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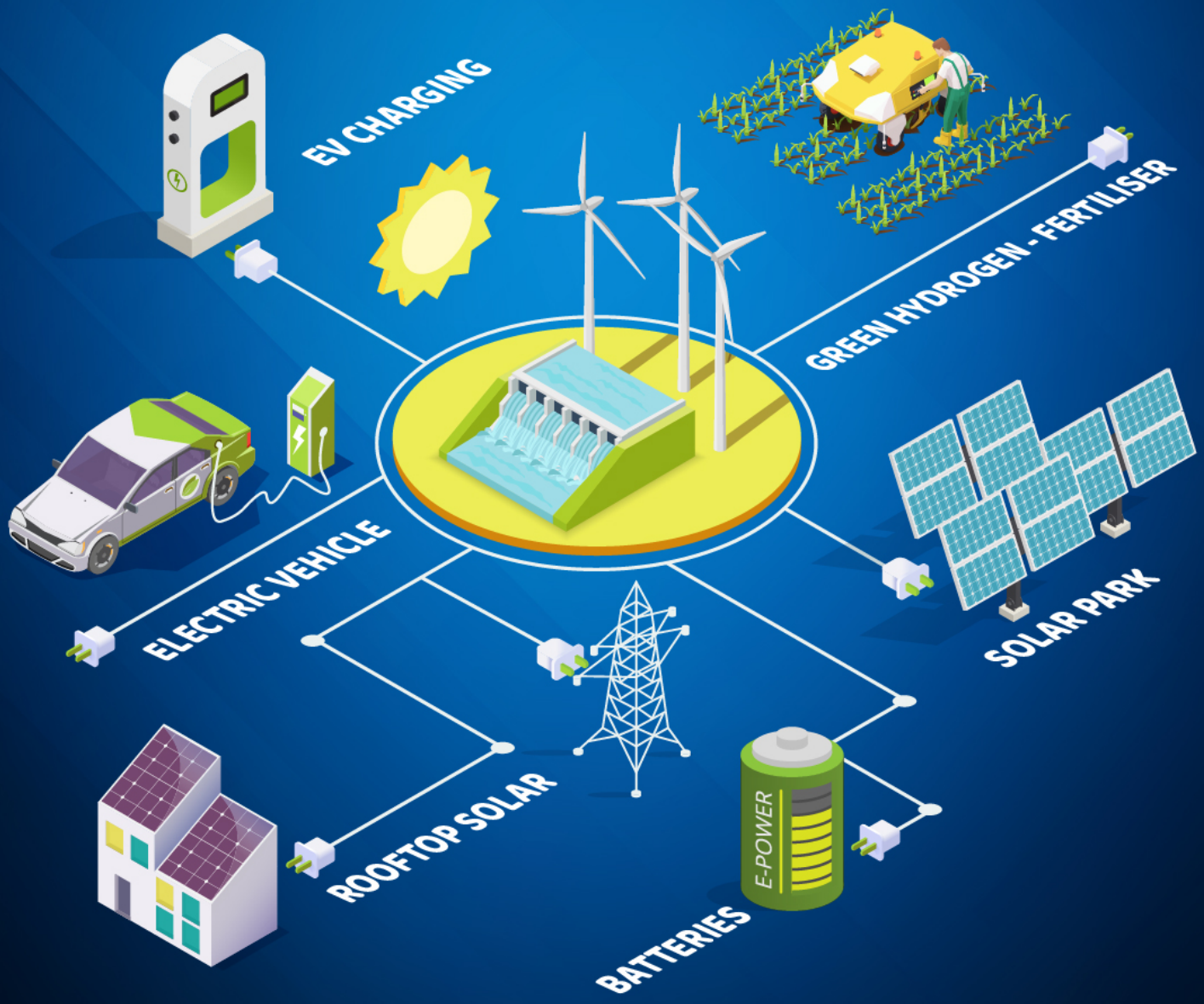
Power: Sector Thematic

Shifting energy landscape

Grey to green gains pace



10 June 2022

INSTITUTIONAL RESEARCH

Power

Shifting energy landscape: Grey to green gains pace

Renewables are poised to play a huge role in India's energy sector, with capacity increasing fourfold by 2030, aided by stringent Renewable Power Obligation (RPO) standards, decarbonisation efforts, and increasing power demand. However, the success of RES will require the penetration of hybrid structures (rather than plain vanilla tenders) along with viable storage systems to ensure peak power requirement and grid stability. Another major leap that India and other global economies are pursuing is green hydrogen, which will replace the conventional pollutant fuel in the fertilizer, ammonia, steel, marine, refinery and heavy vehicle industries but not in the passenger vehicle segment. We expect that India would require ~21GW of electrolyser capacity by FY30 to meet it's anticipated ~4MT of green hydrogen demand, which will be powered by ~80GW of RES capacity. The RES growth would require ~INR20 trillion of funding over the next decade. In this report, we have tried to capture the opportunity and challenges across the RES segment, focusing on important players who might benefit from this transition. In our view, NTPC (BUY), Borosil Renewables (ADD) and Tata Power (REDUCE) will be key listed beneficiaries and should be considered for long-term investment play.

Hybrid structures to gain more traction: We expect India will add ~342GW of RES capacity over FY22-FY30, led by solar +280GW which represents a capex opportunity of INR11.2 trillion (debt funding of INR9.0trillion). Higher RPO obligation of 40% (vs 20% now), which would push discoms to sign renewable PPAs. The bankability would improve with hybrid projects as it ensures RTC power. Companies with a large portfolio of hybrid and storage facilities will attract better valuations.

Duty imposition and incentives to amplify domestic solar equipment industry: Duty imposition on cells/modules and other supportive schemes will provide the much-needed price parity for domestic manufacturers, to compete with Chinese players. At current price level of 35 cents/kWh, domestic modules trade at a 7-10% discount to global counterparts. However, with more than 500GW of module capacity, China will continue to dump its highly unutilised cells/modules in India, giving stiff competition to domestic players. We believe that domestic players will add 37GW of capacity (12GW integrated + 25GW of cell/module) at an investment of INR730-750bn, raising their share in the country's solar market to ~40% by FY26, up from 10% presently. It would assist EPC players like Tata Power, Adanis, Borosil Renewable, and ReNew.

Green hydrogen—huge potential ahead: We believe that green hydrogen's early adoption will take place across the fertilizer, refining, ammonia, marine, and steel industries. Green hydrogen will attain parity with grey hydrogen over the next 6-7 years. Further, India will require an electrolyser capacity of ~21GW to meet ~4 MT of targeted green hydrogen demand by FY30, which will be fuelled by ~80GW of RES capacity, with 4-5 hour BESS. It entails a Capex of INR4.8trn between FY22 and FY30.

Mammoth opportunity in funding and investment deals: We assess that scaling up RES would require a mammoth investment of ~INR20 trillion over FY22-FY30, of which debt/equity would be INR16.7/INR3.5 trillion. This equates to ~28% of the loan book of India's top five banks. Further, with dynamic exit opportunities now accessible through IPO, InVIT, SPAC, etc., the sector will see enhanced PE deals and M&A activity, with diverse portfolios fetching better valuations than plain vanilla ones.

View: We expect that the mega transition from grey to green energy, along with favourable policies, will provide a strong impetus to domestic manufacturers to make RES a sustainable and competitive industry. Further, the viability of storage and green hydrogen will play a key role in the success and mass-scale adoption of RES energy in the system. However, any failure or delay in lowering storage costs or finding another viable alternative could significantly derail the country's renewable adoption program.

Company	Reco	TP	Upside (%)
Borosil Renewable	Add	704	9.0%
NTPC	Buy	174	12.1%
Tata Power	Reduce	231	-0.9%
JSW Energy	Sell	160	-51.5%

FY24E	P/BV (x)	PER (X)
Borosil Renewable	5.6	28.6
NTPC	1.1	8.6
Tata Power	2.8	25.9
JSW Energy	2.1	36.5

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Contents

FY21-FY30 to be the decade of renewables

India aims to meet 50% of its energy requirement from RE by 2030 and reduce its carbon emission by 45%.

- *India targets to increase its RES capacity by 4x over FY21-FY30*
- *This, coupled with RPO obligations, will absorb incremental RES capacity*
- *Focus on building a strong domestic solar equipment manufacturing base to reduce the country's reliance on China*

India targets to increase its non-fossil energy capacity to ~450 GW-500 GW by 2030 and meet 50% of its energy requirement from renewable energy to reduce the carbon intensity of its economy by 45% by 2030 and achieve net-zero status by 2070 (**Annexure 1 - Steps to meet net zero target by 2070**).

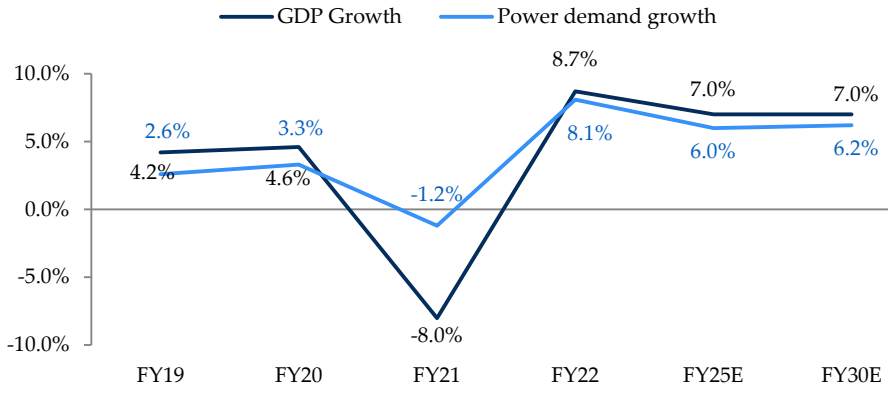
This eventually means that the renewable sector will play a colossal role in not only meeting the country's carbon emission target but also meeting the projected incremental power demand in the next decade.

Renewable capacity to increase 4-4.5x over the next decade

India is expected to add ~423GW incremental capacity by FY30 to reach 805GW.

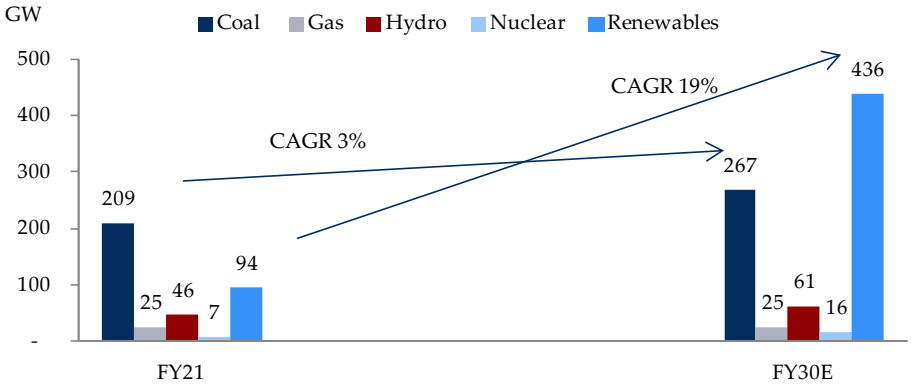
We expect India's power demand to grow at a 6.2% CAGR over FY21-FY30 to reach 2518 BU by FY30 (based on the 0.8x elasticity of power demand with forecasted India's GDP growth rate). In order to achieve the target demand, India is expected to add 423GW of incremental capacity in the next decade to reach 805GW by FY30. Of this, during the same time, renewables are expected to add 342GW, coal – 57GW; hydro – 15GW; nuclear - 9GW.

Exhibit 1: Power demand expected to grow at 6.2% over FY21-FY30



Source: CEA, HSIE Research

Exhibit 2: RES capacity likely to grow at 19% CAGR over FY21-FY30E



Source: CEA, HSIE Research

Center aims to raise RPO targets across state discoms to ~40% vs. 10-15% at present

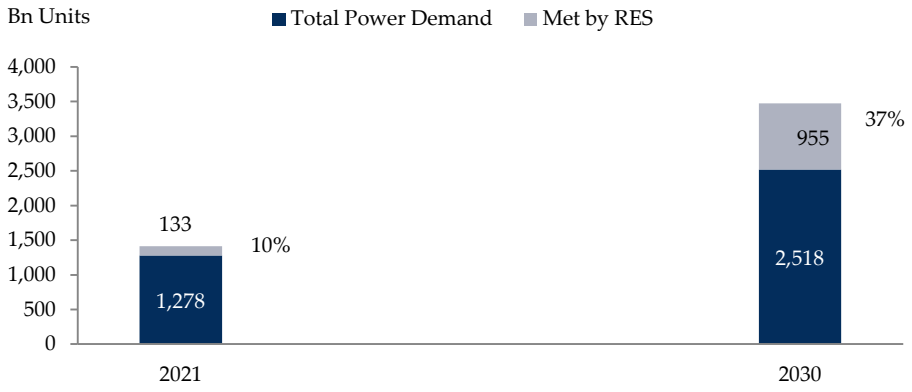
With the aim to absorb the robust RES capacity addition over the next decade, the Center is in talks with state discoms to scale up the Renewable Purchase Obligation (RPO) target, from ~10-15% at present to 40% by FY30. While a lack of parity in renewable energy potential between states and high tariffs were the main obstacles to all states meeting their existing targets (only 5-6 states generally meet their RPO target), this is now being addressed by fewer grid restrictions and falling RES tariffs.

With nearly 436GW of cumulative capacity, RES can generate 955BU of electricity, which is in line with meeting discoms' RPO target of 40% by FY30.

Further, in the minutes of the Conference of Power and Renewable Energy Ministers of States & UTs held on 3 July 2020, the Ministry of Power (MoP) proposed stricter penalties for non-compliance with RPOs in the draft Electricity Act.

As of FY21, the country's base demand stands at 1278 BU, with RES accounting for ~10.2% (based on generation). However, going ahead, with demand expected to increase to 2518 BU by 2030, RES is expected to contribute 37% of it (955BU), assuming 436GW of RES capacity is operating at 25% PLF.

Exhibit 3: With stricter RPO norms, RES to form 37% of discoms' total power purchase



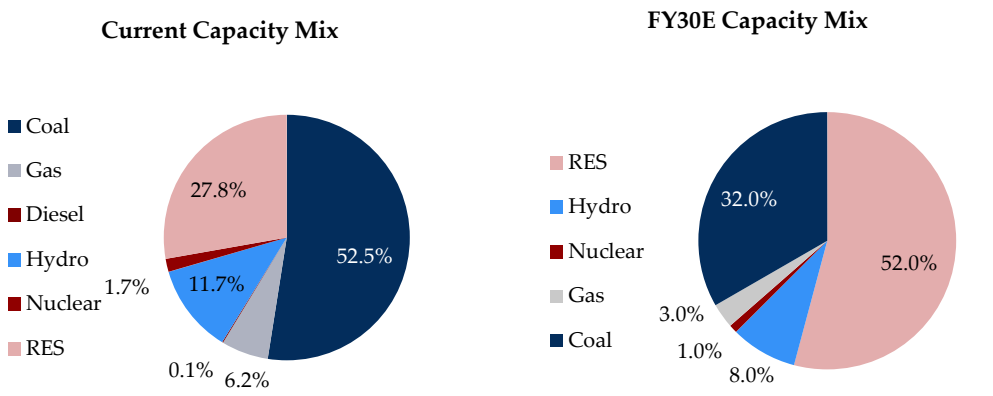
Source: CEA, HSIE Research

In order to achieve this targeted milestone of 450-500GW of renewable capacity by FY30 (from the current level of 112GW), India needs to add ~30GW-35GW of renewable capacity annually in the next decade (a bulk of this - ~25-26GW - would come from solar energy). India's renewable growth story is not limited to the addition of plain vanilla solar or wind capacities alone, but the sector's growth promises to provide many emerging opportunities across hybrids, energy storage, green hydrogen, electric vehicles (EVs) and other segments, which together possess an investment potential of more than US$500 billion over the decade.

India needs to add 35GW of RES capacity annually to meet its FY30 target.

Further, of the RES, solar is expected to take a huge leap in terms of capacity expansion, reaching a cumulative capacity of ~330GW by FY30 (including solar capacity required for meeting the power requirement for green hydrogen production). Recognizing this valuable opportunity to strengthen the country's energy security, establish a global hub for solar equipment manufacturing, and boost economic growth, the Indian government is focusing heavily on enhancing domestic solar equipment manufacturing capacity across the entire value chain.

Exhibit 4: Current Capacity Mix and FY30E Capacity Mix



Source: CEA, HSIE Research

Government's push to create a strong solar equipment base in India

The lack of scale and integration of the PV manufacturing industry has been a critical barrier to the country's solarisation program

Under the first round of PLI scheme, corporates showcased interest to set up 55GW of cell and modules manufacturing capacity which could attract an investment of INR950bn-1000bn

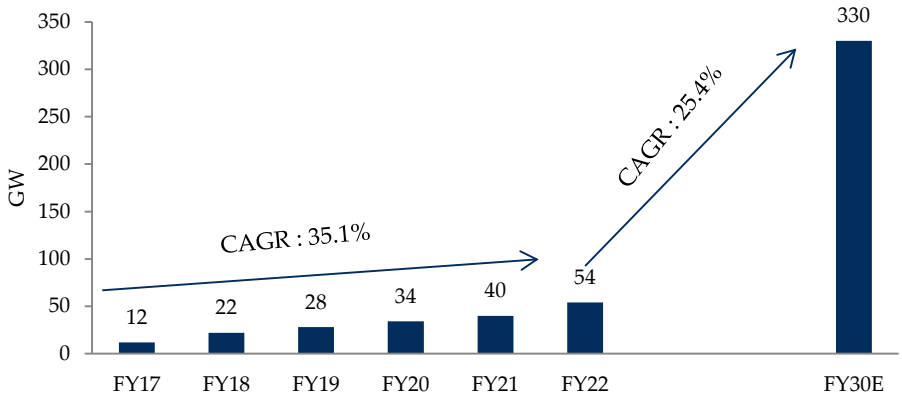
While domestic players are keen to set up a healthy domestic capacity of ~55GW, the non-clarity in allotment under the PLI scheme could delay the capacity addition plan

We believe that domestic equipment players could meet 40-50% of the domestic solar capacity addition, while China's share in the Indian solar market would fall to 50-55%, from 85-90% at present.

Solar power capacity is expected to grow at a CAGR of 25.4% over FY22-FY30.

India's solar power capacity crossed 54GW, as of Mar-22, surpassing wind power (40GW) to become the leading renewable energy resource, in terms of installed capacity. The solar capacity in India has grown the fastest amongst all renewable power sources, increasing at a CAGR of 35.1% between FY17 and FY22; it is expected to grow at 25.4% CAGR over the next 8 years to reach ~330GW by FY30.

Exhibit 5: Solar capacity addition over FY17-FY30E



Source: CEA, HSIE Research

Major initiatives by various states

The top 10 states with the highest installed renewable energy capacity together account for about 93% of India's total installed renewables capacity. At present, Rajasthan has the highest installed renewable capacity, followed by Gujarat and Tamil Nadu. Meanwhile, Rajasthan has emerged as the state with the largest solar capacity, followed by Gujarat and Karnataka. Uttar Pradesh and Punjab have started expanding their renewable capacity installations. While solar power is dominant among renewables, wind (including repowering of the existing plants), hydropower, wind-solar hybrid and pumped hydro storage are being harnessed across several states as well.

Currently, Rajasthan ranks first, with 12.9GW of installed capacity, which is only ~9.1% of the state's potential.

Exhibit-6: Major state-wise solar potential and achievement until FY22

States	Potential(GW)	Installed Capacity(GW)	Potential achieved
Rajasthan	142	12.9	9.08%
Gujarat	36	7.6	21.11%
Karnataka	25	7.6	30.40%
Tamil Nadu	18	5.4	30.00%
Telangana	20	4.5	22.50%
Andhra Pradesh	38	4.4	11.58%
Madhya Pradesh	62	2.7	4.35%
Maharashtra	64	2.7	4.22%
Uttar Pradesh	23	2.2	9.57%
Punjab	3	1.1	36.67%
Total	431	51.1	11.86%

Source: CEA, HSIE Research

Annexure 2 - **Renewable energy outlook of the states**

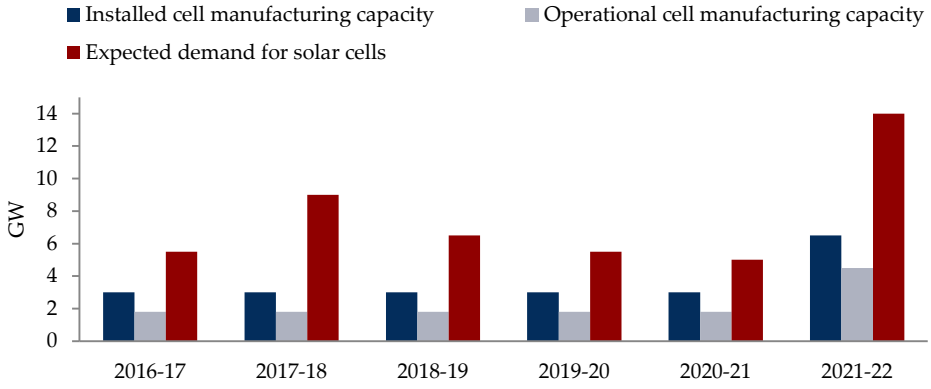
Current scenario: Domestic facilities uncompetitive to global players

Small scale of operations, high capital expenditure, and lack of an integrated model make domestic players less competitive to Chinese players.

More than 80% of Indian solar equipment used in power projects is imported from Asian countries such as China, Vietnam, and Malaysia. India's domestic manufacturing capacity for cells and modules stands at 4GW and ~12GWmm ; it is largely underutilised because of their higher costs (10-15% more than that of imported cells and modules). These high costs can be largely attributed to (1) lack of manufacturing capacity for ingots and wafers (the upstream stages of polysilicon), (2) small scale of operations that does not allow firms to benefit from economies of scale, and (3) higher capital expenditure for plants made before 2010 with high-interest costs. These factors have mainly increased production costs, making cells and modules uncompetitive compared to the Chinese rivals. Thus, lack of scale and integration in the PV manufacturing industry are critical barriers to the nation's solarisation program.

Exhibit 7: Historically, cell capacities have failed to meet domestic demand

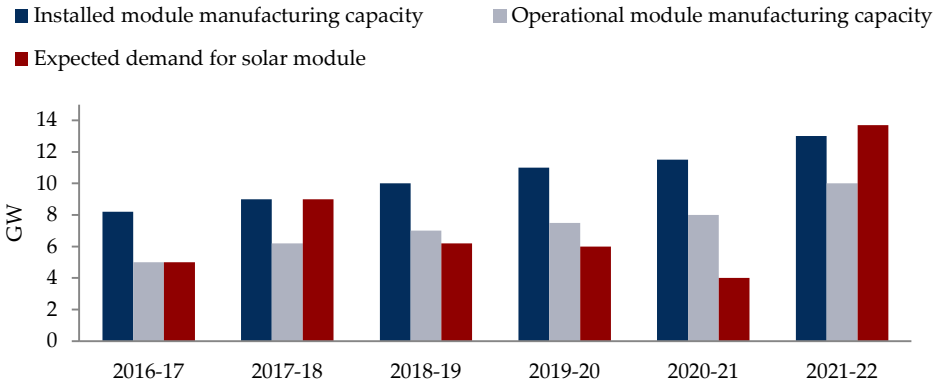
Currently, India's solar cell demand has always outpaced its domestic cell capacity.



Source: CRISIL, HSIE Research

Exhibit 8: Modules capacity underutilised as they are incompetently priced vs. low-cost Chinese equipment

However, in case of modules, their under utilisation is due to availability of low-cost modules from China.



Source: CRISIL, HSIE Research

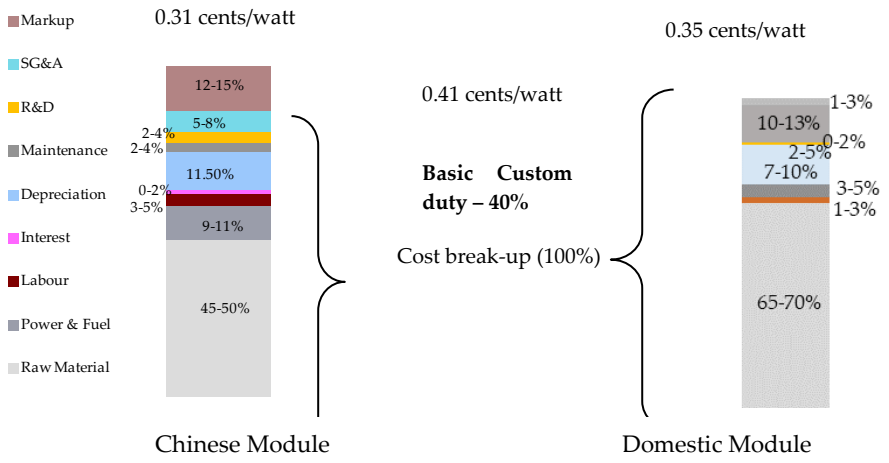
Overdependence on cheaper but superior imported equipment exposes the Indian industry to variability of prices, currency fluctuations, and trade account imbalance. Furthermore, the recent impact of the global energy crisis had an influence on China's solar industry, with power supply to cities that are module manufacturing hubs being curtailed. This disrupted operations and pushed the price of imported mono PERC PV modules up in India to 22-23 cents/watt in June 2021, 15-20% up from 19-20 cents/watt in December 2020.

It further went up to 27-28 cents/watt in October 2021 and is now at 30-32 cents/watt (as of May 2022). This resulted in a 30-35% increase in solar project costs for India and

led to delay in ordering of solar modules & cells by developers of solar projects, which were aggressively bid out at fixed pre-determined tariffs.

Further, with the imposition of duties on solar cells (25%) and modules (40%), the cost of imported solar modules is expected to increase to 0.39-0.41 cents/watt (INR31mn/MW), which would be expensive compared to indigenous equipment and manufactured modules that come at 0.35cents/watt (INR28mn/MW).

Exhibit 9: Cost difference charts between Indian and Chinese solar power module tariffs



Source: CRISIL, HSIE Research

Cost of domestic module is likely to be 10-15% cheaper after imposition of Basic Custom duty on solar cells and modules

Earlier efforts to incentivise domestic players failed to provide desired result

Over the years, the government has tried to guard domestic module manufacturing companies and lower the influence of cheaper imports by introducing measures such as Domestic Content Requirement (DCR) in 2014 and safeguard duties in 2018.

However, these measures have seen very limited success in strengthening and flourishing the domestic solar equipment industry due to continuous dumping of relatively cheaper modules by the Chinese players.

In order to boost domestic production of solar modules, government has introduced Manufacturing-linked solar development tenders

***Manufacturing-linked solar development tenders*:** In 2019, in order to provide a boost to domestic production by linking it with a big solar tender, the government introduced manufacturing-linked solar development tenders in 2019. The Solar Energy Corporation of India (SECI) issued a project development tender for 12GW of solar generation capacity and, within that, a tied contract for 3GW of domestic module manufacturing capacity. These were won by Adani Green (2,000 MW of solar cell and module manufacturing and 8 GW of generation capacity) and Azure Power (1,000 MW of cell and module manufacturing and 4 GW of generation capacity) at a winning tariff of INR2.92 (~$0.04)/kWh. The ceiling tariff for this tender was fixed at INR2.93 ($0.041)/kWh.

Government approved PLI scheme for Solar PV Manufacturing in April 2021

***Production-linked incentive (PLI) scheme and imposition of import duties*:** Further, in April 2021, the government approved the PLI scheme for the solar PV manufacturing sector, with INR44.5bn allocated by the Ministry of New and Renewable Energy (MNRE) for investment in high-efficiency solar PV modules. This was later enhanced to INR240bn in the FY22 budget. The Indian Renewable Energy Agency (IREDA) has conducted an auction for a fully integrated polysilicon to PV modules manufacturing capacity of 10GW p.a, with priority given to interested manufacturers with the lowest requirement of corresponding incentives.

Exhibit 10: Formulation of Solar PV Module

Source: HSIE Research

The tender received a tremendous response, with total bids received for 54.8 GW of capacity, for manufacturing one of, or a combination of, various components including polysilicon, wafers, ingots, cells, and modules. The PLI tender saw Shirdi Sai Electricals, Reliance New Energy Solar and Adani Infrastructure Pvt Ltd emerging as beneficiaries through the allotment on a bucket filling basis for a total capacity of 12 GW and a total PLI amount of INR44.5 bn. The beneficiaries were awarded capacities of 4 GW each at PLIs of INR18.8 bn, INR19.2 bn and INR6.6 bn respectively.

Exhibit-11: PLI scheme winners

Company	Amount Awarded (INR Bn)	Capacity in MW	Eligible Capacity for PLI (MW)
Shirdi Sai Electricals	18.8	4,000	2,000
Reliance New Energy Solar	19.2	4,000	2,000
Adani Infrastructure Pvt Ltd	6.63*	4,000	2,000

Source: MNRE, HSIE Research

**Adani infrastructure applied for a PLI of Rs 36 Bn, but Rs 6.63 Bn has been allotted*

Government enhanced PLI scheme from INR44.5bn to INR240bn

Others major players that had participated but couldn't qualify through the bids under the PLI scheme included First Solar, Coal India, Larsen & Toubro, Renew Solar, Tata Power, Waaree Energies, and many more. Considering the robust response to the PLI tender, the government approved the ministry's proposal for INR190bn more under the PLI, enhancing the scheme's layout to INR240bn.

Recently MNRE issue draft guidelines for Tranche II of the PLI scheme

Recently, the MNRE issued draft guidelines to implement the second phase (tranche II) of the PLI program where INR120bn has been reserved for companies setting up vertically-integrated capacities of polysilicon, wafers, cells, and modules. An allocation of INR45 bn (~$580.84 mn) has been made for those setting up wafers, cells, and modules capacity, and INR30 bn (~$387.23 mn) for cells and modules capacity. SECI has been appointed now to implement tranche II of the PLI scheme in place of IREDA.

The move will help accommodate more willing manufacturers under the Scheme. This is illustrative of the government of India's serious ambition of a large domestic module manufacturing capacity and self-reliance for long-term decarbonisation.

Cost of setting up an integrated solar PV plant

Domestic solar equipment manufacturing showed interest to develeop 55GW of solar equipment capacity under the PLI scheme

Solar PV panels are assemblies of solar cells, which in turn are fabricated from silicon wafers through a type of chemical treatment. The wafers are processed from silicon ingots. As per industry standards, the capital cost for 1 GW of backward integrated solar panel manufacturing capacity, right from the manufacturing-grade silica, works out to INR32bn. However, of the 55GW interest floated by domestic players, only three companies with a total 12 GW capacities have shown interest to build a complete integrated model that would attract an investment of INR384bn.

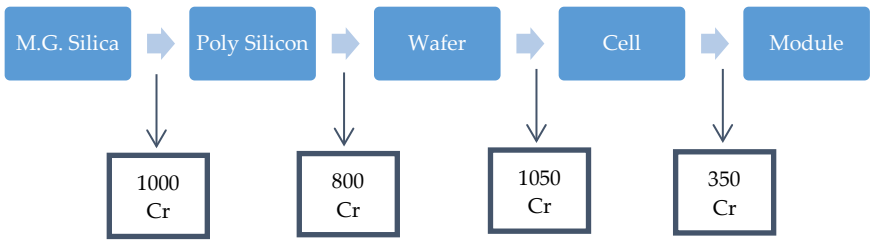
Our interaction with selected industry players suggests that backward integration is not only expensive, but also technology and energy intensive. Also, frequent changes in cell-based technologies often disrupt the cost dynamics related to cell capacities, which generally take 3-4 years to break even. Hence, not many players are interested in venturing into integrated solar manufacturing and prefer to focus mainly on the upstream chain of module manufacturing (cell + modules only).

Domestic players would attract an investment of INR730bn – INR750bn for 37GW of capacity (12GW integrated capacity + 25GW of cell and module capacity)

Furthermore, in China, 5,30,000 TPA of polysilicon production capacity and 500GW of cell and module manufacturing capacities are expected to come up by end-2022; moreover, it has easy access to required raw material for manufacturing silica and ingots. Thus, China will continue to dominate the supply side of this capital-intensive polysilicon + ingot segment. Accordingly, it will pose tough competition to an undeveloped domestic manufacturing segment (which has proposed 12GW) that has no exposure to these areas.

Thus, we believe that the country might see 25GW of inhouse module and cell manufacturing capacity. Moreover, the 12GW of integrated solar equipment capacity to be built over 5-6 years would be sufficient to meet ~50% of the country's solar module demand, while the balance will be utilised for exporting. Hence, the total investment opportunity in the solar manufacturing segment could attract a sum of INR730-750bn over the next 3-4 years.

Exhibit-12: Capital expenditure for 1 GW manufacturing capacity

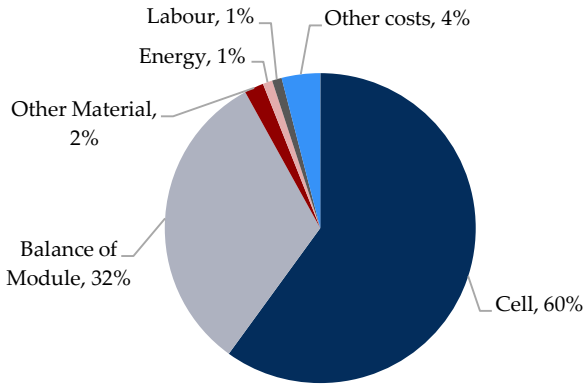


Source: MNRE Factsheet, HSIE Research

Cost break-up across segment:

Module cost: Cell and Balance of Module (BOM) components account for the major share of module costs (~92%), of which cell contributes 60%. Also, module manufacturing needs a lot of working capital.

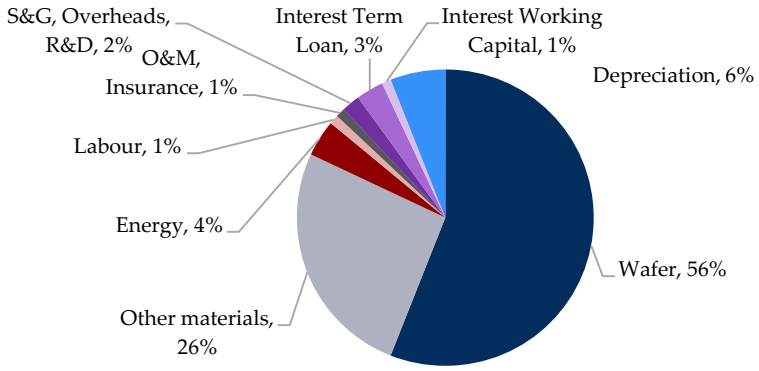
Exhibit 13: Module manufacturing costs



Source: Cstep, HSIE Research

Cell cost: Raw material cost accounts for 80% of the total cell manufacturing cost, within which major contributor is wafer which accounts for 56% of the overall cost. Wafers are largely imported by Indian cell manufacturers.

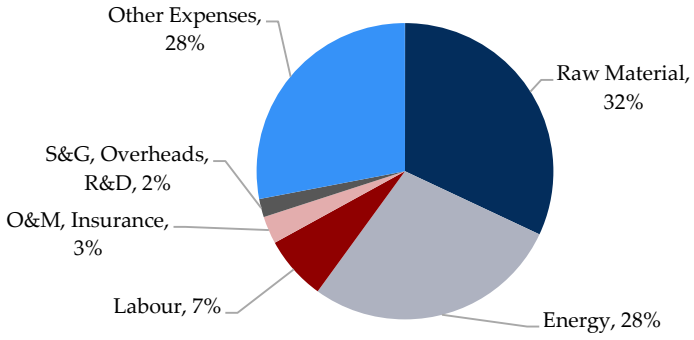
Exhibit 14: Cell manufacturing costs



Source: Cstep, HSIE Research

Wafer manufacturing cost: Polysilicon accounts for 32% wafer manufacturing cost, which along with other materials account for 60% of the cost share. Other significant cost components are other expenses, energy, depreciation, and labour.

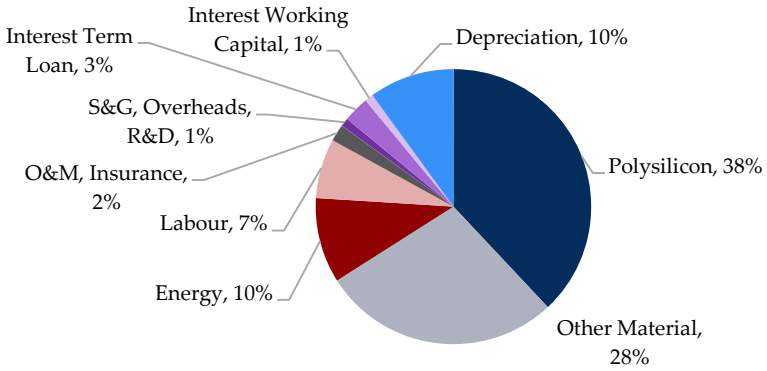
Exhibit 15: Ingot/Wafer manufacturing costs



Source: Cstep, HSIE Research

A polysilicon plant of 10,000 TPA capacity can produce around 2.4 GW of PV modules per annum. The plant typically uses Trichlorosilane (TCS) Siemens CVD3 technology to manufacture polysilicon. The cost of domestically manufactured polysilicon is estimated to be around INR 823/kg. Raw material contributes 38% of the overall cost, followed by other material (28%), and energy and depreciation (10% each), which are the other major cost components.

Exhibit 16: Polysilicon manufacturing costs



Source: Cstep, HSIE Research

Solar developers and EPC players enhancing and adding capacity in the solar equipment space to bank upon the opportunity

Furthermore, many solar developers and EPC players have committed to expand their existing solar equipment capacities or add new ones, so as to bank upon the massive opportunity in the solar equipment space in the coming decades. Some of the major capacity enhancement plants by solar EPC players are mentioned below:

Exhibit-17: Solar manufacturing expansion plan by major developers

Sr. No.	Company Name	Current Operational Capacity			Targeted Additional Capacity			Total Targeted Capacity		
		Modules (GW)	Cells(GW)	Polysilicon	Modules (GW)	Cells (GW)	Polysilicon	Modules (GW)	Cells(GW)	Polysilicon
1	Premier Energies	1.25	0.75		1.0	1.0		2.25	1.75	
2	Vikram Solar	2.5	Nil		2.0	2.0		4.5	2.0	
3	Renewsys	1.7	0.13		2.0	0.5		3.7	0.63	
4	Waaree	2	Nil		3.0	4.0		5.0	4.0	
5	Emmvee Photovoltaic	0.5	Nil		1	Nil		1.5	Nil	
6	Goldi Solar	0.5	Nil		1 + 1	Nil		1.5 + 1		
7	First Solar	1.8	Nil			3				
8	Adani Green	1.5	Nil			5.5				5.5
9	Reliance					2.5				
10	Sai Shirdi Electricals					4				
11	Jindal Solar					4				

Source: Industry, HSIE Research

While these facilities will take a few years to be ready, we believe that such a massive domestic manufacturing capacity would create the scale required to curb imports and ensure self-sufficiency in domestic supply chains.

Alongside PLI scheme, in order to ensure the use of quality products in solar projects, the ministry has released the Approved List of Models and Manufacturers (ALMM), where it has listed the eligible models and manufacturers of solar PV cells and modules that comply with the BIS standards. Only the listed models and manufacturers are eligible for use in government projects, government-assisted projects, projects under government schemes and programs, open access, and net metering projects installed in the country. **Annexure 3 - ALMM List**

Utility based capacity addition

Apart from manufacturing capacities, many major power developers amongst the PSUs, state gencos and private players have committed to set up green energy capacities, going ahead, with very little or almost nil capacities to add across the thermal space. These capacities would come through a mixture of plain solar, plain wind, hybrid (solar+wind), battery enabled storage system (BESS) based solar & wind capacities, pumped hydro storage, etc. Developers like NTPC, Adani Green, Tata Power, NLC India, JSW Energy, GIPCL, JSW Energy, SJVN, and many state gencos are expected to add significant renewable capacity over the next decade.

Exhibit-18: Promoter backed company's plant for expansion

Sr. No.	Company Name	Current Operational Capacity (GW)	Targeted Capacity
1	Avaada	3.6	6 GW by 2024
2	Mahindra	1.13	0.6-9.8 GW annually
3	Amplus	0.92	3 GW by 2025
4	Tata Power Renewables	4.0	15 GW by 2025 and 25 GW by 2030
5	Adani Green	11.8	25 GW by 2025
6	CLP	1.72	
7	JSW Renewable Energy	2.22	2.5 GW

Source: Companies, HSIE Research

Exhibit-19: PE backed company's plan for expansion

Sr. No.	Company Name	Current Operational Capacity (GW)	Targeted Capacity
1	O2 Power	1.6	4 GW by 2025
2	KKR Renewables	0.34	2 GW
3	Brookfield Renewables	1.7	
4	Azure Power	3.0	6 GW by 2025
5	Cleanmax	0.5	0.9 GW
6	Macquarie (Stride Climate)	0.41	
7	4th Partner	0.64	
8	Vena	0.91	
9	Ayana	2.19	5 GW
10	AI Jomaith Energy & Water	0.28	

Source: Companies, HSIE Research

Exhibit-20: PSU's plan for expansion

Sr. No.	Company Name	Current Operational Capacity (GW)	Targeted Capacity (GW)
1	NTPC Ltd	1.4	60
2	NLC India	1.4	4.2
3	Coal India	1.5	5.5
4	NHPC Ltd	0.1	7.1
5	SJVN Ltd	2.7	25

Source: Companies, HSIE Research

In FY22, India added 14 GW of RE capacity and almost a 40% capacity came from SECI tendered projects

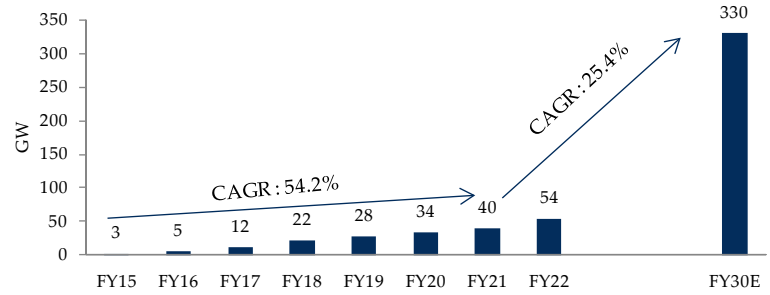
These capacities will be largely tendered out through a reverse bidding process either by SECI or through respective state nodal agencies. In FY22, India added 14 GW of renewable energy capacity and almost 40% of the capacity came from SECI-tendered projects. Developers are more comfortable with SECI tenders as they ensure timely payments to developers and have multilayered payment security systems, such as letters of credit and a payment security fund to back up timely payments from discoms. These payments are offered additional security by the government through the Reserve Bank of India. With the introduction of innovative tenders such as wind solar hybrids, RTC and storage-based peak power projects, the uptake of renewable power is expected to accelerate significantly in the coming years.

While solar grows strong, wind sees limited activity

Solar capacity addition has witnessed strong capacity addition growth of 54.2% CAGR over 2015-2021, much ahead of growth in the wind capacity addition of 8.3% over the same period (far below its target). As a result, wind would not only fall short of its targeted 60GW capacity by 2022 but it has been lagging far behind the solar sector cumulative capacity till date.

Exhibit 21: Solar's aggressive growth will continue going ahead as well

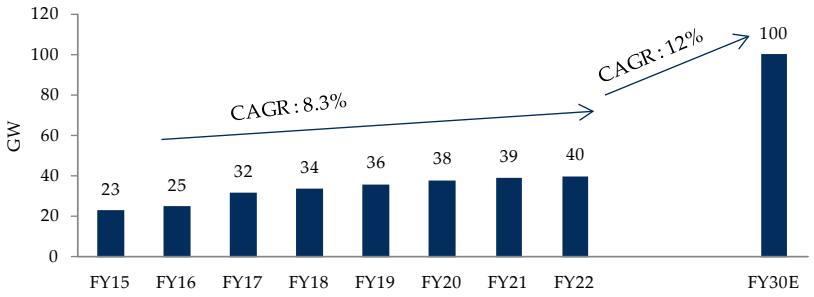
India targets to reach 330 GW of installed solar capacity by 2030



Source: CEA, HSIE Research

Exhibit 22: Wind addition has been subdued relative to solar growth

India targets to reach 100 GW of installed wind capacity by 2030

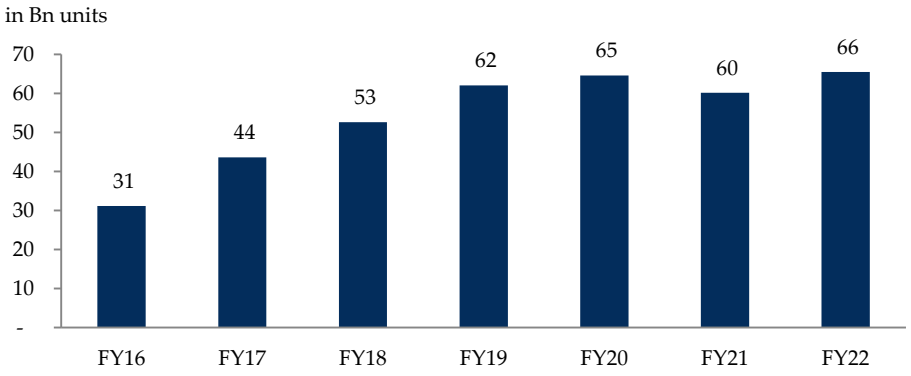


Source: CEA, HSIE Research

Growth in the wind segment was impacted after the removal of two key incentive (generation based incentives and feed in tariff-based PPA). Furthermore, with the introduction of competitive tariffs, the sector has been less lucrative largely due to highly volatile wind velocity, which has impacted wind generation in the past few years.

Wind Generation growth has been flat over FY20-FY22, in spite of capacity additions

Exhibit 23: Wind generation impacted by seasonal volatility



Source: CEA, HSIE Research

The year FY22 witnessed an improved tendering activity across the wind projects

Further, low tariffs from competitors and limited site availability in the two key states of Gujarat and Tamil Nadu, as well as power curtailment and payment delays by some of the state discoms, deterred activity in the segment.

Another important thing to notice is that the segment has underperformed in generation growth despite capacity additions. This is largely due to the impact of seasonal volatility, which has lowered wind velocity across the country, and thus impacted wind generation and the desired level of returns from these projects.

Wind demand has found support through the rising demand for hybrid structures

However, the sector has witnessed improved tendering activity in FY22 compared to FY21 levels, largely led by a very intense competition across the solar space (resulting in low IRRs) and also due to rising tendering activity across the hybrid structure (solar + wind), which provides more stable power flow to the grid (RTC route), compared to the plain vanilla solar or wind projects. The year FY22 also witnessed a record low tariff of INR2.34/kWh for the SECI IV Hybrid tender.

Exhibit-24: Tendering activity across wind improved in FY22

Particulars	No of Tenders	Wind Capacity Tendered (GW)	Hybrid Capacity Tendered (GW)
FY19	6	4.6	2.4
FY20	10	4.4	8.4
FY21	3	1.4	0.2
FY22	7	2.7	3.5
YTD FY23	2	0.5	0.8

Source: Elekore, HSIE Research

C&I segment also favors the hybrid structure as it supplies RTC power and players like CleanMax, Fourth partner and Amplus are playing noticeable role in the segment.

In March 2021, SECI's auction for developing 1.2 GW of ISTS-connected wind projects (Tranche X) witnessed Adani Renewable Energy winning 300 MW of wind projects at the L1 tariff of INR 2.77/kWh. Also, Ayana Renewable Power won 300 MW, Evergreen Power won 150 MW, and JSW Future Energy won 450 MW, at a tariff of INR 2.78/kWh each. JSW had placed bids for 600 MW but was awarded only 450 MW under the bucket filling method. The auction had received bids for a total of 3.15 GW of projects from 11 developers with tariffs as high as INR3.39/kWh.

On wind EPC front as well, GE Renewable energy has been doing much better compared to its other peers like Inox Wind, Suzlon, Gamesa and Vestas. GE Renewable won fresh orders from CleanMax, Continuum Green Energy, and JSW Energy.

Exhibit-25: Tendering activity across wind improved in FY22

Particulars	Capacity won (MW)	Details
1. GE Renewable		
a. Cleanmax	110	Hybrid Project
b. Continuum Green Energy	148.5	SECI Tranche VI
c. JSW Energy	810	Wind farm in Tamil Nadu
2. Inox		
a. Integrum Energy Infrastructure	92	
b. NTPC Renewable Energy	150	
c. IPPS and retailers	61	
3. Vestas		
a. Renew Power	101	
b. MSPL Ltd	17	
4. Suzlon		
a. CLP India – Apraava Energy	252	

Source: Elekore, HSIE Research

With large focus on hybrid structure, going ahead, we believe wind will play a secondary role in the country's decarbonisation effort (after solar) which would lead to more tendering and ordering activity across the sector in the coming decade.

Wind-solar hybrids (WSH) tenders to gain more traction than the plain vanilla one which fails to meet the peak power demand

Wind-solar hybrid tenders not only improves grid stability but also provide RTC power

While the plain solar or wind tenders have attained a price parity with coal based plants and provided discoms a cheap source for power, they cannot replace conventional sources in meeting peak power demand. Also, standalone solar and wind projects often witness variability in power generation, which leads to grid instability. These intermittency issues associated with the solar and wind power generation, alongside few hours of availability, pose problems in grid integration and failure in meeting peak power demand without storage support. Thus, in order to overcome these issues and ensure better utilisation of these resources, there is an emerging interest in WSH, which can not only improve grid stability but also provide RTC power. Other forms of hybrid tenders have also been explored by bundling renewable generation with other balancing sources such as thermal power and BESS.

More than 15 GW of WSH and RTC capacity has been tendered

Until date, more than 15 GW of WSH and RTC capacity has been tendered, of which more than 12.5 GW has been allocated. Of this 7.5 GW is expected to come online by 2023.

Policy support:

- In 2018, MNRE released the National Wind-Solar Hybrid policy, which provides a framework for the promotion of large-scale WSH projects. It stated that WSH projects can be used as captive plants, third party sale through open access, and sale to discoms under LT PPA through competitive biddings.
- In addition, the states of Gujarat and Andhra Pradesh came out with state level policies for WSH in 2018, followed by Rajasthan in 2019.
- Further, in order to enhance the overall output from WSH along with storage facilities, the MNRE issued guidelines for procurement of WSH through transparent TBCB process in October 2020.
- Later, this guideline was amended in August 2021, to address the issues to implement the large hybrid projects and encourage investment by allowing discoms to directly procure power from these project developers. The move is aimed to lower the power procurement cost from these WSH projects by omitting the trading margins charged by intermediaries like SECI and other state nodal agencies.

Since 2018, SECI has tendered five tranches of interstate transmission system (ISTS)-connected WSH projects, of which four have been concluded. The tariffs discovered for the first two tranches ranged from INR2.67-2.69/kWh. The tariffs have since been falling, with the lowest discovered rate for tranche III being INR2.42/kWh and the recently concluded auction for tranche IV resulting in a new low of INR2.34/kWh.

The fifth and most recent tranche of 1,200 MW was issued in October 2021 which witnessed tariff of INR2.53/kWh.

Further, SECI has been coming out with other innovative hybrid tenders as well, a 1,200 MW tender introduced in August 2019 for WSH projects with storage support to supply peak power and another one in March 2020 for 2,500 MW of ISTS-connected blended wind power projects with a wind component of at least 80%. Other state agencies and utilities like Adani Electricity, Tata Power, and Maharashtra State Electricity Distribution Company Ltd (MSEDCL) have also come up with hybrid tenders.

Exhibit 26: SECI WSH Tenders

Tender	Launch date	Capacity tendered (MW)	Capacity awarded (MW)	Lowest tariff (INR/kWh)	Winners
SECI WSH Tranche 1	Jun-18	1,200	840	2.67	SB Energy (SoftBank Group) 390 MW; Adani Green (Adani Group) 450 MW
SECI WSH Tranche 2	Mar-19	1,200	720	2.69	Adani Green (Adani Group) 600 MW; Renew Power 120 MW
Adani Electricity	Jul-19	700	700	3.24	Adani Green 700 MW
SECI WSH with storage peak	Aug-19	1,200	1,200	6.85	Greenko Group 900 MW; Renew Power 300 MW
MSEDCL Tender 1	Sep-19	80	-	-	Results not available
SECI RTC Tender 1	Oct-19	400	400	2.90	Renew Power 400 MW
SECI WSH Tranche 3	Jan-20	1,200	1,200	2.42	ABC Renewables (Axis Energy) 380 MW; Adani Green (Adani Group) 600 MW; Amp Energy 130 MW; Acme Solar 90 MW
SECI wind Tranche 9	Mar-20	2,500	970	2.99	Vena Energy 160 MW; JSW Solar 810 MW
Tata Power	Jun-20	225	225	2.59	Tata Power Renewables 225 MW
SECI RTC Tender 2*	Jan-21	2,500	2,500	3.01	Hindustan Thermal Projects 250 MW; Greenko 1,001 MW; Renew 600 MW; Power Mech Projects 550 MW; JSW 99 MW
SECI WSH Tranche 4	Apr-21	1,200	1,200	2.34	NTPC 450 MW; Ayana Renewable 450 MW; NLC 150 MW; Azure Power 150 MW
NTPC Tender	Apr-21	600	-	-	Results not available
MSEDCL Tender 2	May-21	500	500	2.62	Tata Power 300 MW; Azure Power 200 MW
SECI WSH Tranche 5	Oct-21	1,200	-	2.53	TP Saurya 600 MW; NTPC 450 MW; AMP Energy Green 120 MW; SJVN 30 MW.

** **Amended***

Source: Elekore, SECI

With the advancement of PV technology and expected fall in battery cost, hybrid projects will become more viable and reliable

While the cost of hybrid projects is still relatively high, it escalates further with the bundling of thermal power or with the inclusion of storage components. This would require higher levelised tariff for developers to cover up the costs.

However, we believe that, with the advancement in PV technology (which would enhance capacity utilisation) and expected fall in battery cost, going ahead, the hybrid projects will become more viable and reliable renewable power. Such a mix could be an apt solution for ensuring the power grid's stability and meet peak power demand.

Battery storage–a crucial pillar for success of RES projects

In order, to achieve its goal of 450-500 GW of non-fossil capacity, the country will require 108GWh (27GW) of battery storage

Energy storage will play a vital role in grid integration and the balancing of variable generation from renewable sources in the system. Storage systems absorb excess renewable power during the off-peak demand period and discharges during the period of peak demand, thus lowering the peak demand charges and grid fluctuations. The system improves power quality, enhances the capacity of transmission grids, reduces deviation penalties and can provide solar and wind power during peak hours, thus reducing peak demand. A battery storage system allows developers to shift their energy usage and charge batteries with solar energy or grid electricity when it is the cheapest and discharge it when it is expensive. As per the CEA, the conservative projection for BESS deployment by 2030 is expected to be 108GWh (27GW for four-hour backing), which would support 450-500 GW of non-fossil capacity.

Despite the recent advancements in terms of technology uptake and deployment, challenges towards battery application remain. The key one is the cost factor.

CEA estimates that the storage system cost would fall by ~40% to INR43mn by FY30

- The cost for a four-hour battery energy storage system for 1MW capacity as on date stands at INR70mn. However, going ahead, CEA estimates that the storage system cost would fall by ~40% to INR43mn by FY30. This, along with improved utilisation level, should bring down the combined solar tariff, which would still be competitive to thermal power plants and alongside would emit zero pollutant particles. Further, as per the report by Lawrence Berkeley National Laboratory, the cost for a solar project with a storage system in India is expected to decline from US$57/MWh in 2020 to US$40/MWh in 2030. This implies that levelised bids for solar with battery storage should decline from INR3.94 /kWh in 2020 to INR2.83/kWh by 2030.

India's dependency for battery storage capacity will continue to remain on China

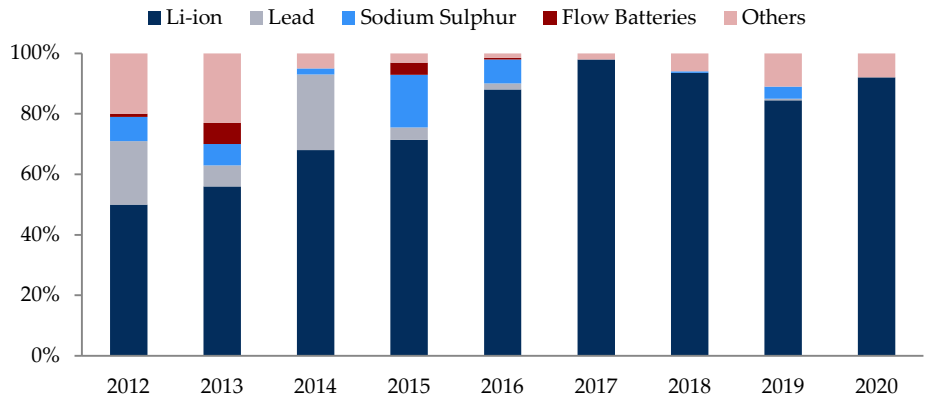
- Another issue is, unlike solar plant equipment, battery energy storage system cannot be fully manufactured in India. While India has many battery pack assembly plants for lithium-ion (Li-ion) batteries, it relies on import of cells from China. During the pandemic, these plants' operations were severely impacted by supply disruptions in China. Cells that are one of the key ingredients for Li-ion batteries are available in China in bulk. China accounts for a lion's share of the world's Li-ion battery manufacturing capacity. While the Indian government has announced a PLI scheme for manufacturing of advanced chemical cells, we believe it will be very difficult to completely reduce the dependency on China.

Outlook: Strong market growth in India

Energy storage market in India is likely to grow at a compound annual growth rate of 6.1% up to 2026

Li-ion batteries will continue to dominate the energy storage market in India over the next 10-15 years due to its lower cost and multiple applications, which would help the market growth of this technology. It is also envisaged that electric mobility will be the primary driver for battery demand in the next five years, before storage demand for grid applications takes center stage. The India Smart Grid Forum and the India Energy Storage Alliance (IESA) forecast that the energy storage market in India is likely to grow at a compound annual growth rate of 6.1% up to 2026. Meanwhile, global electrical energy storage is estimated to grow six times between 2016 and 2030. According to the IESA, the energy storage market in India was worth US$2.8 bn in 2018 and to scale up to 27GW capacity by 2030, a total investment of US$15.5bn would be required.

Exhibit 27: Proportion of various forms of storage



Source: HSIE Research

Li-ion battery to continue to dominate the energy storage market in India

Recent government initiatives

The government has been actively engaged in establishing large scale energy storage systems by promoting research and development in the area.

- NTPC Ltd has floated a global tender for setting up a 1-GW grid-scale battery storage system.
- The ministry of power also announced its plans to invite global bids for developing battery storage projects, totaling a capacity of 4,000 MWh. A 13 GWh facility in Ladakh and a 14 GWh storage facility in Kutch, Gujarat, will also be built.
- Recently, the central government gave its approval for inviting expressions of interest for the installation of a 1,000 MW battery energy storage system as a pilot project.

Pumped Hydro Energy Storage (PHES)

Pumped Hydro Energy Storage will help in managing concerns related to grid's security and stability

PHES is among the few matured storage technologies available to manage concerns related to balancing of India's power grid and its security and stability.

Apart from generating electricity for supply, it also stores it in the form of potential energy of water. It is operated with two water reservoirs at different altitudes. Both upper and lower reservoirs are connected through a penstock (water supply pipeline) with a reversible turbine in the middle. When PHES is operated to generate power, the upper reservoir supplies water to the lower reservoir through the penstock and turbine system to generate electricity. To store energy, water is pumped to the upper reservoir again using the excess energy available in the grid (or through other captive power available) and stored in the form of potential energy.

PHES is the world's largest energy storage system, representing 96% of the installed storage capacity worldwide (176 GW). PHES contains 169 GW (96%) and the rest is divided into thermal storage (3.3 GW–1.9%), electro-chemical storage (1.9 GW–1.1%) and electro-mechanical storage (1.6 GW – 0.9). This signifies that PHES dominates the energy storage capacity globally.

India stands 5th as it represent 4% of global PHES capacity

China has the largest PHES capacity share of 18.9%, followed by Japan, US, and Spain, with 16.7%, 13.4%, and 4.7% share respectively. With a 4.8GW capacity, India stands fifth in the world for PHES capacity, representing 4% of the global PHES capacity.

Exhibit 28: Global Operational Energy Storage Power Capacity by Technology Group – May 2017

Type	Total Capacity (GW)	Total Capacity (%)
Pumped Hydro Energy Storage	169	96
Thermal Storage	3.3	1.9
Electro-Chemical Storage	1.9	1.1
Electro-Mechanical Storage	1.6	0.9
10 Countries account for about 75% of Global Energy Storage		
3 Countries account for about 48% of Global Energy Storage		
China – 32.1 GW		
Japan – 28.5 GW		
USA – 24.2 GW		

Source: Integrated Research and Action for Development (IRADe), HSIE Research

Benefit of PHES –

The ramp rate of Hydro storage based power plants is 50%/minute, highest amongst the different categories

Peak shaving: PHES can meet the highest demand in a short period of time with very high ramp rate, to the tune of 200 MW/min. As per a study, the ramp rate of pondage/storage hydro-based power plants is about 50%/minute, the highest amongst different plant categories. In comparison to this, the ramp rate of combined cycle gas-based plants is up to 10%/ minute. The lowest ramp rate is that of coal-based power plants, the maximum of 3% for super-critical power plants.

Load balancing: PHES can play a crucial role in load balancing or load leveling, i.e., storing power during off peak hours in the power system, and utilising the same during peak demand period.

Seasonal storage: The intermittent RE generation varies seasonally; PHES has the ability to cater to seasonal mismatches of RE generation and the load.

Energy arbitrage: PHES may prove economical in the daily energy arbitrage business, as it buys energy during off-peak hours when the price is less and sells it during peak hours when the price is high.

Target to add 10-11GW of PHES by FY30:

India plans to add 10-11 GW of PHES capacity by 2030

As per the CEA 2030 energy mix, India plans to add 10-11GW of PHES project by 2030 as, with increased penetration of RES in the grid, PHES can play a vital role in integration of RES in the national grid. India currently has eight PHES projects, with a total capacity of 4,785 MW, of which six plants with an installed capacity of 3,305 MW are operable, while the remaining two plants with 1,480 MW of capacity are not working in the pumping mode at present due to the delay in the construction of tail pool dams and some technical issues.

However, India has identified 63 sites for PHES, with a probable installed capacity of 96,530MW. Around 1580 MW of PHES (1,000MW by THDC, 500MW by TANGEDCO and 80 MW by Maharashtra Water Resource Department) are under construction and 9730 MW are under proposal development.

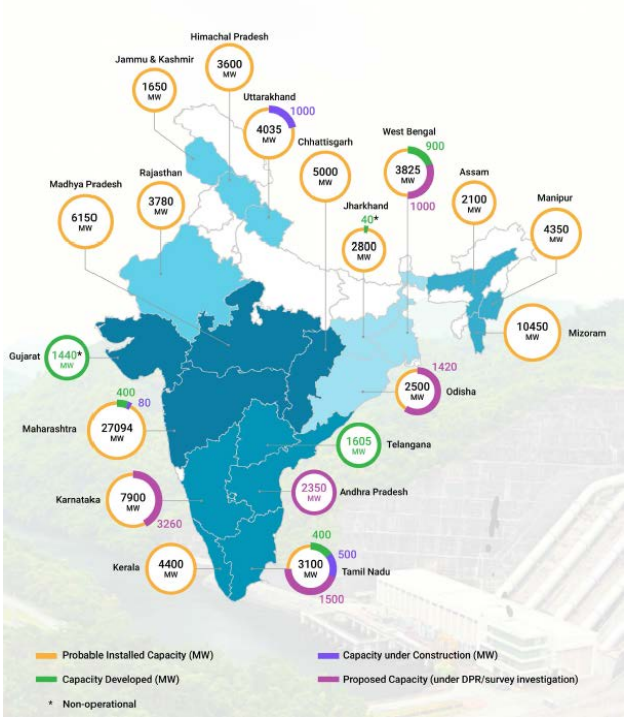
Exhibit 29: Status of pump hydro development in India

S.No.	Particulars	Capacity (MW)
A.	Schemes Constructed	4746
	a) Working in Pumping Mode	3306
	b) Presently not working in Pumping Mode	1440
B.	Schemes Under Construction	1580
	a) Under Active Construction	1500
	b) On which Construction is held up	80
C.	DPR Concurred by CEA	1000
D.	Scheme Under Examination in CEA	1200
E.	Scheme under Survey & Investigation	16700
	a) Both Reservoirs Existing	3850
	b) One Reservoir Existing & One to be constructed	6420
	c) Both Reservoirs to be constructed	6500
F.	Schemes Under Pre-Feasibility	8855
	a) Prepared	7755
	b) Under Preparation	1100
	Total	**34081**

Source – CEA Report date Feb 25, 2022

Exhibit 30: Pump hydro storage - operational capacities, non-operational, under construction and proposal development

India has identified 63 sites for PHES, with a probable installed capacity of 96,530MW.



Source: CEA, HSIE Research

Greenko aggressively eyeing development of PHES project:

Greenko Energy Holdings has announced three PHES projects alongside solar-wind hybrid projects.

Greenko aggressively eyeing PHES projects

- An Integrated Renewable Energy Project at the Pinnapuram, Andhra Pradesh, consisting of 2GW of solar, 400MW of wind hybrid and 1,200MW of hydro pumped storage facility. The projects expect to generate 7bn units of electricity on an annual (RTC) basis.
- An Integrated Renewable Energy Project at Saundatti, Karnataka, consisting of 1GW of solar, 400MW of wind hybrid and 1260MW of hydro pumped storage facility.
- Greenko plans to invest INR116bn to set up a solar-wind hybrid project, supported by pumped hydro storage in Shahpur, Rajasthan. The project is likely to be completed by 2024. The project expects to generate 6.1bn unit of electricity on an annual (RTC) basis.
- The company has won 900MW solar-wind-PHES hybrid project in Jan-20 under the SECI hybrid tranche III tender to supply power at INR6.12/unit during peak period and INR2.88/unit during the off-peak period (blended tariff at INR4.04/unit).

The company has also signed an agreement with NTPC Ltd to develop renewable power projects meant for around-the-clock supply.

PHES-issues and challenges:

A major challenge to PHES is of economic viability

- A major challenge to PHES is that of economic viability. Input power cost (off-peak, peak, and plant cost) needs to be minimised to make such plants viable.
- Topographical requirements like the range for elevation (20-1,000m) between the two reservoirs along with proximity to a large water body.
- Initial investments are very high ranging from US$1800-2000/kW.
- Environmental impact like loss of wildlife habitats and issues of resettlement and rehabilitation of human population.
- Long gestation period due to delays in obtaining environment clearances.
- Low recovery from the existing pricing mechanism.

Probable solution to above challenges:

Closed-loop PHES system and differential pricing mechanism can help resolve the challenges

- **On high-cost and environmental issues:** These issues can be resolved using a closed-loop PHS system that utilises less water, has a low gestation period, and has a minimal impact on the environment.
- **On pricing mechanism:** The need of the hour is to have a differential pricing mechanism. The present mechanism comprises two-part tariffs with fixed and variable costs. The fixed component recovers the capital costs like the cost of plant and machinery and employee costs. The variable component takes care of operational costs. However, it does not consider the variation in prices during different periods of PHES operation, leading to under-recovery. Further, the existing tariff mechanism does not account for the multiple services provided by the PHES to the grid like RE smoothing, peak-load shaving, and ancillary services.
- A different pricing mechanism with separate pumping (off-peak rate) and generation (peak prices) will help PHES to earn better return.

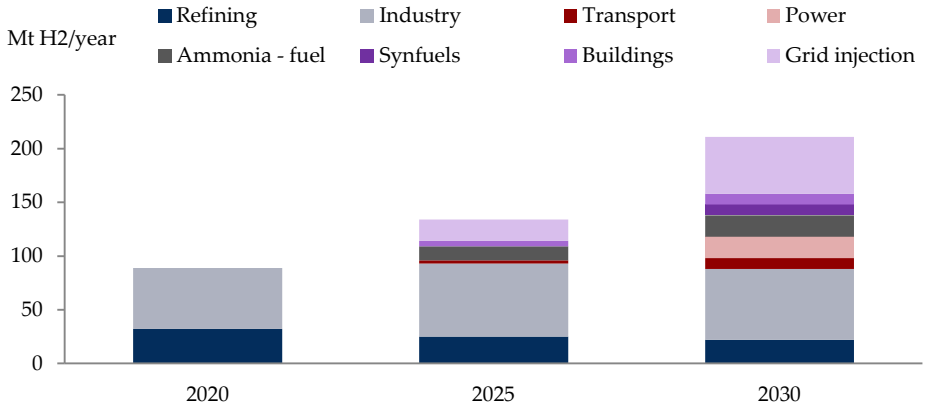
Thus, a different pricing mechanism and higher utilisation of closed loop projects will not only make PHES more competitive but also attract more investment in the sector, which eventually can play a significant role not only in maintaining grid stability but also in bringing down the sector's dependence on expensive imported batteries.

Green hydrogen: a huge potential

Around 95% of the current usage of 90MTPA of hydrogen is derived from fossil fuels

Green hydrogen and its lineages are expected to play a critical role in decarbonising the pollutant sector globally. Around 95% of the current usage of 90MTPA of hydrogen globally is derived from fossil fuels. With demand for hydrogen expected to increase beyond 200 MTPA by 2030, the bulk of it is expected to come from green hydrogen through renewable energy-powered electrolysis, which will have minimal net emissions.

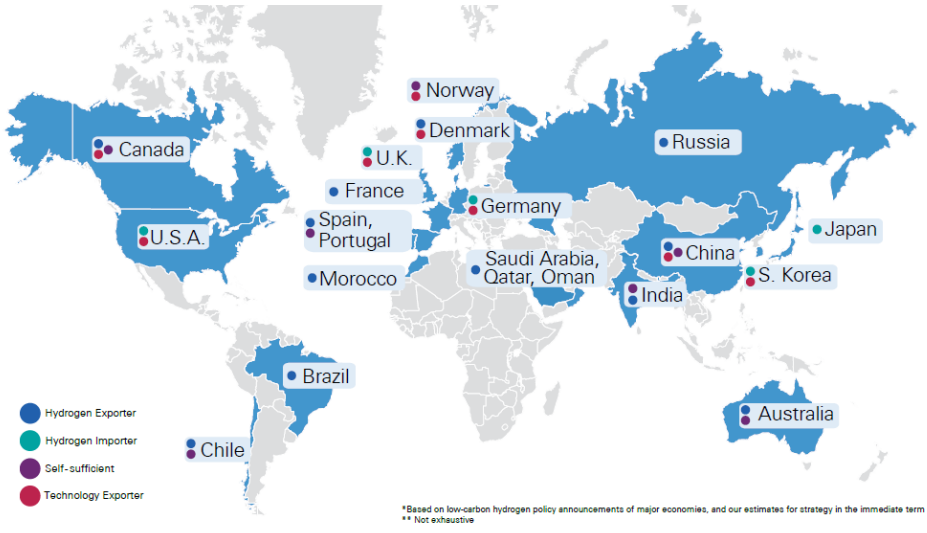
Exhibit-31: Global hydrogen demand by sector (Mt H2/year)



Source: IEA, 2020

Globally, countries are making substantial progress in aligning strategies and becoming either demand centers or major suppliers of green hydrogen. While Germany, Japan, and South Korea could become the net importers of green hydrogen, Chile, Australia, and India are working on strategies to become net exporters.

Exhibit 32: Low carbon hydrogen hotspots

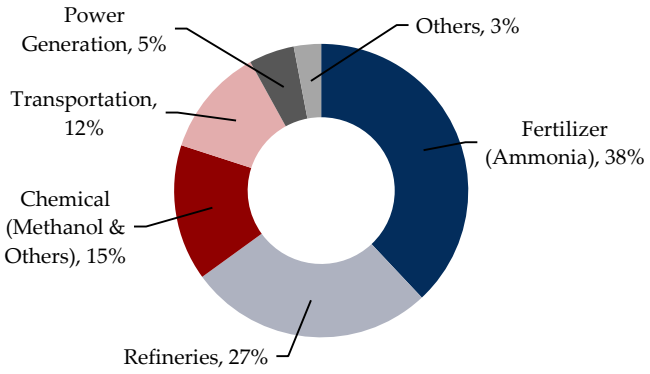


Source: KPMG India

Current hydrogen market in India is capped at US$11bn

India's current hydrogen demand/usage stands at 6.7 MTPA (7.5% of the global demand), which mainly serves as feedstock in ammonia production and in refineries. In transportation, it is catching up but is in very nascent stages in India. The current market for hydrogen in India is pegged at US$11bn, of which nearly 80% caters to the fertilizer (ammonia), refineries, and chemical segments. Currently, India is among the top-4 largest consumers of the hydrogen globally, after Europe, the US, and China.

Exhibit 33: Hydrogen consumption by key sectors in India (2021)



Source: HSIE Research

Usage of hydrogen:

Fertilizer: Hydrogen is used to produce ammonia through Haber Bosch process. ~90% of ammonia is used to manufacture fertilizers, which is a regulated market; and low cost domestic natural gas is provided (US$3-4/MMBTU) to the industry.

Refining: Hydrogen is used to process crude oil to obtain refined fuels like gasoline and diesel. Hydro-desulfurization is used to remove sulphur impurities. Refining however is a deregulated sector largely dominated by PSUs and few large private companies. This sector primarily uses imported natural gas to produce hydrogen.

Methanol: Hydrogen is also used in production of methanol which is further used in production of acetic acid and formaldehyde. Furthermore, 80% methanol is imported because of high prices of natural gas in India.

Further, India also imports 3.54MMTPA of ammonia and ~14.5 MMTPA of fertilizers annually from China, US, and UAE, primarily due to availability of low-cost natural gas/coal in these countries. This also creates an additional indirect demand of 2 MMT of hydrogen leading to its actual consumption of 8MMT in the country. Of this, ~96% of the hydrogen comes from the brown and grey method.

Grey & Brown Hydrogen	•Hydrogen produced using fossil fuels without carbon capture, usage and storage (CCUS) technology. Sometimes further divided into 'grey' for gas and 'brown' for coal.
Blue Hydrogen	•Hydrogen produced using fossil fuels with CCUS technology (typically methane reforming) which captures carbon emission (10kg CO2/1kg of hydrogen) and provide storage. Currently, capturing hydrogen through the Blue Hydrogen process costs around US$150/ton.
Green Hydrogen	•Hydrogen produced via electrolysis (alkaline and proton exchange membrane [PEM] technologies) using renewable electricity where hydrogen is extracted from water using electrolysis process.

The Colors of Hydrogen

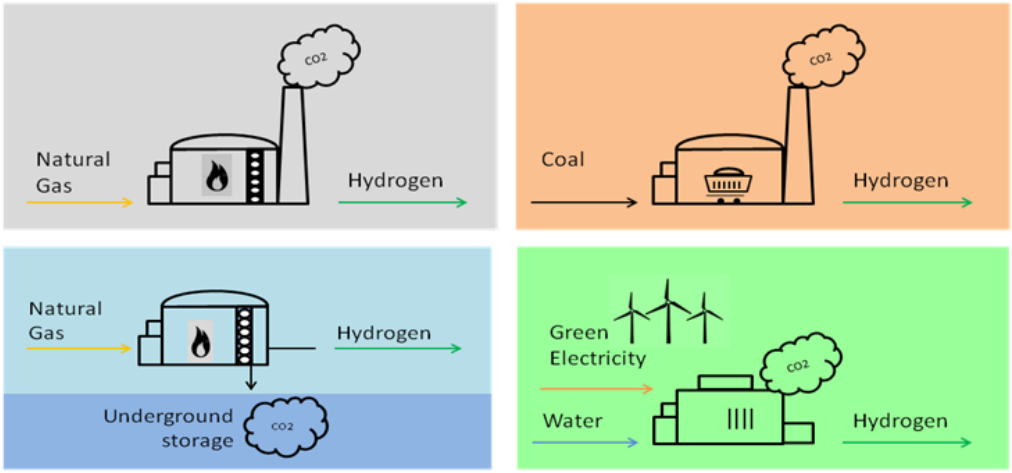
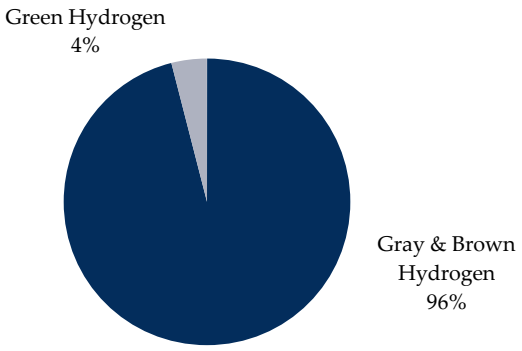


Exhibit 34: Share of Green Hydrogen

Only 4% of hydrogen produced globally is green



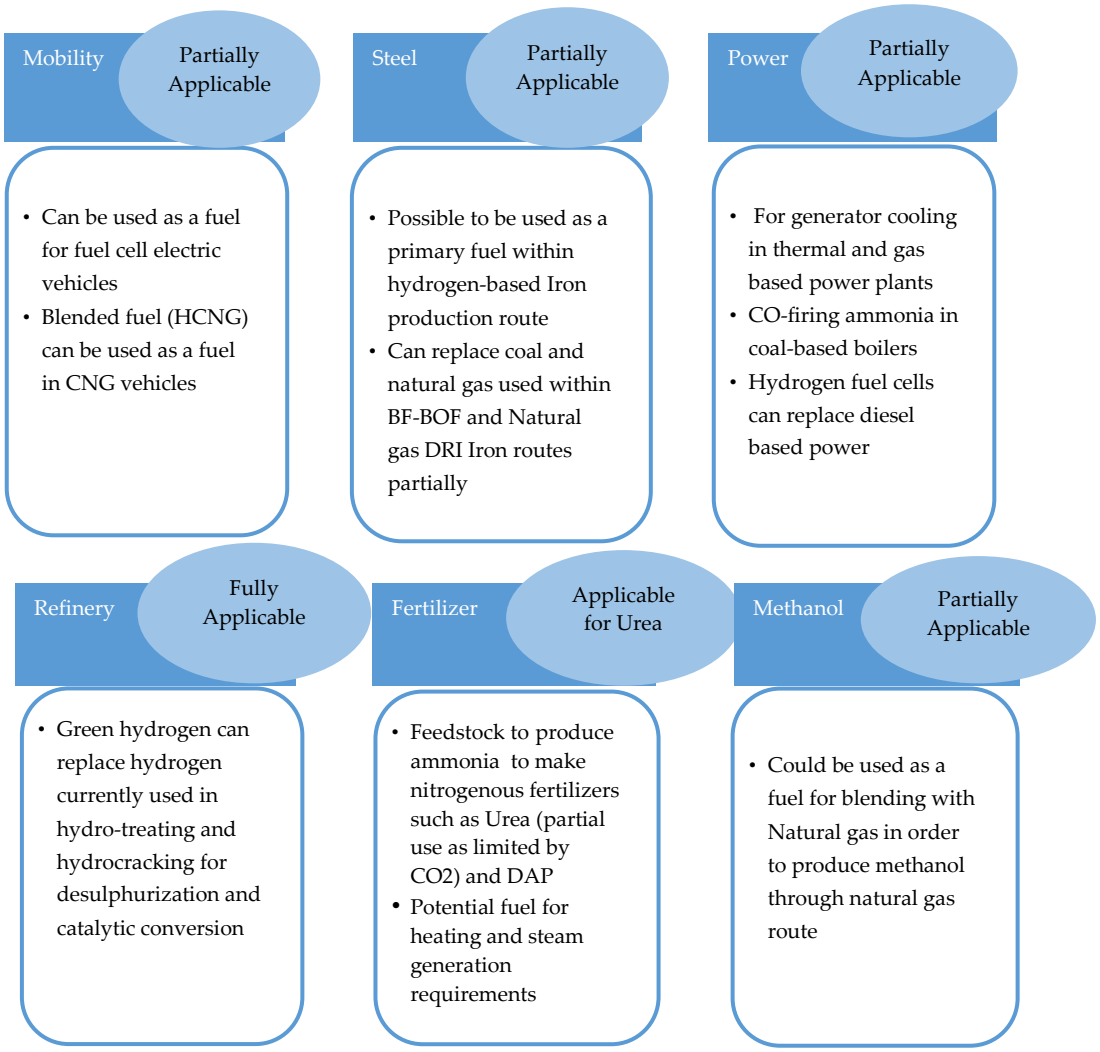
Source: World Energy Council, HSIE Research

As countries step up their decarbonisation efforts to mitigate climate change, green hydrogen has emerged as a key alternative to controlling emissions while meeting the growing energy demand. The government across the globe has envisaged tremendous potential for low cost and low carbon production of green hydrogen, which can enable broad adoption of hydrogen across other sectors such as steel, power, and vehicles. Also, in the light of the net-zero commitments at COP 26, there is a worldwide push to fulfil hydrogen's potential as a clean energy solution.

Potential use cases of green hydrogen and ease of the switch

The transitions are likely to be fueled by decarbonization pressures faced by these sectors as well as improvement in cost economics of green hydrogen.

Exhibit-35: Usage of hydrogen



Global demand for hydrogen has been rising (3x since 1975) and is largely produced using fossil fuels, with 6% of global natural gas and 2% of global coal going towards its production. As a result, hydrogen production leads to an emission of 803MT p.a of CO2 which is equivalent to the CO2 emissions of UK and Indonesian combined.

Steel manufacturing emits large quantum of carbon accounting for 7% of the world's carbon emission. Hence, decarbonizing this sector using green hydrogen could significantly help in achieving climate goals.

India's ammonia consumption for fertilizer production is ~15MT p.a. and roughly 2MT of this is met through imports. Mandating even 1% of green ammonia share could save about 0.4 million standard cubic feet/day of natural gas import.

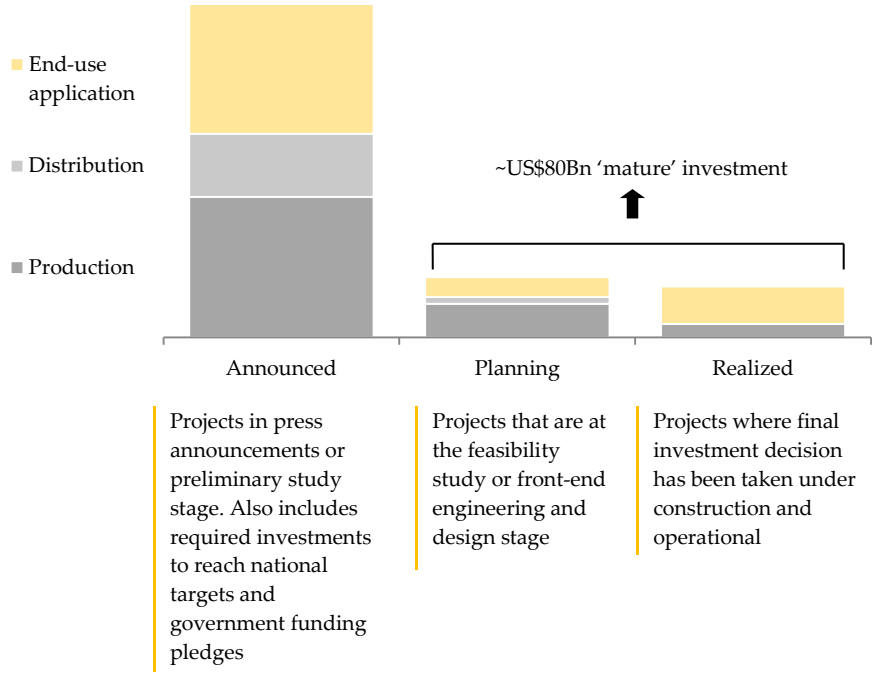
Japan aims to reach 1GW of power capacity based on green hydrogen by 2030, and to 15-30GW in the long run.

Korea has set a target of 1.5GW installed fuel cell capacity in the power sector by 2022 and 15GW by 2040.

Only $80 Bn of hydrogen investment is in advanced stage

Japan, China, the EU, Saudi Arabia and several other countries, are actively pursuing green hydrogen production and distribution. Green hydrogen projects of ~US$300 bn have been announced over the last year worldwide. However, only US$80 bn of this investment has reached an advanced stage i.e. they are either in a planning stage, has passed a final investment decision, or are associated with a project under construction, already commissioned or operational stage.

Exhibit 36: Projected hydrogen investment through 2030 USD Bn



Source: McKinsey & Company, HSIE Research

Hydrogen demand in India to increase from 6.7MMT to 12MMT

India foresees usage of hydrogen to enhance from 6.7MMT in FY21 to 12MMT over the next decade

India has envisaged that hydrogen usage in the country will enhance from 6.7MMT in FY21 to ~12MMT over the next decade, led by strong growth in the fertilizer and refining sectors and also from the replacement of expensive natural gas/oil/coal across other sectors like steel, chemicals, long-haul transport, shipping and aviation. In this context, hydrogen needs to be low carbon from the outset and ultimately green. India targets to achieve 20-30% of this 12 MMT of demand through green hydrogen.

Why should India opt for green hydrogen?

Reduce dependency on expensive and pollutant fuel

India's dependence on imported oil and gas fuels is very high, with nearly 85% of its oil and >50% of its gas requirement being met through imports. Green hydrogen can be used as an alternative and it can displace fossil fuels across the above-mentioned industries; it can also be produced in bulk through the abundant renewable energy resources available in India. The move would not only help decarbonize the economy, but it will ensure much-needed energy security and independence to the country, helping lower imports and thereby smoothening fiscal deficit.

Decarbonising the economy through fuel switch

With high dependency on fossil fuels to meet its energy requirement, India's energy sector accounts for ~70% of the country's greenhouse gas (GHG) emission (next only to China and the US), followed by agriculture (20%), industrial processes (6%), land use change and forestry (4%) and others (2%). Hydrogen, with its versatile prospects, can be applied across these sectors by displacing conventional pollutant fuels; this would help decarbonize the sector as well as the economy.

Demand mandates and incentives for the procurer will create initial demand for green hydrogen

Enable acceleration of renewable energy capacity

The adaptability of green hydrogen would lead to acceleration in renewable capacity addition across sectors through opening of significant alternative end uses.

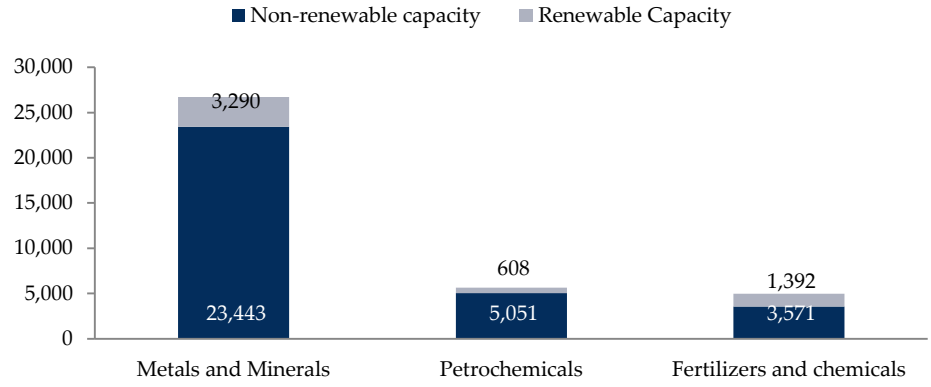
However, in order to achieve the above task, we believe that the government should consequently come up with demand mandates and incentives for the procurers and suppliers to create initial demand for green hydrogen. Also, green hydrogen is expected to initially gain traction in refineries and fertilizer industries where grey hydrogen can be displaced; its applicability in the transport and steel sectors will take place over a period of time.

Hydrogen mandates

The major three sectors have cumulative captive conventional power capacity of 32GW which can be transitioned into green hydrogen

- GoI proposes to impose small mandates on usage of green hydrogen by fertilizer and petroleum industries, which already consume the bulk of hydrogen used in the country produced from fossil fuels. Thus, even a small mandate could create a huge demand for green hydrogen in India. Furthermore, many metals and minerals companies are also planning to replace their captive coal/gas-based power capacities with green hydrogen for manufacturing green steel, green ammonia, etc. All put together, the three sectors viz, fertilizer & chemicals, petrochemicals and metals & minerals have a cumulative captive conventional power capacity of ~32GW, which can be transitioned to green hydrogen.

Exhibit 37: Existing captive power projects available across select industries for hydrogen production (MW)



Source: HSIE Research

- Alongside production of green hydrogen, the government is also working on building a fully integrated electrolyser manufacturing capacity in India. The GoI plans to provide incentives to support and promote a large scale electrolyser manufacturing base in the country. It is planning a PLI scheme to support electrolyser manufacturing, similar to that for batteries and solar photovoltaics. The government is also working with the Bureau of Indian Standards and the Department of Commerce on standards and regulations.

Green hydrogen cost needs to fall by 60% by 2030 to become viable

However, the cost of green hydrogen from alkaline electrolysis is very expensive at INR400-INR450/kg (US$5.5- $6.0/kg) as on date, compared to INR150/kg (US$2.1/kg) for grey hydrogen and INR250/kg (US$3.3/kg) for blue hydrogen.

The cost of producing green hydrogen needs to fall by over 60% to $2.0-$.5/kg by 2030 in domestic market to make it a viable alternative to conventional fuels.

Indian government's initiative – green hydrogen policy

The Government of India (GoI) has introduced the green hydrogen policy, in line with the country's National Hydrogen Mission launched in 2021, which aims at boosting the domestic green hydrogen production to 5MTPA by 2030 and making India an export hub for green hydrogen.

Key aspects:

- *Reducing transmission charges:* At its core, the policy focuses on reducing the cost of green hydrogen by providing free and easy access to the inter-state transmission system (ISTS) for 25 years for capacity installed by June 2025 for green hydrogen/ammonia production.
- *Ease of setting projects:* The policy also facilitates ease of setting up green hydrogen projects by providing a single window clearance for setting up green hydrogen production as well as a facility for producers to bank any surplus renewable energy generated for up to 30 days and use it as required, by paying relevant banking charges.
- *Priority towards grid connectivity*: Furthermore, RES plants set up for green hydrogen projects would be given priority for grid connectivity. Discoms may also procure green power to facilitate supply to green hydrogen projects.
- *Access to RES capacity:* Green hydrogen manufacturers can buy renewable power from power exchange or set up renewable energy capacity themselves, or through any other developer. The plant will be granted open access for sourcing RES within 15 days of receipt of application.

- *Storage facility at ports for export purpose:* Manufacturers of green hydrogen/ green ammonia shall be allowed to set up bunkers near ports for storage of green ammonia for export/use by shipping. The land for storage purpose shall be provided by respective port authorities at applicable charges.
- *Facilitation for RPO obligation:* RES consumed for the production of green hydrogen/ammonia shall count towards RPO compliance of the consuming entity. The RE consumed beyond obligation of the producer shall count towards RPO compliance of the discom in whose area the project is located.

The above measures/incentives are largely on the supply side and would help in lowering green hydrogen price by 10%-15% (~US$0.5/kg). However, the need of the hour is to have a strong long-term market for green hydrogen, which would make these projects bankable. This can be achieved by implementing consumption mandates mechanism for fertilizer production and petroleum refineries. Also, the government should extend the PLI scheme for the manufacture of electrolysers, which would help reduce the electrolysers cost, thereby making green hydrogen competitive with fossil fuels, going ahead.

60% production cost reduction projected for green hydrogen by 2030.

As per the Hydrogen Insights Report 2021 published by Hydrogen Council, McKinsey & Company, the cost of green hydrogen could fall by ~60% over the next decade, led by a fall in electrolyser Capex cost, fall in renewable tariffs, and improved utilisation of the entire electrolysis system.

Fall in electrolyser capital cost is expected to reduce the cost of hydrogen by US$1.4/kg

- As per the report, the electrolyser system costs could drop from about US$ 1,120/kW in 2020 to an estimated US$230/kW in 2030. This calculation includes the stack as well as the balance of plant (e.g., transformer and rectifier, drying/purification to 99.9% purity). The fall in Capex cost would also lower the finance cost for the project. As a global benchmark, a US$250/kW drop in electrolyser capital cost, meanwhile, would reduce the cost of hydrogen by $0.3-0.4/kg. Thus, a ~US$900/KW decline in capital cost (from 1,120/kW to US$230/kW) could lower the green hydrogen cost by US$1.4/kg.

Decline in power price would reduce the cost of hydrogen by US$0.4-$0.5/kg

- The electrolysis process requires 50 kWh of electricity to produce 1 kg of green hydrogen. Electricity cost accounts for 55-60% of the total green hydrogen cost. The levelised cost of energy has been declining over the years and is expected to fall further with technology development and improved utilisation. A US$10/MWh decline in the power price from the current US$30/MWh (i.e. INR0.75/kWh decline from INR2.25/kWh) would reduce the cost of hydrogen by US$0.4-0.5/kg.

Improved utilization of renewable to reduce the cost of hydrogen by US$0.4/kg

- Improved utilisation of renewables (from ~25% to 30%) would reduce the cost of hydrogen by US$0.4/kg.

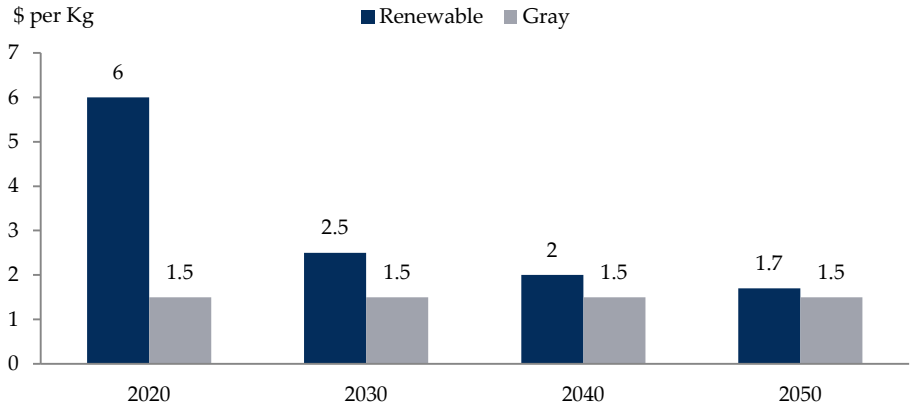
Increase in capacity utilization factors of electrolysers would further reduce the cost of hydrogen by US$1/kg

- An increase in capacity utilisation of the electrolysers to 85-90% from 60% would also reduce the cost of hydrogen by a further $1/kg. The rise in utilisation will be led by technology advancement and combination of large-scale, integrated renewable hydrogen projects. This performance is driven largely by the centralisation of production, a better mix of renewables (e.g., onshore wind and solar PV), and integrated design optimisation (e.g., oversizing renewable capacity versus electrolyser capacity for optimised utilisation).

Cost of green hydrogen is expected to reduce by US$3.8/kg to reach by 2030

All these put together, along with policy initiatives, are expected to reduce the cost of green hydrogen by US$3.8/kg, from current US$6.0/kg, making it available at US$2.2/kg by 2030, which would be fairly competitive to grey hydrogen. Rather, current grey hydrogen price of US$1-1.5/kg is based on natural gas input price of US$10-13/MMBtu. This price could increase further, if the current steep gas price of over US$20/MMBtu sustains in the long run. This would make green hydrogen attain price parity with grey hydrogen at a much earlier stage.

Exhibit 38: Hydrogen production costs by production pathway



Source: McKinsey, HSIE Research

However, many industry players who have already committed to set up a green hydrogen plant in next two years are actually targeting the green ammonia segment both across the domestic and export markets, the latter having significant growth potential to displace the existing grey hydrogen usage.

Market opportunity size for electrolyser –

Green hydrogen would require INR 1.6 trillion investments across electrolysers and INR3.2 trillion across the renewable capacity

India initially targets to meet 30% of its FY30 hydrogen requirement i.e. ~3.6 MT through green energy. As a thumb rule, 5MW of electrolyser capacity can produce 2.4 tonne of hydrogen daily and 876 tonnes annually. Hence, in order to meet 3.6MT of hydrogen by FY30, the total electrolyser capacity required in the country would be ~20.5GW. The electrolyser system costs around INR80mn for 1 MW capacity; hence, for 20.5GW of capacity, it would require a Capex of INR1.64trillion over the next decade.

Also, in order to supply green power to this 20.5GW of electrolyser capacity, the country would require ~80GW of renewable capacity to supply RTC power (backed by hybrid or BESS). These quanta of renewable capacity itself would attract an investment of INR3.2trillion over the next decade.

Challenges:

Cost of hydrogen, one of several challenges in unlocking full benefits of green hydrogen

Although there is a growing momentum for creating a hydrogen ecosystem, there are several challenges in unlocking the full benefits of green hydrogen. The cost of production is one of them, which needs to be brought down through favourable policies and economies of scale. Policymakers, therefore, need to incentivise industries and create demand for green hydrogen, besides focusing on supply and production. Further, there is a need to build a strong manufacturing base for electrolysers. This will go a long way towards making the cost of green hydrogen comparable to grey hydrogen and increase its uptake.

Another challenge is the development of large-scale infrastructure for generation, storage, transportation, and handling of hydrogen, which would entail significant investments. Given that hydrogen is explosive in nature, proper and safe storage and handling facilities are crucial to expand usage. Government think tanks are also working on a process where hydrogen would be first converted into liquid ammonia for transportation usage (ammonia transportation is much safer and cheaper compared to hydrogen) and then it will again be converted into hydrogen at the consumption point. In the short term, the government is expected to focus on industries that are already using hydrogen and have these facilities built in.

Green ammonia offers solution to many of the challenges mentioned above which could provide easy adaptability of green hydrogen across sector

Energy storage: Ammonia can be easily stored in bulk in liquid form at modest pressures (10-15 bar) or refrigerated to -33°C, which makes it an ideal chemical store for renewable energy. There already exists a distribution network, in which ammonia is stored in large, refrigerated tanks and transported around the world by pipes, road tankers, and ships.

Zero-carbon fuel: Ammonia can be burnt in an engine or used in a fuel cell to produce electricity. When used, ammonia's only by-products are water and nitrogen. The maritime industry is likely to be an early adopter, replacing the use of fuel oil in marine engines**.**

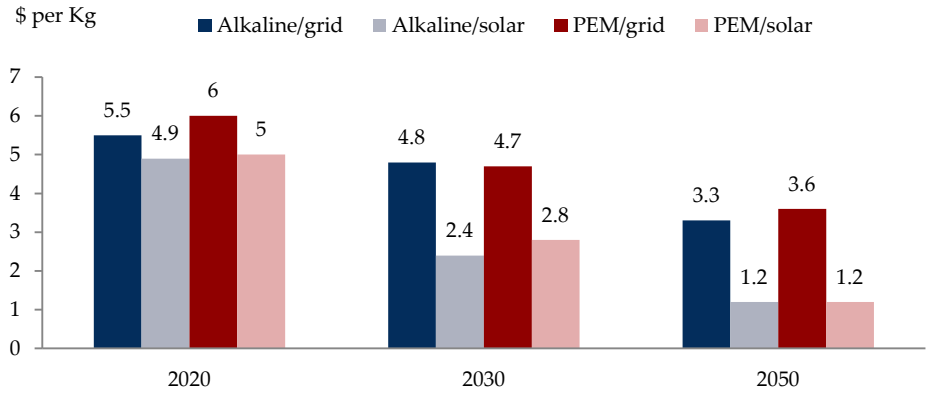
Another challenge is development of large-scale infrastructure for generation, storage, transportation

Hydrogen carrier: While hydrogen is difficult and expensive to store in bulk (requiring high-pressure cylinders), ammonia is easier and cheaper to store and transport and it can be readily cracked and purified into hydrogen gas when required.

Our view:

While green hydrogen has been considered as a game changer in decarbonising economies, it will take a few years to become commercially viable. Only then its usage can penetrate across various industries and sectors (supported by a strong policy push and a focused approach in addressing the challenges), which would unlock the true potential of green hydrogen. Also, if the current high global fuel prices remains sustainable going ahead as well, then green hydrogen parity can be attained much earlier than anticipated. Furthermore, ammonia in green form is likely to ab an early adapted of green hydrogen alongside refining, fertilizer and marine industry.

Exhibit 39: Hydrogen costs



Source: TERI

Captive solar/wind plants gaining traction among commercial and industrial clusters

RES capacity addition across the C&I segment has been gaining strong traction, led by improved tariff competitiveness and growing sustainability/green initiatives by C&I players to meet their energy requirements through renewables.

A 20% transition of C&I demand towards green energy would require 80GW of RES capacity addition.

The C&I segment accounts for ~45% of the country's total power consumption, accounting for nearly ~90-100GW of the peak power demand. Even a 20% transition of this demand towards green energy would require a significant RES capacity addition of ~80GW, assuming an average solar-wind combined PLF of 25%.

As against the earlier captive level limited to rooftop projects, C&I projects are now increasing in size and scale, owing to open access and group captive arrangements. This has provided a significant growth opportunity for specialised EPC developers such as ReNew Power, Hero Future Energies, Amp Energy, SunSource Energy, CleanMax and Cleantech Solar to capture large market shares. This arrangement also tables a favourable cost economics for both buyers and sellers. For sellers, C&I consumers are preferable to discoms, owing to not only better contract prices but also assured payments.

Access to captive RES capacity would offer the electricity at a much lower rate of INR5.0-6.0/kWh vs INR8.0-9.0/kWh offered through grid.

From the C&I perspective, access to captive RES capacity would offer them electricity at a much lower rate of ~INR5.0-6.0/kWh compared to grid connected electricity of INR8.0-9.0/kWh for HT consumers (even after factoring in the open access charges, which range from INR1.0/kWh to INR2.5/kWh, and cross subsidy charges of INR1.7-2.2/kWh). The open access charges mainly comprise Cross Subsidy Surcharge (CSS), additional surcharge, wheeling charges and banking charges as per the applicable norms by State Electricity Regulatory Commission (SERCs). Accordingly, buyers, including large industries such as metro corporations, railways, airports, hotels and multinational corporations generate substantial savings by using solar power based captive, group captive and open access projects to meet their power requirements.

Recent captive deals:

- In February 2021, Hinduja Renewables developed a 75 MWp captive solar project for Ashok Leyland.
- In May 2021, Godawari Power & Ispat Ltd announced plans to set up a 250 MW solar power plant in Raigarh, Chhattisgarh.
- In April 2021, Bharti Airtel completed a 14 MWp captive solar plant in Uttar Pradesh, which will help the company meet power requirements of its core and edge data centres in the state. This project was set up by the company in partnership with AMP Energy.
- Shree Cement plans to construct 106 MW of solar power projects to meet the captive power needs of its cement manufacturing facilities at various locations.
- In July 2021, Mahindra & Mahindra announced that it had signed a PPA with ReNew Green Energy Solutions to procure solar power from its 43 MW open access project in Maharashtra.
- In Jan 2022, Birla Corp's arm RCCPL commissioned 40 MW captive power plant at Mukutban, Maharashtra.
- In Mar 2022, Southern Petrochemicals Industries Corp Ltd' captive floating solar power plant formally went on stream at Tuticorin.
- In Apr 2022, Hindustan Zinc entered into long-term captive renewable power development plan with a capacity of 200 MW.

- In Apr 2022, Tamil Nadu Cement Corp Ltd announced plans to set up a 10 MW solar power plant at an outlay of INR65 Cr for captive use.
- In May 2022, IOCL invited bids for EPC of 1.2 MW grid-connected captive solar project with a net metering facility at its LPG bottling plant at Sanand in Ahmadabad, Gujarat.
- In June 2022, Cipla announced commercial operation captive renewable energy power plant in Maharashtra and Karnataka.

Both central and state governments have promoted growth in rooftop segment through comprehensive frameworks with net and gross metering regulations exemptions on captive, open access, and group captive charges for solar power in many states. Further, FY21-22 also witnessed many tenders from state agencies promoting the setting up of rooftop solar projects at government buildings, identified localities, or even residences. These include

- Haryana's 10.4 MW (July 2021),
- Madhya Pradesh's 41 MW (April 2021), and
- Lucknow Smart City's 8.5 MW (August 2021) roof-top solar tenders.
- Tata Power has been selected by Kerala SEB to develop a total of 84 MW of solar rooftop capacity across all districts of Kerala, covering individual households (64 MW) and housing society projects (20 MW).
- MGVCL Gujarat's 300 MW Rural and 700 MW Urban (Feb 2022),
- PDD Nagaland's 3.8 MW (Mar 2022)
- Himachal Pradesh's 7 MW (Mar 2022)
- REMCL Madhya Pradesh's 14 MW for Railways (Mar 2022),
- BCPL West Bengal's 2 MW (Mar 2022)

Challenges:

Inconsistency in RES generation forces C&I users to procure unscheduled power from grids leading to high DSM grids.

However, despite these positive measures, the developers and consumers face many challenges at the ground level related to policy inconsistency at the state level, delayed discom approvals, lengthy arbitration process, and uncertainty around wheeling, transmission and banking charges. Further, inconsistent projection and generation in RES projects force the user to procure unscheduled power from the grid to meet his demand, which exposes developers to high DSM charges. This makes the group RES captive/rooftop projects less attractive to users. Also, while some state discoms do promote open access, there have been reports of many restricting such projects, and thus group captive projects are becoming more popular. These bureaucratic and regulatory hurdles need to be addressed promptly to promote growth of the high-potential C&I solar segment. If achieved in a timely fashion, the favorable cost economics of the various business models in this space will greatly help the country augment capacity and reduce carbon footprint.

Exhibit 40: Key renewable players active in C&I segment include:

Particulars	
CleanMax	· Founded in 2012, Clean-Max operates in the C&I solar segment and has successfully installed over 550 projects for more than 170 corporates. It has a total operating capacity of over 700 MWp. · Facebook has signed a deal with CleanMax for buying renewable energy from a 32 MW wind project being developed in Karnataka for which, CleanMax will own and operate the project, while Facebook will purchase electricity off the grid through environmental attribute certificates or carbon credits
AMP Energy	· Canada-headquartered Amp Energy entered the In-dian market in 2016. It is an integrated renewable energy power producer and delivers clean and green energy to co-m-mercial and industrial (C&I) and utility customers. · In October 2021, Jubilant Ingrevia, a Noida-based integrated life sciences company, signed an agreement with AMP Energy to acquire a 26.6 per cent stake in AMP Green Energy Fifteen Private Limited. The acquisition was made to set up a 15.5 MW solar project in Maharashtra for captive power generation.
Amplus Solar	· A member of the Petronas (Petroliam Na-si-onal Ber-had) Group, Ma-la-ysia, Am-p-lus Solar has a portfolio of more than 850 MW of projects under op-eration and development spread across 24 states in India. It primarily caters to C&I customers and ser-ves more than 250 clients across di-verse verticals. · In April 2021, the company announced the acquisition of 17 operational solar pro--jects totaling 7.2 MWp from Sterling & Wilson Private Limited. Spread across Har-yana, Punjab, Madhya Pradesh, Ra-ja-s-than, Maharashtra, Telangana and Kar--nataka, these projects supply solar po-wer to 13 C&I customers.
Cleantech Solar	· Headquartered in Singapore, Cleantech Solar has over 600 MW of so-lar capacity at various stages of develop-ment across India and Southeast Asia, comprising projects for operations, construction and development. It is primarily focused on the C&I solar segment. · In August 2021, Cleantech Solar commissioned a 30 MWp open access solar park in Beed district, Maharashtra. The solar park will supply power to leading corporate customers under the captive structure. · In October 2021, Cleantech Solar an-no-unced the financial closing of a Rs 2 billion senior-secured loan facility with NIIF IFL for its portfolio of open acc-ess projects in India. · In November 2021, Cleantech Solar an-nounced that Siemens Limited has executed a PPA and entered into a share subscription and shareholders agreement for the subscription of 26 per cent of the paid-up equity share capital of Sun-sole Renewables Private Limited, Mumbai, India, subject to the fulfilment of conditions precedent as agreed bet-ween the parties.
Fourth Partner Energy	· Fourth Partner Energy is a distributed solar energy de-veloper for commercial, in-dustrial and government institutions. It was founded in October 2010. Its offerings include capex-, RESCO- and open access-based plants. The firm manages a portfolio of over 550 MWp of assets for over 150 corporate and government clie-nts in India. · In April 2021, Noida-based packaged sn-a-cks manufacturer DFM Foods invested Rs 9.6 million to acquire 5.57 per cent equity shares in Belenus Solar Private Li-mited, an SPV of Fourth Partner Energy. · In July 2021, Fourth Partner Energy ac-q-uired a distributed solar portfolio with 8.9 MWdc capacity from Statkraft In-dia. This includes a 5 MW open acc-ess solar project, while the rest is roof-top solar capacity.

Source: HSIE Research

Financing the green energy–banks need to take giant steps to enhance their exposure in the sector

RES expansion would require a funding of INR20trillion (US$262bn) to meet the desired goal

With considerable capacity additions anticipated in the renewable space to meet the set climate goals, access to capital and funding will be critical in determining the success of RES in India. The sector has been attracting increasing investments in the form of debt and equity through various channels like NBFC, NBFC—infrastructure debt funds, private equity, domestic and international bonds, institutional capitals such as pension funds and insurance companies, private equity, government entities, foreign funds, and banks.

Furthermore, development financial institutions such as the Asian Development Bank, the Asian Infrastructure Investment Bank, and their consortiums have also joined the international bond market for financing RES projects worldwide. These institutions provide long-term funds with negligible interest rate fluctuation risks, which bode well for RES projects that already face a volatile generation risk due to unavoidable seasonal variations.

Debt funding for RES to be ~INR16.7 trn (US$217 bn); equity requirement to be ~INR3.5 trn (US$45.5bn)

With a target of increasing its RES capacity from 111GW to 436GW by FY30, the total investment required would be INR16.3 trn (US$212bn), and with a D/E ratio of 80:20, the debt requirement would be INR13 trn (US$169bn) over a period of eight years. Apart from this, the investment in transmission, PHES, and battery storage is expected to be around INR3.7 trn (US$48bn), taking the sector's overall debt requirement to ~INR16.7 trn (US4217bn). Over the next eight years, RES would require ~INR3.5 trn in equity capital (US$45.5bn).

The overall loan book of India's top five banks stands at INR59.3 trn, as of 31 March 2022. This shows the huge quantum of debt financing opportunity provided by the RES over the next 8-9 years period, with a debt requirement of INR16.7 trn (which accounts for 28% of the current loan book of top five banks).

Exhibit 41: Investment break-up

Technology	Capacity (MW)	Cost per MW (INR Mn)	Total Investment (INR Bn)
Solar	2,40,000	32.5	7800
Wind	1,00,000	55.0	5500
Transmission	3,40,000	6.0	2040
Pumped hydro	10,000	50.0	500
Battery (without BOS)(MWh)	108000	11,250 (INR/ kWh)	1215
Total			17,055

Source: TERI

Bank's exposure to the RES sector has been historically low due to projects' unstable cash flow, relatively lesser yield and no green element in RES investment

As per publicly available data, the total outstanding of domestic financiers (banks and government NBFCs like PFC, REC, and IREDA) to the RE/non-conventional sector is INR1.2 trn (US$16bn), as of March 31, 2021 (on an outstanding basis). The share of RES loan exposure by these financing schemes is not high at 7% of total bank credit exposure for PSUs banks and ~12% for private banks to the power sector. This is largely because banks play it safe and earn relatively better yields on other segments. Also, infirm nature of power generation across the RES segment eventually impacts the project cash flow and its expected return. Furthermore, renewable energy projects are treated as any other project in

India's financial system and there is no 'green' element attached to it. Hence, banks do not gain any indirect advantages from directing investments in the renewable sector.

Exhibit 42:Bank credit outstanding to non-conventional energy, as of March 2020 (energy transition risk to banks)

Particulars	Public Sector Banks	Pvt Sector Banks	Other Banks
Amount Outstanding (INR Bn)	217	123	25.9
As % of utlity sector credit	6.2%	11.9%	27.1%
As % of total bank credit	0.5%	0.5%	0.7%

Source: TERI

Considering the above factors and the reluctance of banks to finance RES, the government is pushing PSU banks to take up enhanced responsibility of providing funding to RES, as the segment is likely to comprise a major part of the country's energy mix, going ahead. We believe that the success of RES growth will not be possible unless banks enhance their credit exposure to the sector significantly through increased lending.

In 2021, the country witnessed significant financial activity in the RES sector, both on the equity and debt fronts. The equity segment, however, witnessed increased traction due to a huge influx of foreign investment in the year. The segment is also witnessing the emergence of a new trend, with many US and European funds typically investing for multiple returns and opting to buy out operational RES assets.

Innovative financing mechanism and alternative funding avenues provides various exit opportunity to PEs

A key reason for the changing sector dynamics is the diversification of exit opportunities for private equity players. The exit options have evolved from raising a larger round, followed by an exit through the IPO (both domestic and overseas route), setting-up an InvIT and exit through acquisitions by offshore Special Purpose Acquisition Company (SPAC) vehicles. We are witnessing enhanced levels of interest from SPAC sponsors in the US and Europe to acquire assets in India's RES space.

New entrants from non-related sector ventures in the RES segment to fulfill their ESG mandate

Furthermore, major players from non-related sectors like oil majors, steel producers to leading consumer brands, and other global corporates have also forayed into the renewables market, with a long-only strategy to fulfil their ESG commitments. Also, existing conventional and non-conventional players who have initially marked their presence with pure vanilla RES projects are now aggressively focusing on more futuristic models like hybrid projects, storage facility, PHES and green hydrogen by entering into technology partnerships with European, American, and Australian firms.

Our discussion with industry players also highlighted that the investment opportunity landscape for M&A and PE deals is also shifting from plain vanilla portfolios to more balanced ones comprising hybrids, rooftops, EPC, C&I, etc. These portfolios are fetching much higher multiples and valuations than those of plain vanilla RES developers.

Exhibit 43: Key equity deals announced between Apr 2021 and May 2022

Acquirer/Investor	Target Company	Deal size	Month
Total Carbon Neutrality Ventures, Schieder Electric Energy Access Asia and Capital 4 Development Partners	Freyr Energy	Rs 180 mn	Apr-21
SHV Energy	SunSource Energy	Rs 18 bn	May-21
Adani Green Energy Limited	SB Energy	$3.5 bn	May-21
Actis	Fortum	$333 mn	Jun-21
Norfund and TPG	Fourth Partner Energy	$125 mn	Jul-21
IndiGrid	Fotowatio Renewable Ventures	Rs 6.6 bn	Jul-21
Copenhagen Infrastructure Partners	AMP Energy	$100 mn	Aug-21
Augment Infrastructure	CleanMax	$222.23 mn	Aug-21
Torrent Power	CESC Limited, Haldia Energy Limited and other shareholders	Rs 7.9 bn	Sep-21
Reliance New Energy Solar	Sterling & Wilson	Rs 28 bn	Oct-21
Reliance New Energy Solar	REC Solar Holdings	$771 mn	Oct-21
Jubilant Ingrevia	AMP Green Energy	Rs 551 mn	Oct-21
Siemens Ltd	Sunsole Renewables	Rs 160 mn	Oct-21
Avaada Energy	Essel Group	$1.4 bn	Nov-21
Blackrock	Tata Power	$500-750 mn	Nov-21
SJVN	Solarworld Energy Solutions Pvt Ltd	Rs 3.14 bn	Nov-21
Torrent Power	Visual Percept Solar	Rs 1.63 bn	Feb-22
Reliance New Energy Solar	Altigreen	Rs 501 mn	Feb-22
Virescent Renewable Energy Trust	Godawari Green Energy Limited	Rs 6.65 bn	Feb-22
Airtel	Avaada Clean	Rs 78.8 mn	Mar-22
ThomasLloyd Energy	SolarArise India	$ 34.6 mn	Mar-22
Linde India	Avaada MHYavat	Rs 114 mn	Apr-22
Torrent Power	Sunshakti Solar	Rs 4.2 bn	Apr-22
Shell Overseas Investment	Actis	Rs 118 bn	May-22

Source: Renewable Watch, Elekore, HSIE Research

Exhibit 44: Key debt deals announced between Jan 2021 and Dec 2021

Borrower	Lender	Deal size	Month
TCCL	CDC Group	$30 mn	Jan-21
AGEL	Standard Chartered Bank, Intesa Sanpaolo, MUFG Bank, Sumitomo Mitsui Banking Corporation, Cooperative Rabobanl U.A., DBS Bank, Mizuho Bank, BNP Paribas, Barclays Bank PLC, Deutsche Bank AG, Siemens Bank GmbH and ING Bank N.V.	$1.35 bn	Mar-21
TCCL	JICA	JPY 10 bn	Mar-21
Fourth Partner	CDC Group	Rs 2.5 bn	Apr-21
Azure Power	MUFG	$163 mn	Jul-21
Enel Green Power	AIIB	$50 mn	Jul-21
MYSUN	TCCL	$150 mn	Jul-21
NTPC REL	Bank of India	Rs 5 bn	Sep-21
Vector Green Energy	IREDA	Rs 11 bn	Oct-21
Green Growth Equity Fund	CDC Group	$70 mn	Oct-21
KfW	REC	$169.5 mn	Dec-21

Source: Renewable Watch, Elekore, HSIE Research

Exhibit 45: Green bonds issued between Mar 2021 and Jan 2022

Issuing Company	Amount	Month
Hero Future Energies	$3 bn	Mar-21
ReNew Power	$585 mn	Apr-21
ACME Solar	$334 mn	Jul-21
Adani Electricity Mumbai	$300 mn	Jul-21
Azure Power	$414 mn	Aug-21
Adani Green Energy	$750 mn	Sep-21
State Bank of India	$650 mn	Nov-21
ReNew Energy Global	$400 mn	Jan-22
IRFC	$500 mn	Jan-22

Source: Renewable Watch, Elekore, HSIE Research

Companies:

Borosil Renewables Ltd

Solar glass giant in the making

(TP INR 704; ADD)

BRL is a trailblazer in solar glass business with a capacity of 450 TPD and 35% market share in India

Borosil Renewables Ltd (BRL) is a trailblazer in solar glass business, with current capacity at 450 tonnes per day (TPD). BRL is the largest non-Chinese solar glass producer globally, with around 35% market share in India. As India is planning to enhance its solar capacity 6x-7x over FY22-FY30, BRL is well-placed to leverage the robust growth opportunity. Also, as the robust demand would scale up the domestic cell and module manufacturing capacity, BRL plans to expand its capacity by 6x to 2600 TPD over FY22-FY25 to support ~15GW of solar module manufacturing requirements. The company plans to incur a Capex of INR22bn for it. We see huge revenue potential from the enhanced capacities, strong solar capacity addition and duty imposition on imported solar glasses. We expect BRL's top line/PAT to grow at CAGRs of 65%/29% over FY22-FY25 to INR28.9bn/3.5bn, while EBITDA margin will hover around 32-33%. The RoE is expected to settle at 22% in FY25E, down from 24% in FY21, as robust capacity additions would take some time for initial stabilisation. We initiate coverage on BRL with an ADD recommendation and a TP of INR704 by ascribing a targeted FY25 P/E of 26x (PEG – 0.9x). Our valuation is based on: (1) growing demand for solar PV modules; (2) brownfield expansion plan (6x capacity by FY25); and (3) strong domestic market share.

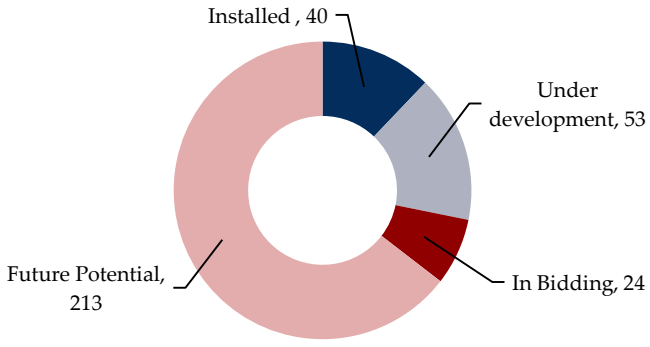
Investment rationale:

Demand to stay up due to potential growth in solar energy

Government's push towards DCR will boosts demand for solar glass

As the country's solar energy capacity is expected to grow 6-7x to ~350 GW by FY30, India would require ~25-30GW of solar capacity addition p.a. It would provide significant growth opportunities to domestic solar glass manufacturers like BRL, which already has a 35% domestic market share in solar glass segment. Further, GoI's push towards key programs of domestic content requirement (DCR) like the SECI scheme, KUSUM and CPSU scheme will support domestic panel manufacturers and lead to greater requirement of solar glass.

Exhibit 46: ~330 GW solar plan by 2030



Source: HSIE Research

Enhancement of PLI scheme to boost domestic solar equipment market

PLI is scheme is expected to add 35 GW of additional domestic solar modules and cells capacity which will bolster demand for solar glass.

The government has extended PLI scheme to solar equipment by allocating additional INR195bn (from earlier INR 45bn) to facilitate domestic manufacturing; it has witnessed strong interest from domestic players, who would like to build up module and cell capacities. This is expected to add ~35GW of additional module and cell manufacturing capacity in India, thus lowering the country's dependency on Chinese equipment. However, not all developers are venturing into solar glass manufacturing because of the technical barriers they would face and readily available surplus capacity in domestic and global market (led by China). Further, solar glass accounts for only ~7% of the total module costing; hence, manufacturers prefer to source it from BRL or Chinese players. Hence, the rising solar module and cell capacity addition will bolster supplies of the domestic solar glass market, which will benefit BRL.

Plan to enhance capacity 6x by FY25

BRL plans to increase its capacity to 2,100 TPD through brownfield expansion.

Bownfield expansion*:* BRL has planned a brownfield expansion of its manufacturing capacity to 2,100 TPD (current level 450 TPD) in two phases, which would support 12 GW of solar module requirements p.a., vs the current level of 2.5 GW. It plans to add 550 MT (which is under construction) by the end of FY23 (for which capex is largely done), which will increase its production capacity to 1,000 TPD. Further, the board has approved capacity expansion through SG4 and SG5 line, which will add another 550 TPD each and will take its capacity to 2,100 TPD by FY25E. BRL will incur Capex of ~INR19.5bn for it over the next three years, which would be largely funded by debt.

Overall capex for 6x capacity expansion by FY25 is expected to be INR22bn

Acquisition of Interfloat Group, GMB**:** Furthermore, the company signed a share purchase agreement to acquire 100% equity stake in Interfloat and GMB (Interfloat Group), Europe's largest solar glass manufacturer, which has an installed capacity of 300 TPD. Interfloat is expected to expand its capacity to 500 TPD in the next 18 months. With this, BRL expects to increase the capacity to 2,600 TPD in CY25 with SG5. The acquisition is largely built to derisk its manufacturing base with a presence in two geographies. The company will shell out €52.5mn for the acquisition (cash - €30mn or ~INR2.5bn and balance through stake sale in BRL).

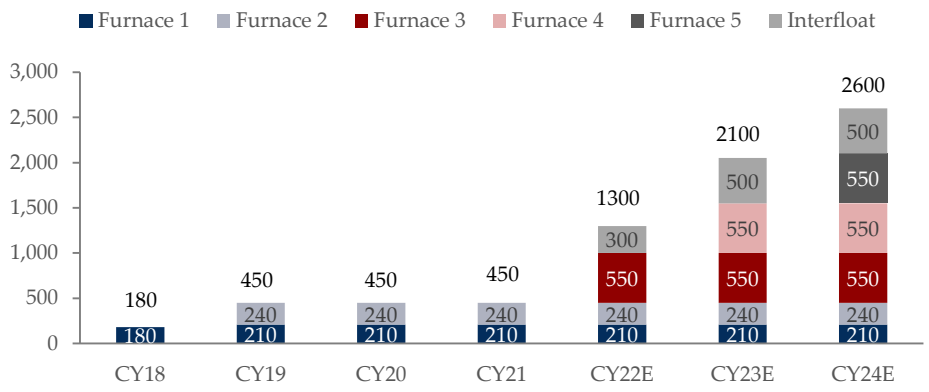
Hence, for both brownfield and acquisitions together, the company is expected to incur Capex of INR22bn from FY23 to FY25.

Europe acquisition to scale up companies' presence in Europe market

Interfloat has 60% market share in Europe's solar glass market

With Interfloat's acquisition, the company plans to leverage upon the growing solar market in European region which plan to add 20GW-25GW of solar capacity p.a. Likewise in India, Europe is also building up to strengthen its domestic cell and modules market so as to lower its dependency on Chinese players. They have already imposed a 40% duty on Chinese solar glasses and could expand the restrictions on other countries as well including India. Interfloat has 60% market share in the European market and the balance 30% is dominated through import segment, with other local payers contributing the balance 10% of the solar glass market. Hence, through this acquisition, BRL targets to strengthen its market share and positioning in the growing European solar market. Also, the acquisition would derisk the company's exposure to growing European market if it imposes import duty on glasses exported from India.

Exhibit 47: Roadmap towards 2600 TPD



Source: Company, HSIE Research

Duty imposition and exclusion of foreign players from ALMM list will safeguard domestic players

Imposition of BCD in import of solar modules and cells will ramp up demand of BRL

With the imposition of BCD of 40%/25% on import of solar modules/cells, GoI targets to lower country's import dependency from China, Malaysia and Vietnam. Also, countervailing duty of 9.71% is levied on textured and tempered glass imported from China for 5 years since March 2021 which would provide a level playing field for domestic solar glass manufacturers like BRL. Furthermore, with the scheme of the approved list of models and manufacturers (ALMM) introduced in FY22, whereby effectively only Indian manufacturers of solar modules are able to supply to many types of government tenders, the government is focusing on safeguarding the domestic players from dumping practices of Chinese players. The scheme have now been extended to open access and net metering projects as well. Apart from this, other initiatives like CPSU scheme, KUSUM scheme, Atmanirbhar Bharat are in place to provide necessary incentives to domestic module manufacturer. All these initiative by the GoI will not only safeguard domestic solar equipment manufacturers but would also lead to incremental domestic modules/cell capacities additions. This would provide an enhanced market opportunity for BRL to meet the solar glass requirement of its domestic customers. Accordingly, the company has planned a robust capacity addition to meet this robust potential demand.

Established customers and technical expertise provides BRL an edge over its peers

BRL has competitive advantage, having met the stringent quality requirements and needs for testing.

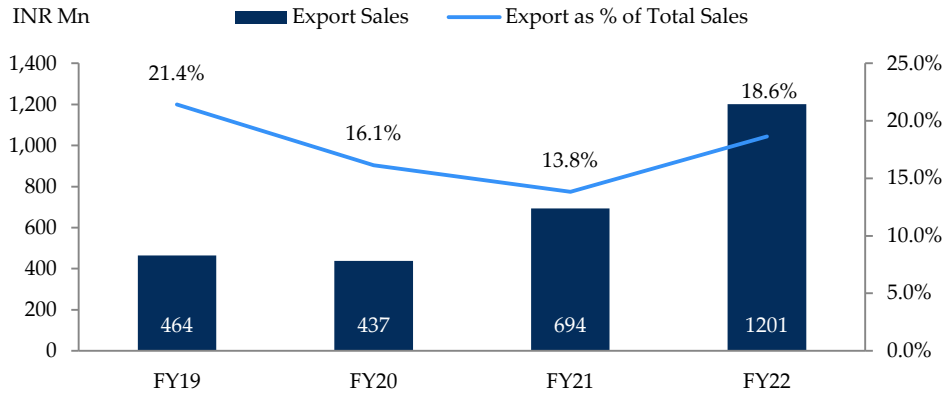
BRL remains the only major domestic producer of solar glass in the country so far and enjoys widespread acceptance. BRL with decade long experience has the technical know-how, economic moat with growing scale of business and strong customer relationship plays an important role which act as a strong entry barrier. Having met the stringent quality requirements and needs for testing at component as well as PV module level, it has an edge over new entrants. By offering shorter lead-time to module manufacturers with assured supplies, works favorably for BRL to secure business. A significant portion of the expansion in module capacity is being done by its existing customers, which will make it relatively easier for BRL to sell them additional volumes. While, other players like Asahi and Goldi glass have also planned capacity expansion within the solar glass segment, we believe they would face stiff competition from both BRL and Chinese players, who already have technical expertise and have established a strong network and market share in the country.

Marking strong presence in export segment as well

BRL exports account for 19% of overall sales

Regions like the EU and the US have set renewable target of reaching 40/50% by 2030. The EU recently extended the anti-dumping duties on solar glass from China by five years. BRL has been providing an increased focus on exports to all markets, including Russia, the Middle East, Africa, North and South America, in addition to the regular markets in the EU and Turkey (exports account for 19% of overall sales and has grown at ~44% CAGR over FY19-FY22).

Exhibit 48: Export sales growth over the years and also as a % of sales



Source: Company, HSIE Research

Shift towards bifacial glass will enhance demand for solar glass

Thinner glass comprises around 30% of total sales of the company and forms the part of exports

Since there has been a structural shift in demand for solar glass with technological changes in solar cells and modules, the modules sizes are becoming larger and there is growing preference for bifacial modules, using two glasses in each module as against one in a conventional one. Thinner glass (2.2-2.8mm size) comprises around 30% of the company's total sales with better margins. On 2mm, this glass size comprises 3-4% of BRL's export but its demand in domestic market is yet to pick up, as prevailing demand is miniscule. However, going ahead, the 2mm glass component's share is expected to rise beyond 30% due to its huge demand from bifacial panels both in domestic and export markets. Further, a 2mm glass commands 25% premium above the price of a normal 3mm one. Glass to glass modules using bifacial cells can enhance power generation by 10-15%. As per projections by International Technology Roadmap for Photovoltaic, bifacial modules will grow until they constitute 60% of global solar glass demand (expected by 2025). The company is also increasing its sale of solar glass with anti-soiling coating. It has successfully developed an anti-glare glass, certified for use in solar modules installed around airports. The company has recently obtained a patent for antimony-free glass.

Exhibit 49: Global PV glass outlook

Particulars	Unit	CY20	CY21P	CY22E	CY23E
Global Installed Capacity	GW	120	160	220	270
Average Module Efficiency	%	18.5%	19.2%	19.6%	20.0%
Global PV glass demand	100 Mn square metres	9.14	11.25	15.71	19.58
3.2 mm glass demand	100 Mn square metres	4.92	5.42	6.73	7.43
2.0 mm glass demand	100 Mn square metres	4.22	5.83	8.98	12.15
Total global PV glass capacity demand	Tonnes/day	22061	26136	35386	42778
YoY	%	5.95%	18.47%	35.4%	20.89%

Source: CLSA Global

Exhibit 50: Growth of Glass-Glass Modules

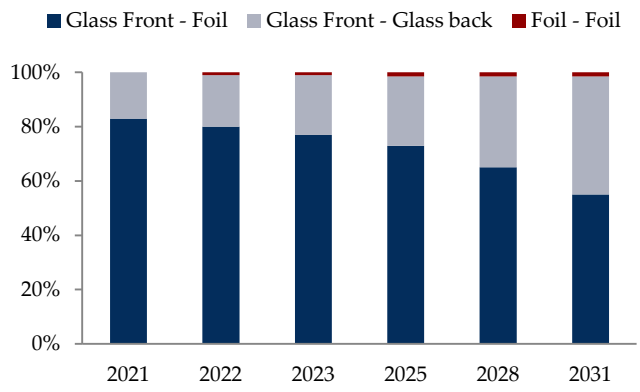
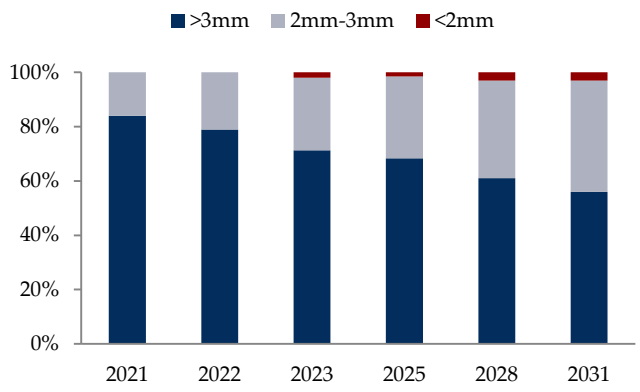
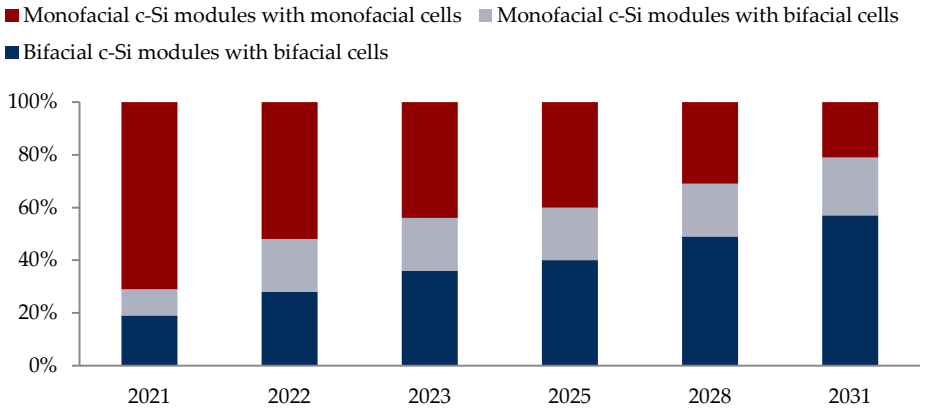


Exhibit 51: Growth of Thinner Modules



Source: Company, HSIE Research

Exhibit 52: Growth of bifacial modules



Source: Company, HSIE Research

Key risks

Dumping by Chinese players may force BRL to cut prices, which will dent margin

Customers of BRL follow the price trend of imported glass and therefore become reluctant to pay higher price to BRL

95% of the global production of solar glass is controlled by Chinese companies like Xinyi solar and Flat glass, which determines international pricing. Since BRL's customers follow the price trend of imported glass, they become reluctant to pay a higher price for the company's product. Large capacity additions have been initiated by Chinese companies. Any drastic change in policy or supply/demand mismatch can result in surplus capacity for module/glass, which could enhance dumping at heavily discounted prices and, therefore, put severe pressure on selling prices of glass, adversely impacting profitability.

Failure in executing module expansion plan could hurt solar glass market

Steady volumes are a must in this industry to maintain margins. Government's effort to provide solar power at the cheapest prices and methods like reverse bidding for power projects and capping of tariffs have led to possibilities of compromise on quality and long-term aspects of power generation. Lower prices, insufficient margins, and continuous change in cell technologies have deterred manufacturers of components from taking up expansion. While the government's PLI scheme to boost domestic manufacturing has received a positive response from participants, any delay in its execution and disbursal could impact the capacity expansion plan, which would severely impact the demand for solar glass in domestic market.

Non extension of anti-dumping duty post Aug-22 could impact BRL's sales

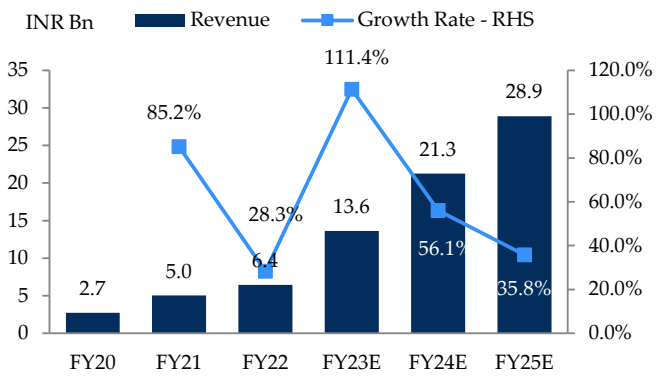
Anti-dumping duty against the import of solar glass from China is valid until August 2022. The proposal to extend the same has been recommended to the ministry of finance. If it is not extended, it can lead to renewed dumping by Chinese players in the Indian market. A similar recommendation on duty imposition is expected to be made for Malaysia and Vietnam as Chinese players have set up manufacturing units there to avail duty waivers. If the duty on China does not get extended and there is a failure to impose duties on Vietnam and Malaysia, BRL may witness stiff pricing pressure, which would force it to cut prices and further dent its profitability.

EBITDA/PAT expected to increase at a CAGR of 56%/29% over FY22-25 at an EBITDA margin of 32% and RoE of 22%

Financial

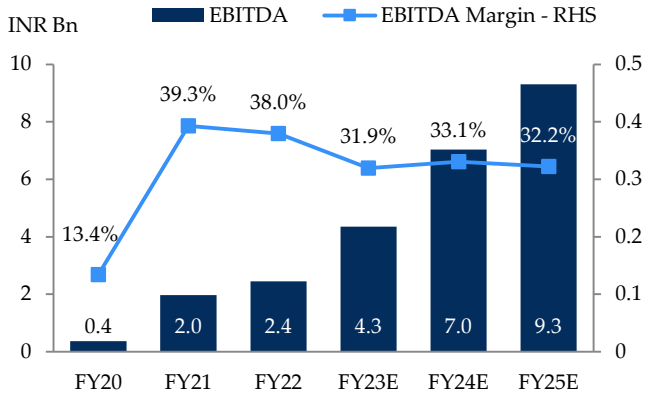
We expect BRL's revenue to grow at a CAGR of 65% over FY22-FY25 to INR28.9bn, led by 6x increase in its capacity addition from 450 TPD in FY22 to 2,600TPD by FY25. EBITDA, too, is expected to grow at a CAGR of 56% over the same period to INR9.3bn, with a margin of 32%. PAT, however, is expected to grow at a CAGR of 29% over FY22-FY25 to INR3.5bn as increased Capex and debt would dent its earnings during the initial stages of stabilisation period, when the new capacities will operate at low utilisation levels. BRL's depreciation and interest costs are expected to increase at a CAGR of 96% and 233% respectively over the same period. We expect RoE to remain largely around 22%, with D/E increasing towards 0.8x, from almost nil in FY22. We value BRL at 26x its FY25 EPS (PEG – 0.9x) to arrive at a TP of INR704/share, which provides a potential upside of 9% from its CMP of INR645. We initiate coverage on BRL with an ADD rating.

Exhibit 53: Revenue and revenue growth rate



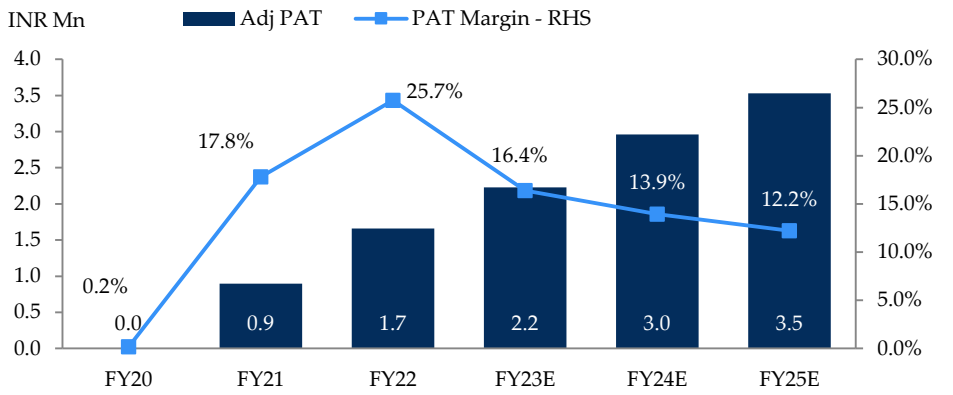
Source: Company, HSIE Research

Exhibit 54: EBITDA and EBITDA Margin



Source: Company, HSIE Research

Exhibit 55: PAT and PAT Margin



Source: Company, HSIE Research

Financials (Standalone)

INCOME STATEMENT

INR Mn	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E	FY25E
Net Revenues	**1,981**	**2,168**	**2,712**	**5,023**	**6,442**	**13,618**	**21,258**	**28,877**
Growth (%)	***5.2***	***9.4***	***25.1***	***85.2***	***28.3***	***111.4***	***56.1***	***35.8***
Power&Fuel	343	413	555	758	1,063	2,580	3,837	5,239
Purchases of stock and Packing Material Consumes adj for Change in Inventory	523	558	842	1,076	1,138	2,672	4,385	5,925
Packing Materials Consumed	115	116	135	-	-	681	1,116	1,624
Consumption of Stores and Spares	-	-	74	101	-	-	-	-
Freight Outward	-	-	181	272	-	-	-	-
Employee Cost	237	267	268	346	453	885	1,275	1,733
O&M and Other expenses	310	476	291	494	1,343	2,451	3,614	5,053
EBITDA	**452**	**338**	**364**	**1,974**	**2,445**	**4,348**	**7,030**	**9,303**
EBITDA Margin (%)	*22.8*	*15.6*	*13.4*	*39.3*	*38.0*	*31.9*	*33.1*	*32.2*
EBIDTA Growth (%)	*-1.8*	*-25.1*	*7.7*	*441.7*	*23.9*	*77.8*	*61.7*	*32.3*
Depreciation	167	179	321	421	424	965	2,015	3,181
EBIT	**285**	**160**	**43**	**1,553**	**2,021**	**3,383**	**5,016**	**6,122**
Other Income (Including EO Items)	35	80	36	54	205	107	53	27
Interest	138	4	67	80	28	345	778	1,032
PBT	**182**	**235**	**13**	**1,527**	**2,198**	**3,145**	**4,291**	**5,117**
Tax	-2	-1	8	630	539	915	1,330	1,586
RPAT	**185**	**236**	**5**	**897**	**1,658**	**2,230**	**2,961**	**3,530**
EO (Loss) / Profit (Net of Tax)								
APAT	**185**	**236**	**5**	**897**	**1,658**	**2,230**	**2,961**	**3,530**
APAT Growth (%)	*-5.9*	*27.5*	*-98.1*	*19,699.6*	*85.0*	*34.5*	*32.8*	*19.2*
AEPS	**8**	**3**	**0**	**7**	**13**	**17**	**23**	**27**
EPS Growth (%)	*-5.9*	*27.5*	*-98.1*	*19,699.6*	*85.0*	*34.5*	*32.8*	*19.2*

BALANCE SHEET

INR mn	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E	FY25E
SOURCES OF FUNDS								
Share Capital	23	92	114	130	130	130	130	130
Reserves	8,319	3,230	3,150	6,015	7,718	11,948	14,909	18,440
Total Shareholders' Funds	**8,342**	**3,322**	**3,264**	**6,145**	**7,849**	**12,079**	**15,040**	**18,570**
Long-term Debt	0	237	768	600	1,396	6,720	10,567	11,159
Short-term Debt	100	189	159	193	176	1,366	2,119	2,481
Deferred Tax Liabilities	225	118	66	219	263	363	463	563
Total Debt	**324**	**544**	**993**	**1,011**	**1,835**	**8,449**	**13,149**	**14,202**
TOTAL SOURCES OF FUNDS	**8,667**	**3,866**	**4,258**	**7,157**	**9,684**	**20,528**	**28,188**	**32,772**
APPLICATION OF FUNDS								
Net Block	**2,325**	**1,169**	**3,447**	**3,203**	**2,779**	**12,722**	**17,457**	**27,026**
CWIP	70	1,251	10	42	2,968	3,188	6,188	100
Investments	1,946	13	20	48	51	51	51	51
Other Non-Current Assets	944	449	181	66	912	912	912	912
Total Non-current Assets	**5,285**	**2,882**	**3,658**	**3,359**	**6,710**	**16,872**	**24,608**	**28,089**
Inventories	621	370	468	379	688	1,199	1,742	2,197
Debtors	941	241	406	724	596	1,679	2,330	2,769
Cash & Equivalents	117	2	8	22	183	562	246	1,093
ST Loans & Advances	534	37	3	355	4	360	593	802
Current Investments	1,872	457	70	2,803	2,137	1,068	534	267
Other Current Assets	184	263	324	188	238	242	282	282
Total Current Assets	**4,269**	**1,370**	**1,280**	**4,470**	**3,845**	**5,110**	**5,726**	**7,410**
Creditors	427	102	174	224	326	705	1,161	1,506
Provisions	44	15	22	34	38	56	66	67
Other Current Liabilities	417	268	484	414	507	694	918	1,153
Total Current Liabilities	**887**	**386**	**680**	**672**	**871**	**1,455**	**2,145**	**2,726**
Net Current Assets	**3,382**	**984**	**600**	**3,798**	**2,974**	**3,656**	**3,581**	**4,683**
TOTAL APPLICATION OF FUNDS	**8,667**	**3,866**	**4,258**	**7,157**	**9,684**	**20,528**	**28,188**	**32,772**

Source: Company, HSIE Research

CASH FLOW STATEMENT

INR Mn	FY19	FY20	FY21	FY22	FY23E	FY24E	FY25E
Reported PBT	235	13	1,527	2,198	3,145	4,291	5,117
PBT from discontinued operations	348						
Non-operating & EO Items	80	36	54	205	107	53	27
Interest Expenses	-162	59	50	-165	345	778	1,032
Depreciation	204	321	421	424	965	2,015	3,181
Working Capital Change	-958	15	-153	-60	-1,014	-543	-314
Tax Paid	156	146	235	663	815	1,230	1,486
OPERATING CASH FLOW (a)	**-570**	**226**	**1,557**	**1,529**	**2,519**	**5,257**	**7,503**
Capex	*1,553*	*1,047*	*268*	*3,731*	*11,120*	*9,750*	*6,663*
Free Cash Flow (FCF)	**-2,123**	**-821**	**1,289**	**-2,202**	**-8,601**	**-4,493**	**841**
Investments	1,237	395	-2,705	760	1,068	534	267
Non-operating Income	-42	81	-292	576	-258	-179	-182
INVESTING CASH FLOW (b)	**-359**	**-571**	**-3,265**	**-2,395**	**-10,309**	**-9,395**	**-6,577**
Debt Issuance/(Repaid)	997	496	-141	785	5,298	3,876	592
Other Financing activity	-45	-75	-151	-57	871	-55	-670
Payment of Dividend	70	69	0	-195	0	0	0
Share Capital Issuance	0	0	2,014	36	2,000	0	0
FINANCING CASH FLOW (c)	**882**	**351**	**1,722**	**959**	**8,169**	**3,822**	**-78**
NET CASH FLOW (a+b+c)	**-46**	**6**	**14**	**93**	**379**	**-316**	**847**
Opening cash balance	49	2	8	22	183	562	246
Closing Cash & Equivalents	**2**	**8**	**22**	**183**	**562**	**246**	**1,093**

KEY RATIOS

Particulars	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E	FY25E
PROFITABILITY (%)								
GPM	56.3%	55.2%	48.5%	63.5%	65.8%	61.4%	61.3%	61.3%
EBITDA Margin	22.8%	15.6%	13.4%	39.3%	38.0%	31.9%	33.1%	32.2%
EBIT Margin	14.4%	7.4%	1.6%	30.9%	31.4%	24.8%	23.6%	21.2%
APAT Margin	9.3%	10.9%	0.2%	17.8%	25.7%	16.4%	13.9%	12.2%
RoE	2.0%	4.0%	0.1%	19.1%	23.7%	22.4%	21.8%	21.0%
RoCE	3.7%	3.8%	2.0%	28.1%	26.4%	23.1%	20.8%	20.2%
EFFICIENCY								
Tax Rate (%)	-1.3%	-0.3%	64.5%	41.3%	24.5%	29.1%	31.0%	31.0%
Asset Turnover (x)	0.2	0.5	0.5	0.6	0.6	0.6	0.7	0.8
Inventory (days)	234	113	109	67	105	85	75	70
Debtors (days)	173	41	55	53	34	45	40	35
Payables (days)	161	31	40	40	50	50	50	48
Cash Conversion Cycle (days)	207	116	114	44	64	50	35	27
Net Debt/EBITDA (x)	-4.2	-0.1	2.3	-1.0	-0.3	1.5	1.7	1.3
Net D/E	-0.2	0.0	0.3	-0.3	-0.1	0.5	0.8	0.7
Interest Coverage	2.3	55.6	1.2	20.2	79.5	10.1	6.5	6.0
PER SHARE DATA								
EPS (Rs/sh)	8	3	0	7	13	17	23	27
CEPS (Rs/sh)	15	4	3	10	16	25	38	52
DPS (Rs/sh)								
BV (Rs/sh)	361	36	29	47	60	93	115	142
VALUATION								
P/E	81.0	254.3	16,338.2	94.1	51.0	37.9	28.6	23.9
P/BV	1.8	18.0	22.7	13.7	10.8	7.0	5.6	4.6
EV/EBITDA	-0.9	17.6	22.6	3.2	3.2	3.4	2.9	2.2
OCF/EV (%)	0.0	-0.1	0.0	0.2	0.2	0.2	0.3	0.4
FCF/EV (%)	**0.0**	**0.1**	**0.0**	**0.3**	**0.1**	**0.5**	**0.2**	**0.0**

Source: Company, HSIE Research

NTPC

Evolution into a cleaner and greener company is taking shape

(TP INR 174; BUY)

NTPC is striving to increase the pie of its capacity mix more in favour of renewables, from ~3% currently (1.9GW) to 46% in FY32 (60.0GW), as a part of its transition to become an integrated power company. We believe NTPC is making huge strides in transforming itself into a company with cleaner coal assets, higher share of renewables, and greater focus on ESG parameters. Although this transition will take place over the next decade, it will require huge investments, which would largely be funded through cash flows generated from its current basket of thermal assets. Thus, current thermal technologies will continue to play a vital role of both supporting power demand and funding future green technologies. It plans to install ~2.5GW of incremental RES capacity by FY24, followed by another ~55GW by FY32. Over FY22-24E, we expect 6.6% CAGR in PAT while generating INR346bn in FCF. Management plans to monetise its trading arm and renewable business, which will enhance the value proposition for stakeholders. We maintain BUY with a TP of INR 174/share, assigning a 1.2x BV to its regulated equity and a 1.5x BV to its equity investment in 8GW of upcoming solar capacities. The stock is attractively valued at 1.0x/7.6x FY24 P/BV and PE.

Key investment rationale

- **Risk averse regulatory business model**: NTPC operates on a risk averse regulatory business model, with fixed return on project equity. It has an installed capacity of 69.1GW on a consolidated level and 54.6GW on a standalone level as of FY22 and plans to become a 130-GW firm by 2032. We expect 6.5% earnings CAGR over FY21-24E from the rise in regulated equity, improved availability of coal due to better coal supply from Coal India, and captive mining.

NTPC expects to add 2.5GW solar capacity in FY23/24

- **Expect NTPC to commercialise 4.7 GW in FY23E and 6.0 GW in FY24E**: NTPC has commercialised 2.9 GW in FY22 and for entire FY23E/FY24E, we expect asset commercialisation of 4.7GW/6.0GW.NTPC currently has 1.9GW of installed RES capacity, while another ~5GWof RES capacity is under construction and in the tendering stage. We expect the company to commission 2.5GW of Solar capacity over FY23-24. The capacity addition pace has been slightly impacted due to steep rise in module prices and GIB related issue which has stuck ~900MW of its solar projects in Rajasthan.

Regulated equity expected to grow at a CAGR of 7.0% over FY22-24 to reach Rs820bn

- **Stable growth across regulated equity will continue to enhance earnings**: NTPC's earnings growth mirrors its rise in regulated equity, driven by its cost plus model, where it earns 15.5% RoE on project equity. Overall, the company has ~13GW of thermal projects under execution, which provide growth visibility in regulated equity over the next three years. Further, factoring in the current power supply crisis, the company has planned to add incremental 6GW of coal capacity for a Capex of INR600bn. Discoms have already provided PPA consent for these projects on regulatory norms. Based on our capacity addition assumptions, NTPC's standalone regulated equity will grow at a CAGR of 7.0% over FY22-FY24E to INR820bn, from INR704bn in FY22. The incremental INR116bn of regulated equity will provide an additional INR18.0bn rise in its standalone PAT to INR174.2bn in FY24.

Even at aggressive tariffs, the solar projects are likely to earn equity IRR of ~12%

- **With greater focus on clean energy, the target is to increase score in ESG metrics**: In a move to transform itself into a cleaner source of energy, NTPC is planning huge capacity addition in the RES space. Along with implementation of FGDs across its coal-based plants, the company plans to add 60GW of RES capacity by 2032, with an aim to build a 40% non-fossil fuel portfolio by 2032, up from 3.0% in

FY22. NTPC currently has 1.9-GW of operational solar projects, with another 3.4GW of capacity under construction and 2.8GW under tendering stage. With cost of debt low at ~6.3% and waiver of development costs by states, the company can earn an equity IRR of 12% even by bidding for projects at aggressive tariffs. The company targets to add 2.5GW of solar capacity by FY24. With cleaner emissions from thermal projects and greater thrust on renewable capacity, the company's score on the ESG metrics is expected to improve in the coming years.

- **Cash flow sufficient to fund Capex**: While the transition to a cleaner source of energy will take place over the next decade, capacity addition and implementation of FGD equipment would require huge investments. We believe that with improved earnings and efficient working capital management, NTPC would generate sufficient cash flow to fund this Capex. We expect the company to generate an FCF of INR346bn over FY22-24E. Eventually, the existing thermal assets will continue to play a vital role in not only meeting the future power demand but also providing sufficient cash flow to meet equity requirement for upcoming RES projects.

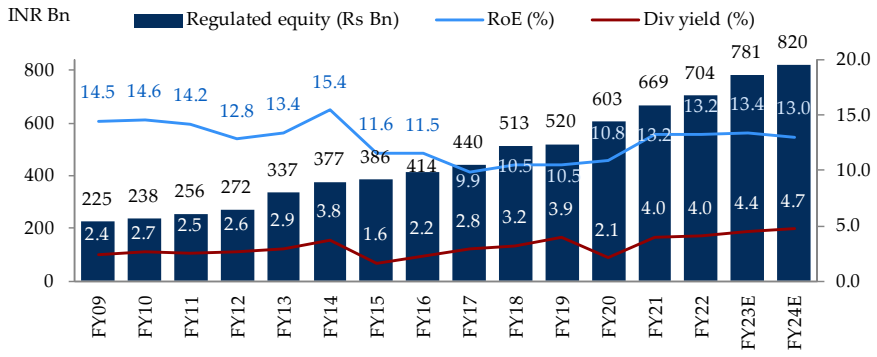
We expect the company to generate a FCF of INR346bn over FY22-24E.

Exhibit-57: Key assumption for standalone business

	FY20	FY21	FY22	FY23E	FY24E
Standalone capacity addition (MW)	3940	3080	3292	4872	6320
Cumulative Standalone capacity (MW)	50198	53278	56408	61442	67762
Regulated Equity (INRbn)	603	669	704	781	820
Coal PLF (%)	70%	62%	68%	66%	64%

Source: Company, HSIE Research

Exhibit-58: Key assumption for standalone business



Source: Company, HSIE Research

PAT is expected to grow at a CAGR of 7% over FY22-24.

Valuation: NTPC plans to add 60GW of RES capacity by FY32 and it has 7GW under construction. Along with strong Capex on the thermal front, this would drive earnings growth at 6.6% CAGR over FY22-24E and improve the RoE. While 14GW of the company's capacity will have completed 25 years of plant life by FY22, their PPAs are expected to continue. It plans to monetise the trading arm and renewable business, going ahead. We maintain BUY with a TP of INR 174/share, assigning a 1.2x BV to regulated equity and a 1.5x BV to equity investment in 7GW of upcoming solar capacities. The stock is trading at a discount to its peers, with FY24 consolidated P/BV at 1.0x and PE at 7.6x.

Exhibit-59: Valuation table

SOTP	Total value(INR Bn)	Per/share	Multiple	TP (INR/share)
Regulated Equity std alone	820	85	1.2	98
CWIP	218	23	0.7	16
Cash & Inv	310	32	1.0	32
Regulated Equity JV	179	18	0.9	17
RES project	80	8	1.5	12
Target Price				**174**

Key risks:

Key downside risks that could impede NTPC shares from reaching our target price include the following:

- Slower execution in project completion, which could delay capacity addition
- A weak ramp-up of domestic coal supply from CIL and captive coal blocks
- Changes in the regulatory environment–NTPC's RoE could be impacted if any stringent norms are implemented by the CERC. The regulator had enforced stringent norms earlier which have impacted plant incentives; these norms are related to tax calculation, return on equity, and tightening of O&M expenses

Financials (Standalone)

INCOME STATEMENT

INR mn	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E
Net Revenues	**8,29,450**	**9,00,768**	**9,49,879**	**9,91,536**	**10,73,766**	**11,93,722**	**12,68,762**
Growth (%)	***6.7***	***7.9***	***8.6***	***5.5***	***4.4***	***8.3***	***11.2***
Power&Fuel	4,96,290	5,52,074	5,62,943	5,47,925	5,79,933	6,57,685	6,82,984
Employee Cost	42,987	47,799	49,256	49,422	53,114	54,323	56,870
O&M and Other expenses	64,884	66,577	90,201	92,368	98,640	1,00,885	1,05,616
Total Operating Expenses	6,04,161	6,66,450	7,02,401	6,89,715	7,31,687	8,12,892	8,45,470
EBITDA	**2,25,289**	**2,34,318**	**2,47,478**	**3,01,820**	**3,42,079**	**3,80,830**	**4,23,292**
EBITDA Margin (%)	***27.2***	***26.0***	***26.1***	***30.4***	***31.9***	***31.9***	***33.4***
EBIDTA Growth (%)	***12.0***	***4.0***	***5.6***	***22.0***	***13.3***	***11.3***	***11.2***
Depreciation	70,989	72,544	88,127	1,04,118	1,21,880	1,31,778	1,48,635
EBIT	**1,71,853**	**1,80,495**	**1,87,131**	**2,41,162**	**2,61,487**	**2,82,081**	**3,01,081**
Other Income (Including EO Items)	17,553	18,721	27,780	43,460	41,287	33,030	26,424
Interest	39,843	47,167	67,820	74,590	77,490	83,155	92,801
PBT	**1,32,010**	**1,33,328**	**1,19,312**	**1,66,572**	**1,83,996**	**1,98,926**	**2,08,280**
Tax	36,106	-28,915	65,512	39,990	43,219	46,778	49,137
RPAT	**1,07,945**	**1,17,499**	**1,01,102**	**1,37,695**	**1,53,233**	**1,65,849**	**1,74,214**
Rate regulated activities	8,153	-53,834	48,288	17,794	12,456	13,701	15,071
EO (Loss) / Profit (Net of Tax)	6,212	14,521	-1,575	-10,671	0	0	0
APAT	**1,04,056**	**1,08,409**	**1,02,088**	**1,44,375**	**1,53,233**	**1,65,849**	**1,74,214**
APAT Growth (%)	*10.9*	*4.2*	*-5.8*	*41.4*	*6.1*	*8.2*	*5.0*
AEPS	**12.3**	**10.7**	**11.5**	**14.7**	**15.8**	**17.1**	**18.0**
EPS Growth (%)	*10.9*	*4.2*	*-5.8*	*27.1*	*7.8*	*8.2*	*5.0*

BALANCE SHEET

INR mn	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E
SOURCES OF FUNDS							
Share Capital	82,455	98,946	98,946	96,967	96,967	96,967	96,967
Reserves	9,35,323	9,75,136	10,36,749	10,92,888	11,84,828	12,84,337	13,88,866
Total Shareholders' Funds	**9,30,645**	**10,36,722**	**10,39,084**	**10,72,850**	**11,64,790**	**12,64,299**	**13,68,828**
Long-term Debt	10,86,976	11,96,981	14,65,387	14,97,590	15,22,030	16,44,319	16,75,184
Short-term Debt	65003	155029	140494	143303	146170	149093	152075
Total Debt	**11,51,979**	**13,52,010**	**16,05,881**	**16,40,894**	**16,68,199**	**17,93,412**	**18,27,259**
Deferred revenues & Regulatory deferral A/C credit balance	20,859	21,394	32,425	19,944	19,944	19,944	19,944
Long-term Provisions & Others	26,456	19,030	12,879	33,287	33,287	33,287	33,287
Net Deferred Tax Liability	1,00,472	42,001	80,940	91,610	91,610	91,610	91,610
TOTAL SOURCES OF FUNDS	**23,17,543**	**25,08,517**	**28,67,819**	**29,75,590**	**30,94,835**	**33,19,557**	**34,57,933**
APPLICATION OF FUNDS							
Net Block	**11,94,276**	**12,52,907**	**15,62,730**	**16,38,921**	**16,35,297**	**17,61,641**	**17,40,606**
CWIP	7,90,763	9,12,067	7,33,593	7,54,385	7,92,104	8,31,709	8,73,295
Investments	1,00,475	1,31,459	2,64,009	2,86,256	3,14,882	3,77,858	4,53,430
LT Loans & Advances	87,133	37,359	96,610	1,17,005	1,17,005	1,17,005	1,17,005
Total Non-current Assets	**21,72,646**	**23,33,793**	**26,56,942**	**27,96,567**	**28,59,287**	**30,88,213**	**31,84,336**
Inventories	60,574	79,880	1,07,319	91,789	1,11,220	1,26,131	1,30,983
Debtors	75,780	84,339	1,56,681	1,37,017	1,61,800	1,89,687	2,08,564
Cash & Equivalents	39,784	21,443	22,091	23,385	52,788	43,193	38,564
ST Loans & Advances	1,91,175	2,36,943	2,02,161	2,18,666	2,14,496	2,16,225	2,24,543
Other Current Assets	1,38,363	1,52,380	1,31,480	1,64,770	1,69,713	1,83,290	1,97,953
Total Current Assets	**5,05,675**	**5,74,985**	**6,19,732**	**6,35,627**	**7,10,017**	**7,58,526**	**8,00,607**
Creditors	2,79,889	3,31,857	3,40,553	3,83,844	4,00,924	4,45,420	4,40,108
Provisions	80,888	68,404	68,302	72,761	73,546	81,762	86,902
Total Current Liabilities	**3,60,778**	**4,00,261**	**4,08,855**	**4,56,604**	**4,74,470**	**5,27,182**	**5,27,009**
Net Current Assets	**1,44,898**	**1,74,724**	**2,10,877**	**1,79,023**	**2,35,547**	**2,31,344**	**2,73,597**
TOTAL APPLICATION OF FUNDS	**23,17,543**	**25,08,517**	**28,67,819**	**29,75,590**	**30,94,835**	**33,19,557**	**34,57,933**

Source: Company, HSIE Research

CASH FLOW STATEMENT

INR Mn	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E
Reported PBT	1,32,010	1,33,328	1,19,312	1,66,512	1,83,996	1,98,926	2,08,280
Non-operating & EO Items	-17,553	-18,721	-27,780	-43,460	-41,287	-33,030	-26,424
Interest Expenses	-39,843	-47,167	-67,820	-74,590	-77,490	-83,155	-92,801
Depreciation	-70,989	-72,544	-88,127	-1,04,118	-1,21,880	-1,31,778	-1,48,635
Working Capital Change	89,400	-1,06,637	3,433	43,818	-27,121	-5,392	-46,882
Tax Paid	-25,768	-46,899	-24,933	-25,974	-43,219	-46,778	-49,137
OPERATING CASH FLOW (a)	**2,88,921**	**80,781**	**2,25,979**	**3,19,605**	**2,84,194**	**3,42,361**	**3,42,344**
Capex	-2,58,029	-2,52,479	-2,19,476	-2,01,101	-1,55,974	-2,97,728	-1,69,185
Free Cash Flow (FCF)	*30,891*	*-1,71,698*	*6,502*	*1,18,503*	*1,28,220*	*44,633*	*1,73,159*
Investments	-1,00,876	-12,196	-3,24,350	-64,889	-57,251	-1,25,953	-1,51,143
Non-operating Income	17,553	18,721	27,780	43,460	41,287	33,030	26,424
Others	-78,974	49,773	-59,251	-20,394	0	0	0
INVESTING CASH FLOW (b)	**-3,30,402**	**-2,14,969**	**-3,83,497**	**-2,00,283**	**-1,43,313**	**-3,27,675**	**-2,18,334**
Debt Issuance/(Repaid)	1,42,579	1,93,140	2,58,752	42,940	27,306	1,25,213	33,847
Interest Expenses	-39,843	-47,167	-67,820	-74,590	-77,490	-83,155	-92,801
Other Financing activity	-6,155	15,553	8,392	-22,821	0	0	0
Share Capital Issuance	0	16,491	0	-1,979	0	0	0
Dividend	-44,622	-62,169	-41,158	-61,577	-61,293	-66,340	-69,686
FINANCING CASH FLOW (c)	**51,960**	**1,15,848**	**1,58,166**	**-1,18,028**	**-1,11,478**	**-24,281**	**-1,28,639**
NET CASH FLOW (a+b+c)	**10,479**	**-18,340**	**648**	**1,294**	**29,404**	**-9,596**	**-4,629**
Opening cash balance	29,305	39,784	21,443	22,091	23,385	52,788	43,193
Closing Cash & Equivalents	**39,784**	**21,443**	**22,091**	**23,385**	**52,788**	**43,193**	**38,564**

Source: Company, HSIE Research

KEY RATIOS

	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E
PROFITABILITY (%)							
GPM	40.2	38.7	40.7	44.7	46.0	44.9	46.2
EBITDA Margin	27.2	26.0	26.1	30.4	31.9	31.9	33.4
EBIT Margin	18.6	18.0	16.8	19.9	20.5	20.9	21.6
APAT Margin	11.6	18.0	5.7	12.8	13.1	12.7	12.5
RoE	10.5	10.5	10.8	13.2	13.4	13.4	13.0
Core RoE	11.0	11.0	9.8	13.7	13.7	13.7	13.2
RoCE	8.1	7.7	7.1	8.6	9.0	9.1	9.2
EFFICIENCY							
Tax Rate (%)	27.4	-21.7	54.9	24.0	23.5	23.5	23.6
Asset Turnover (x)	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Inventory (days)	27	32	41	34	38	39	38
Debtors (days)	33	34	60	50	55	58	60
Payables (days)	169	182	177	203	200	200	190
Cash Conversion Cycle (days)	-23	-3	14	-25	35	23	35
Net Debt/EBITDA (x)	5.1	5.9	6.6	5.5	4.9	4.7	4.4
Net D/E	1.2	1.3	1.6	1.6	1.4	1.4	1.3
Interest Coverage	0.2	0.3	0.4	0.3	0.3	0.3	0.3
PER SHARE DATA							
EPS (Rs/sh)	12.3	10.7	11.5	14.7	15.8	17.1	18.0
CEPS (Rs/sh)	21.2	17.7	19.2	25.6	28.4	30.7	33.3
DPS (Rs/sh)	4.6	5.4	3.6	6.4	6.3	6.8	7.2
BV (Rs/sh)	116.1	106.7	106.3	110.7	120.0	130.0	140.6
VALUATION							
P/E	12.6	14.5	13.5	10.6	9.8	9.1	8.6
P/BV	1.3	1.5	1.5	1.4	1.3	1.2	1.1
EV/EBITDA	10.8	12.4	12.8	10.5	9.3	8.7	7.9
OCF/EV (%)	11.8	2.8	7.1	10.1	9.0	10.3	10.2
FCF/EV (%)	1.3%	-5.9%	0.2%	3.7%	4.0%	1.3%	5.2%
Dividend Yield (%)	**3.0**	**3.5**	**2.3**	**4.1**	**4.1**	**4.4**	**4.6**

Source: Company, HSIE Research

Tata Power

Strengthening renewable business but valuation seems fair

(TP INR 231; REDUCE)

Tata Power (TPWR) has fully positioned itself to capitalise on the significant growth opportunity that lies ahead in the renewable business, led by the country's green energy revolution. The company holds a strong leadership position in various renewable sub-segments, including solar EPC, solar pumps, EV charging, and setting up of own utility capacities. TPWR's transition into the green segment is gaining strong momentum, with nearly 40/10% market share enjoyed by its EV charging/solar EPC segments. The company has reported strong 50% YoY revenue growth across its EPC division in recent quarters and has consistently maintained a healthy order book of ~INR120-130bn by winning fresh orders alongside strong executions. The company also plans to incur INR34bn in Capex to enhance its cell and module manufacturing capacities by 4GW each. Furthermore, with discoms de-licensing opportunity, the company will continue to build its legacy in the regulated business. The recent renewable deal will provide the equity Capex for renewables; however, its valuation stands below our expectation. Hence, we believe that the company is fairly valued at CMP and thus provides limited upside potential. Hence, we maintain our REDUCE rating, with a SoTP TP of INR231.

EPC segment will continue to benefit with strong order book from rising capacity addition in the solar segment

Strong order book in solar EPC business to increase earnings multifold: Tata Power Solar is one of the largest EPC players in India and a major beneficiary of the growing thrust on solar capacity addition in the country. The segment has a strong order book of over ~3GW in the pipeline valued at ~INR122.8bn as of Q4FY22. Tata Power plans to add at least 2GW of solar capacity p.a. while NTPC (which shares a major chunk of the company's EPC order book) plans to add 60GW of solar capacity over the next decade. Both these opportunities, alongside robust capacity addition by other players, provide a bright future growth outlook for its TPWR's EPC segment. The company targets to enhance its market share in the EPC segment from current 17-18% to over 20-22% over FY22-FY25 and aims to maintain an order book of 3.5-4GW every year.

Tata power to gain from its early mover advantage into the EV charging space. With 15% market share, we believe there is a potential business opportunity of ~US$650-750mn for Tata Power

Expansion in cells and modules: TPWR plans to incur a Capex of INR34bn over the next 18 months to enhance its cell and module manufacturing capacity by 4GW each. Its EPC order book, as on date, stands at INR122.8bn and is gaining strong traction across orders for solar pump, rooftop, and utility based EPC segments. This will help Tata Power to retain its market share and leadership position in the solar EPC segment, which is on the verge of robust domestic expansion led by the government of India's huge thrust on in-house solar equipment manufacturing through PLI schemes.

Growing presence in EV segment: The EV ecosystem in India's auto segment is still in nascent stages, but it should undergo a major transition in the next decade. TPWR is strengthening its EV charging segment by signing MoUs with many realty developers (Lodha, Kolte Patil) and auto pioneers like TVS Motors and Apollo Tyres to deploy charging stations. We believe that Tata Power would be a beneficiaries in this ecosystem; benefitting as an early mover into the segment. Also, the transition may be slow from 2W/3W and then 4W, but the setting up of charging infrastructure will be critical in the first place to alleviate any hindrance to such adoption. Market studies have estimated that the EV charger market would touch US$5-5.5bn in India by 2030. Based on ~15% market share, we believe there is a potential business opportunity of ~US$650-750mn for Tata Power.

Struck RE deal, but valuation below our expectation: A consortium led by BlackRock Real Assets shall invest INR40bn (in two tranches over a period of next eight months) for a 10.53% stake in Tata Power Renewables by way of equity/compulsorily

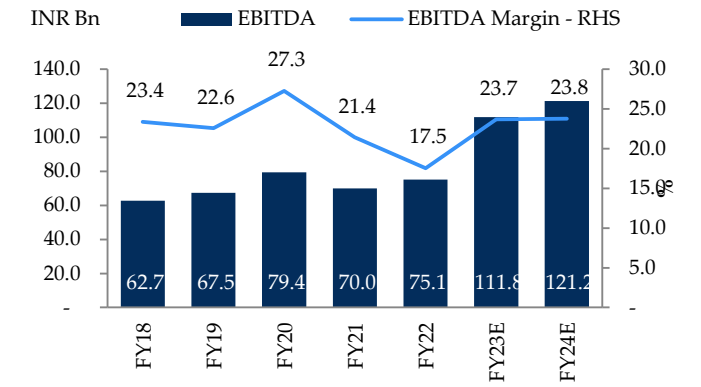
convertible instruments. The investment would translate into a base equity valuation of INR340bn and an enterprise value of ~INR500bn for a platform that will house all renewable energy businesses of Tata Power. While the deal is better than the earlier monetisation plan through InvIT (which was likely to be valued at ~8x FY23 EV/EBITDA), it is below our expected equity value of ~INR45bn for the entire renewable portfolio.

View:

Company fairly valued at CMP. Maintain our reduce rating with SoTP TP of INR231/share

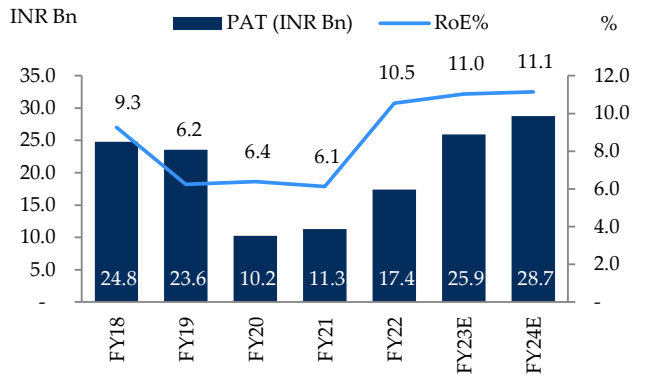
While the fund raise of INR40bn will be used to fund future Capex for renewable portfolio, the deal valuation is below our expectation. We had assumed an equity value of ~INR450bn for TPWR's entire RES portfolio, but the same is executed at base valuation of INR340-INR380bn. Accordingly, we had lowered our SoTP from INR277/share to INR231/share. The stock price reacted to this deal, falling almost 20% from its high to INR233/share as on date. While the company has huge potential to benefit from the robust opportunity across the renewable space (because of its leadership position across segments), we believe that the company is fairly valued at CMP and thus provides limited upside potential. Hence, we maintain our REDUCE rating, with a SoTP TP of INR231.

Exhibit-60: EBITDA (INR bn) and EBITDA margin (%)



Source: Company, HSIE Research

Exhibit-61: PAT (INR bn) & RoE (%)



Source: Company, HSIE Research

Exhibit-62: SoTP valuation

Business	Segment	Tata power share (%)	Method	Regulated Equity Rs bn	RoE	Multiple (x)	Implied Valn (Rs bn)	Value/ shr (Rs)
Mumbai Operations	Generation and T&D	100%	P/BV	43.0	17.0%	2.2	94	29
Mumbai other segments (Wind, Jojobera, haldia)	Generation	100%	P/BV	7.4	16.0%	2.5	18	6
Powerlinks - 51% stake	Transmission JV	51%	P/BV	4.7	15.9%	2.0	5	1
Delhi Distribution (NDPL)	Distribution Licensee	51%	P/BV	18.2	16.9%	2.2	20	6
IEL - 74% stake	Captive – Tata Steel	74%	P/BV	7.3	16.0%	2.0	11	3
Maithon Power	Power generation	74%	DCF				20	6
Bumi stake	Coal mining		EV/EBITDA			4	47	15
Orissa (CESU, WESCO, SOUTCO. NESCO)	Distribution Licensee	51%	DCF				33	10
4GW Mundra UMPP	Power Generation	100%	DCF				51	16
Tata Power Trading	Trading		P/E			10	4	1
International Power Ventures	Power Generation	50%	P/BV	6.5	15.0%	1.8	12	4
Renewable				EBITDA (INR bn)				
TPREL	Power Generation		EV/EBITDA	20		10.0	204	64
WREL (Welspun Acq)	Power Generation		EV/EBITDA	10.5		10.0	105	33
Tata Solar Mfg/EPC	EPC	100%	P/E			15	61	19
EV and Solar Pump business			P/E			12	25	8
Investments	% stake holding							
Tata Projects stake	EPC	48%	EV/EBITDA			7	23	7
Other investments (MFs)							13	4
Cash on Book							66	21
Non Project debt							-113	-35
Tax saving benefit on Mundra merger							30	9
TPWR SOTP Valn							**739**	**231**

Financials (Standalone)

INCOME STATEMENT

INR mn	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E
Net Revenues	**2,68,403**	**2,98,811**	**2,91,364**	**3,27,033**	**4,28,157**	**4,71,701**	**5,09,539**
Growth (%)	***-3.8***	***11.3***	***-2.5***	***12.2***	***30.9***	***10.2***	***8.0***
Power&Fuel	1,68,113	1,95,367	1,74,101	2,05,715	2,76,325	2,78,100	3,03,268
Purchase of electricity	55,973	66,078	64,345	88,390	1,56,588	1,57,198	1,63,068
Employee Cost	13,819	13,391	14,406	23,167	36,115	37,921	38,679
O&M and Other expenses	23,741	22,602	23,428	28,125	40,604	43,868	46,368
EBITDA	**62,729**	**67,451**	**79,428**	**70,027**	**75,113**	**1,11,812**	**1,21,224**
EBITDA Margin (%)	***23.4***	***22.6***	***27.3***	***21.4***	***17.5***	***23.7***	***23.8***
EBIDTA Growth (%)	***0.8***	***7.5***	***17.8***	***-11.8***	***7.3***	***48.9***	***8.4***
Depreciation	23,462	23,931	26,336	27,449	31,222	34,180	36,582
EBIT	**39,268**	**43,520**	**53,093**	**42,578**	**43,891**	**77,632**	**84,642**
Other Income (Including EO Items)	4,327	3,862	5,626	4,392	9,200	3,526	5,500
Interest	37,615	38,252	44,937	40,104	38,590	43,281	44,181
PBT	**1,881**	**10,163**	**11,894**	**12,226**	**12,105**	**35,377**	**42,459**
Tax	1,643	10,876	6,360	5,019	3,796	13,257	16,085
RPAT	**238**	**-713**	**5,535**	**7,207**	**8,310**	**22,120**	**26,373**
Profit from Associates	15,539	14,018	9,526	8,734	19,428	8,154	6,939
EO (Loss) / Profit (Net of Tax)	11,025	12,751	-1,896	-1,555	-7,726	0	0
Minority Interest	-2,026	-2,495	-2,991	-3,113	-4,142	-4,349	-4,566
APAT	**24,777.0**	**23,561.9**	**10,228.8**	**11,273.8**	**17,415.6**	**25,925.1**	**28,746.4**
APAT Growth (%)	*-1.4*	*-15.7*	*13.2*	*5.9*	*74.0*	*9.1*	*10.0*
AEPS	**9.2**	**8.7**	**3.8**	**3.5**	**5.4**	**8.1**	**9.0**
EPS Growth (%)	*-1.4*	*-15.7*	*13.2*	*5.9*	*74.0*	*9.1*	*10.0*

Source: Company, HSIE Research

BALANCE SHEET

INR mn	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E
SOURCES OF FUNDS							
Share Capital	2,705	2,705	2,705	3,196	3,196	3,196	3,196
Reserves	1,61,294	1,79,507	1,92,955	2,20,027	2,21,220	2,42,695	2,66,692
Total Shareholders' Funds	**1,63,999**	**1,82,212**	**1,95,660**	**2,23,223**	**2,24,416**	**2,45,890**	**2,69,888**
Long-term Debt	4,85,892	4,85,060	4,83,759	3,84,812	4,75,900	4,85,900	4,95,900
Short-term Debt							
Total Debt	**4,85,892**	**4,85,060**	**4,83,759**	**3,84,812**	**4,75,900**	**4,85,900**	**4,95,900**
Deferred revenues & Regulatory deferral A/C credit balance	19,053	19,598	21,623	9,931	10,333	10,333	10,333
TOTAL SOURCES OF FUNDS	**6,89,098**	**7,08,537**	**7,24,363**	**6,47,239**	**7,46,518**	**7,82,341**	**8,20,905**
APPLICATION OF FUNDS							
Net Block	**4,94,350**	**4,98,470**	**5,39,194**	**5,49,367**	**5,67,744**	**5,69,964**	**5,69,785**
CWIP	16,526	25,757	16,115	35,998	46,351	46,351	46,351
Investments	1,24,289	1,30,181	1,45,348	1,31,491	1,41,603	1,41,603	1,41,603
Other Non-Current Assets							
Total Non-current Assets	**6,35,165**	**6,54,408**	**7,00,658**	**7,16,856**	**7,55,698**	**7,57,918**	**7,57,739**
Inventories	16,231	17,064	17,524	18,848	42,315	38,770	39,088
Debtors	1,07,027	1,18,378	1,13,579	1,42,976	1,63,973	1,80,926	2,02,419
Cash & Equivalents	11,858	7,875	20,942	61,127	66,407	78,823	95,547
ST Loans & Advances	49,820	43,001	44,037	46,866	1,00,453	1,03,387	1,04,700
Total Current Assets	**1,84,935**	**1,86,318**	**1,96,081**	**2,69,816**	**3,73,148**	**4,01,905**	**4,41,754**
Creditors	1,26,068	1,27,083	1,67,138	3,28,336	3,66,698	3,61,853	3,62,959
Provisions	4,934	5,106	5,238	11,097	15,630	15,630	15,630
Total Current Liabilities	**1,31,002**	**1,32,189**	**1,72,376**	**3,39,433**	**3,82,328**	**3,77,483**	**3,78,589**
Net Current Assets	**53,933**	**54,129**	**23,705**	**-69,617**	**-9,181**	**24,423**	**63,165**
TOTAL APPLICATION OF FUNDS	**6,89,098**	**7,08,537**	**7,24,363**	**6,47,239**	**7,46,517**	**7,82,341**	**8,20,905**

Source: Company, HSIE Research

CASH FLOW STATEMENT

INR Mn	FY18	FY19	FY20	FY21	FY22E	FY23E	FY24E
Reported PBT	1,881	10,163	11,894	12,226	12,105	35,377	42,459
Non-operating & EO Items	4,327	3,862	5,626	4,392	9,200	3,526	5,500
Interest Expenses	37,615	38,252	44,937	40,104	38,590	43,281	44,181
Depreciation	23,462	23,931	26,336	27,449	31,222	34,180	36,582
Working Capital Change	-25,029	-3,635	45,516	1,21,815	-54,754	-21,188	-22,018
Tax Paid	-1,643	-10,876	-6,360	-5,019	-3,796	-13,257	-16,085
OPERATING CASH FLOW (a)	**63,639**	**45,738**	**73,753**	**1,92,183**	**14,168**	**74,868**	**79,618**
Capex	4,497	-37,283	-23,948	-57,505	-59,951	-36,400	-36,403
Free Cash Flow (FCF)	*68,136*	*8,455*	*49,806*	*1,34,678*	*-45,783*	*38,468*	*43,215*
Investments	10,820	8,127	-5,642	22,592	9,315	8,154	6,939
Non-operating Income	4,327	3,862	5,626	4,392	9,200	3,526	5,500
INVESTING CASH FLOW (b)	**-15,179**	**-3,192**	**-5,429**	**-37,155**	**-47,863**	**-24,721**	**-23,964**
Debt Issuance/(Repaid)	-28,561	-832	-1,301	-98,947	91,088	10,000	10,000
Interest Expenses	-37,615	-38,252	-44,937	-40,104	-38,590	-43,281	-44,181
Other Financing activity	24,136	-3,811	-4,513	0	-6,181	0	0
Share Capital Issuance	0	0	0	26,000	0	0	0
Dividend	-4,165	-4,104	-5,006	-1,793	-7,342	-4,450	-4,749
FINANCING CASH FLOW (c)	**-46,205**	**-46,998**	**-55,757**	**-1,14,844**	**38,975**	**-37,731**	**-38,930**
NET CASH FLOW (a+b+c)	**2,317**	**-3,983**	**13,067**	**40,185**	**5,280**	**12,415**	**16,725**
Opening cash balance	9,540	11,858	7,874	20,942	61,127	66,407	78,822
Closing Cash & Equivalents	**11,858**	**7,874**	**20,942**	**61,127**	**66,407**	**78,822**	**95,547**

Source: Company, HSIE Research

KEY RATIOS

	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E
PROFITABILITY (%)							
GPM	16.5	12.5	18.2	10.1	-1.1	7.7	8.5
EBITDA Margin	23.4	22.6	27.3	21.4	17.5	23.7	23.8
EBIT Margin	14.6	14.6	18.2	13.0	10.3	16.5	16.6
APAT Margin	0.1	-0.2	1.9	2.2	1.9	4.7	5.2
RoE	9.3	6.2	6.4	6.1	10.5	11.0	11.1
Core RoE	4.6	4.0	3.8	3.3	3.1	3.3	3.1
RoCE	6.0	5.1	5.5	5.4	6.4	6.9	7.3
EFFICIENCY							
Tax Rate (%)	87.3	107.0	53.5	41.0	31.4	37.5	37.9
Asset Turnover (x)	0.4	0.4	0.4	0.5	0.6	0.6	0.6
Inventory (days)	22	21	22	21	36	30	28
Debtors (days)	146	145	142	160	140	140	145
Payables (days)	224	200	288	466	379	367	341
Cash Conversion Cycle (days)	57	57	3	-146	-64	-42	-23
Net Debt/EBITDA (x)	7.3	6.9	5.7	4.4	5.4	3.6	3.3
Net D/E	2.8	2.6	2.3	1.4	1.8	1.6	1.5
Interest Coverage	0.9	0.8	0.8	0.9	0.7	0.5	0.5
PER SHARE DATA							
EPS (Rs/sh)	9.2	8.7	3.8	3.5	5.4	8.1	9.0
CEPS (Rs/sh)	14.5	13.8	15.3	13.6	18.5	20.2	21.9
DPS (Rs/sh)	1.5	1.5	1.9	1.6	1.8	1.8	1.8
BV (Rs/sh)	60.6	67.4	72.3	69.9	70.2	76.9	84.5
VALUATION							
P/E	25.4	26.7	61.6	66.0	42.8	28.7	25.9
P/BV	3.8	3.5	3.2	3.3	3.3	3.0	2.8
EV/EBITDA	17.4	16.3	13.6	15.1	15.3	10.3	9.4
OCF/EV (%)	5.8	4.2	6.8	18.2	1.2	6.5	7.0
FCF/EV (%)	6.2	0.8	4.6	12.8	-4.0	3.4	3.8
Dividend Yield (%)	**0.7**	**0.7**	**0.8**	**0.7**	**0.8**	**0.8**	**0.8**

Source: Company, HSIE Research

JSW Energy

Strong leap and execution in green energy, but valuation rich

(TP INR 160; Sell)

JSW Energy has one the strongest balance sheets in the industry, with the current net D/E at 0.4x (vs the industry average of ~ 2.0x). The company has been generating strong cash flows over the past four years (~INR17bn-INR21bn p.a.), which have been largely utilised to repay its debt and strengthen its balance sheet. The company has taken a huge leap in the green energy business and has committed to add 10GW of RES capacity by FY25 and 20GW by FY30. Apart from grid connected RES capacity, the company is also working on adding PHES and green hydrogen project to its portfolio. The company plans to add 10GW of PHES project and has until date tied up 5GW of these projects with various states. It plans to utilise the PHES projects to produce green hydrogen and ammonia for commercial business. Because of its healthy balance sheet, the company is well-placed to add these capacities to its portfolio without putting much stress on its financials. However, the stock has been witnessing a substantial rise in its price and, thus, factors in majority of these benefits in the CMP. Hence, we maintain SELL and retain our target price of INR149, as we believe the stock has been trading at an unjustifiable valuation at CMP of INR243 (RoE - ~6.0%, FY24 P/E – 36x, P/BV – 2.1x)

JSW energy targets to execute 2.2GW of renewable project over the next 2 years

Target to increase its capacity 4x to 20GW by FY30: JSW Energy commissioned 225MW of solar capacity in Q4FY22, taking its total power generation capacity to 4,784 MW (thermal - 3,158 MW, hydro - 1,391 MW and solar - 235 MW). In line with the country's commitment to lower its carbon emission footprint, the company aims to add 10GW/20GW of renewable capacity to its portfolio by FY25/FY30. It has 2.2GW of green projects under construction phase, with a blended tariff of INR3.08/unit, to be commissioned in parts over FY23 (+1,200MW) and FY24 (+700MW) for a Capex of ~INR167bn. The company's 240MW of Kutehr Hydro project is progressing well, with completion of 70% of tunneling work. It is expected to achieve CoD by Sept-24 and has already singed a PPA with the state of Haryana.

Venturing into PHES projects through tie-up for 5GW with states: The company is planning to set up 10GW of PHES capacity and has secured tie-ups for projects totaling 5GW (1GW with Chhattisgarh, 1.5GW - Telangana, 1.5GW - Maharashtra and 1GW – Rajasthan). It expects to start construction of at least one project in FY23 in Karnataka. The company expects to utilise the PHES projects to produce green hydrogen and ammonia which would be largely used for captive and commercial purpose.

High LT PPA mix renders strong cash flow visibility: JSW Energy has now tied up 4,100 MW of its capacity under the LT PPA (86% of its total capacity) as compared to 2,866 MW in FY17 (64.5% of its total capacity). Accordingly, the company now generates a more stable cash flow (~INR17-INR23bn p.a.) under the two-part tariff scheme (with full fuel cost pass through), which insulates it from forex/fuel price fluctuations. For the balance untied capacity, the management plans to tie up with the group's captive requirement (with JSW Steel and cement) over the next 2-3 years.

The company has repaid ~INR84bn of its debt over the past 5 years; net D/E has fallen from 1.8x in FY16 to 0.5x in FY22

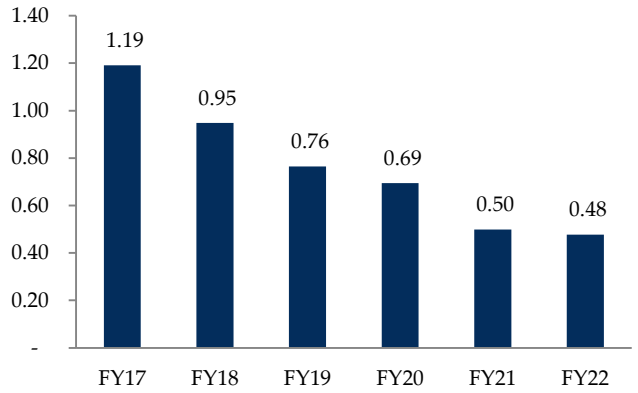
Net debt/equity bottomed out; fresh capacities should leverage the balance sheet: The company has been consistently deleveraging its balance sheet over the past four years by repaying debts from its healthy cash flows. It reduced its net debt from INR151bn in FY16 to INR70bn in FY22. Accordingly, its net debt/equity also fell from 1.8x in FY16 to 0.5x in FY22 (at an average interest cost of 7.7%), making it one of the strongest balance sheets among its peers. However, with robust capacity addition in the pipeline over the next 2-3 years, we expect debt to increase.

JSW Energy's exposure to the merchant market has fallen from 35.5% in FY17 to 14% as on date

Company to benefit from near-term hiccups in power demand: JSW Energy and other merchant players have benefitted from a steep rise in merchant rates, led by recent demand supply deficit due to rise in demand, steep rise in international coal prices resulting in unaffordability, and domestic supply constraints during the summer season. With mega transition from grey energy to green energy, coal stations tend to sit on low coal inventory due to must-run status of RES projects. And with the intermittent issues with the RES in 24x7 power supply, these deficit scenarios are expected to occur more frequently now than earlier, especially during the peak seasons. We believe that the issue will continue to crop till the time the system has viable BESS or any alternative arrangement that ensures stability in power supply and help grid and discoms better manage their requirements. Thus, companies with untied capacities (JSW Energy has 14% of its capacity open) would continue to benefit from such scenarios.

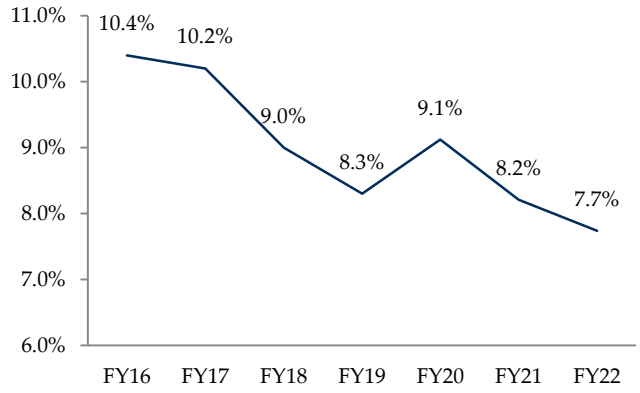
Valuation and view: The Company is far better placed to attain its 20GW target capacity, driven by a strong balance sheet and cash flows. However, we maintain SELL on the stock, factoring in its high stock price and the prevailing low RoE (RoE - ~6.0%, FY24 P/E – 36x, P/BV – 2.1x). We have revised our SoTP target price upwards to INR160/share, from INR 149/share, factoring in FY22 numbers and uptick in power demand and merchant realisation for FY23. Further, the companies venture into green hydrogen and PHES looks promising, but we have restrained from factoring it into our valuation due to uncertainty over the timeline of execution and investment plan.

Exhibit-63: D/E (x)



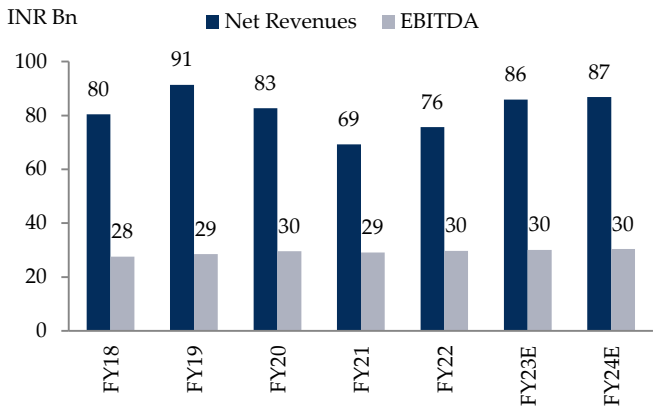
Source: Company, HSIE Research

Exhibit-64: Weighted average cost of debt (%)



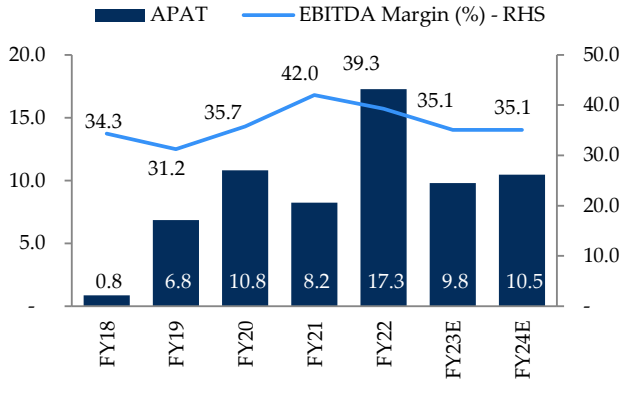
Source: Company, HSIE Research

Exhibit-65: Revenue and EBITDA trend



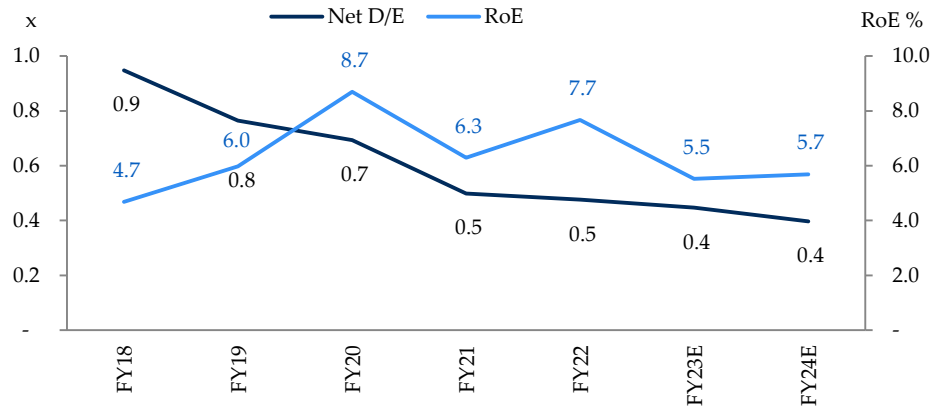
Source: Company, HSIE Research

Exhibit-66: PAT (INR bn) and EBITDA margin (%)



Source: Company, HSIE Research

Exhibit-67: D/E (x) and RoE (%)



Source: Company, HSIE Research

Exhibit-68: SoTP valuation

Project	Value	Per/share
Vijay SBU -1	3,951	2.4
Vijay SBU-2	8,105	5.0
Rajwest - Barmer	38,810	23.6
Ratnagiri 1200	22,530	13.8
Baspa	4,657	2.9
Karcham Wangtoo	31,411	19.1
Cash & liquid investments	25,265	15.5
JSW Steel investment	47,276	29.0
RES project	78,504	48.2
Total Value	**2,64,456**	**159.6**

Source: Company, HSIE Research

Financials (Standalone)

INCOME STATEMENT

INR mn	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E
Net Revenues	**80,490**	**91,376**	**82,727**	**69,222**	**75,712**	**88,025**	**88,937**
Growth (%)	***-2.6***	***13.5***	***-9.5***	***-16.3***	***9.4***	***16.3***	***1.0***
Power&Fuel	43,389	53,562	44,605	32,830	35,742	47,111	47,294
Purchase of electricity	746	785	378	0	0	0	0
Employee Cost	2,151	2,436	2,430	2,366	2,642	2,495	2,632
O&M and Other expenses	6,579	6,062	5,746	4,960	7,598	7,750	7,905
EBITDA	**27,625**	**28,531**	**29,569**	**29,066**	**29,730**	**30,668**	**31,106**
EBITDA Margin (%)	***34.3***	***31.2***	***35.7***	***42.0***	***39.3***	***34.8***	***35.0***
EBIDTA Growth (%)	***-16.9***	***3.3***	***3.6***	***-1.7***	***2.3***	***3.2***	***1.4***
Depreciation	9,661	11,637	11,681	11,669	11,311	11,673	11,673
EBIT	**17,965**	**16,894**	**17,888**	**17,396**	**18,420**	**18,995**	**19,433**
Other Income (Including EO Items)	4,650	3,680	2,870	2,375	5,687	2,634	2,363
Interest	14,559	11,924	10,511	8,957	7,769	7,858	6,819
PBT	**8,056**	**8,650**	**10,247**	**10,814**	**16,337**	**13,771**	**14,976**
Tax	2,532	2,124	330	2,759	4,948	3,581	4,044
RPAT	**5,523**	**6,526**	**9,917**	**8,055**	**11,389**	**10,191**	**10,932**
Minority Interest	495	-319	-280	-172	-85	0	0
EO (Loss) / Profit (Net of Tax)	0	0	0	0	0	0	0
APAT	**849**	**6,845**	**10,812**	**8,227**	**17,264**	**10,191**	**10,932**
APAT Growth (%)	*-19.8*	*36.1*	*48.8*	*-19.3*	*37.6*	*-9.8*	*7.3*
AEPS	**3.1**	**4.2**	**6.2**	**5.0**	**6.9**	**6.2**	**6.7**
EPS Growth (%)	*-19.8*	*36.1*	*48.8*	*-19.3*	*37.6*	*-9.8*	*7.3*

Source: Company, HSIE Research

BALANCE SHEET

INR mn	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E
SOURCES OF FUNDS							
Share Capital	16,401	16,401	16,419	16,423	16,397	16,397	16,397
Reserves	94,657	1,01,814	1,00,037	1,28,647	1,57,752	1,64,664	1,72,318
Total Shareholders' Funds	**1,11,058**	**1,18,214**	**1,16,456**	**1,45,070**	**1,74,149**	**1,81,061**	**1,88,715**
Long-term Debt	1,08,210	92,404	82,807	69,724	68,764	63,227	52,790
Short-term Debt	148	61	0	7,434	25,587	25,587	25,587
Total Debt	**1,08,358**	**92,464**	**82,807**	**77,158**	**94,351**	**88,814**	**78,377**
Deferred revenues & Regulatory deferral A/C credit balance	4,280	4,441	3,466	5,994	8,943	8,943	8,943
TOTAL SOURCES OF FUNDS	**2,23,695**	**2,15,119**	**2,02,730**	**2,28,222**	**2,77,443**	**2,78,818**	**2,76,035**
APPLICATION OF FUNDS							
Net Block	**1,88,774**	**1,78,245**	**1,67,128**	**1,56,368**	**1,48,306**	**1,48,633**	**1,48,960**
CWIP	2,935.30	3,991.70	3,913.20	4,727.70	20,906.00	20,906.00	20,906.00
Investments	24,150	24,505	18,536	40,522	66,232	66,732	67,232
Other Non-Current Assets	0	0	0	0	0	0	0
Total Non-current Assets	**2,15,859**	**2,06,742**	**1,89,576**	**2,01,617**	**2,35,444**	**2,36,271**	**2,37,098**
Inventories	5,355	4,547	6,396	3,951	9,010	7,099	7,126
Debtors	11,512	14,278	21,032	9,645	6,702	14,470	14,620
Cash & Equivalents	3,110	2,036	2,007	4,792	11,341	7,390	3,682
ST Loans & Advances	31,372	31,650	32,107	44,359	46,827	66,101	66,357
Total Current Assets	**51,350**	**52,510**	**61,542**	**62,747**	**73,881**	**95,060**	**91,785**
Creditors	23,271	18,395	16,029	9,499	10,759	19,361	19,436
Provisions	20,243	25,738	32,360	26,642	21,122	33,153	33,413
Total Current Liabilities	**41,846**	**42,718**	**46,810**	**34,650**	**30,273**	**52,514**	**52,849**
Net Current Assets	**7,836**	**8,377**	**13,154**	**26,605**	**41,999**	**42,547**	**38,937**
TOTAL APPLICATION OF FUNDS	**2,23,695**	**2,15,119**	**2,02,730**	**2,28,222**	**2,77,443**	**2,78,818**	**2,76,035**

Source: Company, HSIE Research

CASH FLOW STATEMENT

INR Mn	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E
Reported PBT	8,056	8,650	10,247	10,814	16,337	13,771	14,976
Non-operating & EO Items	4,650	3,680	2,870	2,375	5,687	2,634	2,363
Interest Expenses	14,559	11,924	10,511	8,957	7,769	7,858	6,819
Depreciation	9,661	11,637	11,681	11,669	11,311	11,673	11,673
Working Capital Change	10,819	-1,454	-5,780	-8,139	-5,895	-4,498	-99
Tax Paid	-2,532	-2,124	-330	-2,759	-4,948	-3,581	-4,044
OPERATING CASH FLOW (a)	**32,228**	**24,633**	**23,793**	**17,996**	**24,762**	**22,590**	**26,964**
Capex	-1,195	-2,165	-484	-1,724	-19,428	-12,000	-12,000
Free Cash Flow (FCF)	*31,033*	*22,468*	*23,309*	*16,272*	*5,334*	*10,590*	*14,964*
Investments	-8,362	-355	5,970	-21,986	-25,710	-500	-500
Non-operating Income	4,650	3,680	2,870	2,375	5,687	2,634	2,363
INVESTING CASH FLOW (b)	**-4,907**	**1,160**	**8,356**	**-21,336**	**-39,451**	**-9,866**	**-10,137**
Debt Issuance/(Repaid)	23,005	15,894	9,657	5,649	-17,193	5,537	10,437
Interest Expenses	-14,559	-11,924	-10,511	-8,957	-7,769	-7,858	-6,819
Other Financing activity	-990	639	561	343	0	0	0
Share Capital Issuance	6,500	312	-12,570	20,387	11,815	-3,279	-3,278
Dividend	0	1,640	1,642	3,285	3,279	3,279	3,279
FINANCING CASH FLOW (c)	**-32,054**	**-26,867**	**-32,176**	**6,124**	**21,239**	**-16,674**	**-20,535**
NET CASH FLOW (a+b+c)	**-4,733**	**-1,074**	**-28**	**2,785**	**6,549**	**-3,950**	**-3,709**
Opening cash balance	7,843	3,110	2,036	2,007	4,792	11,341	7,390
Closing Cash & Equivalents	**3,110**	**2,036**	**2,008**	**4,792**	**11,341**	**7,391**	**3,682**

Source: Company, HSIE Research

KEY RATIOS

	FY18	FY19	FY20	FY21	FY22	FY23E	FY24E
PROFITABILITY (%)							
GPM	45.2	40.5	45.6	52.6	52.8	46.5	46.8
EBITDA Margin	34.3	31.2	35.7	42.0	39.3	34.8	35.0
EBIT Margin	22.3	18.5	21.6	25.1	24.3	21.6	21.8
APAT Margin	10.0	9.5	12.4	15.6	21.6	15.6	16.8
RoE	4.7	6.0	8.7	6.3	7.1	5.7	5.9
Core RoCE	4.7	6.0	8.7	6.3	7.1	5.7	5.9
RoCE	9.7	9.4	9.9	9.2	9.5	7.8	7.9
EFFICIENCY							
Tax Rate (%)	31.4	24.6	3.2	25.5	30.3	26.0	27.0
Asset Turnover (x)	0.3	0.4	0.4	0.3	0.3	0.3	0.3
Inventory (days)	24	18	28	21	43	29	29
Debtors (days)	52	57	93	51	32	60	60
Payables (days)	289	248	321	315	240	318	317
Cash Conversion Cycle (days)	21	25	49	115	148	146	145
Net Debt/EBITDA (x)	3.8	3.2	2.7	2.5	2.8	2.7	2.4
Net D/E	0.9	0.8	0.7	0.5	0.5	0.4	0.4
Interest Coverage	0.6	0.6	0.5	0.5	0.3	0.4	0.3
PER SHARE DATA							
EPS (Rs/sh)	3.1	4.2	6.2	5.0	6.9	6.2	6.7
CEPS (Rs/sh)	9.0	11.3	13.3	12.1	13.8	13.3	13.8
DPS (Rs/sh)	0.0	1.0	1.0	2.0	2.0	2.0	2.0
BV (Rs/sh)	67.7	72.1	70.9	88.3	106.2	110.4	115.1
VALUATION							
P/E	79.4	58.3	39.2	48.6	35.3	39.2	36.5
P/BV	3.6	3.4	3.4	2.8	2.3	2.2	2.1
EV/EBITDA	18.3	17.2	16.3	16.2	16.2	15.7	15.2
OCF/EV (%)	6.4	5.0	5.0	3.8	5.1	4.7	5.7
FCF/EV (%)	6.2	4.6	4.9	3.4	1.1	2.2	3.2
Dividend Yield (%)	**0.0**	**0.4**	**0.4**	**0.8**	**0.8**	**0.8**	**0.8**

Source: Company, HSIE Research

Non-covered companies

Renewable Project Developers

ACME Solar

Company background
ACME Solar is one of the largest solar IPPs in India, which is engaged in developing, building, owning, operating, and maintaining utility-scale grid-connected solar power projects. It is engaged in developing and operating on-grid solar power projects using the latest photovoltaic technology.

Current capacity
The company currently has a portfolio of solar power projects, with an aggregate capacity of more than 5.5GW, of which 2.9GW is operational and 2.6GW is under construction.

Capacity expansion
» The company plans to set up 7GW of renewable power and green ammonia facilities in Tamil Nadu, which will entail an investment of US$6bn.
» It is already working on a green ammonia project in Oman.
» It is also working with Sweden Scatec ASA in a JV arrangement. The project is expected to produce 100,000 tonnes of green ammonia in the first phase and the company eventually plans to increase it to 1.2mn, with 3.5GW of electrolyzer and 5GW of peak solar power capacity.

FOUNDED: 2015

Location: Gurgaon

PROMOTER
Manoj Upadhyay

INVESTORS
Investment Fund for Developing Countries, Amplus Solar, Actis Long Life Infrastructure Fund, ACME Cleantech Solutions Pvt Ltd

VCC Edge

Adani Green Energy Limited

Company background
Adani Green Energy Ltd. is engaged in the generation of renewable energy. It develops, builds, owns, operates and maintains utility-scale grid-connected solar and wind farm projects. It caters to central and state government entities and government-backed corporations. On the back of long-term PPAs of 25 years with central and state government entities, AGEL has leveraged its capabilities and expanded its presence in 12 Indian states.

Current capacity
Adani Green is one of the largest renewable companies in India, with current portfolio of 20.3GW that includes 54 operational projects (5.8GW) and 12 under-construction projects. The company has an asset base of USD 2bn.

Capacity expansion
» The company's management recently approved allotment of 20mn equity shares worth INR38.5bn to Green Energy Investment Holdings RSC Ltd.
» The Adani group plans to invest US$70 bn to achieve 45GW of installed RE capacity by 2030 and invest US$20 bn to develop 7.5GW per solar manufacturing capacity by FY25.

FOUNDED: 2015

Location: Ahmadabad

PROMOTER
Gautam Adani

INVESTORS
Total Energies, Abu Dhabi IHC, Elara Fund

VCC Edge

AMP Energy India

Company background

Amp Energy India Pvt. Ltd. is engaged in operating clean energy assets both behind and in front of the meter. It provides digital energy platform for power generation and grid edge, asset management and optimisation, aggregation of flexible generation and dsm, creating virtual power plants, transactive grids. It is also an integrated power producer and delivers clean and green energy to C&I and utility customers.

Current capacity

AMP energy has a current portfolio of 2GW with 50+ customers across 8 sectors.

Capacity expansion

» Company aims to achieve portfolio of 5GW in five years, which will entail an investment of INR200bn.

FOUNDED: 2016

Location: Delhi

PROMOTER

Pinaki Bhattacharyya

INVESTORS

Lightrock India, AMP Energy Canada, Copenhagen Infrastructure New Markets Fund I, Bharat Serums and Vaccines Ltd

VCC Edge

Amplus Solar

Company background

Amplus Solar Power Pvt. Ltd., a member of PETRONAS Group, is engaged in providing low-carbon solutions to C&I customers through both on-site solar projects and off-site solar farms. The company has diversified into new avenues such as Residential Solar, Battery Storage, Energy Efficiency, and Eletric Mobitlity. It operates as a wholly-owned subsidiary of Amplus Energy Solutions Pte. Ltd., Malaysia.

Current capacity

The company owns and manages a portfolio of 1GW of operational and under-construction distributed solar assets comprising 400 projects spread across 24 states. Amplus's operational plants are expected to cumulatively generate 14,000+ mn units of electricity over the projects' 25-year duration.

Capacity expansion

» Achieve 3GW capacity by 2025, acquisition of C&I, rooftop & CPSE/GUVNL PPA project along with organic expansion for C&I/rooftop.
» Plans to finance through USD green bonds to refinance entire debt.

FOUNDED: 2015

Location: Delhi

PROMOTER

Sanjeev Aggarwal

INVESTORS

Amplus Energy Solutions Pte. Ltd

VCC Edge

Apraava Energy (f.k.a CLP India)

Company background
Apraava Energy is an independent power producer formally known as CLP India. It is a joint venture between Hong Kong-based China Light Power Group (CLP Group) and Caisse de dépôt et placement du Québec, a Canadian pension fund.

Current capacity
The company's current portfolio comprises 3,150MW of installed capacity, including 1,320MW coal fired power plant in Jhajjar, Haryana; 655MW gas fired power station in Gujarat; 924MW of wind and 250MW of solar energy projects across seven states, and a power transmission asset.

Capacity expansion
» The company plans to double its energy portfolio in the next 3-4 years

FOUNDED: 2002

Location: Mumbai

PROMOTER
Rajiv Mishra, Saurabh Aggarwal

INVESTORS
CLP Holdings Ltd, Quebec Deposit and Investment Fund

VCC Edge

Avaada Energy

Company background
Avaada Energy is a renewable energy project developer and provides EPC services. The company has been actively developing large-scale solar projects participating in competitive bidding. It develops open access solar projects for commercial and industrial consumers. In July 2021, Global Power Synergy Public Company (GPSC), a power subsidiary of Thailand-based PTT Group, had announced that its subsidiary Global Renewable Synergy Company had acquired a 41.6% stake in Avaada Energy for THB 14.582 bn (~US$453 mn). The joint venture between Avaada and GPSC will also help expand GPSC's renewable energy capacity to 8 GW by 2030. In 2019, Avaada Energy had secured financing of around INR10 bn (US$143.8 mn) in the form of equity infusion from the Asian Development Bank, German development bank –DEG, Dutch development finance company-FMO, and the promoters' equity.

Current capacity
Current operational capacity stands at 2GW and 3GW of capacity is under execution which is expected to be commissioned by FY24-FY25.

Capacity expansion
» Company aims to grow platform to 10GW by 2025 across Asia and Africa
» Backward integration to module manufacturing
» Exploring green hydrogen segment

FOUNDED: 2017

Location: Mumbai

PROMOTER
Vineet Mittal

INVESTORS
Avaada Ventures Pvt. Ltd., GPSC, ADB, DEG

VCC Edge

Ayana Renewable Energy

Company background

Ayana commenced with funding from UK's CDC Group. Ayana is a utility scale renewable energy platform with primary focus on India. It aims to build multi-GW renewable energy portfolio in India and its neighbouring countries of Bangladesh, Nepal, Sri Lanka, Myanmar, and Bhutan.

Current capacity

Currently, company has a portfolio of 4GW across India.

Capacity expansion

- Company plans to have 10GW portfolio by 2025 through Greenfield and acquisitions with an equity commitment of $720 mn.
- It is engaged in development and management of 3.7GW of committed, under construction and operational solar, wind and hybrid projects.

FOUNDED: 2018

Location: Bangalore

PROMOTER

Shivanand Nimbargi

INVESTORS

Eversource Capital, CDC Group, Green Growth Equity Fund, NIIF, BII

VCC Edge

ENGIE

Company background

Engie is engaged in providing solar power solutions. It operates as a subsidiary of Engie SA. Engie SA is a global energy player that operates in around 70 countries.

Current capacity

ENGIE has 781MW of renewable installed capacities and 306MW under construction. It has installed over 1mn solar panels and over 2750 string inverters. It has supplied 400,000 households with green energy.

FOUNDED: 1997

Location: Gurgaon

PROMOTER

Isabelle Kocher

INVESTORS

Engie SA

VCC Edge

Azure Power

Company background
Azure Power has developed, constructed amd operated solar projects of varying sizes, from utlity scale and rooftop to mini and micro grids.

Current capacity
Current operational capacity stands at 1.5GW and under-execution capacity is at 3GW.

Capacity expansion
» Company aims to grow platform to 6GW in next two years.
» Backward integration to module manufacturing.

FOUNDED: 2008

Location: Mumbai

PROMOTER
Inderpreet Wadhwa

INVESTORS
Azure Power Global Ltd

VCC Edge

CleanMax

Company background
CleanMax is India's leading renewable energy company pioneering the energy sale model in rooftop solar in 2011. It develops projects on turnkey basis, providing cheaper-than-grid clean power without any upfront investment from its customers (which generally comprises of C&I segment).

Current capacity
CleanMax has installed over 550 rooftop solar projects for more than 170 corporates with a total rooftop solar capacity of over 250MW.
It also operates 450+MW of large scale solar and wind farms for supplying clean energy to its corporate customers.

Capacity expansion
» Company aims to install 2GW of installed solar and wind-solar hybrid power in next 3 years.
» It recently received funding of US$34mn from Danish Investment Fund for Developing Countries.

FOUNDED: 2012

Location: Bangalore

PROMOTER
Kuldeep Jain

INVESTORS
IFY, Augment Infrastructure, UK Climate Investments, IFC, Warburg Pincus

VCC Edge

EDF Renewables

Company background
EDF Renewables is one of the largest foreign investors in India's renewable energy market. The company mainly focuses on wind and solar PV. It operates mostly in Europe and North America, but is now growing in emerging markets. In India, it operates through EDEN Renewables India, its solar PV JV with Total Eren.

Current capacity
Current renewable portfolio stands at 2.8GW, of which 2.2GW is for solar energy production and 569MW for wind capacity.

Capacity expansion
» EDF Renewables plans to push it ambitious plan to double the portfolio for India through EDEN Renewables, its JV with Total Eren.

FOUNDED: 2012

Location: Delhi

PROMOTER
Harmanjit Nagi

INVESTORS
Eden Renewables India, EDF Renewable Global

VCC Edge

Fortum India

Company background
Fortum has been focusing on building its solar portfolio ever since and has taken significant steps by building nearly 550MW of solar portfolio in the country. The company is also a major operator aross EV charging infrastructure networks and customer interfaces to other charging point opertors, thereby enabling electric vehicle businesses to manage operations effectively. The company is making fast progress across building EV charging stations and facilities across India and also tied up with few auto companies like MG Motors India.

Current capacity
Company currently operates six solar plants with a combined annual generation capacity of 685MW.

Capacity expansion
» Company targets to add at least 250MW of generation capacity every year.
» In Feb 2022, Fortum won the right from SECI to build 2 solar power parks with a total capacity of 600MW in Karnataka, India.

FOUNDED: 2012

Location: Delhi

PROMOTER
Sanjay Aggarwal

INVESTORS
Fortum Oyj

VCC Edge

Fourth Partner Energy

Company background
Fourth Partner Energy is distributed solar energy developer for commercial, industrial and government institutions. It offerings include capex-, RESCO- and open access based plants.

Current capacity
The firm currently manages 950+MW of assets for over 200 corporate and government clients in India.

Capacity expansion
» Fourth Partner Energy has targeted 3GW of installed solar capacity by 2025 and expands capabilities across energy storage and EV charging infrastructure.

FOUNDED: 2010

Location: Hyderabad

PROMOTER
Vivek Subramanian, Saif Dhorajiwala, Vikas Saluguti

INVESTORS
ASN Bank NV, Indian Fund for Sustainable Energy, Responsibility India Business Advisors Pvt Ltd, Symbiotics SA, The Rise Fund, Triodos Ban NV, The Norwegian Investment FDC

VCC Edge

Greenko

Company background
Greenko Group is a leading renewable energy player, with assets across the solar, wind, hydro, biomass and gas based power generation segments in India.

Current capacity
The net installed capacity of the company stands at 7.5GW across 15 states in India.

Capacity expansion
- » Greenko is constructing world's largest integrated RE storage project in AP at US$3Bn.
- » Arcelor Mittal and Greenko have made an arrangement to construct a RTC 975 MW of nominal solar and wind capacity project which will entail $600 Mn of fund. The commissioning is expected by mid-2024 and the transmission will be through Power Grid Corp of India.
- » The company is aggressively venturing into PHES project and targets to commission 3-4GW of PHES based project over the next 3-4 years period.

FOUNDED: 2004

Location: Hyderabad

PROMOTER
Anil Kumar Chalamalasetty, Mahesh Kolli

INVESTORS
Greenko Group

VCC Edge

Hero Future Energies

Company background
Hero Future Energies Pvt. Ltd. is an IPP and distributor. It is engaged in the business of producing renewable energies like wind power, solar power, and hydropower. The firm develops rooftop and off-grid projects providing decentralized power to consumers and offers solutions such as demand assessments, design, engineering, approval and permits, and installation, commissioning, operating, maintenance, and monitoring of system performance, etc.

Current capacity
Hero Future Energies has 500MW under construction RES Project in India and 2GW overseas. It has commissioned capacity of 1.5GW in India.

Capacity expansion
- » Hero Future Energies has partnered with US based Ohmium International on the development of green hydrogen plants in India, the UK and Europe with a cumulative electrolyser capacity of 1GW.
- » Company plans to build a 5GW portfolio and expand its operations in Africa and India.

FOUNDED: 2012

Location: Delhi

PROMOTER
Hero Group

INVESTORS
Abu Dhabi Future Energy Company

VCC Edge

O2 Power

Developer

Company background

O2 Power Pvt. Ltd. owns and operates renewable energy platform O2 Power. It develops and executes utility scale renewable energy projects in India.

Current capacity

The company currently has an RE asset portfolio of 1.6GW.

Capacity expansion

» O2 Power is constructing solar plant in Madhya Pradesh which will generate 350MW of solar power once commissioned.

» O2 has commissioned 250MW solar project in Jaisalmer and is selling power to SECI under 25-year PPA.

FOUNDED: 2019

Location: Gurugaon

PROMOTER

Parag Sharma, Peeyush Mohit

INVESTORS

Temasek, EQT

VCC Edge

Rays Power Infra

Developer and EPC Management Company

Company background

Rays Power Infra is an integrated solar power company projects currently in the development and construction phases across India.

Current capacity

It has a portfolio of over 1 GW of renewable energy projects across states such as Tamil Nadu, Karnataka, Telangana, Uttarakhand, Rajasthan, Punjab and Uttar Pradesh.

Capacity expansion

» Rays Power Infra plans to sell assets worth over INR 700Cr to two global investors

» It is developing three solar parks in Rajasthan totalling 2.3 GW and executing EPC projects of 225MW in India and 280MW outside India.

FOUNDED: 2011

Location: Jaipur

PROMOTER

Rahul Mishra

INVESTORS

DMI Finance Pvt Ltd

VCC Edge

Renew Power

Company background

ReNew Power Pvt. Ltd. operates as an IPP. It is engaged in the production of renewable energy through wind energy, solar en ergy, solar rooftop projects as well as distribution of solar energy projects that generate energy for commercial and industrial customers. It sells its output to state electricity boards, large industrial companies .

Current capacity

The company currently has an aggregate capacity of 12GW which includes 7GW of commissioned capacity.

Capacity expansion

» Renew Power aims to achieve 18GW of installed capacity by FY25.

» Mitsui plans to invest in the company's RTC project of 400MW to supply electricity to SECI.

FOUNDED: 2011

Location: Delhi

PROMOTER

Sumant Sinha

INVESTORS

Goldman Sachs, Canadian Pension Plan Investment Board, Abu Dhabi Investment Authority, JERA, Global Environment Fund

VCC Edge

Sprng Energy

Company background
Sprng Energy is a renewable energy platform set up in India by Actis - a leading global investor in sustainable , with a total commitment of US$450mn of equity from Actis Energy Fund 4 to set up 2.5GW of renewable energy capacity (solar and wind) by 2022.

Current capacity
Till date, the company has a cumulative contracted capacity of 3000 MW, of which solar forms 2503 MW and balance 497MW wind. Further, 1634MW of solar and 497MW of wind stands operational.

Capacity expansion
» Shell Plc, in an agreement, has agreed to buy Sprng Energy for US$1.55bn.

FOUNDED: 2017

Location: Pune

PROMOTER
Gaurav Sood

INVESTORS
Actis LLP, Shell Plc (Potential Investor)

VCC Edge

Sun Source Energy

Company background
SunSource Energy provides distributed energy solutions for commercial and industrial customers in India with a presence across South-East Asia. It is a wholly-owned subsidiary of SHV, a global 125-year-old family business with a portfolio of companies in over 60 countries.

Current capacity
The Company has expanded its operational portfolio to 64.3MW capacity across multiple states in India and has assets under development of 105MW capacity which are in advanced stages of execution.

Capacity expansion
» Targets renewable capacity of 550MW by FY2024.
» The company has secured project financing to expand portfolio in Southeast Asia.

FOUNDED: 2010

Location: Noida

PROMOTER
Adarsh Das

INVESTORS
SHV Group

VCC Edge

Sembcorp Energy

Company background
Sembcorp Energy India Ltd is engaged in the generation of energy. It generates energy from a diversity of fuels, including natural gas, coal, renewable sources, and waste.

Current capacity
Sembcorp currently has an energy portfolio of 12,800MW which includes 3,300MW of renewable energy.

Capacity expansion
» Targets renewable capacity of 10GW by FY25.

FOUNDED: 2008

Location: Gurgaon

PROMOTER
Sembcorp Industries

INVESTORS
NA

VCC Edge

EPC Players

BHEL

Company background

BHEL is one of the first engineering enterprises to manufacture solar PV cells and modules in India. It provides end to end in-house solutions for all solar power needs- including conceptualisation, design, engineering, manufacturing, erection, testing, commissioning and O&M.

Current capacity

Company currently has 1225+ MW facility under solar manufacturing, 105MW of cell manufacturing and 226MW of module manufacturing.

Upcoming projects

» BHEL entered into an agreement with SJVN along with REMC to develop renewable energy projects for Indian Railways.
» BHEL also plans to set up GW scale ACC battery storage facility through SPV under PLI program, for which it had invited bids to select a partner.

FOUNDED: 1964

Location: Delhi

PROMOTER

NA

INVESTORS

NA

VCC Edge

First Solar

Company background

First Solar India Ltd. is engaged in providing clean and green energy requirements of the globe. It offers solar power projects developments, operates through two segments, components and systems.

Current capacity

Company has an installed base of about 1.8GW of module manufacturing in India.

Upcoming projects

» First Solar plans to set up 3.3GW manufacturing facility of fully vertically integrated PV thin-film solar module in India with an investment of $684Mn.
» First Solar is in talks to receive $500Mn in debt financing from US International Development Finance Corp for the above facility.

FOUNDED: 1999

Location: Mumbai

PROMOTER

Akhil Kamalkumar Jalan, Anisha Jalan, Nikhil Kamalkumar Jalan

INVESTORS

NA

VCC Edge

Gensol Engineering

Company background
Gensol Engineering Ltd. is engaged in providing solar designing and engineering services. It offers solar advisory, solar EPC, solar O&M services etc. It has a portfolio of over 20,000 MW, offering technical due diligence, policy, and strategic advisory and project management.

Current capacity
Gensol currently has a portfolio of 20000+ MW under its belt. It has erected solar plants with a cumulative capacity of more than 277MW on roofs and lands. It provides consultancy services in countries like Kenya, Ukriane, Oman, Gabon, Sierra Leone, Nepal, Afganistan, Indonesia, the Philippines and Chad.

Upcoming projects
» Company recently secured purchase orders to develop Grid-connected ground-mount and rooftop solar power generation systems cumulating to 15MWp in states of Goa, Gujarat and Punjab.
» Company is also looking out to venture into EV vertical, for which it received a loan of INR2.7bn.

GENSOL

FOUNDED: 2012
Location: Punjab

PROMOTER
Anmol Jaggi

INVESTORS
Gensol Consultants Pvt Ltd

VCC Edge

Inox Wind

Company background
INOX is the wind OEM part of Inox group, engaged in providing wind energy solutions. It also manufactures wind turbine generator and provide turnkey solutions. Its services include wind resource assessment, site acquisition, infrastructure development, erection and commissioning, and also long term operations and maintenance of wind power projects.

Current capacity
Cumulative manufacturing capacity stands at 1,600MW based in Gujarat, Himachal Pradesh and Madhya Pradesh.

Upcoming projects
» Inox Wind plans to raise INR4bn through preferential issue of equity shares and convertible warrants, of this promoter will infuse INR1.5bn.
» Inox Wind arm, Inox Green Energy board approved proposal to raise INR9bn through an IPO.

INOXWIND
Energizing INDIA

FOUNDED: 2009
Location: Noida

PROMOTER
INOXGFL Group

INVESTORS
NA

VCC Edge

Jackson Power

Company background

Jackson Power is an EPC contractor, IPP and module, cells and inverter manufacturer. The Jackson Group entered the solar segment in 2011. It has four state of the art manufacturing facilities for manufacturing of Generating Sets, Solar Modules and Battery Energy Storage Systems.

Current capacity

Jakson currently has a solar IPP portfolio of 200MW with 60MW of operational plants in Rajasthan and Uttar Pradesh and is setting up another 120MW of land based solar power plants in the states of Assam and Uttar Pradesh. Additionally, Jakson has 20MW of operational solar rooftop installations in the country.

Upcoming projects

» Company recently secured purchase orders to develop Grid-connected ground-mount and rooftop solar power generation systems cumulating to 15MW in states of Goa, Gujarat and Punjab.

» Company is also looking out to venture into EV vertical, for which it received a loan of INR2.7bn.

FOUNDED: 1947

Location: Noida

PROMOTER

Jackson Engineering Ltd

INVESTORS

Renew Power

VCC Edge

Mahindra Susten Pvt Ltd

Company background

Mahindra Susten Pvt. Ltd. is engaged in manufacturing solar power products. It also provides solar EPC services. It offers pre-feasibility studies, facilitation of land selection and acquisition, facilitation of project finance, turnkey engineering, procurement and construction solution for utility scale and rooftop projects, telecom tower solar systems, complete operations and maintenance service.

Current capacity

IPP portfolio stands at 1665+MW which includes 350MW projects under execution and 1315MW operational projects.

Utility scale solar portfolio stands at 4212MW which includes 350MW under execution and 3862MW executed projects.

Upcoming projects

» Mahindra Susten is developing 250MW solar project across a site spanning 900 acres in Bikaner, Rajasthan.

FOUNDED: 2010

Location: Mumbai

PROMOTER

Mahindra and Mahindra Ltd

INVESTORS

NA

VCC Edge

Sterling & Wilson

Company background

Sterling and Wilson is a global pure-play, end-to-end solar engineering, procurement and construction (EPC) solutions provider, functioning on an asset-light business model. While the company's portfolio caters to many utility-scale solar projects, it has also expanded into verticals such as rooftop, floating and solar-plus-storage solutions. In addition to turnkey EPC services for utility-scale, rooftop and floating solar projects, Sterling and Wilson provides operations and maintenance (O&M) services, including for projects constructed by third parties. The company has an established global presence, diversified portfolio offerings, a robust pipeline and a promising growth trajectory.

Current capacity

Solar EPC Portfolio stands at 11.1GW globally and O&M portfolio at 5.8GW.

Takeover deal

» RNESL had purchased interest in SWREL in October 2021 from the Shapoorji Pallonji Group and made an open offer as per takeover regulations. Later, the Competition Commission of India (CCI) cleared the deal. With this transaction, RNESL hold over 40.00% stake in SWREL while SP Group and KYD group owns 25.71% and 12.85% respectively. Earlier RNESL, Reliance Industries Limited (RIL) and Reliance Ventures Limited (RVL) had made initial payment of INR2.59 bn for the acquisition of 25.90% equity stake in the SWREL.

STERLING & WILSON

FOUNDED: 1927

Location: Mumbai

PROMOTER

Sharpoorji Pallonji and Company Pvt Ltd

INVESTORS

Goldman Sachs

VCC Edge

Vikram Solar

Company background

Vikram Solar Ltd. is engaged in manufacturing solar PV module. It offers photo voltaic modules, lighting systems and power packs. It also offers solar EPC solutions and design, install and commission solar projects.

Current capacity

Vikram Solar manufacturing footprints consists a total of 2.5GW of modules manufacturing capacity comprising of 1.2GW facility in Falta, West Bengal and a new facility of 1.3GW in Chennai, Tamil Nadu.

Upcoming projects

» Vikram Solar contemplates to enhance its module manufacturing capacity by 2.0GW and also setup a 2.0 GW of cell manufacturing capacity in next two years.

vikramsolar

FOUNDED: 2006

Location: Kolkata

PROMOTER

Vikram India Ltd

INVESTORS

NA

VCC Edge

Waaree Energies

Company background

Waaree Energies Ltd. is engaged in manufacturing solar products including solar photo-voltaic module, on-grid inverters, off-grid inverters, solar water pumps, electric water pump, solar the rmal, solar garden light, solar study lamp, inverter, etc.

Current capacity

Waaree has a current capacity of 4GW for PV module manufacturing.

Future Outlook

» It plans to increase the capacity by additional 5GW by December 2022.

WAAREE®

FOUNDED: 1989

Location: Mumbai

PROMOTER

Hitesh Doshi

INVESTORS

Baring Private Equity Partners India Ltd., Centrum Financial Services Ltd, Muthoot FinCorp Ltd

VCC Edge

Annexures

1. Steps to meet net zero target by 2070

Currently, India is the fourth largest emitter after China, the US, and EU, as per the Statistical Review of World Energy 2021 Report. Its carbon emissions stood at 2.88 BT in 2020 and are projected to reach 4.48 BT in 2030 in a business-as-usual (BAU) scenario, as reported by Centre for Science and Environment. Thus, with a 1-BT carbon reduction target, India would require reducing its projected carbon emission by 22% under the BAU scenario.

Furthermore, India has set a target of net zero emissions by 2070, which is two decades beyond the 2050 target set by climate summit's organisers. As per Council on Energy, Environment and Water, the following steps would be critical for India to meet its target.

Particulars	
Power sector	• Coal-based power generation must peak by 2040 and reduce to 99% between 2040 and 2060. • Solar-based electricity generation capacity must increase to 1,689 GW by 2050 and 5,630 GW by 2070. • Wind-based electricity generation capacity much increase to 557 GW by 2050 and 1,792 GW by 2070. • Nuclear-based electricity generation capacity must increase to 68 GW by 2050 and 225 GW by 2070.
Transport Sector	• The share of electric cars in car sales must reach 84% by 2070. • The share of electric trucks in freight trucks must total 79% by 2070, the rest being fueled by hydrogen. • The share of biofuel blend in oil for cars, trucks, and airlines must touch 84% by 2070.
Industrial Sector	• Coal use in the industrial sector must peak by 2040 and reduce by 97% between 2040 and 2065. • Hydrogen share in total industrial energy use (heat and feedstock) must increase to 15% by 2050 and 19% by 2070. • The industrial energy intensity of total GDP must decline by 54% between 2015 and 2050, and by a further 32% between 2050 and 2070.
Building Sector	• The intensity of electricity use in the building sector with respect to total GDP must decline by 45% between 2015 and 2050, and by another 2.5% between 2050 and 2070.
Refinery Sector	• Crude oil consumption in the economy must peak by 2050 and decrease by 90 per cent between 2050 and 2070.

Source: HSIE Research

2. Renewable energy outlook of the states

Particulars	RE Installed Capacity (GW)	RE share in total installed capacity	Outlook
Rajasthan	17.51	48%	• 13 GW installed capacity of solar power • Large capacity of solar power is expected to get built in the state • Although, some solar projects to be developed in Great Indian Bustard and Lesser FLorican habitats have been stranded and awaits Supreme Court's decision
Gujarat	17.11	40%	• 9.3 GW installed capacity of wind power • 7.6 GW installed capacity of solar power • Potential for solar and wind energy development estimated at 122 GW • 30 GW solar-hybrid park is planned in Kutch region, foundation was laid in December 2020 • Massive clean energy equipment facilities are planned by various industry players such as Adani, Reliance Industries and ReNew Power to leverage the state's strategic location on international shipping routes and ports access
Tamil Nadu	16.41	46%	• Highest installed capacity of wind power in India with 9.8 GW • 5.4 GW installed capacity of solar power • RE forms around 46% of total power generation capacity • The state has favourable coastline for wind speed, conducive policies and incentives, and offers a huge potential for repowering the existing wind plants • State plans to retire old thermal plants and re-evaluate the energy mix by integrating more renewable energy to meet its demand
Karnataka	15.91	53%	• 7.6 GW installed capacity of solar power • 5 GW installed capacity of wind power • Through the RE Policy of the state, it aims to develop 10 GW of additional RE projects with and without energy storage of which 1 GW will be rooftop solar.
Maharashtra	10.69	25%	• Highest bioenergy installed capacity of 2.6 GW • State has been promoting the use of decentralized and off-grid renewable energy applications to reach communities that are not able to secure regular supply of grid electricity • MSEDCL has tendered 500 MW of wind-solar hybrid capacity to be developed across the state
Andhra Pradesh	9.2	34%	• 4.4 GW installed capacity of solar power • 4.1 GW installed capacity of wind power • The state largest power consumer is agriculture sector and to meet the increasing demand and uninterrupted power to the agricultural sector, state government plans to set up solar projects • Regarding pump hydro potential in the state, Greenko is developing a multi GW scale integrated renewable energy storage project with national grid connectivity in the state
Madhya Pradesh	5.48	18%	• 2.7 GW installed capacity of solar power and wind power each • Solar power development in the state driven through progress of large scale solar parks • 5000 MW of approved capacity of total 18000 MW capacity of solar parks is in Madhya Pradesh
Telangana	4.9	32%	• 4.5 GW installed capacity of solar power • State aims to have total RE installed capacity of 6 GW primarily through solar by end of FY23
Uttar Pradesh	4.5	14%	• 2.2 GW installed capacity of bioenergy owing to the abundance of sugar industries • State has 4 under construction solar parks which will have a total power generation of 2.8 GW
Punjab	1.8	32%	• 1.1 GW installed capacity of solar power • As per draft RE policy of the state, it has a target of 3000 MW of solar projects by 2030 which will include utility scale, canal top, rooftop, floating and hybrid solar • 491 MW installed capacity of bioenergy and has a lot of untapped biomass potential

Source: Renewable Watch, NPP, HSIE Research

3. ALMM List

S. No.	Name of the Manufacturer	Enlisted Capacity
1	Mundra Solar PV Ltd	1100
2	Vikram Solar Ltd	1050
3	Bharat Electronics Ltd	10
4	Emmvee Photovoltaic Power Pvt Ltd	500
5	ORB Energy Pvt Ltd	50
6	Tata Power Solar Systems Ltd	300
7	Swelect Energy Systems Ltd	140
8	Renewsys India Pvt Ltd	750
9	Premier Energies Ltd	482
10	Visaka Industries Ltd	30
11	Websol Energy System Ltd	250
12	Sova Solar Ltd	240
13	Goldi Solar Pvt Ltd	500
14	Australian Premium Solar(India) Pvt Ltd	50
15	Solex Energy Ltd	45
16	Topsun Energy Ltd	100
17	Waaree Energies Ltd	1100
18	Waree Energies Ltd	500
19	Waaree Renewables Pvt Ltd	500
20	Icon Solar-En Power Technologies Pvt Ltd	125
21	PV Power Technologies Pvt Ltd	200
22	Saatvik Green Energy Pvt Ltd	240
23	Navitas Green Solutions Pvt Ltd	100
24	Central Electronics Ltd	35
25	Patanjali Renewable Energy Pvt Ltd	70
26	Jakson Engineers Ltd	80
27	Himalayan Solar Pvt Ltd	40
28	Sun N Sand Exim (India) Pvt Ltd	40
29	Insolation Energy Pvt Ltd	100
30	Pennar Industries Ltd	75
31	Green Brilliance Renewable Energy LLP	50
32	Sanelite Solar Pvt Ltd	20
33	Gautam Solar Pvt Ltd	110
34	Solarium Green Energy LLP	70
35	Novasys Greenergy Pvt Ltd	100
36	Pahal Solar	100
37	Pixon Green Energy Pvt Ltd	355
38	Alpex Solar Pvt Ltd	240
39	Vikram Solar Ltd	972
40	Contender Greenergy Pvt Ltd	47
41	Ritika Systems Pvt Ltd	40
42	M/s ECE (India) Energies Pvt Ltd	50
43	M/s Rayzon Green Energies	200
44	M/s Lubi Electronics	125
45	M/s Kosol Energies Pvt Ltd	171
46	M/s Citizen Solar Pvt Ltd	50

Source: MNRE, HSIE Research

4. Industry initiative:

Indian industry has also offered its hand to promote the usage of green hydrogen, with CPSUs and private players working on the ground to create enabling infrastructure.

NTPC:

NTPC is setting up a 1.25 MW solar plant in Leh to make the country's first green hydrogen fuelling station

- In June 2021, the company invited global expressions of interest (EoIs) to set up two pilot projects, a standalone fuel cell-based back-up power system and a standalone fuel cell-based microgrid system with hydrogen production using electrolysers on the premises. At present, diesel gensets are used to meet back-up power requirements as well as for microgrid applications.
- The company's renewable arm (NTPC REL) had released a domestic tender in July 2021 to set up the country's first green hydrogen fueling station in Leh, Ladakh. NTPC REL is setting up a 1.25-MW solar plant in Leh to make the hydrogen fueling station completely green.
- In August 2021, NTPC floated a global EoI for setting up a pilot project for hydrogen blending with natural gas for city gas distribution (CGD) in India. On successful implementation of the project, NTPC is expected to take it up on a commercial scale across the country.

Indian Oil Corporation Ltd (IOCL):

IOCL has set up a R&D centre for research in the areas of hydrogen production, storage and application

- IOCL has announced its plans to set up the country's first green hydrogen plant in Mathura through an electrolysis process, for which it will source power from its wind energy project in Rajasthan.
- IOCL has also set up an R&D centre for research in the areas of hydrogen production, storage and applications. It also conducted a pilot project in Delhi, wherein hydrogen was mixed with CNG to be used as fuel in buses, which resulted in lower emissions and better efficiency. Further, it has signed an agreement with the Norwegian company Greenstat to set up a Centre of Excellence on Hydrogen in India.

Reliance Industries Ltd:

RIL has planned to invest INR750 bn in solar and green hydrogen business.

- RIL has unveiled an ambitious investment plan for entering the clean energy segment. It plans to invest INR750 bn in its new business lines comprising solar and green hydrogen. The company will build four giga factories focused on solar, storage battery, green hydrogen, electrolyser manufacturing and fuel cells. The company is planning to generate 400,000 tonnes of hydrogen through the use of about 3 GW of solar energy at its proposed electrolyser gigafactory. By 2030, the company plans to create or enable enough capacity to generate at least 100 GW of renewable energy projects, which can be converted into green hydrogen. Reliance Industries and US-based Chart Industries have also formed the India Hydrogen Alliance.

Adani Group:

Adani Group has envisaged making its ports carbon-neutral by 2025.

- The Adani Group plans to triple its renewable power generation capacity, produce green hydrogen, power its data centres with renewable energy, and make its ports carbon-neutral by 2025. The group has signed a non-binding MoU with Ballard Power Systems, a global leader in fuel cell technology, to explore the possibility for commercialisation of hydrogen fuel cells in various mobility and industrial applications in India.

JSW Energy:

- JSW Future Energy Ltd, a wholly-owned subsidiary of JSW Energy, has signed an agreement with an Australian company Fortescue Future Industries to collaborate on potential projects relating to the production of green hydrogen and utilising it for green steel making, hydrogen mobility, green ammonia, and other applications.

BGR Energy:

BGR Energy plans to install a facility to produce green hydrogen from solar energy in Tamil Nadu.

- BGR Energy Systems has partnered with Ireland-based Fusion Fuel Green Plc to develop green hydrogen projects in India. The latter will install a demonstrator facility to produce green hydrogen from solar energy in Cuddalore, Tamil Nadu. Subsequently, large-scale projects will be undertaken jointly for the supply of hydrogen for the production of green ammonia and bio-ethanol and as feedstock for other heavy industrial applications.

ACME:

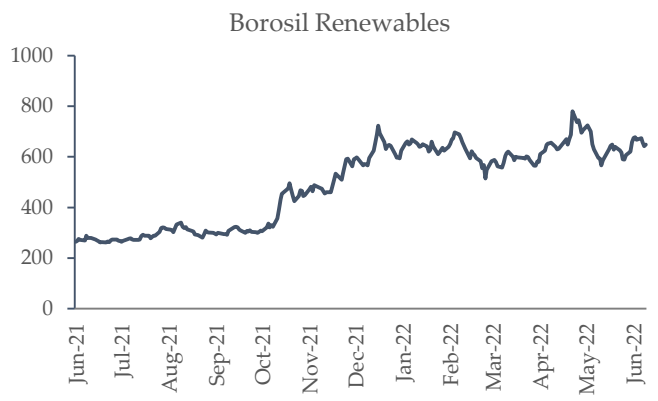
ACME to build a 3.5 GW green hydrogen and green ammonia facility in Oman.

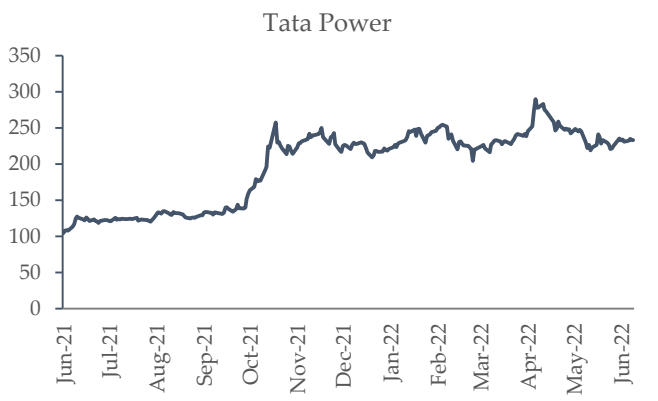
- ACME signed an agreement to advance a 3.5 GW green hydrogen and green ammonia facility in Oman. The deal entails an investment of US$3.5 bn in the SEZ at the port of Duqm in central Oman. The electrolysers at the facility will be powered by 3 GW of solar energy and 0.5 GW of wind energy. The plant will be developed in phases, and the first phase is likely to be commissioned by the end of 2022. When operational, it will export green ammonia to demand hubs such as Europe and Asia. The construction of the facility is expected to begin after ACME's first green hydrogen and green ammonia facility is commissioned at Bikaner, India.

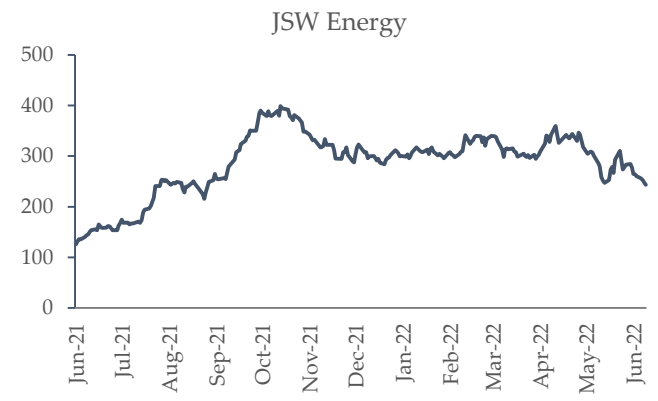
Ohmium:

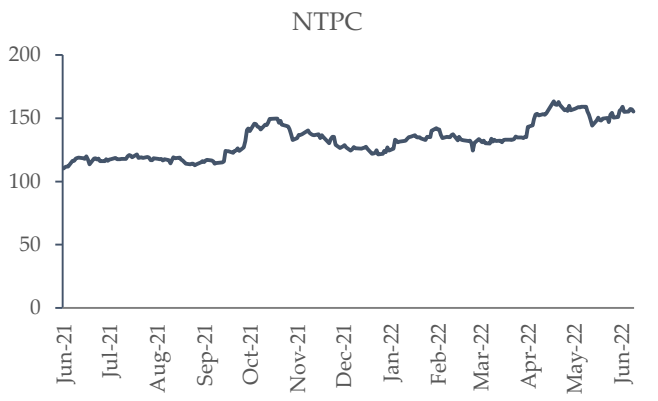
- Ohmium International, a renewable energy start-up, announced the launch of its PEM electrolyser factory in Bengaluru. The plant will have an initial manufacturing capacity of 500 MW p.a., with plans to scale up the capacity to 2,000 MW.

1 Yr price movement









Rating Criteria

BUY: >+15% return potential
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REDUCE: -10% to +5% return potential
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Power: Sector Thematic

Thematic reports by HSIE

Cement: WHRS – A key cog in the flywheel

Autos: Where are we on "S" curve?

FMCG: Defensive businesses but not valuations

Autos: A changed landscape

Banks: Double whammy for some

India Equity Strategy: Atma Nirbhar Bharat

Indian IT: Demand recovery in sight

Life Insurance: Recovery may be swift with protection driving margins

Retail: Whole flywheel is broken?

Appliances: Looing beyond near-term disruption

Pharma: Chronic therapy – A portfolio prescription

Indian Gas: Looking beyond the pandemic

India Equity Strategy: Quarterly flipbook

Real Estate: Ripe for consumption

Indian IT: expanding centre of gravity

Indian Chemical: Evolution to revolution!

Life Insurance: ULIP vs. MF

Infrastructure: On the road to rerating

Cement: Spotting the sweet spot

Pharma: Cardiac: the heartbeat of domestic market

Life Insurance: Comparative annual report analysis

Indian microfinance: Should you look micro as macros disappoint?

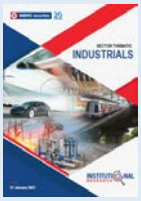
India Equity Strategy: Quarterly flipbook

Autos: Divergent trends in PVs and 2Ws

India Internet: the stage is set

FMCG: Opportunity in adversity - A comparative scorecard

Logistics: Indian Railways - getting aggressive



Industrials: Triggering a new cycle

Indian IT: raising the bar

India Equity Strategy: Quarterly flipbook

FinTech Playbook: P2M Payments | Surging pool, dwindling yields

India Hospitals: capital discipline improving, sustenance is key

Autos: Will EVs impact the 'EV'?

Cement: Riding High

Power: Reforms essential for rennaissance

Fashion & Lifestyle: From a disruptor's lens II

India Equity Strategy: Quarterly flipbook

Indian Gas Sector: Resilience in the eye of the storm

Consumer Durables: Fans - a compounding story but underrated

Quarterly flipbook: Q2FY22–Demand environment improves but input cost inflation dents profitability

FinTech Playbook: Discount Brokers

Footwear: No bargains here!

Holdcos for portfolio diversification

Cement: A concrete road for net-zero emissions

FinTech Playbook: Buy Now Pay Later | De-mystifying the tablestakes

India Equity Strategy: PLI: Spearheading India's manufacturing push

Disclosure:

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