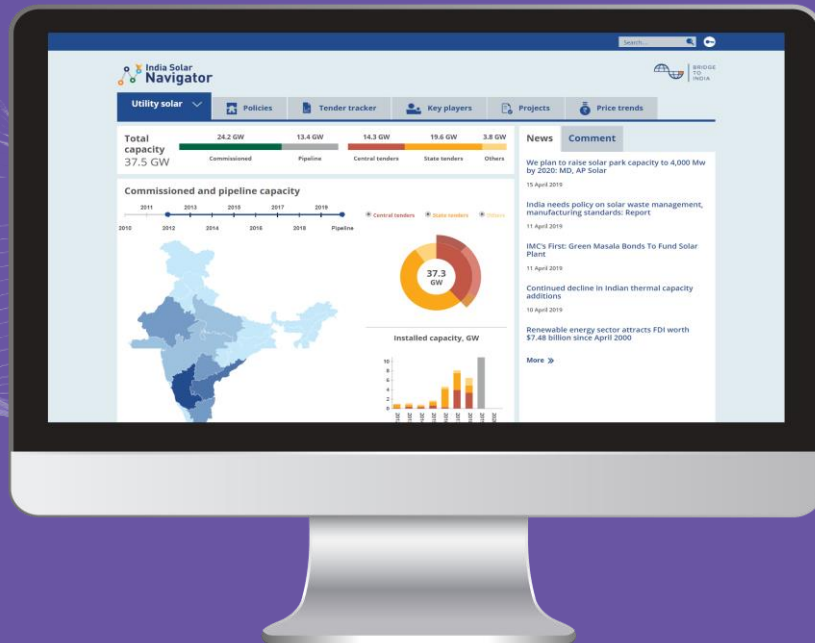
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India RE Navigator

Utility scale solar | Rooftop solar | Wind | Storage | Hydrogen

www.india-re-navigator.com



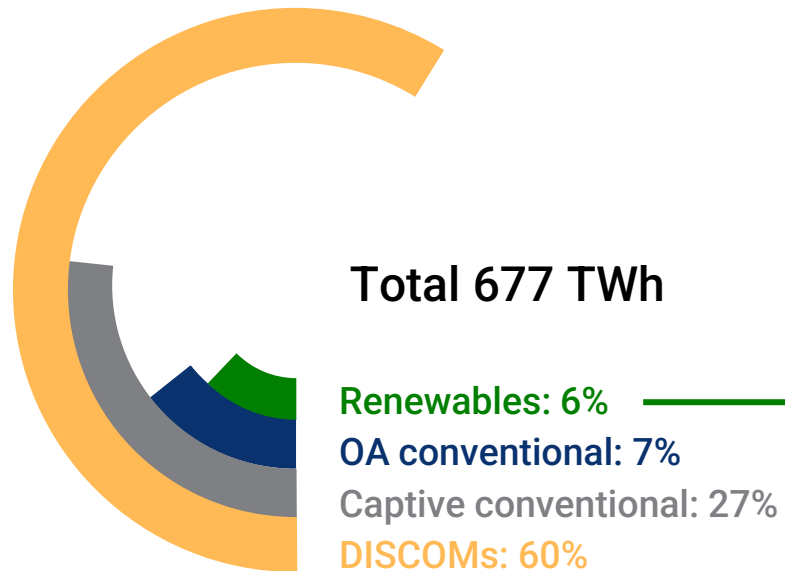
- Tenders
- Projects
- Government policies
- Player profiles
- Prices
- News
- Opinion

Agenda

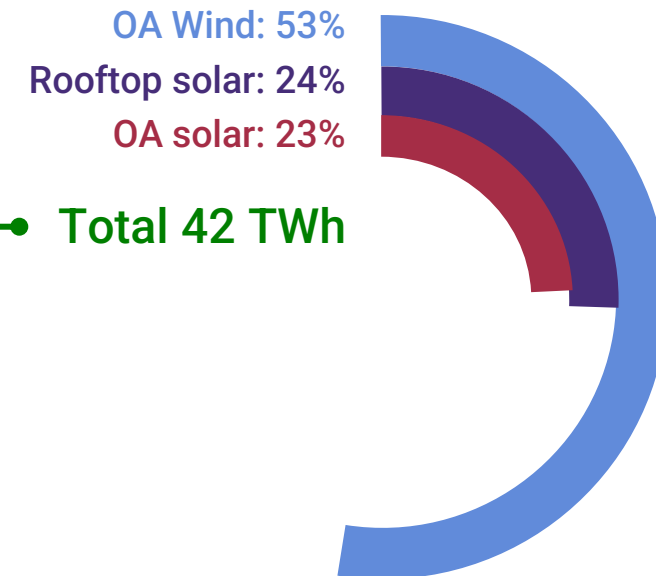
- Overall market landscape
- Market drivers
- Policy and regulatory framework
- Market evolution
- Conclusion

C&I renewable market holds huge growth potential

Power consumption mix for C&I consumers, FY 2021

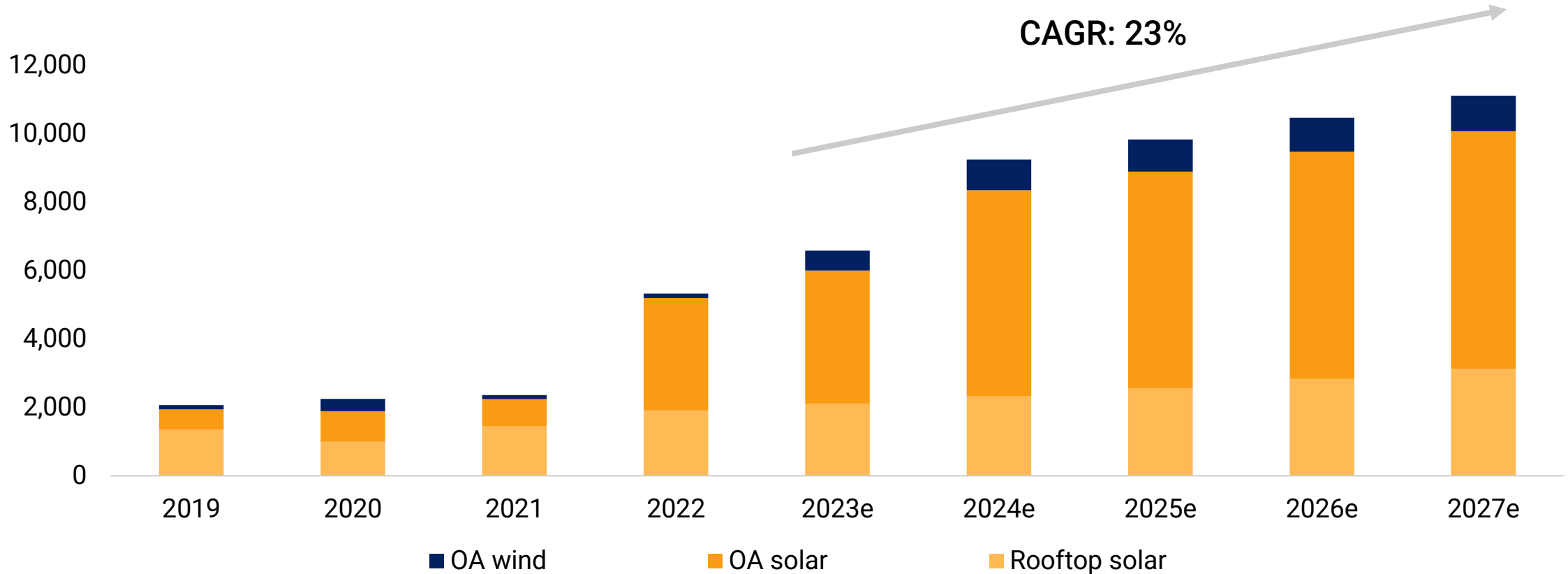


Renewable power procurement



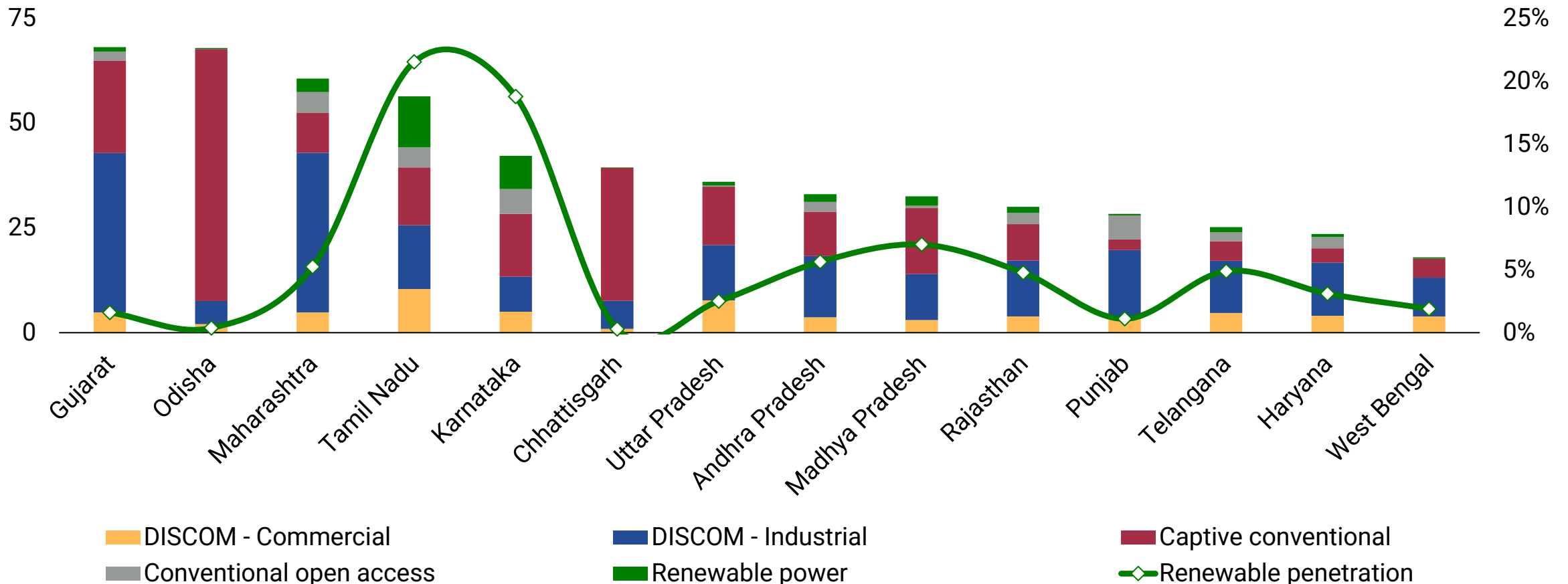
Growth prospects are looking increasingly more positive

Corporate renewable capacity addition, MW



Maharashtra, Gujarat and Odisha are expected to provide bulk of growth

Corporate power procurement across states, FY 2021, TWh



Corporate focus is shifting from cost savings to emission reduction



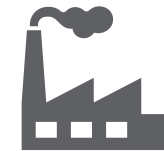
- 250 MW RTC renewable power
- 20% RE penetration for a 10 million tonne plant in Gujarat



- 6 GWh pumped hydro storage
- 1 GW RTC renewable power for manufacturing plant

43.3%

Rising RPO targets



Carbon trading scheme



- 420 MW renewable power



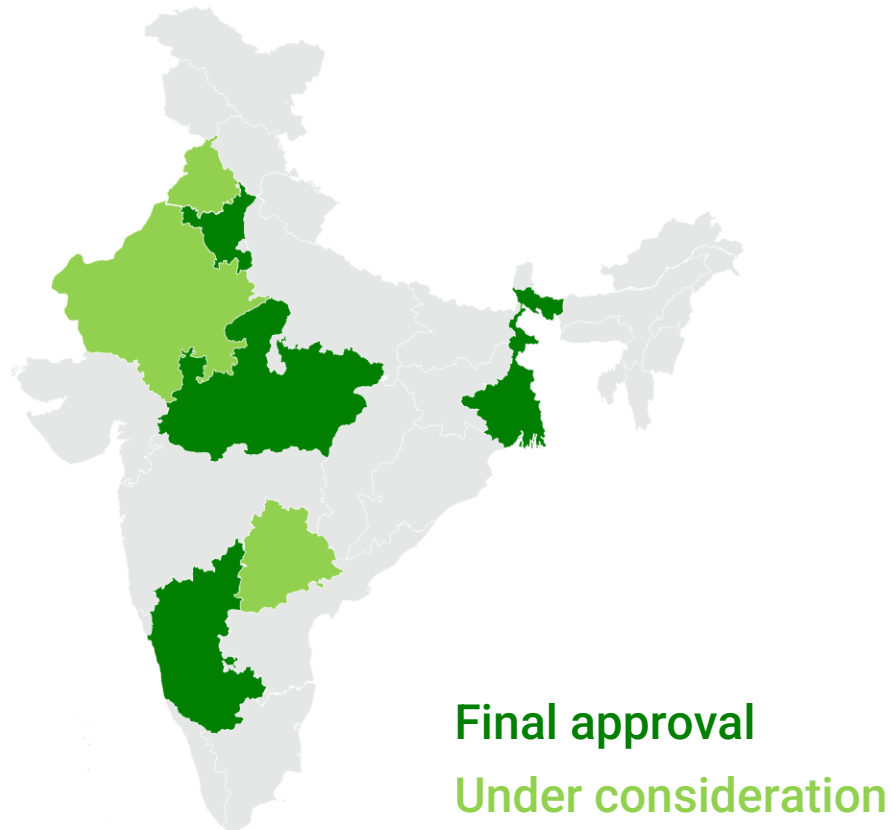
- ISTS connectivity to procure renewable power



EU Carbon Border Adjustment Mechanism

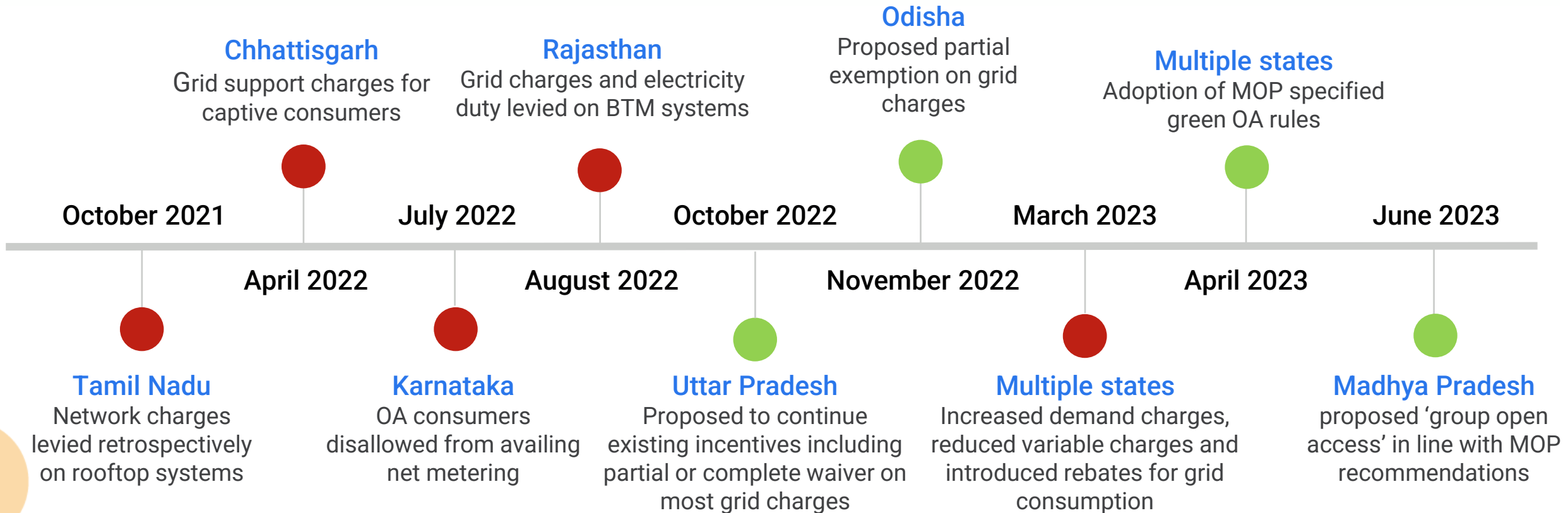
The central government seems determined to support the market

Adoption status of green OA rules



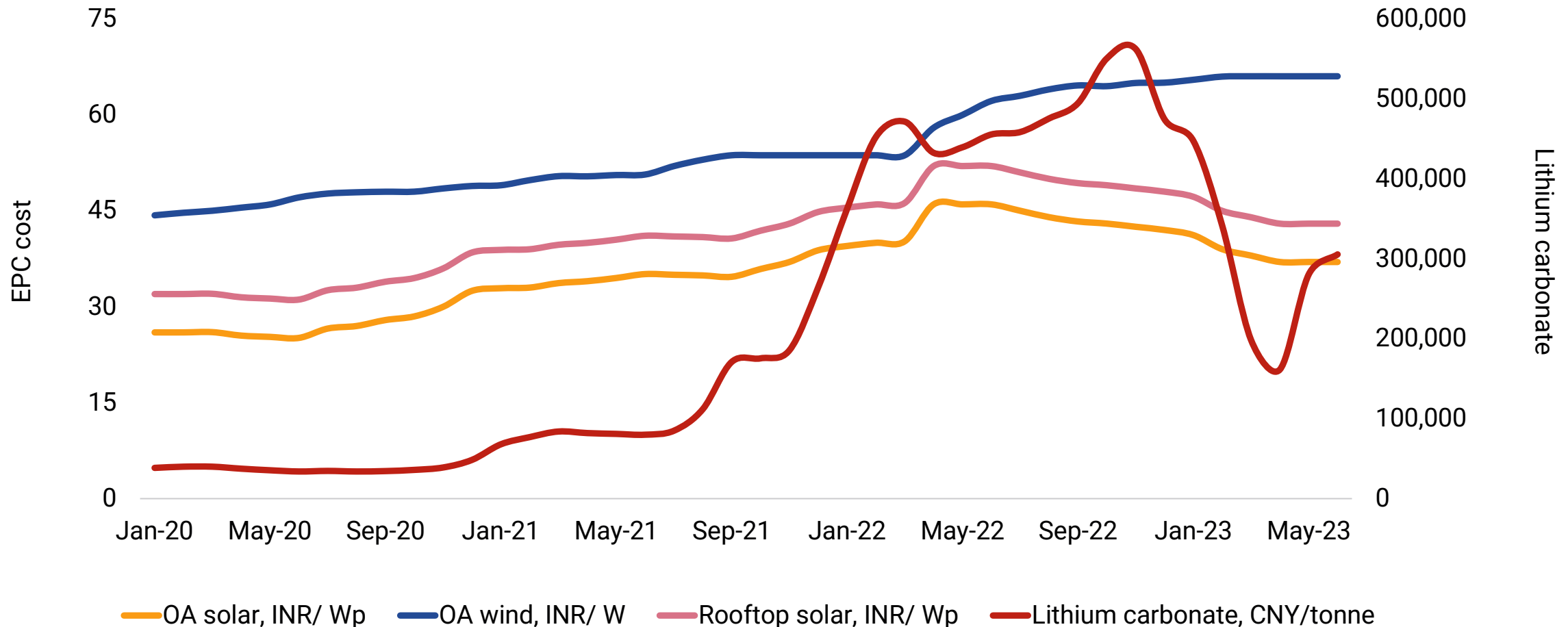
- Minimum sanctioned load of 100 kW on a group basis
- Single-window application process
- Monthly banking
- Simplified General Network Access

State government stance remains mixed



Cost inflation is beginning to moderate

EPC cost and lithium carbonate China spot price



The market place is becoming more dynamic

Technologies	<ul style="list-style-type: none">• Wind-solar hybrid projects• RTC solutions with integrated storage• Renewable heating for process heat applications• Green hydrogen
PPA structures	<ul style="list-style-type: none">• Despatchable power from composite supply sources• Shorter tenors
Business models	<ul style="list-style-type: none">• Integrated project development-cum-EPC solutions• Virtual power purchase agreements (VPPAs)• Unbundled green attributes – RECs, iRECs, TIGRs• Green tariffs• Group open access

Conclusion

- Overall growth outlook extremely positive
- Strong growth drivers partly offset by state-level regulatory challenges
- Central government policy support encouraging
- More dynamic market with emerging business models, new PPA structures and improving technologies



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Role of different technologies

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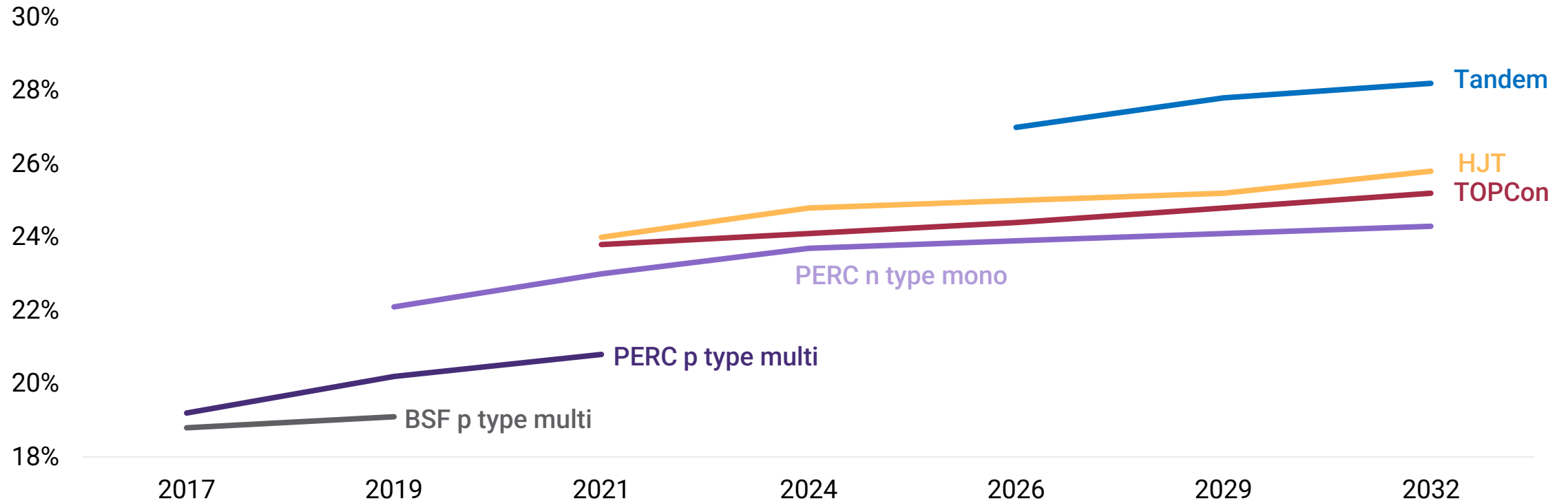
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Solar cell technology is improving rapidly

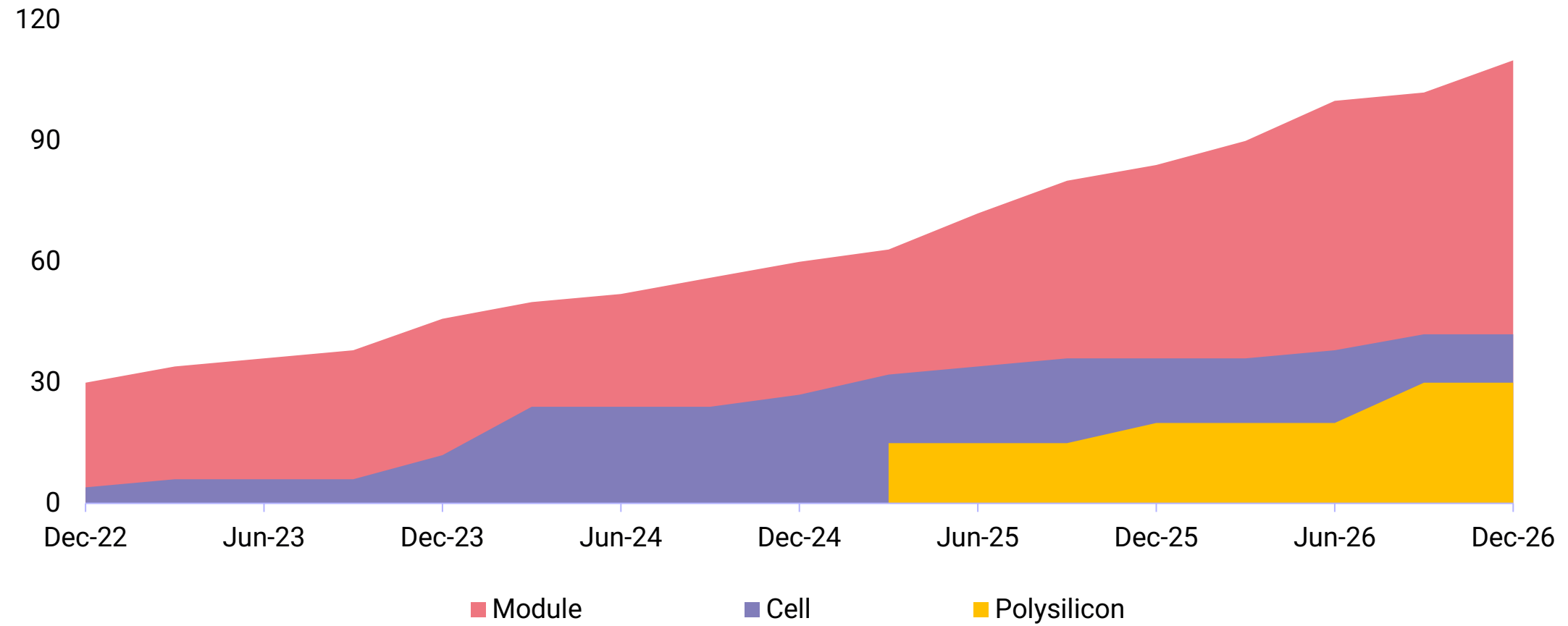
Higher efficiency + higher power yield + lower BOS cost = Lower LCOE

Efficiency of cells in mass production



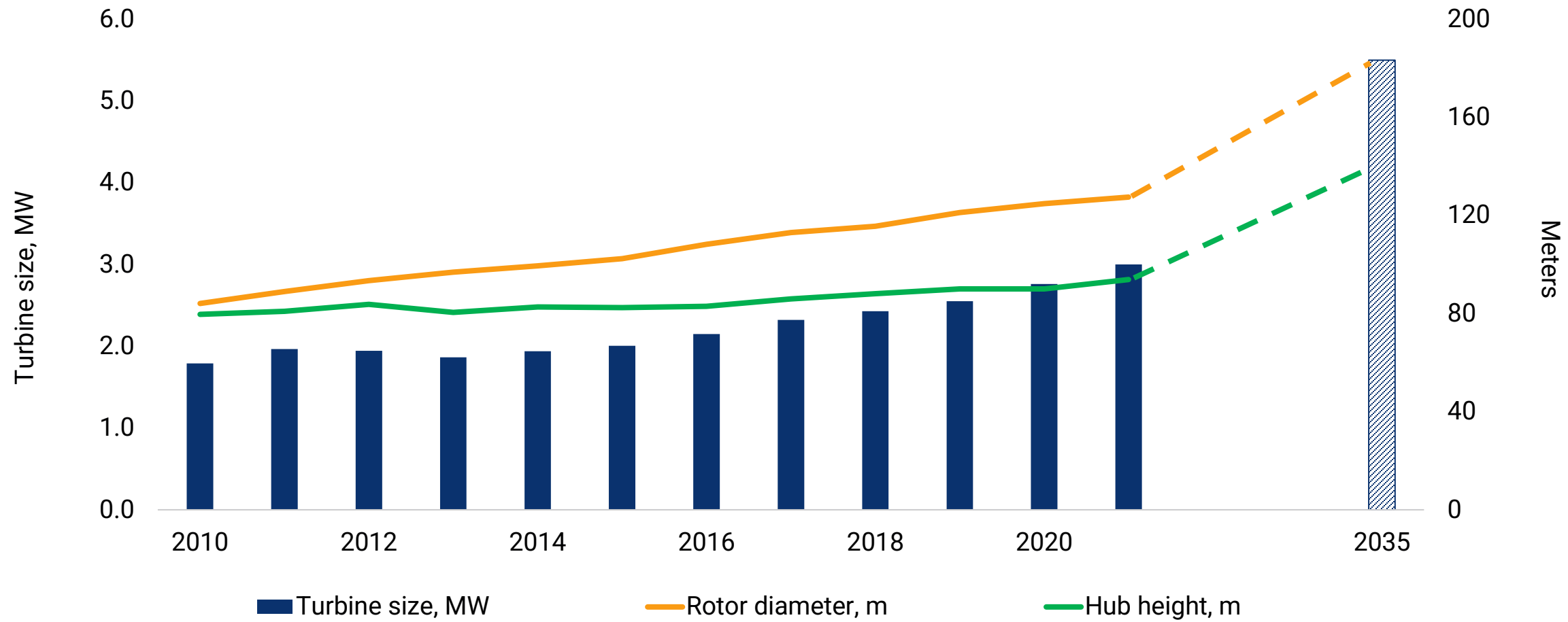
Make in India is expected to scale up from next year onwards

Projected manufacturing capacity, GW



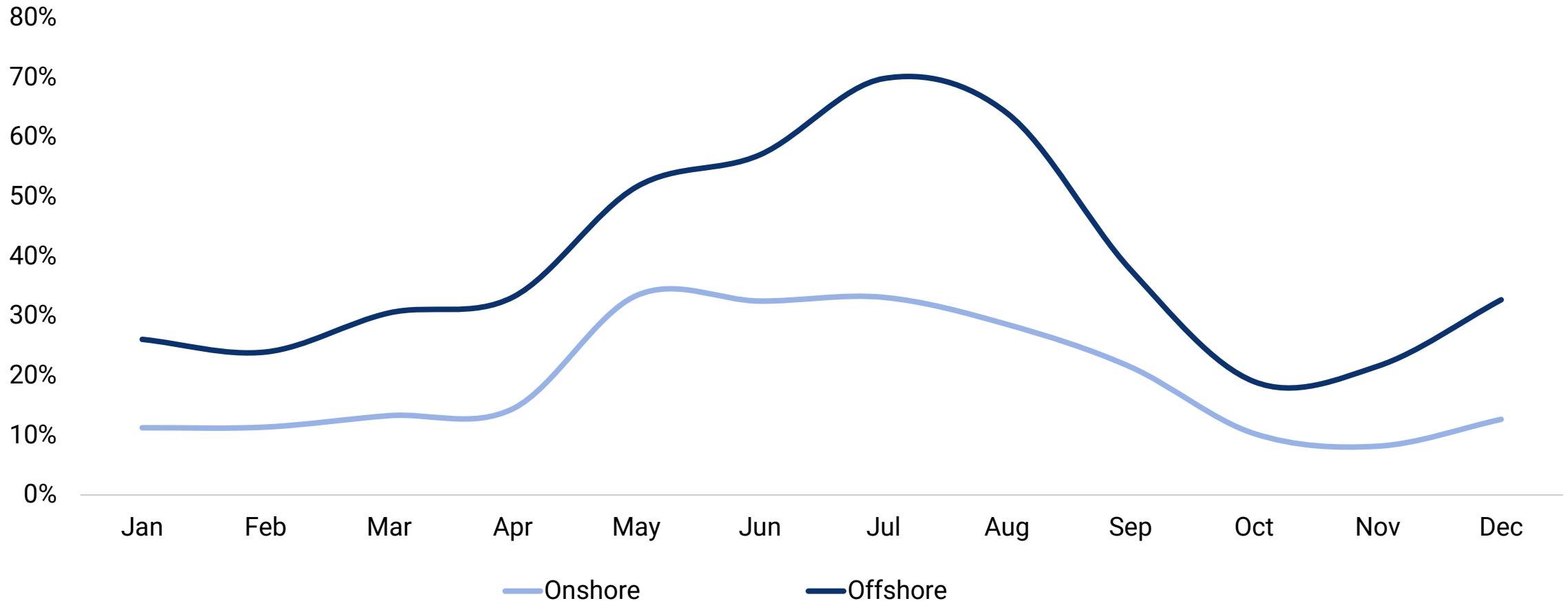
Larger turbines can utilise increasingly limited wind resources

Average onshore wind turbine size, MW



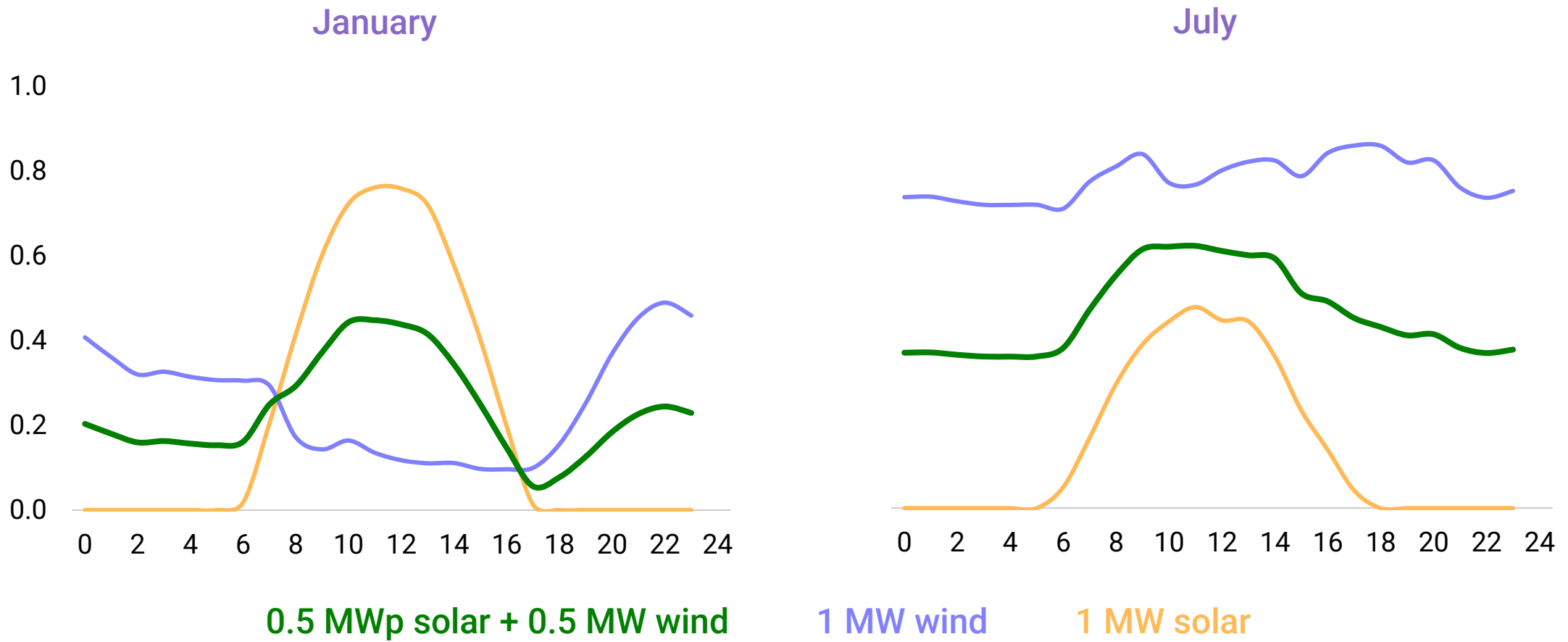
Offshore wind provides higher utilisation and greater RE penetration

Seasonal variation in capacity utilisation factor



Wind can complement solar output profile and enable higher RE penetration

Typical hourly generation profile in Karnataka, MW



0.5 MWp solar + 0.5 MW wind

1 MW wind

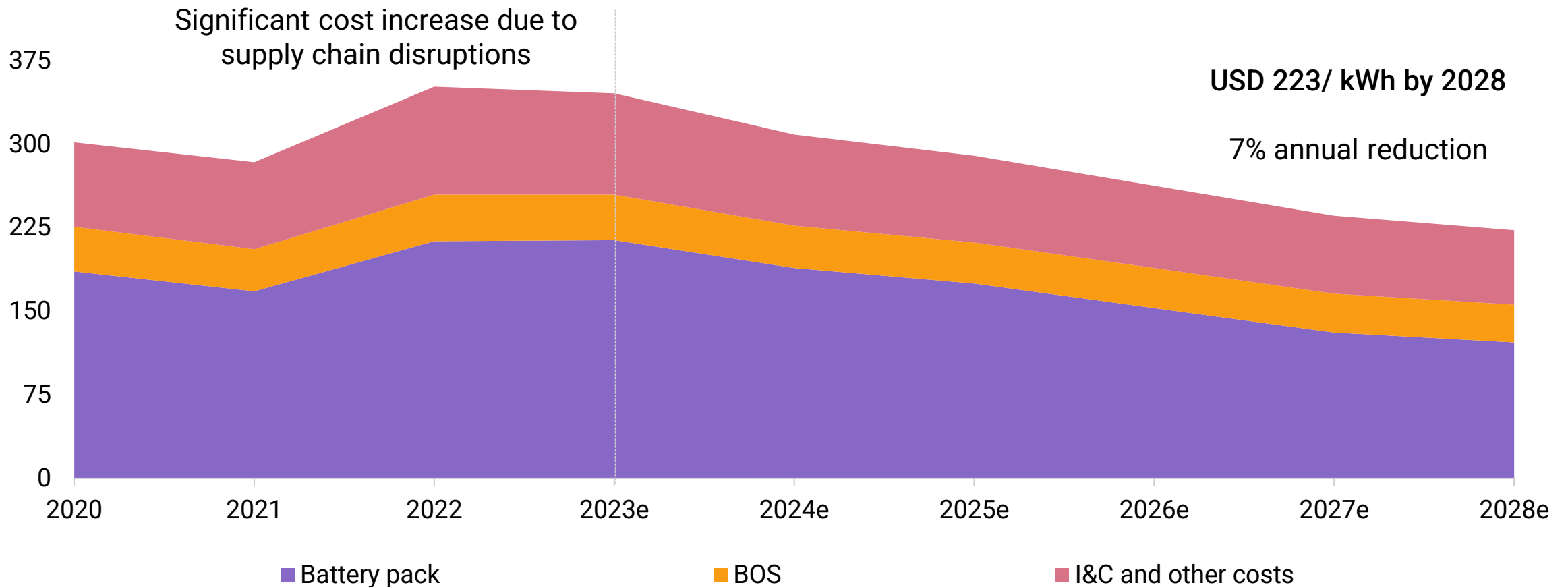
1 MW solar

Low cost, proven track record and long duration storage favours pumped hydro technology for bulk applications

	PSP	LI-ION
LCOS (single cycle)	INR 5-6/ kWh	INR 11-13/ kWh
Storage duration	6-12 hours	2-4 hours
Gestation period	4-5 years	1-2 years
Project life	40-50 years	7-8 years
Scale	Bulk applications	Small-medium size applications
Availability	Location specific	Modular

High cost of battery storage is still a deterrent

EPC cost for a 4-hour lithium-ion battery installation, USD/ kWh

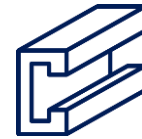


Hydrogen is a versatile energy source



Refineries

To reduce sulphur content in petroleum products



Iron and steel

Blended with natural gas to reduce emissions from smelting



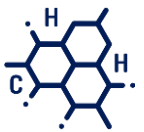
Fertilisers

Green ammonia used for urea and other fertiliser production



Methanol

Feedstock in sectors like railways, automobiles



Chlor-alkali

Co-firing gas turbines

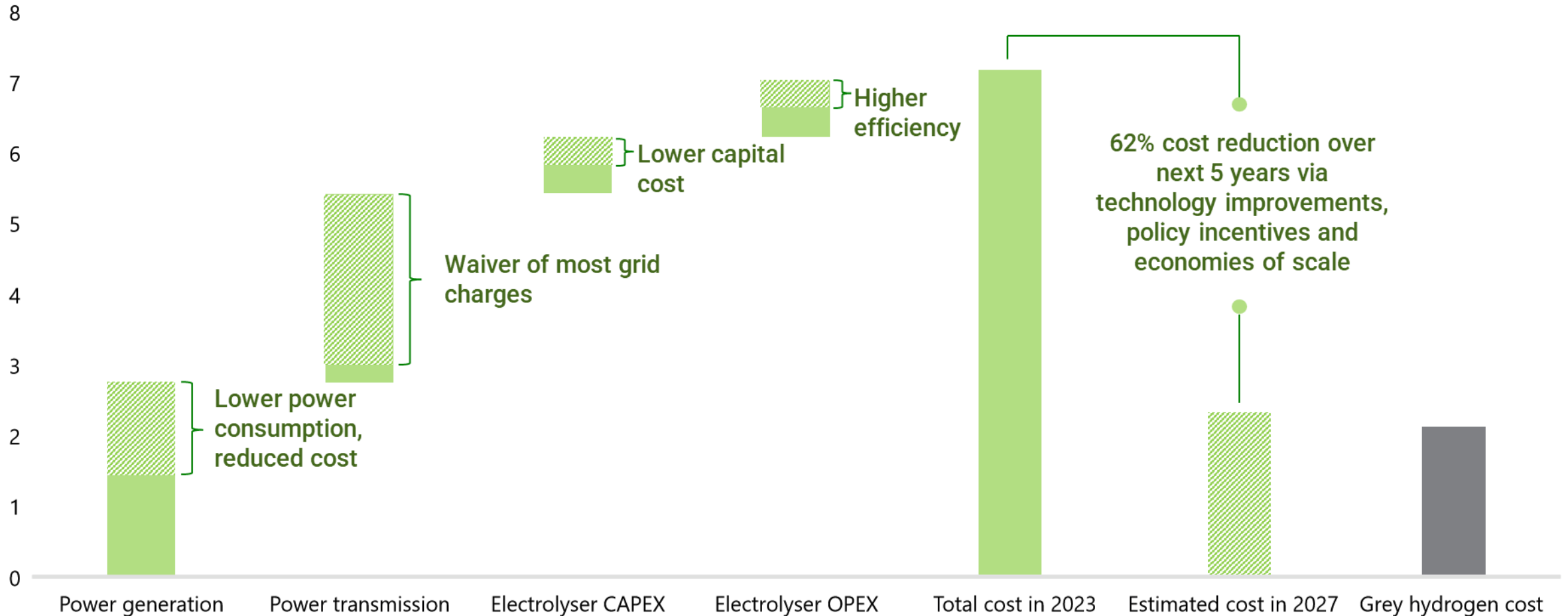


Data centres

Reduced reliance on diesel gensets and grid power

Technology advancements are critical to drive down cost

Estimated production cost, USD/ kg



Conclusion

- Technology a major driver of change
- Technology challenges – high cost, intermittent output, low efficiency, supply side risks
- Green hydrogen and storage huge opportunities
- High technology dependency on other countries – need more investments in R&D, skills, equipment testing and standards, willingness to pay higher price



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Open access and VPPAs

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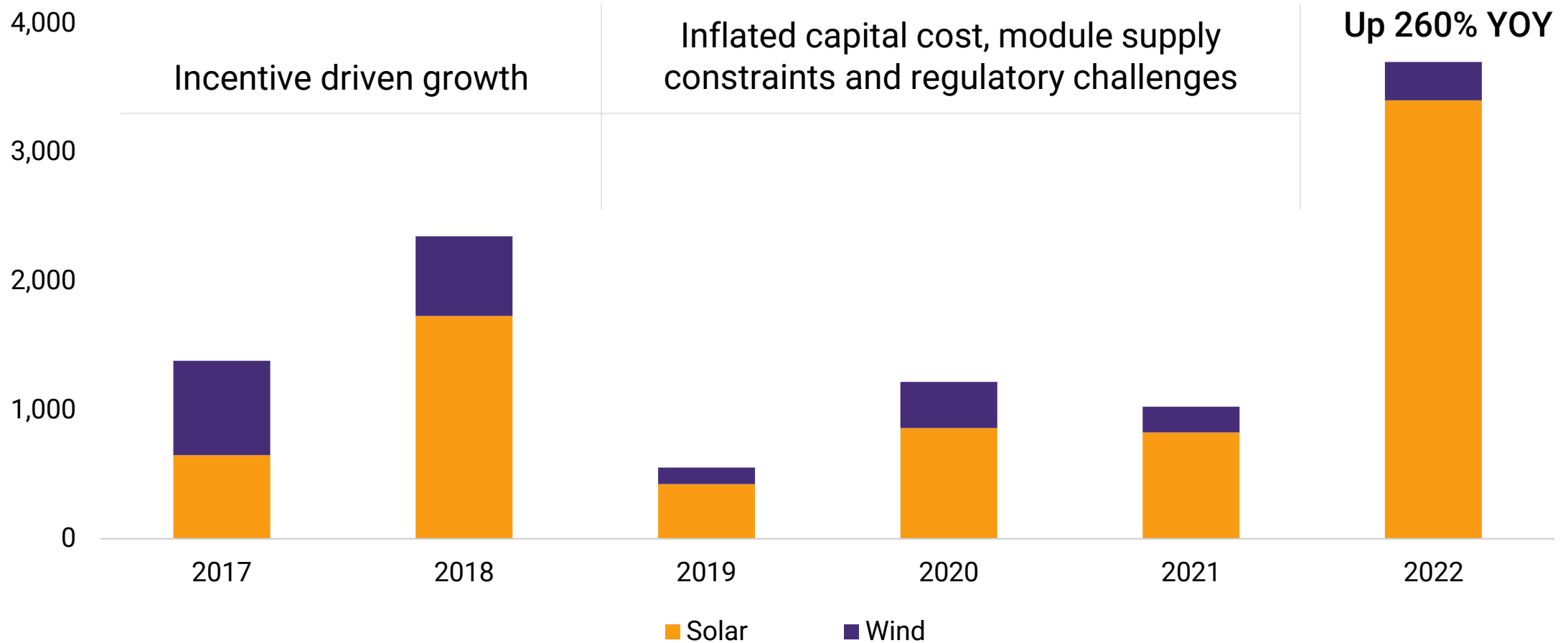


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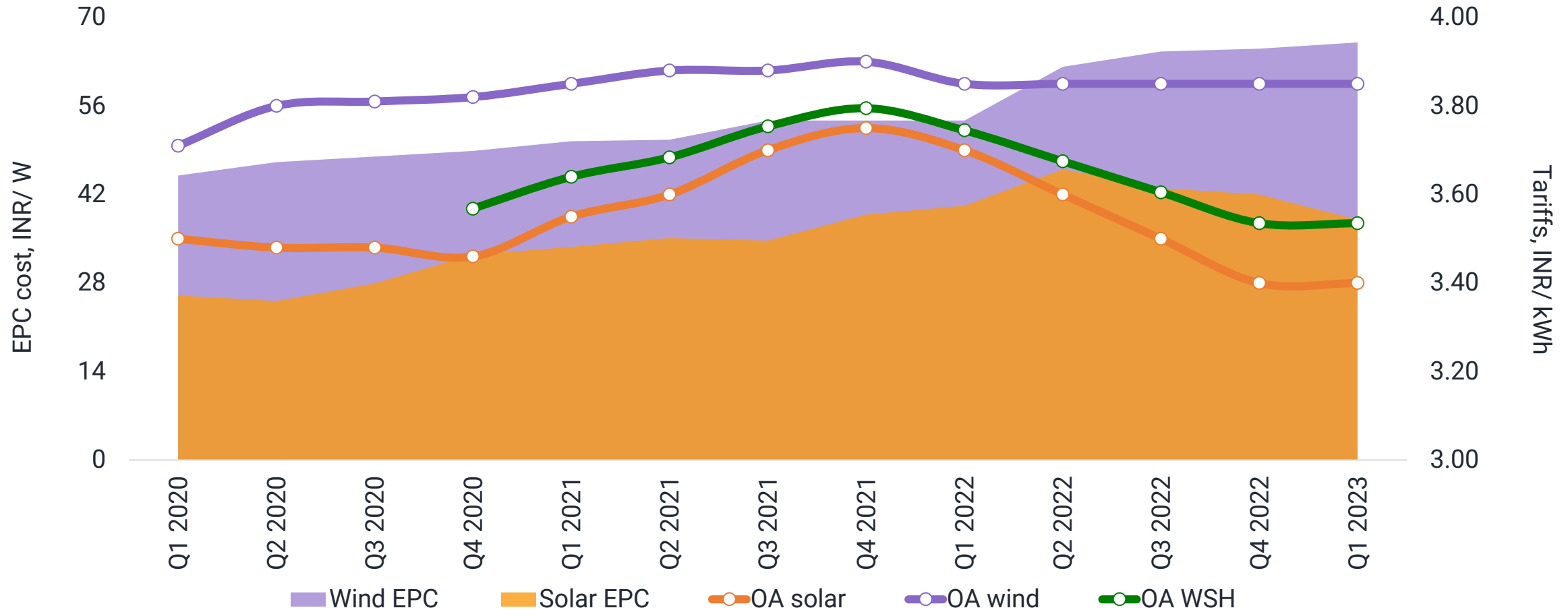
Market growth has picked up in the last 18 months

OA renewable capacity addition, MW



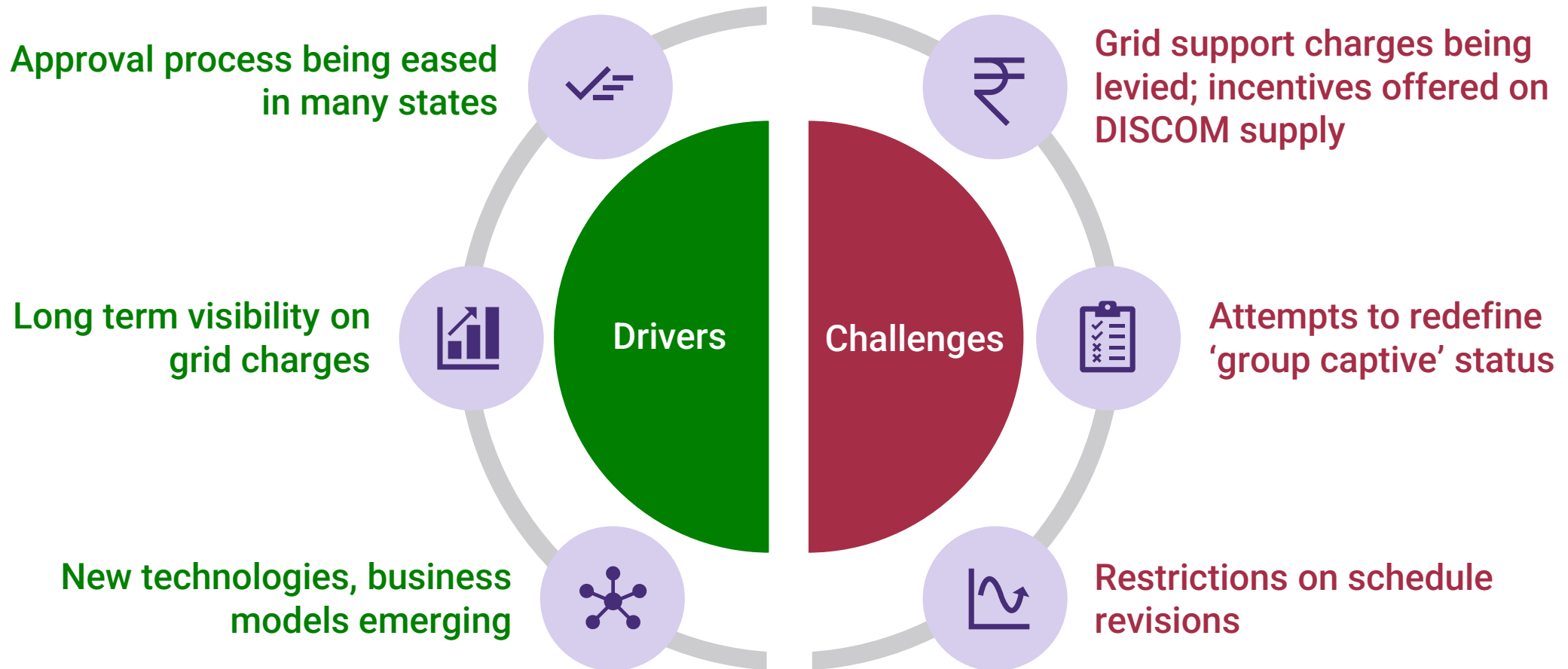
Solar and WSH tariffs have come down in recent months

EPC cost and OA tariffs



Note: Solar EPC cost is estimated using central inverters and imported mono-crystalline modules in a fixed tilt layout. Cost includes GST and import duty, as applicable, but excludes cost of land and evacuation system.

Despite announcement of green OA rules, regulatory uncertainty persists



Preference is growing for WSH projects

Growth drivers

- Incentives being shifted from vanilla solar and wind to WSH projects
- Withdrawal/ tightening of banking provisions
- Need for dispatchable power
- Demand for greater RE penetration

Policy

- Dedicated policies in Rajasthan, Madhya Pradesh, Gujarat and Andhra Pradesh
- Exemptions on ED, grid charges; incentives on purchase of land

Group captive projects are facing increased scrutiny and resistance

'Group' captive	100% captive	Third party sale	Group OA
<ul style="list-style-type: none"> • Most popular • Minimal capital investment and lower OA charges • Coming under greater scrutiny in multiple states 	<ul style="list-style-type: none"> • 10-15% share • Most consumers unwilling to make 100% equity investment • Lowest regulatory risk 	<ul style="list-style-type: none"> • Not attractive due to levy of AS and CSS • Limitations on project size and banking • Highest regulatory risk 	<ul style="list-style-type: none"> • One company owns all individual units in same DISCOM region with aggregated demand of over 100 kW • Attractive for large corporates with distributed operations – banks, OMCs, telcos • Untested

Key policy parameters in select states

Green OA rules adoption status

Punjab

Annual banking with high charges

Haryana

Project approval process simplified

Rajasthan

No approval for group captive projects

Gujarat

High banking charge for solar, resistance to group captive projects

Maharashtra

Proposed AS levy on group captive projects

Karnataka

Quick approval process

Uttar Pradesh

Stable and attractive incentives, half-yearly banking

Chhattisgarh

Long term visibility on charges

Odisha

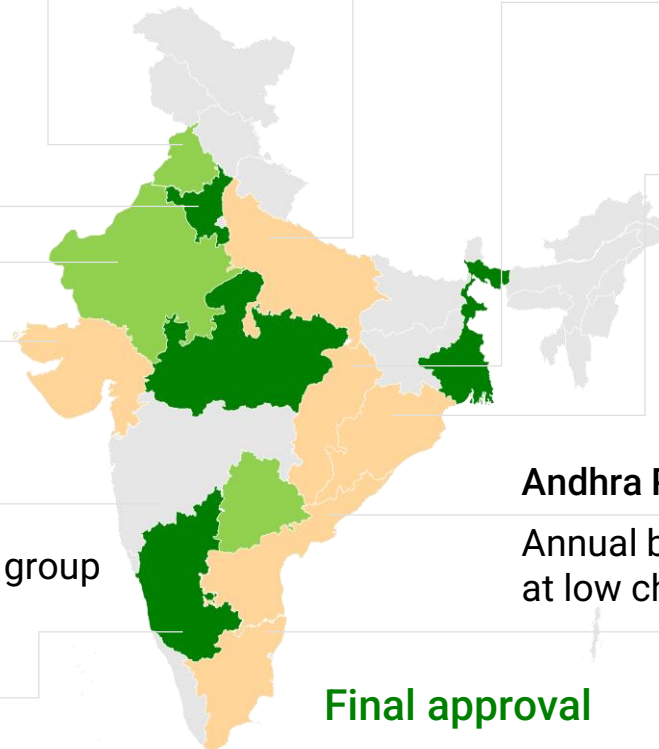
Attractive incentives, no banking

Andhra Pradesh

Annual banking at low charges

Tamil Nadu

DISCOM resistance to group captive projects, incentives



Final approval

Under consideration

DISCOMs are tactically fighting back against OA

Tariff orders for FY 2024

Madhya Pradesh

- Rebate of INR 1.00-2.00/ kWh for incremental grid power consumption
- Green tariff premium of INR 0.25-0.97/ kWh

Maharashtra

- Green tariff premium reduced by 11%
- Rebate of INR 0.75/ kWh for incremental consumption
- AS levied on group captive projects

Gujarat

Green tariff introduced

Chhattisgarh

- Grid support charge of INR 0.13/ kWh for captive projects
- Proposed green tariffs for a premium of 0.79/ kWh

Odisha

- Green tariff premium reduced by 50%
- 15% rebate in energy charge for captive consumers

Telangana

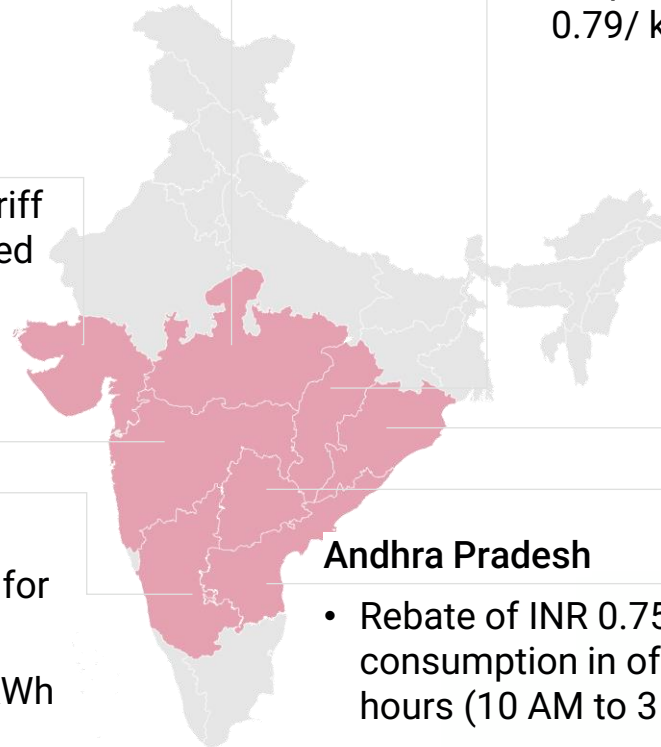
Proposed grid support charge of INR 25,000/ MW/ month

Karnataka

- 2-5% decrease in energy charges
- Discounted energy charge of INR 5.00/ kWh for HT C&I consumers for consumption over
- Proposed grid support charge of INR 3.01/ kWh for captive projects

Andhra Pradesh

- Rebate of INR 0.75/ kWh for consumption in off-peak hours (10 AM to 3 PM)



RE-rich states imposing new charges targeted at captive projects

- Energy development fee – Madhya Pradesh – INR 0.10/ kWh on entire generation from captive projects
- Parallel operation charge – Chhattisgarh – INR 0.13/ kWh
- Tax on captive projects – Rajasthan, Karnataka – INR 0.20-0.40/ kWh
- AS on group captive projects – Maharashtra (proposed) – INR 1.36/ kWh
- Banking charge on entire power generated – Gujarat – INR 1.50/ kWh
- Free power to DISCOMs from ISTS projects – Rajasthan (proposed) – 10% of total power generation

ISTS OA is a major opportunity but some regulatory issues are yet to be addressed

Opportunity

- Up to INR 0.40/ kWh cost saving over intra-state OA
- Flexibility to meet varying demand from multiple units across country
- Relatively stable regulatory framework

Challenges

- Transmission charge waiver yet to be implemented
- Captive status verification procedure awaited
- Teething issues with GNA
- No banking

Suitability of VPPAs is restricted to select consumers

Advantages over traditional PPA

- Appropriate for consumers ineligible for OA, rooftop solar
- No change in existing power procurement structure

Risks and challenges

- Cost-plus option
- Volume and price risk
- Regulatory uncertainty

Conclusion

- Central government policy stance improving but resistance from states continues
- EPC costs on the way down
- Limited sites with high wind and co-located WSH potential, limited evacuation capacity
- ISTS waiver, liberal regulatory regime and new business models to open untapped states and consumer segments



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Rooftop solar

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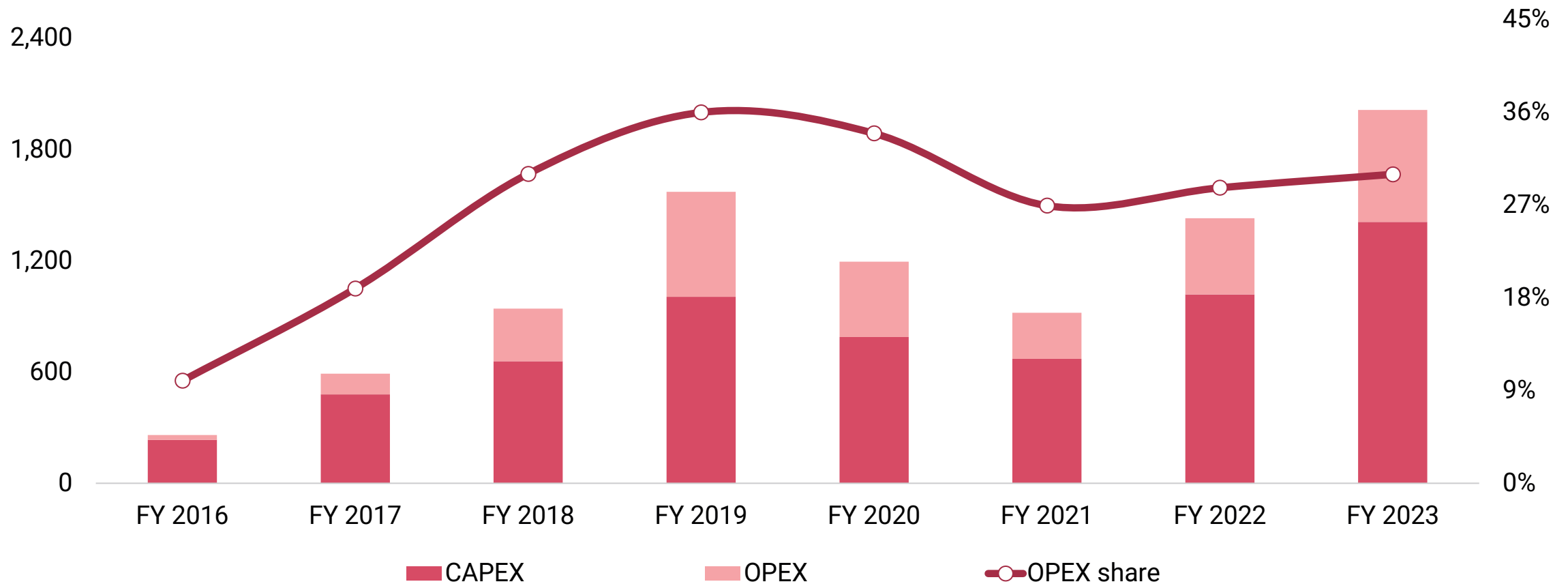


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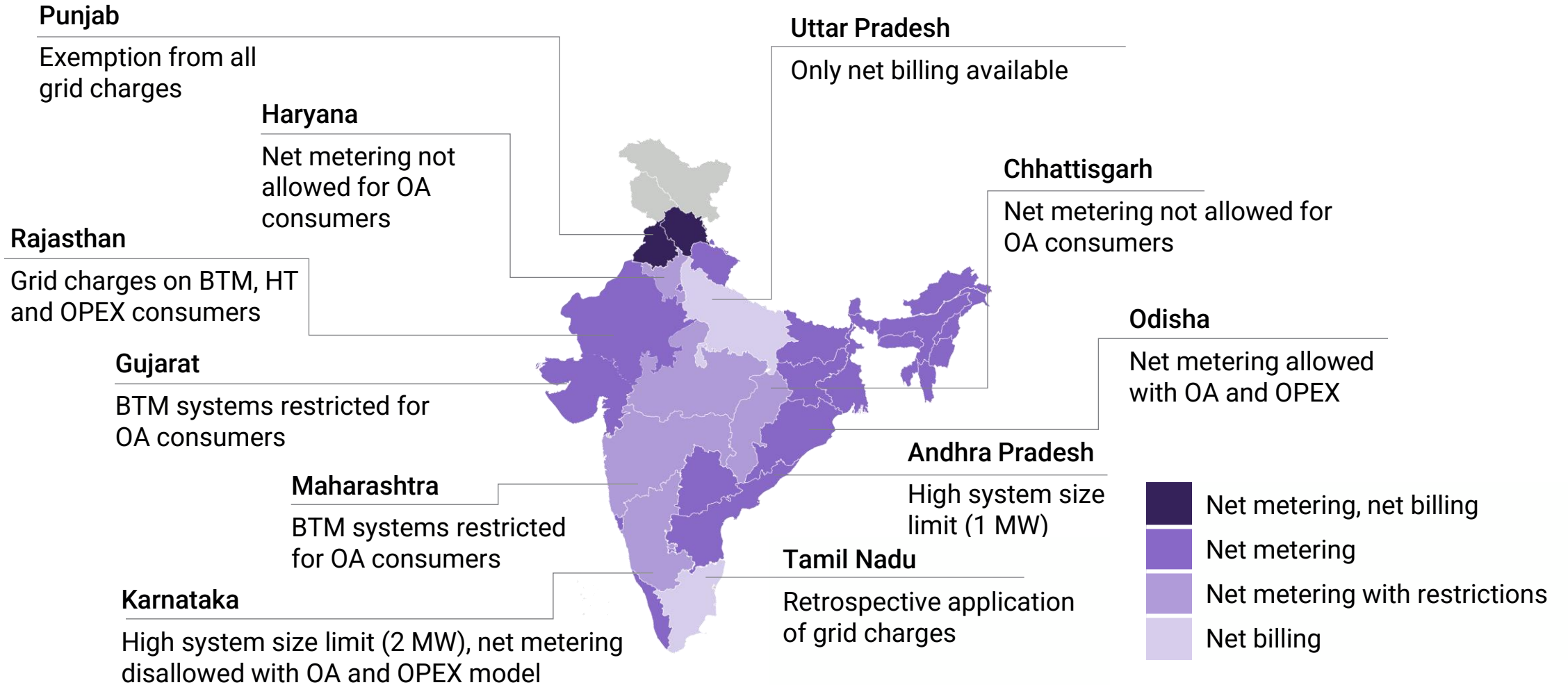
Capacity addition has picked up in recent years

Corporate rooftop solar capacity addition, MW



Grid support charges and restrictions are being introduced

Metering connectivity



Restrictions on BTM systems amid growing adoption

2,661 MW
BTM capacity as of
December 2022

30% of total C&I
rooftop solar
capacity

Growing adoption due to increased policy and regulatory challenges

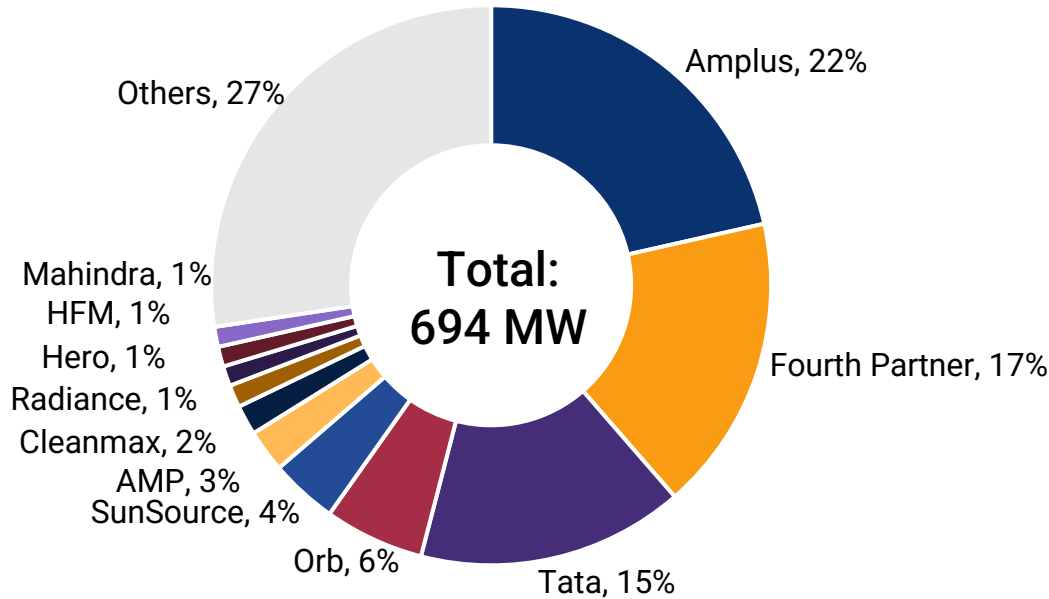
Maharashtra, Rajasthan, Gujarat, Madhya Pradesh, Karnataka and Tamil Nadu lead installations

Maharashtra and Gujarat require BTM systems to switch to gross metering for OA approvals

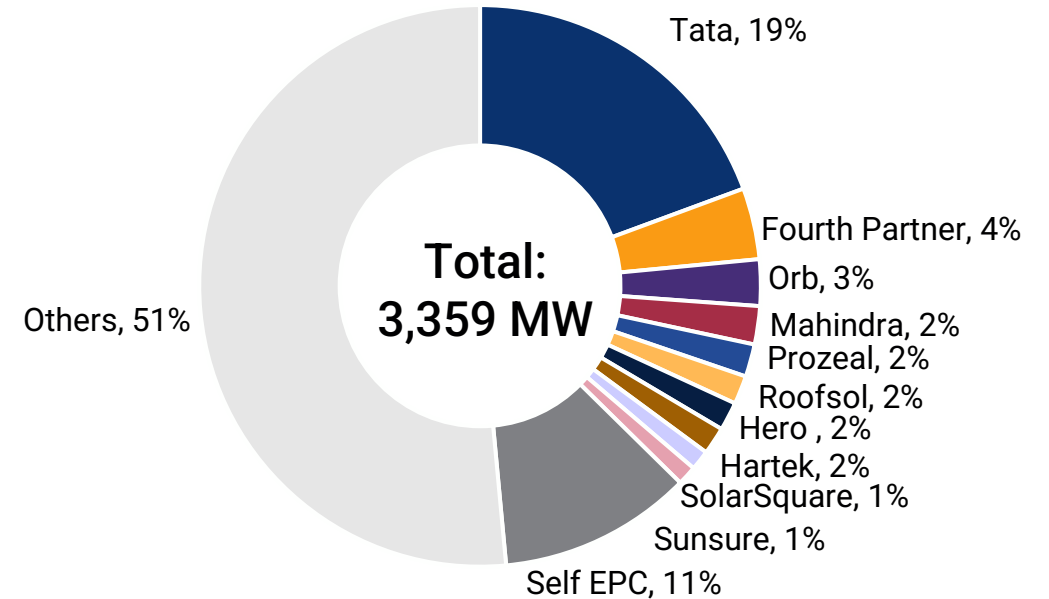
Rajasthan levying grid charges

Supply side eco-system has matured immensely over the years

Project developers,
2021-2022



EPC contractors,
2021-2022



Technical improvements are driving project efficiency up

- Advanced software for plant design and simulation, financial and technical analysis and study of shading effects
- Appropriate choice of mounting structures for different roof type based on dynamic loading analysis
- AI and Machine Learning-based performance monitoring and predictive maintenance
- Robotic cleaning in select industries like cement manufacturing

Conclusion

- Most attractive route despite regulatory challenges
- Increasing attempts by DISCOMs to restrict captive use and BTM systems
- Innovative project structures like virtual and group net metering yet to be tested



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Innovative RTC solutions

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Increasing demand for RTC renewable solutions



- 250 MW RTC renewable power
- 20% RE penetration for a 10 million tonne plant in Gujarat



- 6 GWh pumped hydro storage
- 1 GW RTC renewable power for manufacturing plant



1.5 GWh pumped storage capacity to enable RTC renewable power for group companies

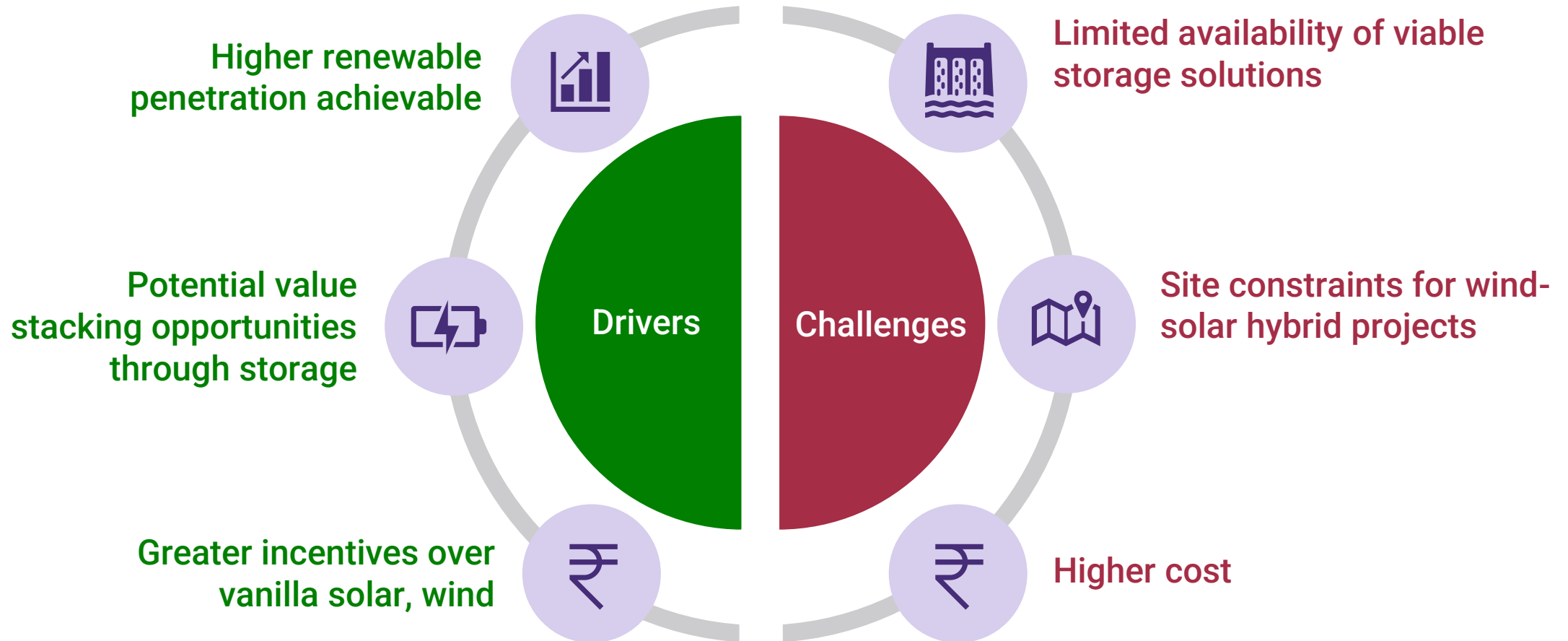


966 MW hybrid renewable power contracted from Tata Power

Consumer expectations

- Load following generation pattern
- High availability during peak hours
- CUF of about 80-100%
- Low seasonal variation

RTC renewables hold significant potential but there are some short-term challenges



WSH potential is limited to a few states

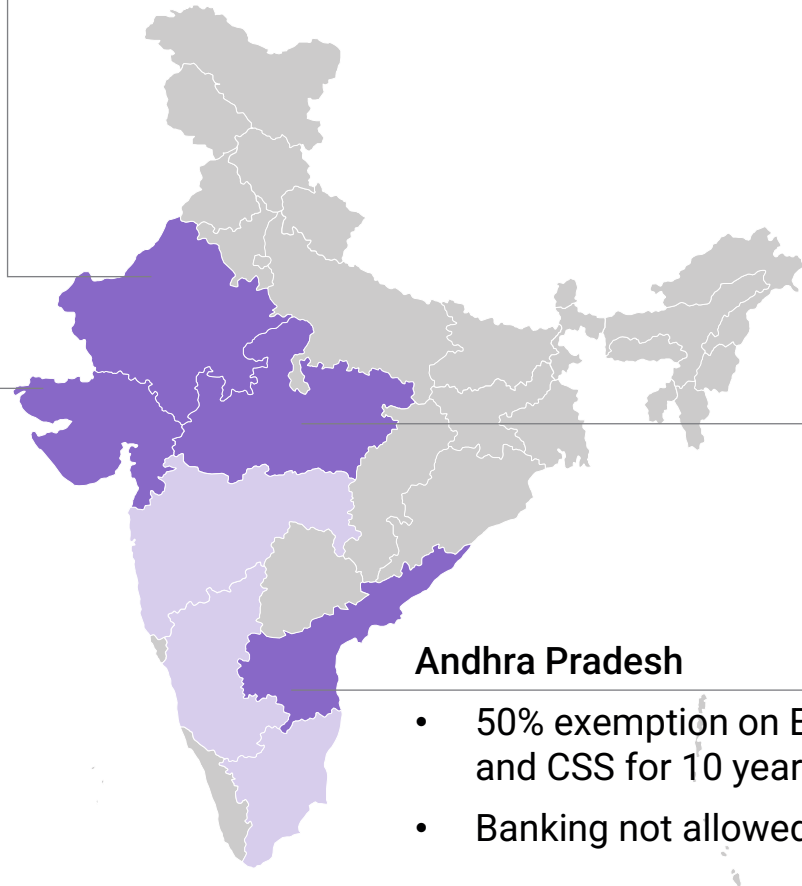
Wind-solar hybrid policies

Rajasthan

- 50% exemption for 7 years on transmission and wheeling charges
- Annual banking at 10% in-kind charge; no compensation for unused power

Gujarat

- 100% waiver on ED
- 50% waiver on wheeling charges and losses, AS and CSS
- Incentives until 19 June 2023
- Monthly banking for consumers not claiming green attributes



Madhya Pradesh

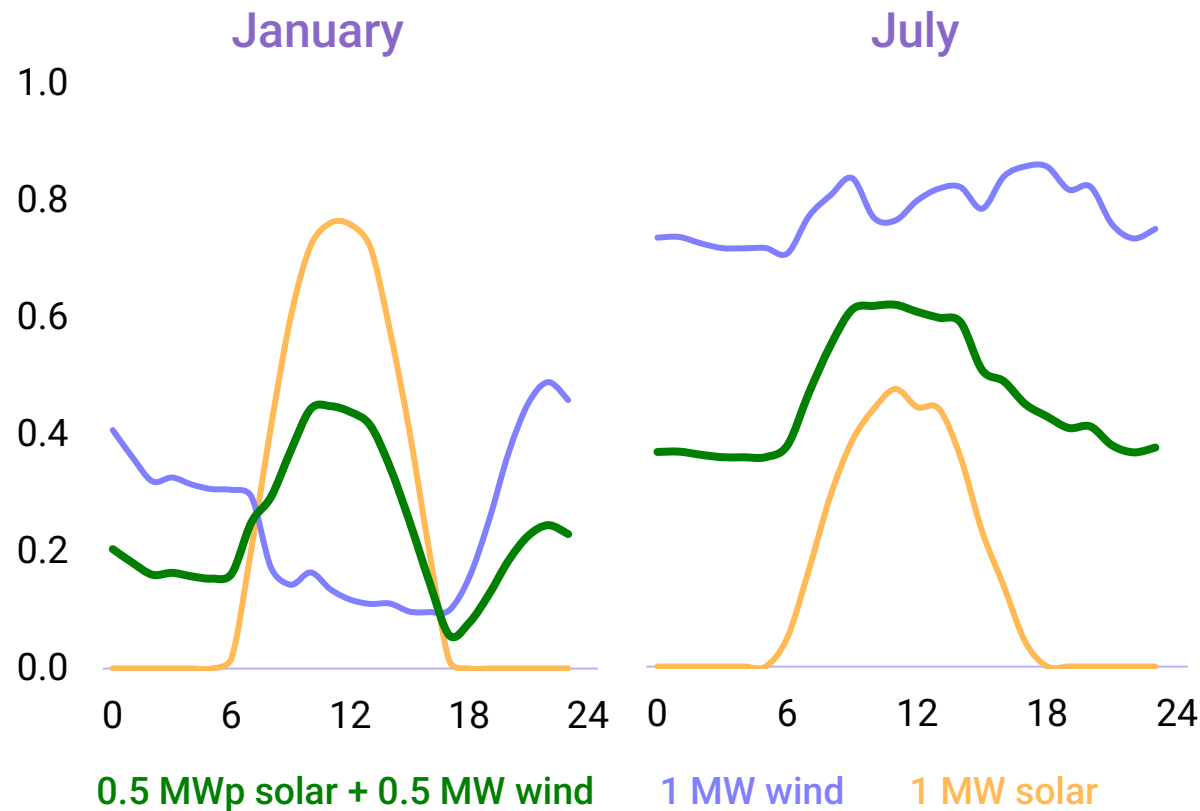
- 100% exemption on ED
- 50% exemption on wheeling charge for 5 years
- 50% reimbursement of stamp duty on purchase of private land
- 15% discount on purchase of government land for storage projects
- Monthly banking allowed with 8% in-kind charge; REC issuance for unused power

Andhra Pradesh

- 50% exemption on ED and CSS for 10 years
- Banking not allowed

Storage is essential to absorb high seasonal and hourly variations

Typical hourly generation profile in Karnataka, MW



	PSP	LI-ION
LCOS (single daily cycle)	INR 5-6/ kWh	INR 11-13/ kWh
Storage duration	6-12 hours	2-4 hours
Gestation period	4-5 years	1-2 years
Project life	40-50 years	7-8 years
Scale	Bulk applications	Small-medium applications
Availability	Location specific	Modular

Conclusion

- Corporate focus is shifting from cost savings to emission reduction
- Consumer requirements and technology are evolving
- Attractive market drivers but lack of viable storage solutions a big challenge



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Power exchange and green attributes

21 June 2023



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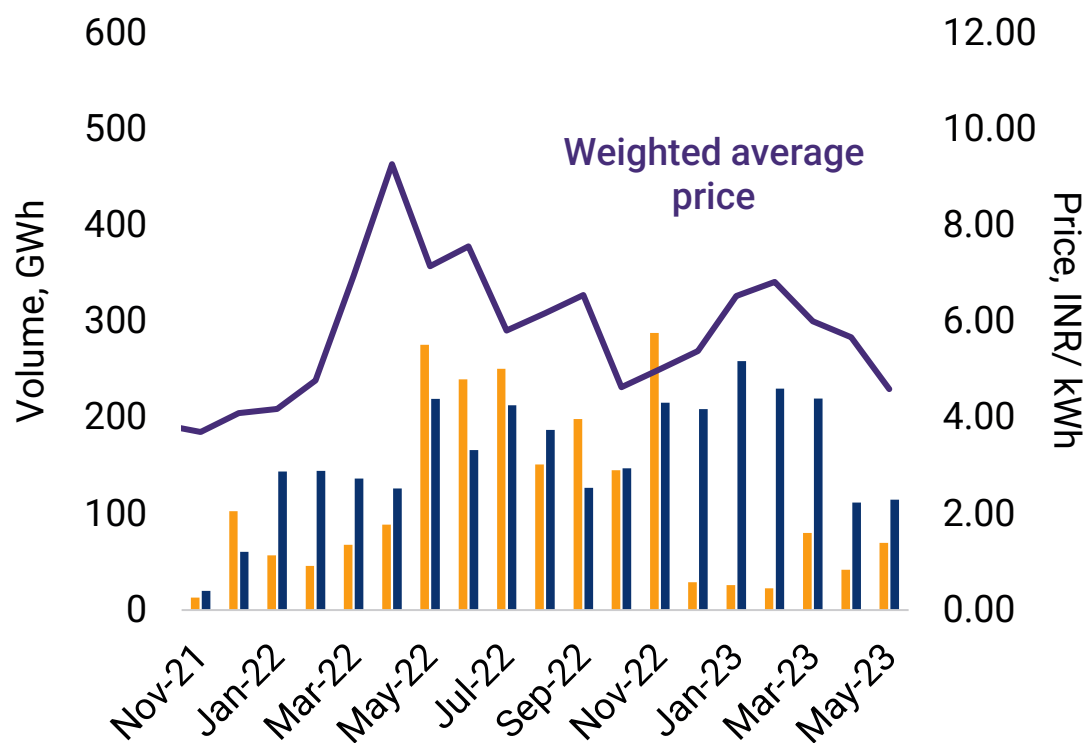
Exchange trading of power can provide much needed procurement flexibility

Use cases

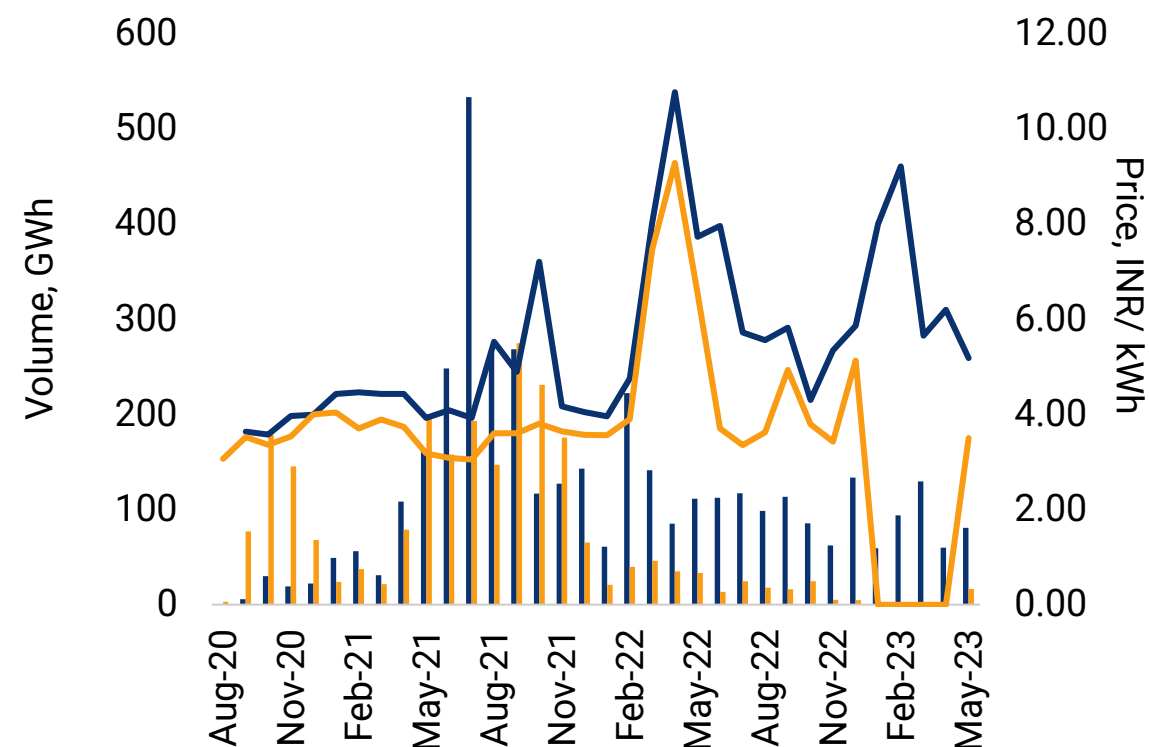
- Sell surplus power during low demand periods
- Buy power bundled with traceable green attributes to fulfil shortfall in RE targets
- Energy arbitrage when low-cost power is available at power exchange

Exchange trading volumes are relatively low

Green day ahead market



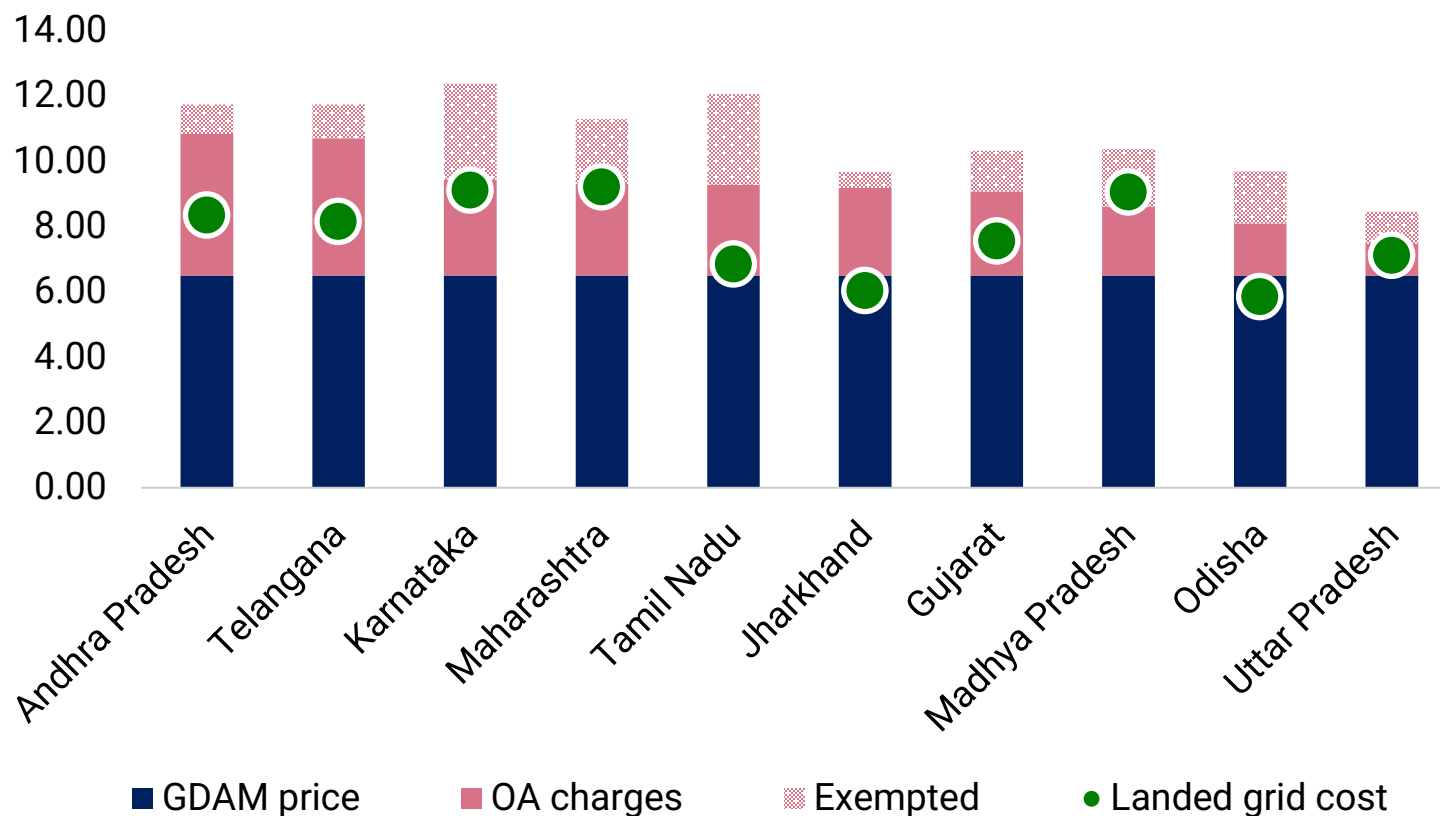
Green term ahead market



Solar **Non-solar**

High cost is another major deterrent for consumers

Landed cost for STU-connected industrial consumers, INR/ kWh



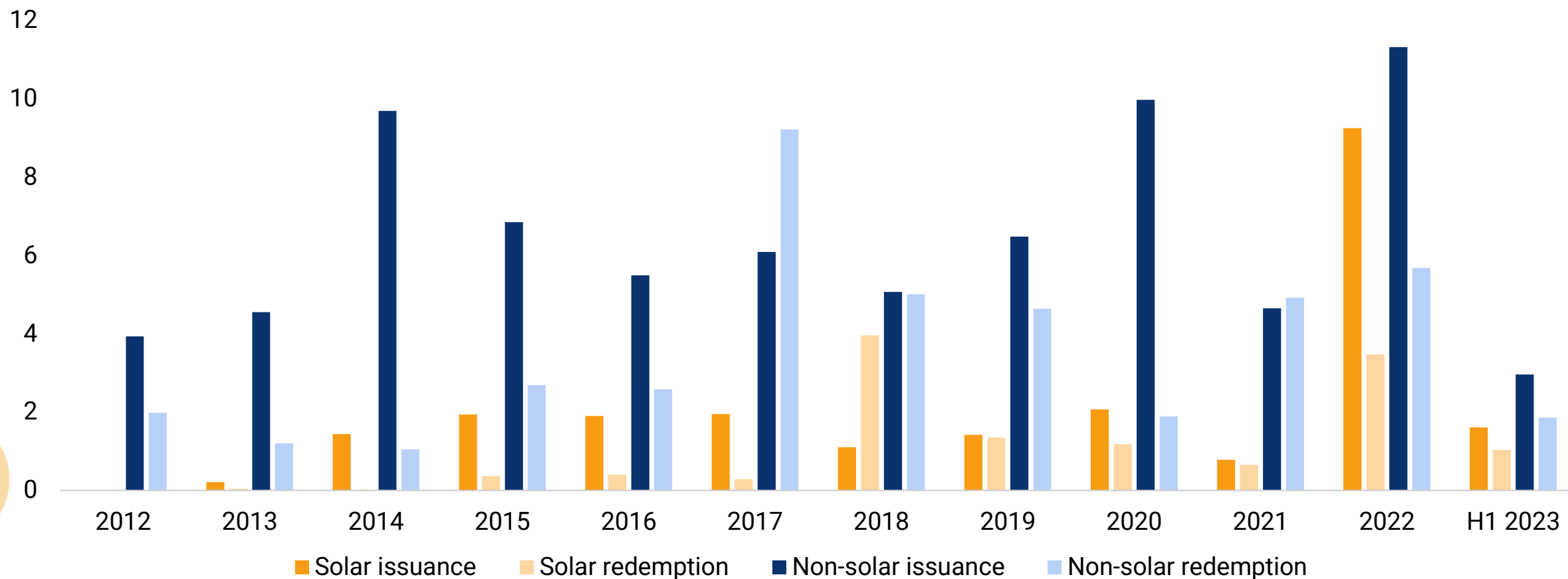
- Low savings over grid power
- Expertise required for day-to-day market monitoring, trading
- Restrictions on schedule revision

REC is a relatively simple procurement option

Use cases	Benefits	Risks
<ul style="list-style-type: none"> • Fulfil any shortfall in annual targets • Circumvent ineligibility for open access, rooftop solar • Resistant to long-term PPA commitment 	<ul style="list-style-type: none"> • Simple procurement • No day-to-day monitoring of power consumption, availability • No long-term commitment • Retention allowed within group company 	<ul style="list-style-type: none"> • Cost plus option • Limited price and volume visibility • High regulatory uncertainty

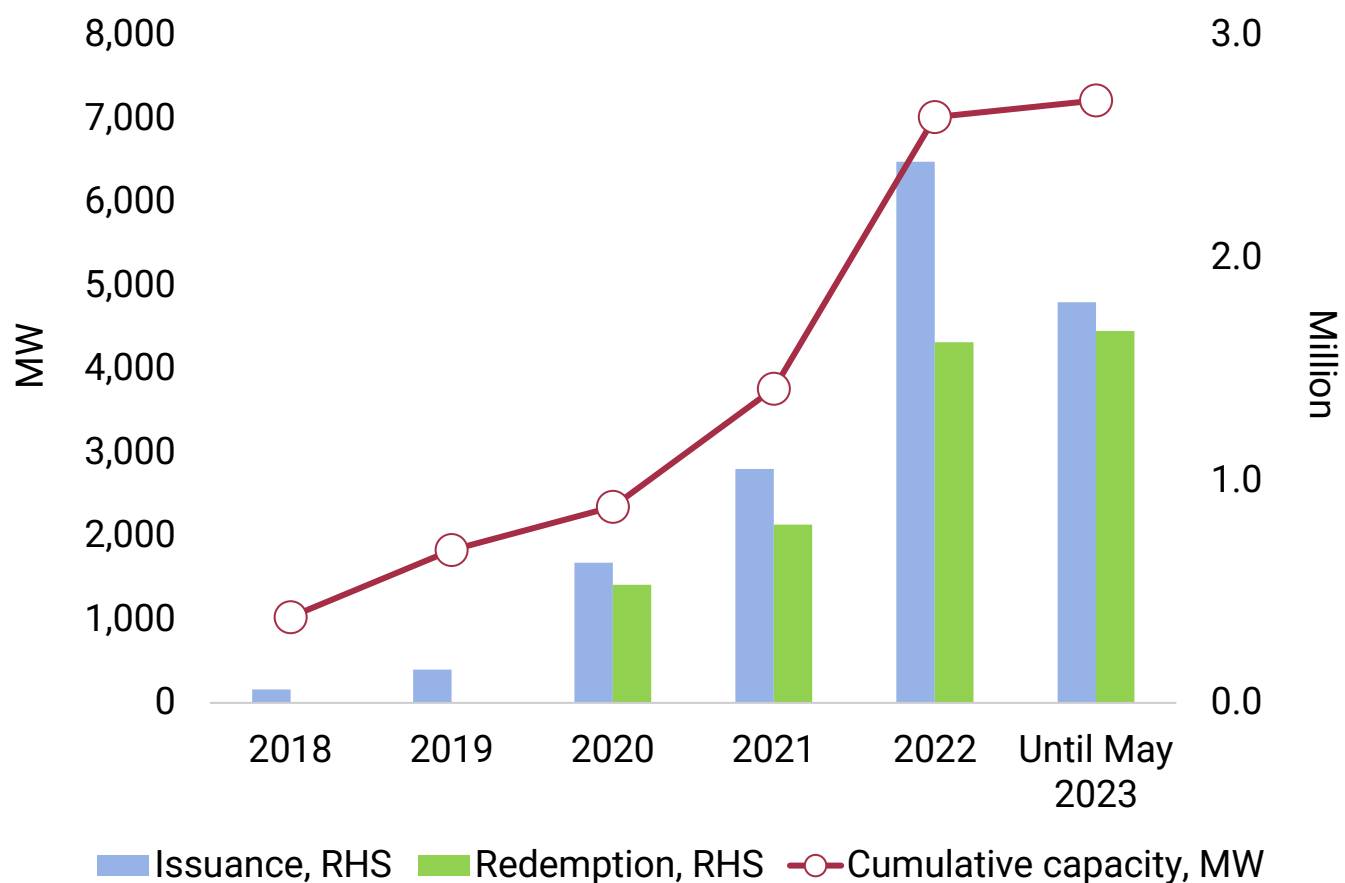
Trading volume has been greatly influenced by policy environment

REC volume, million



I-REC market has picked up recently

India market volumes



- Optimal solution for consumers with voluntary targets
- Suitable for companies with pan-India and multinational operations
- Ineligible for RPO compliance
- Typically available at USD 1.00/MWh
- No price transparency; traded bilaterally

Conclusion

- High cost, operational difficulties make power trading and green attributes unattractive for bulk consumption
- May be used tactically to meet shortfall in annual targets
- More suited for consumers unable to access other procurement routes or with distributed operations

Thank you.
Get in touch
with us.

BRIDGE TO INDIA Energy Private Limited

C 8/5, DLF Phase I
Gurugram (Delhi NCR) 122.001
Haryana, India

—

+91.124.420.4003
contact@bridgetoindia.com

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