OAKLANE
CAPITAL MANAGEMENT

WAAREE
One *with the* Sun

ACCELERATING GLOBAL ENERGY TRANSITION

WAAREE ENERGIES LIMITED

Table of Contents

Please read the following carefully before proceeding any further-

- Since we began covering Waaree Energies in October 2022, we have continuously tracked both the company and the broader industry. All our internal notes have been consolidated into this master document, arranged in chronological order with the most recent updates at the top.
- Over the past two years, both the industry and our understanding of the company have evolved. As a result, there may be instances of conflicting data and opinions. Therefore, the most recent information should be regarded as our current position.
- For ease of navigation, key sections of the RHP, DRHP, Initiating notes have been hyperlinked.
- While we have made every effort to ensure the accuracy of all facts and figures presented, any potential discrepancies are not the responsibility of Oaklane Capital Management. This note is not intended as a buy or sell recommendation for any of the companies mentioned.

Research Analyst

Utsav S Adani
utsav.adani@oaklanecapital.com
020- 4121 4014

Please see the end of this report for Important Disclosures and Disclaimers and Research Analyst Certification

KTAs from Waaree Energies IPO Meetings (Oct'24)

Management Team- Hitesh Doshi: Chairman, Amit Paithankar: CEO, Sonal Srivastav: CFO

Revenue Drivers

- The government's capacity addition plans are in AC (Alternating Current). IPPs, however, adjust this with a DC (Direct Current) overloading factor of 1.2 to 1.4, depending on the project. Hence, the actual demand for modules will be higher than what the government capacity addition.
- Sales growth in Q1FY25 was lower as the company prioritized high EBITDA margin projects.
- Export customers have remained loyal, with repeat orders being placed annually by the same set of customers. The company is also focusing on expanding its customer base.
- In Q1FY25, the realization was $0.24-0.25 per watt peak (excluding shipping). Domestic non-DCR realizations were $0.14-0.15 per watt peak. For FY24, average realizations stood at $0.22-0.23 per watt peak.
- In FY24, two customers cancelled old orders, paid cancellation charges, and placed new orders with Waaree at lower prices, for which advances were paid.

Margin Drivers

- The current production cost for modules is $0.14 per watt peak. Production costs are higher for exports to the U.S. and for the DCR market in India.
- Export margins are between 20-22%, while domestic margins range from 17-20%.

Capital Intensity

- The U.S. plant has utilities for a module capacity of 3 GW, allowing for expansion from 1.6 GW to 3 GW within a few months.
- Maximum capacity utilization is around 70-80%, as line configurations need to change based on customer specifications. However, with increased capacity, the company can dedicate specific lines for standardized specifications, thereby improving utilization.
- The company is working to commission a 6 GW module plant in Odisha within the next 6-8 months.

Corporate Governance

- Except for Waaree Technologies, all other energy transition businesses are and will continue to be under Waaree Energies. A decision has yet to be made regarding whether the battery storage business will fall under Waaree Energies or Waaree Technologies.
- WEL had been seeking to hire a senior management team, as discussed in October 2022. This has now materialized, and the company has implemented an attractive ESOP plan to retain talent.

Competition

- Only module manufacturers that are now setting up large capacities might face challenges in surviving against fully integrated players.

Technology

- Over the past 16 years, the company has witnessed seven significant technology changes. Understanding where the industry will be in the next three years is crucial. The company showcased a 725-watt peak HJT module at an expo in NCR, a technology they've been developing for the last four years. Currently, the company is working on four new technologies and will upgrade its capacity as needed.

Government Policy Related

- The White House has released a document highlighting an Energy Partnership with India. Consequently, the company does not expect the U.S. to impose duties on Indian companies.

KTAs from Waaree Energies RHP (Oct'24)

Contents

Summary

Note- This note builds upon the KTAs from the DRHP note. Therefore, only the sections containing updates have been retained.

IPO Price	**1503**	FY24 Sales	**11,398**	FY24 Gross Margin	**23%**
M Cap	**43,179**	FY24 EBITDA	**1,574**	FY24 ROE	**42%**
Enterprise Value	**36,046**	FY24 PAT	**1,237**	FY24 ROCE	**43%**
FY24E EV/ EBITDA	**23**	FY24 CFO	**2,305**	FY24 D/E	**0.08**
FY24E EV/ CFO	**16**	FY24 Capital Employed	**4,466**	FY24 Fixed Asset Turns	**9**
FY24E P/E	**35**	FY24 Total Debt	**317**	FY24 Working Cap to Sales	**-4%**

Note- Price as per IPO upper band and other data is for FY24

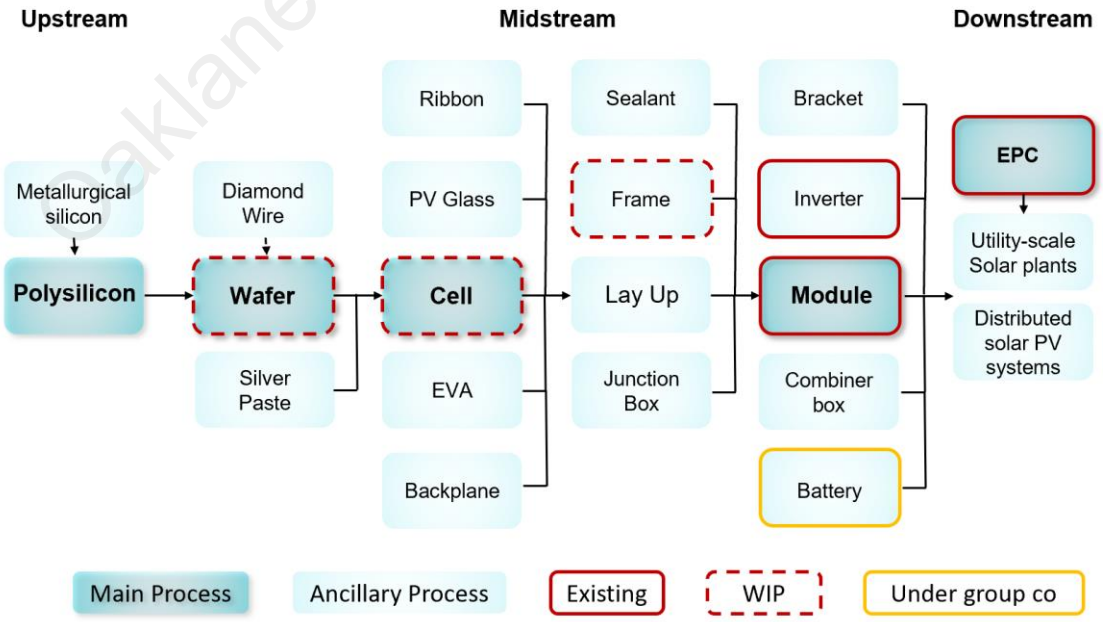
Key Stats

	Sales	EBITDA	PAT	ROE	Debt/ Equity	WC % of Sales
10 Yr CAGR/ Median	43%	L to P*	L to P*	13%	0.88	1%
5 Yr CAGR/ Median	48%	61%	72%	19%	0.46	-4%
3 Yr CAGR/ Median	80%	154%	198%	42%	0.96	-5%
FY24	11398	1574	1237	42%	0.08	-4%
Q1FY24	3409	552	394	-	-	-

L to P* is Loss to Profit

Company Brief

- The Waaree Group was founded in Mumbai in 1989, initially focusing on instrumentation and manufacturing pressure gauges and valves. In 2007, they ventured into the solar energy sector by establishing Waaree Energies Limited (WEL) as the flagship entity. Over the years, Waaree has expanded its module manufacturing capacity from 30 MW in 2007 to becoming the largest module manufacturer in India with a capacity of 13.3 GW by Oct'24.
- Today, the group is led by Mr. Hitesh Doshi and Mr. Viren Doshi, alongside a team of seasoned professionals.
- WEL is a Fortune 500 company in India and has featured as a Bloomberg New Energy Finance (BNEF) Tier 1 company for 8.5 years. It has been recognized as a top performer by PVEL for the third time and remains the only Indian company to receive the RETC High Achiever award in 2024.
- Presence of WEL and its group companies across solar PV value chain-



- Since our initial analysis in October 2022, the company has shown remarkable growth, with revenues growing 4x to INR 11,398 crore and PAT surging 17.4x to INR 1,237 crore in FY24. This growth continued into Q1FY25, where the company reported revenues of INR 3,409 crore and a PAT of INR 394 crore.
- With an operational capacity of 13.3 GW and a substantial order backlog of 16.7 GW as of June 2024, the company's sales performance is poised to remain robust. The company is well-positioned to capitalize on growth opportunities in the renewable energy sector, especially in fast-growing markets of India and the U.S., ensuring sustained performance in the medium term.
- In October 2024, WEL submitted its RHP to raise INR 3,600 crore through a fresh issue, along with an OFS of around INR 721 crore (up to 48 lakh shares). At the upper price band of INR 1503, the post-issue number of shares is anticipated to be 28.55 crore, compared to the pre-issue number of 26.33 crore, all with a face value of INR 10.
- At the IPO price of INR 1,503, WEL implied market capitalization is INR 43,179 crore, with a FY24 PE ratio of 35x. Additionally, WEL holds a 74.46% stake in Waaree Renewable Technologies, which has a market capitalization of INR 18,497 crore as of October 15, 2024. The value of WEL's stake is INR 13,773 crore. Adjusting for this investment, WEL's implied market capitalization reduces to INR 29,406 crore, with an adjusted FY24 PE ratio of 26x, offering a greater margin of safety.

DRHP- Company Brief / IC- Company Brief

Investment Thesis

*Large TAM * Industry growth * Leadership position in India * Management Quality * Size & Scale of Company *Backward Integration * Financial Strength*

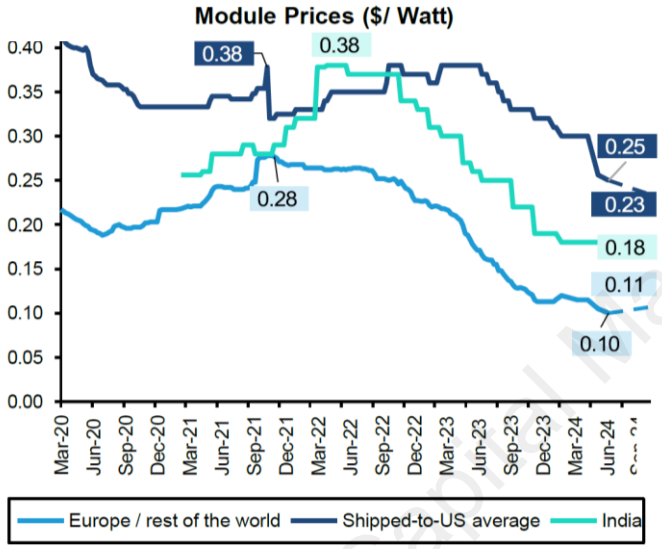
- ***Large TAM & Industry Growth*** – We project the Total Addressable Market (TAM) for WEL to encompass the solar PV module markets in the United States and India, which is expected to exceed 300 GW from 2024 to 2028, indicating a substantial addressable market size of $85 billion (source: IEA). Furthermore, the solar industry in India is emerging as a sunrise sector, benefiting from a favourable macroeconomic cycle that includes decarbonization, a favourable regulatory environment (China + 1), ESG considerations, and a diminishing cost per watt. Presently, solar energy is not only recognized as an ESG investment but is also acknowledged as a cost-effective power solution, as indicated by Lazard.
- **Leadership position in India & Globally (ex-China)-** WEL holds the distinction of being the largest module manufacturer in India and the second largest globally, excluding China. WEL is also the largest exporter of modules from India. With a current capacity of 13.3 GW, the company aims to augment this capacity to 20.9 GW by FY27. This expansion is strategically planned to uphold and strengthen WEL's dominant position in the market.
- **Management Quality-** Over the past decade, global business models in the solar industry have been established and matured. With rapidly evolving technologies, the industry has experienced several phases of upcycles and downcycles. However, WEL has consistently navigated these challenges and emerged as a leading solar company, not only in India but also on the global stage. WEL's management successfully emerged out of this downcycle and has demonstrated its execution capabilities by successfully increasing the capacity from 2 GW in FY22 to 13.3 GW as of today.
- **Size & Scale of the Company-** WEL has achieved a commendable financial performance, reporting sales of INR 11,398 cr and a PAT of INR 1,237 cr in FY24. The company has demonstrated an impressive 3-year CAGR of 80% for sales and 198% for PAT, underscoring the management's adeptness in scaling operations and executing strategic initiatives. The pivotal factor contributing to this success lies in the effective execution of operations and proficient logistics management. The inherent challenges in scaling, particularly in the realm of logistics, make it noteworthy that only a limited number of players have been able to establish capacities exceeding 1 GW.

- **Backward Integration-** While most players in the industry are focusing on investments in module manufacturing, WEL management has taken a proactive approach by investing in backward integration into solar cell and solar wafer production. A 5.4 GW solar cell capacity is expected to be commissioned by FY25, with an additional 6 GW of cell and wafer capacity anticipated by FY27.
- **Financial Strength-** In conjunction with governmental incentives such as the Production-Linked Incentive (PLI) and various state schemes, WEL has successfully procured equity and debt capital under advantageous terms. In addition to its favourable capital structure, the company's working capital needs are met by customer advances, placing it in a very beneficial position of maintaining negative working capital. The company receives advances amounting to 5-10% of the order book, which has effectively reduced its cash working capital to minus 1303 cr from 1839 cr. This strategic financial approach positions WEL favourably for future growth and facilitates forthcoming capacity expansion initiatives.
- **Key Monitorables-** 1) Capacity utilisation 2) Per unit realisation 3) Commissioning of new plants including that of wafer & cell 4) Changes in terms of trade of working capital 5) Change in regulations and incentives from various governments

DRHP- Investment Thesis / IC- Investment Thesis

Risks

- **Slower than expected growth in solar PV installations-** If newly installed solar PV capacity, both in India and in the US, falls short of expectations, it would result in a slowdown in demand for modules and lower realisations. This will have a direct impact on both sales and margins of the company
- **Solar PV Price Dynamics**- Module prices experienced a remarkable surge of 22% in fiscal 2022 and a subsequent 7% increase in fiscal 2023. However, in fiscal 2024, module prices underwent a significant decline of 42% YoY and now at $0.11 per Wp in March 2024, and are expected to remain at that level. Prices of modules shipped to US on the other hand are still at 0.25$/watt (excluding shipping) due to tariff and non-tariff barriers. Assuming a minimum of 70% AD/CVD tariffs, module prices in the US are expected to be near 0.32 $/watt by the end of 2024. Even within India, module prices today are around 0.14 to 0.18 $/watt depending on domestic vs imported cell. A substantial decrease in realizations per Wp can give rise to challenges affecting both revenues and profit margins.



Source: Bloomberg, Bernstein

- **Competitive Intensity-** Backed by government policies, over the next few years solar module industry is likely to face oversupply situation both in India and US. Indian supply is expected to go up to 110 GW by 2027E from 63 GW in 2024E, and US supply is expected to go up to 62 GW in 2027E from 35 GW in 2024E. In contrast cell manufacturing being more capital intensive and technology-driven, its capacity is expected to be at 47 GW in India and 30 GW in US by 2027E. WEL is expected to have 20% capacity share in modules and 24% capacity share in cells in 2027.
- **Risk associated with changes in US government policies**- The current regulatory environment favours manufacturers outside of China. This is evident by anti-dumping duties of up to 239% and countervailing duties of up to 18.5%, contingent on different suppliers from China. Furthermore, the US has implemented a ban on solar modules with cell components manufactured in specific provinces in China. Any significant shift in the US stance towards China could potentially exert a substantial impact on WEL's ability to secure orders under favourable terms.
- **US blocking module imports-** At present, WEL imports its entire solar cell inventory, with Longi being one of its suppliers, sourcing from its manufacturing facilities situated in Malaysia and Vietnam. Previously, modules from these same facilities encountered obstruction by US customs authorities due to suspected forced labour in the production of polysilicon, a crucial component utilized in the module manufacturing process. It is important to highlight that, as of now, no shipments from Indian enterprises have been detained by US customs authorities.

- **Execution risk**- While WEL has successfully demonstrated its ability to scale operations to 13.3 GW in module production, the risks associated with further capacity expansion, effectively managing backward integration into wafer and cell production, and entering new markets such as the U.S. remain to be seen.
- **Order Delay or Cancellation Risks**- Any delay in order delivery or cancellation/modification of orders by customers could strain WEL's financials. In FY24, two customers had cancelled their orders, however for the same they had to pay INR 340 cr to WEL.
- **Most Favoured Customer Clause**- Certain agreements in the US include a most favoured customer clause, wherein if any other customer in the US secures aggregate beneficial pricing for the same product from the company, WEL is obliged to provide the products at such favourable terms to the most favoured customer.
- **Customer Concentration Risk**- The company has been reducing customer concentration over the last 2 years. Number of customers reduced in FY23, as the company was focusing on larger customers with higher ticket size.

Customers	Q1FY25	FY24	FY23	FY22	FY21
Top 1	18%	9%	16%	18%	14%
Top 5	49%	40%	52%	34%	31%
Top 10	58%	57%	66%	43%	40%
Number of customers in India	1067	836	566	716	1381
Number of customers in Exports	12	36	33	26	31

- **Provisions for Delayed Deliveries (Liquidated Damages)-** Liquidated damages and claims, penalties for delayed delivery, are offset from revenues, affecting sales, margins, and return ratios. Any substantial delays in deliveries could result in the company incurring delay charges, further impacting its financial metrics. It should be noted that currently all exports are routed via Inland Container Depot, Navkar Terminal in Tumb.

INR Cr	Q1FY25	FY24	FY23	FY22	FY21
Provision/ (reversal) for penalties	-22	172	86	-	-
% of Sales	-0.6%	1.5%	1.3%	-	-

- **Increase in freight cost-** The COVID-19 pandemic led to elevated freight costs, causing many Chinese companies to default on their obligations as they were not willing to pay escalated freight costs.. WEL effectively capitalized on this opportunity by delivering modules and paying the higher freight cost. This circumstance provided WEL with an opportunity to cultivate favourable relations with its clientele. However, fluctuations in freight rates pose a risk, particularly in cases where contracts do not account for the ability to pass on these increases.

	Q1FY25	FY24	FY23	FY22	FY21
Freight Cost	113	324	296	214	89
Freight Cost % of Sales	3.3%	2.8%	4.4%	7.5%	4.6%

- **Timely Commissioning of New Plant-** The 5.4 GW solar cell plant in Chikhli was supposed to be operational by FY24, however, there has been a delay in operationalising the same and is expected to be operational by FY25. For the 6 GW WCM project, the PLI incentive worth INR 1,923 cr will only be received in full if the project is commissioned on schedule. According to Care Ratings, this project is running with a delay.
- **Risk of technological obsolescence-** One key risk for a solar module manufacturer lies in the challenge of securing cutting-edge technology from technology partners on favourable terms. Failure to successfully negotiate such agreements could lead to technological obsolescence, impacting competitiveness in the market. This risk is further compounded by the possibility that current production capacity, particularly if reliant on technologies like TOPCon, may become obsolete or economically unviable if industry preferences shift away from these technologies

DRHP- Risks / IC- Risks

Revenue Drivers

INR Cr	Q125	FY24	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	CAGR		
											3 Yr	5 Yr	10 Yr
Order Book (MW)	16660	19930	18060	3280	410	-	-	-	-	-	-	-	-
Order Book	29257	35000	45150	8200	1025	-	-	-	-	-	-	-	-
Advances	3083	3142	2329	594	52	-	-	-	-	-	-	-	-
Advances as % of Order Book	10.5%	7.5%	5%	7%	5%	-	-	-	-	-	-	-	-
Net Sales	3409	11398	6751	2854	1953	1996	1591	1341	992	829	-	-	-
Net Sales YoY %	2.4%	137%	137%	46%	-2%	25%	19%	35%	20%	50%	50%	38%	37%
Export %	39%	58%	68%	23%	25%	12%	13%	12%	3%	7%	139%	48%	-
Domestic %	39%	31%	20%	56%	42%	77%	71%	79%	97%	93%	64%	99%	36%
Franchise %	20%	10%	10%	20%	20%	12%	16%	4%	0%	0%	44%	26%	-
EPC & Others %	1%	1%	2%	1%	14%	-	-	-	-	-	-	-	-
Production Volume (MW)	1400	4772	2630	960	810	-	-	-	-	-	-	-	-
Realisations per MW*	2.43	2.39	2.57	2.97	2.41	-	-	-	-	-	-	-	-

*Realisations per MW assuming the entire production volume is sold

- **Order book details -**The aggregate order volume and value stands at 16.7 GW and INR 29,257 cr respectively, against the capacity of 13.3 GW, including domestic, export, and franchise orders from the plants in India. Delivery fulfillment is anticipated to conclude by the end of FY27. A contractual commitment has been established with SB Energy, outlining the supply of 3.75 GW of solar modules from the new plant coming up in the US. The unexecuted order book for EPC as of June 2024 stands at 2.2 GW.
- **Exports-** 58% of FY24 revenues came from exports, US accounted for more than 99% of these exports. Currently a large portion of the prevailing order book originates from the US. The superior revenue realization in the U.S. compared to India is attributed to the higher module prices of $0.29 per Wp in the U.S, in Sept'24 WEL's export realisations were between $0.28 to $0.30 per Wp.
- **Domestic Sales-** The domestic segment contributed 31% to the revenue in FY24 and is increasing due to the imposition of ALMM and the need for the DCR module in certain projects.
- **Franchise Sales-** This segment accounted for 10% of FY24 revenues. Gujarat stands as the foremost market for WEL in retail sales, with Maharashtra, Rajasthan, Kerala, and Uttar Pradesh comprising the top five states in terms of market presence.

INR cr	Q1FY25	FY24	FY23	FY22	FY21
No of Franchisees	369	335	253	373	290
Sales per franchise	1.9	3.5	2.7	1.6	1.3

- **EPC and O&M business- This is a small segment contributing only 1% of revenues.** This business is housed under a material subsidiary (74.5% stake) Waaree Renewable Technologies, a listed entity with a market cap of INR 18,497 cr as of 15th Oct 2024.

	Q1FY25	FY24	FY23	FY22	FY21
Bids participated	5	20	14	34	22
Bids won	0	4	3	-	3
% of Bids won	0%	20%	21%	0%	14%

Outlook

- The management has projected high growth for FY25, supported by a robust order book in both the U.S. and India. However, for Q1 FY25, WEL's revenues increased by a modest 2.4% YoY to INR 3,509 crore. We anticipate the company to achieve a 22% growth for the full fiscal year, with expected sales reaching INR ~14,000 crore.

DRHP- Revenue Drivers / IC- Revenue Drivers

Margin Drivers

Margins (%)	Q1FY25	FY24	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	Delta		
											3 Yr	5 Yr	10 Yr
Gross M	26%	23%	24%	19%	18%	18%	23%	22%	22%	20%	4%	5%	9%
EBITDA M	16%	14%	12%	4%	5%	5%	9%	8%	11%	10%	10%	9%	9%
EBIT M	14%	11%	10%	2%	3%	3%	6%	6%	8%	8%	9%	8%	7%
PBT M	16%	15%	10%	4%	3%	3%	6%	3%	5%	2%	11%	12%	10%
PAT M	12%	11%	7%	3%	2%	2%	5%	2%	3%	0%	8%	9%	9%

- **Margins-** EBITDA margins grew to 14% in FY24 from 4% in FY22, and further improved in Q1FY25 to 16%. This increase can be attributed to higher capacity utilization and a decline in raw material prices.
- **Raw material**- The company currently lacks any long-term contractual agreements with its suppliers. Instead, it employs back-to-back arrangements with majority of its suppliers, a strategic approach aimed at mitigating the impact of price risk associated with long term agreements. Notably, any fluctuations in material prices are directly passed on to clients. However, it is observed that export realizations closely align with the prevailing module prices in the United States, hence the global module prices have limited impact on company revenues and thereby margins. The imported raw materials primarily originate from three key countries: China, Vietnam and Thailand.

INR cr	Q1FY25	FY24	FY23	FY22	FY21
Cost of Imported RM	2541	7807	6794	2140	1220
% of Sales	*75%*	*68%*	*101%*	*75%*	*62%*
Cost of Imported RM from China	2158	4223	2341	1717	925
% of Sales	*63%*	*37%*	*35%*	*60%*	*47%*
Cost of Imported RM from top 3 countries	2539	6860	5747	2069	1108
% of Sales	*74%*	*60%*	*85%*	*72%*	*57%*

- **Top 5 Suppliers-** The procurement of raw materials is conducted on a spot basis through the issuance of purchase orders. The company maintains a diversified sourcing strategy for raw materials, with the top five suppliers collectively contributing to 34% of total sales.

INR cr	Q1FY25	FY24	FY23	FY22	FY21
Purchases- top 5 Suppliers in India	215	580	366	168	381
% of Sales	*6%*	*5%*	*5%*	*6%*	*20%*
Purchases- top 5 Suppliers outside India	1151	4811	3593	838	590
% of Sales	*34%*	*42%*	*53%*	*29%*	*30%*

- **Warranties & Other Liabilities-** The sale of modules typically includes a 12-year warranty covering manufacturing defects and a 30-year warranty addressing output performance. The company has secured product liability insurance coverage. Other customer liabilities extend to claims associated with non-conformity of products with agreed specifications, defects, and inaccurate product specifications.

	Q1FY25	FY24	FY23	FY22	FY21
Warranty Expense & Provision	148.6	174	98	55	38
% of Sales	4.4%	1.5%	1.5%	1.9%	1.9%
Other Customer Liability	250	252	88	0	5
% of Sales	7.3%	2.2%	1.3%	0.0%	0.2%

- **Outlook-** The company posted strong gross margins of 26% in Q125, with EBITDA margin 16%, and PAT margin of 12% (adjusted PAT margin at 8.5%). Fluctuations in polysilicon prices may affect the margins. For our projections, a conservative EBITDA margin of 14% has been considered, with an increment as the company commissions cells and wafer plants.

DRHP- Margin Drivers / IC- Margin Drivers

Capital Intensity

	FY24	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16
Sales / Ex Cash Capital Employed	14.5	10.0	6.2	4.5	8.6	4.4	2.5	2.0	2.0
Total Assets Turnover	1.2	1.4	1.6	1.8	2.3	1.7	1.2	1.0	1.0
Gross FA turnover	6.7	6.3	5.0	7.3	11.4	4.3	2.2	2.1	4.2
Net FA turnover	9.0	7.9	6.4	9.2	16.7	5.1	4.6	5.5	4.8
CWIP to Gross Block	67%	38%	16%	1%	18%	0%	13%	9%	25%
Capex/Depreciation	4.83	5.25	11.45	6.04	2.16	1.52	0.53	4.23	1.32
Depreciation to Avg Gross Block	16%	15%	8%	11%	14%	10%	5%	6%	8%
Depreciation Rate on Plant & Machinery	26%	19%	8%	9%	-	-	-	-	-

The company's operations are asset-intensive but entail low working capital needs.

- **Current Capacity & proposed expansion-** The current operational capacity stands at 13.3 GW, distributed across five distinct plants and 20 production lines spread across 136 acres of land. The company has strategic plans to augment this capacity to 21 GW by incorporating additional capabilities through the establishment of two new plants located in Odisha, and Texas. The maximum capacity utilization can be 85%, as the production lines have to change specifications for different orders.

MW	FY27E	FY26E	FY25E	FY24	FY23	FY22	FY21	FY20
Module Capacity								
Surat, Gujarat*	230	230	230	230	230	230	500	500
Tumb, Gujarat	1000	1000	1000	1000	1000	1000	1000	1000
Nandigram, Gujarat	1100	1100	1100	1100	1100	1280	500	500
Chikhli, Gujarat	9660	9660	9660	9660	9660	6490	2000	-
Noida, UP	1300	1300	1300	-	-	-	-	-
Dhenkanal, Odisha	6000	6000	-	-	-	-	-	-
Houston, Texas	1600	1600	1600	-	-	-	-	-
Total Module Capacity	**20990**	**20990**	**14990**	**11990**	**11990**	**9000**	**4000**	**2000**
Effective Capacity	-	-	-	-	6500	2080	1540	-
Capacity Utilisation	-	-	-	43%	40%	46%	53%	-
Cell Capacity								
Chikhli, Gujarat	5400	5400	5400	-	-	-	-	-
Dhenkanal, Odisha	6000	-		-	-	-	-	-
Total Cell Capacity	**11400**	**5400**	**5400**	**-**	**-**	**-**	**-**	**-**
Wafer Capacity								
Dhenkanal, Odisha	6000	-	-	-	-	-	-	-
Total Wafer Capacity	**6000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

***** The Surat facility's capacity was derated because better quality modules were produced from the same line, reducing its stated capacity.

- **Capex in India-** The comprehensive expenditure for the establishment of the 6 GW Ingot Wafer, Cell & Module (WCM) project is outlined at INR 9,050 cr. Under a long-term lease agreement spanning 76 years, the company has secured an allocation of 595 acres of land in Dhenkanal, Odisha. The development plan includes the construction of four buildings, collectively covering an area of 2 million square feet. The detailed breakdown of estimated project cost is as follows-

Particulars	Estimate cost (INR Cr)	Supplier
Land	139	-
Engineering Consultancy	89	Suhua Construction, Sarang, Avant Garde, etc
Buildings and Civil works	1086	
Ingot & Wafer machinery	2007	Linton, Qingdao
Cell machinery	2004	SC New Energy, Zuvay Tech
Module machinery	412	Jinchen, Wuxi, GSolar, Pasan SA
Utilities	2932	Zuvay, Kiansh, Polyplast, PM Electro etc.
IT Infra	93	Honeywell, Rockwell, Watrana, Unique MEP
Freight cost	129	-
Miscellaneous & contingencies	160	-
Total	**9050**	-

- **Capex in the US-** A module plant with a capacity of 1.6 GW is anticipated to commence operations in the United States during FY25, which can be expanded to 3 GW in a short span of time.

Guidance- The company plans to increase capacity from 13.3 GW of module to 20.9 GW module, 11.4 GW cell, and 6 GW wafer manufacturing by FY28 totalling a capex of more than INR 15,000 cr. Funding for this capacity expansion will be derived from a combination of internal accruals, fresh equity infusion, customer advances, and debt financing. With an increase in the order book, the management anticipates a gradual increase in capacity utilization, reaching 60-65% over next few years.

Working Capital Management & Guidance – The management anticipates that the working capital cycle will persist at its existing levels and does not foresee any substantial alterations within the next five years.

	FY24	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16
Current Ratio	1.5	1.1	0.9	1.2	1.3	1.3	0.8	0.8	0.9
Net Working Capital % of sales	-11%	**-5%**	**-14%**	**5%**	**4%**	**0%**	**-2%**	**-3%**	**-3%**
Inventories	23%	40%	19%	19%	12%	6%	7%	6%	8%
Trade receivables	9%	5%	3%	6%	7%	14%	6%	13%	7%
Advances Paid	3%	6%	3%	1%	-	-	-	-	-
Trade payables	18%	21%	19%	18%	15%	19%	16%	23%	18%
Advances Received	28%	34%	21%	3%	-	-	-	-	-
Cash Conversion Cycle (Days)	**-26**	**-20**	**-20**	**17**	**8**	**-3**	**-8**	**-11**	**-1**
Inventories	85	88	58	57	31	23	21	24	32
Trade receivables	21	11	13	24	32	34	29	35	30
Advances Paid	11	14	7	2	-	-	-	-	-
Trade payables	55	53	57	61	56	59	59	70	63
Advances Received	88	79	41	5	-	-	-	-	-

DRHP- Capital Intensity / IC- Capital Intensity

Capital Structure

	FY24	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16
Total Debt	317	859	371	358	126	107	504	413	421
Total Debt / Equity	0.08	0.46	0.84	0.91	0.37	0.42	2.87	1.84	2.06
Total Debt/EBITDA	0.20	1.03	3.34	3.74	1.36	0.74	4.56	3.93	5.29
Total Debt/CFO	0.14	0.55	0.53	4.99	1.51	1.02	4.95	3.65	-
Net Debt / Equity	-0.85	-0.49	-0.32	0.34	-0.11	-0.37	2.16	1.31	1.40
Interest to Avg Debt	17%	12%	10%	12%	29%	18%	12%	13%	12%
Interest Coverage Ratio	9	8	2	2	2	2	1	1	1

- The company maintains low leverage, indicated by its debt/equity ratio of 0.08. Debt is primarily allocated to capex, as working capital is predominantly financed through customer advances. Additionally, strong cash flow from operations of INR 2305 cr in FY24 has supported its financing requirements.
- **Equity**- There is a proposed fresh issue amounting to a maximum of INR 3,600 cr, coupled with a secondary offer for sale comprising up to 48 lakh shares. Within the OFS, the promoter, Waaree Sustainable Finance, intends to offer 43.5 lakh shares, while Chandurkar Investments, a non-promoter entity, is set to offer 4.5 lakh shares. WEL has raised equity capital of INR 2,123 cr from inception to Sept'24, a detailed capital history of the company has been given below. If all granted ESOPs are vested, it will lead to a dilution of about 0.4% of the post offer number of shares.

Capital History	Month	Amount (INR cr)	Issue Price	No of Shares added	Post issue No of Shares
Public Issue	Oct'24	3,600	1503	2,76,92,308	28,94,31,220
ESOPs	Oct'23 to Sept'24	6.6	10 to 154	17,83,214	26,33,31,104
Private Placement	Jul'23	1,000	550	1,81,81,819	26,15,47,890
Private Placement	Oct'22	1,040	225	4,62,27,579	24,33,66,071
Bonus	Feb'18	-	-	12,13,15,992	19,71,38,492
Rights Issue	Dec'14 to Jan'15	1.1	40	2,62,500	7,58,22,500
Allotment of Equity to Others	Feb'09 to Mar'14	69	10	6,91,55,670	7,55,60,000
Stock Split	Oct'08	-	-	57,63,897	64,04,330
Allotment of Equity to Others	Jun'03 to Oct'08	6.4	100	6,40,233	6,40,433
Subscription to the MOA	Dec'90	0.0	100	200	200
Total Capital Raised before IPO		**2,123**			
Total Capital Raised post IPO (E)		**5,723**			

Source: Ace Equity, RHP

- **Debt-** Up until the fiscal year 2024, the company maintained a low level of indebtedness. Going forward, there is an anticipated increase in debt, attributable to project financing of INR 5,518 cr for the 6 GW WCM project in Odisha and the 1.6 GW module project in the United States. Nonetheless, considering the robust cash flows of the company, it is expected that servicing the increased debt will not pose a challenge.
- **Advances from customers-** As of June'24, WEL holds INR 3,083 cr in advances, and it is anticipated to grow further as the company secures additional confirmed orders from customers. Advances will be utilized to finance both the capex and working capital requirements of the company.
- **Capex in India-** The company secured a project loan of INR 5,518 cr from the SBI for the 6 GW Ingot Wafer, Cell & Module (WCM) project in Dhenkanal, Odisha. A sum of INR 2,775 cr will be sourced from the fresh issue as part of the IPO, with the remaining balance to be funded through internal accruals.
- **Capex in the US-** The capex planned in US is worth $ 70 mn, funding for this initiative will be sourced from internal accruals, debt instruments, and customer advances.

DRHP- Capital Structure / IC- Capital Structure

Financials

Strong Growth – FY24 marked a significant milestone for the company, with reported revenues growing by 69% from INR 6,751 cr in FY23 to INR 11,398 cr in FY24. This growth trajectory is likely to continue in FY25 underscored by the robust order book and favourable renewable energy policies globally. From FY19 to FY24, growth had been commendable at 48% CAGR.

INR Cr/ CAGR	Q1FY24	FY24	1 yr	3 yr	5 yr	10 yr
Sales	3409	11398	69%	80%	48%	43%
EBITDA	552	1574	89%	154%	61%	L to P
EBIT	477	1298	94%	173%	66%	L to P
PAT	394	1237	156%	198%	72%	L to P

Healthy Profitability – Buoyed by margins, return ratios were strong in FY24. Before FY23, the ROE ranged from 2% to 38%. The trend of healthy return ratios is anticipated to persist, driven by sustained robust margins and higher asset turnover resulting from improved capacity utilization.

	FY24	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16
ROA	14%	10%	4%	4%	5%	9%	2%	3%	0%
Ex Cash ROCE	176%	108%	31%	15%	33%	31%	17%	19%	15%
ROCE	43%	44%	19%	15%	22%	24%	15%	16%	11%
Ex Cash ROE	572%	3381%	131%	10%	22%	133%	24%	23%	17%
ROE	42%	43%	19%	12%	13%	38%	12%	12%	2%
PAT / PBT	73%	74%	67%	69%	69%	78%	59%	51%	21%
PBT / EBIT	134%	101%	175%	105%	87%	103%	50%	64%	29%
EBIT / Sales	11%	10%	2%	3%	3%	6%	6%	8%	8%
Sales / Total Assets	1.01	0.91	1.29	1.51	2.13	2.02	1.25	0.91	1.00
Total Assets / Net worth	2.71	3.98	5.05	3.28	2.76	3.05	6.12	4.85	4.06

Cash Flow Analysis – Cash flow generation has been robust over the past three years and has remained positive since FY16. The company finds itself in a unique position where working capital is partly funded by customer advances, effectively reducing the capital requirement for growth.

	FY24	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16
CFO	2305	1560	701	72	83	106	102	113	44
CFO Margin	20%	23%	25%	4%	4%	7%	8%	11%	5%
FCFF	1,093	728	215	(106)	17	(9)	48	(2)	26
FCFF Margin	10%	11%	8%	-5%	1%	-1%	4%	0%	3%

Sensitivity Analysis for FY28E

- By FY28, WEL is projected to attain a module capacity of 20.6 GW, a cell capacity of 11.4 GW, and a wafer capacity of 6 GW.

- The subsequent table illustrates sales sensitivity across various realization levels and capacity utilization rates. With a realization of INR 1.75 cr per MW and a 60% capacity utilization, the company could potentially achieve a revenue of INR 23,876 cr in FY28.

FY 28E Sales Sensitivity (INR cr)		Capacity Utilisation				
		55%	60%	65%	70%	75%
Realisation per MW (INR cr)	1.55	17,894	19,521	21,147	22,774	24,401
	1.65	19,048	20,780	22,512	24,243	25,975
	1.75	20,203	22,040	23,876	25,713	27,549
	1.85	21,357	23,299	25,240	27,182	29,124
	1.95	22,512	24,558	26,605	28,651	30,698

- We anticipate that, through partial backward integration by FY28, WEL could achieve a conservative EBITDA margin of 18% and a PAT of INR 2,115 cr, resulting in a PAT margin of 7.4%, including the PLI subsidy of INR 385 cr receivable from FY26 for a period of 5 years and totalling to INR 1923 cr.

FY 28E PAT Sensitivity (INR cr)		Capacity Utilisation				
		55%	60%	65%	70%	75%
Realisation per MW (INR cr)	1.55	1,324	1,539	1,754	1,969	2,184
	1.65	1,477	1,705	1,934	2,163	2,392
	1.75	1,629	1,872	2,115	2,357	2,600
	1.85	1,782	2,038	2,295	2,551	2,808
	1.95	1,934	2,205	2,475	2,746	3,016

Guidance & Outlook

- FY23 marked a turning point for WEL, as the company successfully capitalized on the US export opportunity and the surge in demand for renewable energy. The company repeated its strong performance in FY24 as well.
- Since our initial analysis in October 2022, the company has demonstrated remarkable growth with a 4x increase in revenues to INR 11398 cr and a 17.4x surge in Profit After Tax to INR 1237 cr in FY24.
- The management has projected high growth for FY25, supported by a robust order book of INR 29257 cr in both the U.S. and India. However, for Q1 FY25, WEL's revenues increased by a modest 2.4% YoY to INR 3,509 crore. We anticipate the company to achieve a 22% growth for the full fiscal year, with expected sales reaching INR 14,000 crore.
- With management's focus on profitability and execution of high margin orders, we believe the company can maintain its EBITDA margin at 14% at the least, as in Q1FY25 they had an EBITDA margin of 16%. Accordingly, our projection for EBITDA is INR ~1960 cr and for PAT is INR 1158 cr (a growth of 25% over adjusted PAT of INR 930 cr in FY24)
- Growth is expected to stem from both the export market and the domestic market on the back of favourable government policies.

DRHP- Financials / IC- Financials

Earnings Quality Checks

1. **Other Operating Income, Other Income and Exceptional income as % of PBT-** Overall, other operating income, other income and exceptional income collectively represent 35% of Profit Before Tax (PBT) in FY24. Among these, the significant gains that may not be sustainable are exceptional income (which is order cancellation charge) and is the profit from forex fluctuations, which accounted for 23% of PBT in FY24.

	Q1FY25	FY24	FY23	FY22	FY21
PBT	**531**	**1734**	**677**	**118**	**66**
Other Operating Revenue	**8**	**26**	**143**	**11**	**11**
Duty Drawback	0	4	129	2	5
Scrap sale	8	21	13	5	3
Franchise Fees	1	2	1	3	4
Other Income	**88**	**235**	**109**	**92**	**30**
Interest Income	64	150	51	9	17
Govt Grant	0	1	3	3	4
Profit on sale of invt	2	31	7	1	0
Gain on change in fair value of invt	0	1	0	0	0
Profit on FX Fluctuation	18	49	48	21	5
Others*	5	3	1	58	3
Exceptional income	-	341	21		
Duty Drawback % of PBT	**0%**	**0%**	**19%**	**2%**	**7%**
Profit on FX Fluctuation % of PBT	**3%**	**3%**	**7%**	**18%**	**8%**
Exceptional income % of PBT	**-**	**20%**	**3%**	**-**	**-**

3. **Cash Flow Conversion –** The cash conversion ratio has consistently been at a healthy average of 1x until FY21 and has experienced a significant increase in the past three years. This notable uptick can be attributed mainly to the influx of high customer advances.

	FY24	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16
Pre-Tax CFO / EBITDA	1.7	2.0	6.6	1.0	1.0	0.9	1.3	1.2	0.7
Adj CFO / PAT	1.8	3.0	8.6	1.5	1.8	0.8	2.3	2.7	0.7

Cumulative INR Cr	3 yr	5 yr	8 yr
PBT	2530	2653	2846
Adjustments for net cash flow	652	763	1001
Working Capital Investments	1846	1800	1753
Taxes	-461	-494	-565
Capex	-2695	-2946	-3232
FCFF	2035	1946	1984
Pre-Tax CFO / EBITDA (x)	2.00	1.93	1.77

Audit Comments under CARO

- **Discrepancy in inventory reported to banks**
  - **Auditor Remark-** The auditors have pointed out a substantial variance of INR 422 cr between the carrying amount of inventory in the company's accounts (INR 2576 cr) and the quarterly returns filed by the company with the bank (INR 2135 cr) for Q4FY23.
  - **Company's Submission-** The differences between declared amounts vis a vis book balances were reconciled as part of the financial reporting closure process. Revised statements for the period were subsequently revised and submitted to respective Banks which are in line with the books of accounts

DRHP- CARO

Capital Allocation

	FY24	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16
Source of cash flows (INR cr)	**2718**	**1881**	**279**	**237**	**106**	**164**	**116**	**111**	**115**
Cash Operating Profit %	63	45	60	40	100	100	66	94	69
Net Borrowings %	-	-	40	60	-	-	34	-	5
Equity %	37	55	-	-	-	-	-	6	26
Allocation INR cr	**-825**	**-507**	**80**	**-220**	**-106**	**-78**	**-5**	**-165**	**-45**
Working Capital %	(72)	(142)	669	10	22	74	-462	-3	52
Capital Expenditures %	162	170	(621)	89	16	70	271	72	48
Invt in JVs and Associates %	-	29	52	1	19	-176	291	-	-
M&A %	-	-	-	-	-	-	-	-	-
Dividend & buyback %	0	0	(1)	-	-	-	-	-	-
Net Debt Repayments %	10	43	-	-	43	131	-	31	-
Surplus INR cr	**1892**	**1,373**	**359**	**18**	**1**	**86**	**111**	**-55**	**70**
ROCE	**43%**	**44%**	**19%**	**15%**	**22%**	**24%**	**15%**	**16%**	**11%**

- **Capacity Expansion-** The company has scaled up its module capacity from 1.5 GW in FY19 to 13.3 GW in Oct 2024, with plans to further increase it to 20.9 GW by FY27, aiming to maintain its dominant position in the Indian market. The management's approach to capital expenditure is cautious and typically hinges on confirmed orders, such as the 1.6 GW module plant in the US, backed by a 3.75GW confirmed order from a customer. They plan to augment module capacity and add cell capacity in the US contingent upon market conditions and government incentives.
- **Backward Integration-** In Q4FY25, the company will commence operations at a 5.4 GW solar cell plant, aiming for a total of 11.4 GW cell capacity and 6 GW Wafer capacity by FY27, with the objective of enhancing gross margins by 5-6% points. This strategic move is also geared towards quality control, ensuring timely supply of raw materials, and reducing lead times for manufacturing.
- **New products/ segments-**
  - Furthermore, WEL has executed a MoU with the government of Odisha for the establishment of a 1 GW green hydrogen electrolyser manufacturing facility in Khurda, with a committed investment of INR 435 cr. The preference is to make electrolysers using Alkaline technology. Anticipated technology collaborations are projected to materialize in late FY25, with the product rollout expected by FY26. The company has secured a PLI for 300 MW.
- **Value Added Distribution –** VADD to shareholders has witnessed a substantial improvement in recent years, primarily attributed to enhanced profitability

	FY24	FY23	FY22	FY21	FY20	FY19	FY18
Value Added (VADD)	2028	878	210	140	140	200	131
Total Income	11398	6751	2854	1953	1996	1591	1341
Value Added (%)	18%	**13%**	**7%**	**7%**	**7%**	**13%**	**10%**
VADD To Employee (%)	8%	13%	24%	30%	35%	20%	25%
VADD To Lenders (%)	7%	9%	19%	22%	24%	28%	44%
VADD To Tax (%)	23%	20%	18%	15%	13%	11%	13%
VADD To Shareholders (%)	63%	57%	38%	33%	28%	41%	19%

DRHP- Capital Allocation / IC- Capital Allocation

Corporate Governance

- **IPO details-** The expected IPO size is INR 4321 cr split into fresh issue of INR 3600 cr and OFS of INR 721 cr at an offer price of INR 1503. The lead bankers to the issue are Axis Capital, IIFL Securities, Jefferies, Nomura, SBI Caps, Intensive Fiscal and ITI Capital.
- **Shareholding Pattern-** Currently the promoters own 71.8% of the company, which will dilute to 64.3% after the fresh issue and OFS.

	Pre-Offer No of Shares	Pre Offer %	Post Issue No of Shares	Post Issue %
Promoters	18,90,82,083	71.80%	18,47,32,083	64.30%
Non Promoters	7,42,49,021	28.20%	10,25,51,117	35.70%
Total	26,33,31,104		28,72,83,200	

- The current **Statutory Auditor is** SRBC & Co and the **Internal Auditor is** KPMG.
- **Board of Directors-** WEL boasts a diversified board of directors, comprising a total of eight members, of which four serve as independent directors. We have given below the composition of board committees. Additional information regarding the concise profiles of board of directors can be found in the KTAs from DRHP note.

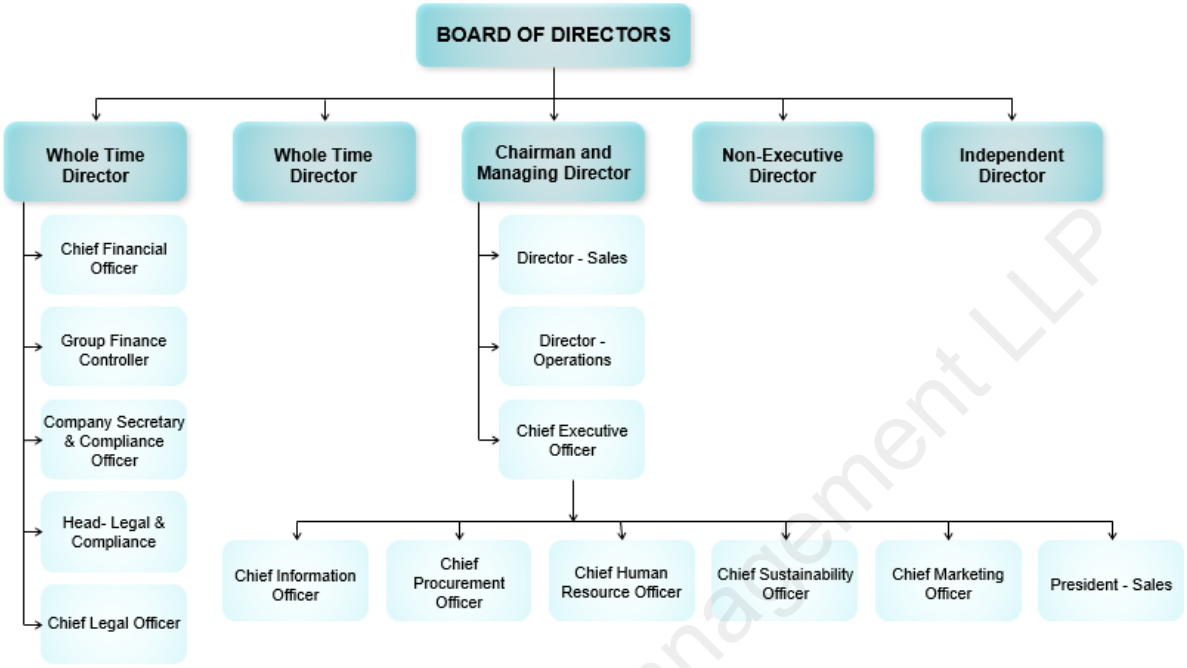
Board of Directors		Committees				
Name	**Title**	**Audit**	**Nomination & Remuneration**	**Stakeholder Relationship**	**CSR**	**Risk Mgmt.**
Hitesh Chimanlal Doshi	Chairperson, Managing Director	-	-		Chair	Chair
Viren Chimanlal Doshi	Whole Time Director	-	-	Y	-	-
Hitesh Pranjivan Mehta	Whole Time Director & CFO	Y	-	Y	Y	-
Dr. Arvind Ananthanarayanan	Non-Executive Director	-	-	-	-	-
Sujit Kumar Varma	Independent Director		-	Chair	-	Y
Rajender Mohan Malla	Independent Director	Chair	Y	-	-	Y
Jayesh Dhirajlal Shah	Independent Director		Y	-	Y	-
Richa Manoj Goyal	Independent Director	Y	Chair	-	-	-

Change in top management- WEL had been looking to hire a senior management team and this was mentioned to us in Oct'22 as well. This has come to fruition now, and they have a very good ESOP plan to retain talent. A succinct overview of the senior management team is provided in the Annexure.

- In Sept'24, WEL appointed Sonal Shrivastava as CFO, who was previously CFO at Vedanta and Holcim (South Asia). The former CFO Hitesh Mehta continues his position on the board of directors.
- In June'24, WEL appointed Sanjeev Pushkarna as Chief Procurement Officer, who was previously with Sterling & Wilson Renewable.
- In May'24, WEL appointed Aniruddha Arvind Khekale as Chief Human Resources Officer, who was previously with Adani Electricity Mumbai.
- In Mar'24, WEL appointed Amit Paithankar as CEO, who was previously the Group President at ReNew. The former CEO Vivek Srivastava resigned in Nov '23, later he joined Suzlon in Feb '24.
- In Mar'24, WEL also appointed Nilesh Malani as CMO, who was previously the CMO at Polycab.
- In Feb '24, WEL appointed Avadut Parab as the Chief Information Officer (CIO), who previously served at Parle Agro. His appointment is intended to strengthen and enhance the internal systems at WEL. A succinct overview of the senior management team is provided in the Annexure.

- On 26th Mar'24, Waaree Solar Americas appointed Gordon Brinser as the Chief Operating Officer (COO), who previously worked as the Vice President of Operations at Enersys, where he managed manufacturing sites and implemented LEAN manufacturing programs.

Management Organization Chart of Waaree Energies



- **Subsidiaries-** The company has 12 subsidiaries. Of these Waaree Renewable Technologies (EPC company), Indosolar (establishing 1.3 GW module capacity) and Waaree Solar Americas (establishing 1.6 GW module capacity in US), Waaree Clean Energy Solutions (for electrolyser and green ammonia), Sangam Solar One (6 GW WCM project), Waaree Energy Storage Solutions (for battery storage), Waaree Energies Middle East (for exports to Europe, Middle East & Africa), Waaree green Aluminium and Waaree Forever Energies are the key entities in terms of revenues or potential revenues.
- **RPT-** The company has engaged in transactions with related parties. Among these related parties, we would like to highlight Dhari Solar. Further details are provided in the subsequent section and the KTAs from DRHP note.
- **Workforce -** As of June 2024, the company employs 1752 staff members and utilizes the services of 7773 contract labourers. The attrition rate for FY23 stood at 16%, marking a decrease compared to previous years. In FY21, the high attrition rate was attributable to employee transfers between group companies. In FY22, attrition was elevated due to the competitive nature of the industry. Notably, the company disbursed a one-time 100% bonus to all employees in FY23.

	Q1FY25	FY24	FY23	FY22	FY21
No of Employees	1752	1630	888	538	471
Attrition Rate	4.7%	19%	16%	38%	25%

Guidance- Although there have been numerous transactions with related party entities in the past, some of which are questionable, the management has proposed moving forward to limit dealings with Waaree Renewable Technologies, a solar EPC company. Waaree Renewable Technologies Ltd is the sole listed subsidiary of the WEL, with WEL holding a 74.8% stake in it.

DRHP- Corporate Governance / IC- Corporate Governance

Earnings Quality Checks

1. **Dhari Solar Park (Dhari)-** Dhari awarded an EPC contract worth INR 120 cr in FY24 to Waaree RTL, a listed subsidiary of WEL, which was takeover by the promoters of WEL and was later acquired by WEL from its promoters
   - **13th June 2023-** Dhari entered a contract worth INR 120 cr with Waaree Renewable Technologies, which is a publicly listed company and a significant subsidiary of WEL. It is worth mentioning that during this period, Dhari was owned by individuals who were not connected to the promoters of the Waaree Group.
   - **29th June 2023-** The promoters of WEL acquired a 100% stake in Dhari, making it a group company of WEL. Consequently, Dhari was included in WEL's financials, reflecting sales and outstanding amounts totalling 59 Cr in Related Party Transactions.
   - **9th September 2023-** Waaree Renewable Technologies sought approval for RPT totalling 61 cr with Dhari. This amount covered the outstanding balance of the INR 120 cr EPC contract initiated on June 13, 2023, as well as the 59 cr recorded as sales to Dhari
   - **26th July 2024-** Waaree Energies entered a term sheet with Dhari Solar Park to acquire a 36 MW solar power project (yet to be commissioned). The maximum consideration payable is INR 125 cr and the company has already paid INR 105 cr.

DRHP- Related Party Transactions / IC- Related Party Transactions

Competition

- This section is covered at length in other notes- RHP- Peer Comp / Global- Competition / Premier Energies- Competition / DRHP- Competition / DRHP- Peer Comp / IC- Competition

Valuation

At an IPO price of INR 1,503 (upper band), WEL's implied market capitalization is INR 43,179 cr, with a FY24 PE ratio of 35x. This is more attractive compared to other listed player like Premier Energies and unlisted player like Vikram Solar, which have lower capacity and relatively weaker financial performance. After adjusting for its 74.46% stake in the listed entity, Waaree Renewable Technologies (Mcap: 18497 cr as on 15th Oct'24), the adjusted PE ratio stands at 26x, providing a greater margin of safety.

Valuation Ratios (FY24)	WEL	PEL	VSL
Price*	1503	1084	315
Market Cap*	43179	48843	11471
EV*	36046	48532	10661
EV / Sales	3.2	15.4	4.2
EV / EBITDA	23	102	27
EV / CFO	16	540	70
P/S	3.8	15.5	4.6
P/B	5.6	25.1	5.9
P/E	35	211	143

* Vikram Solar price based on unlisted market transactions. We have assumed an IPO size of INR 1500 cr at a price of INR 315 for all the calculations.

Outlook- All three WEL, PEL and VSL exhibit promising growth prospects, driven by heightened emphasis on renewable energy and favorable regulatory developments. However, given the leadership position, better financial strength and capital efficiency, it is inferred that WEL presents a more favorable investment opportunity.

DRHP- Valuation / IC- Valuation

Annexure

Corporate Governance

Senior Management Team- This table provides a succinct overview of the senior management team

Name	Designation	Brief profile
Amit Paithankar	Chief Executive Officer	Joined WEL in Mar'24, previously he was the Group President of ReNew, He was also the member of the management board of the company for over a year. A scientist for Swedish-Swiss multinational ABB for 4 years, Paithankar worked for the longest time for 20 years with the US-headquartered engineering services company Emerson. In his last position with Emerson, he was the VP for its Advanced Design Center and Managing Director for South Asia.
Sonal Shrivastava	Chief Financial Officer	Joined WEL in Sept'24, previously she was CFO of Vedanta, prior to that she was CFO of Holcim (South Asia region).
Nilesh Malani	Chief Marketing Officer	Before joining WEL, he was the CMO of Polycab. He has also worked with JSW Steel as its Head of Marketing and Head of Retail Marketing and Channel Sales. He has also worked with Castrol India Limited and Asian Paints.
Jignesh Rathod	Director Operations	Associated with the company since 2007, responsible for overseeing the operational functions at the various factories.
Sanjeev Pushkarna	Chief Procurement Officer	He joined WEL in June'24 and is responsible for supply chain management. Previously he was associated with Sterling & Wilson Renewable Energy.
Aniruddha Arvind Khekale	Chief Human Resources Officer	He joined WEL in May'24 and is responsible for human resources functions. He was previously associated with Adani Electricity Mumbai, Cummins India, amongst other companies.
Rajesh Ghanshyam Gaur	CS and Compliance Officer	Responsible for corporate secretarial and compliance functions, with previous experience at Ambuja Cements as a manager in the secretarial function.
Prabhu Narayan Singh	Chief Sustainability Officer	He joined WEL in Jan'24 and is responsible for ESG functions in the company. Previously he was associated with Vikram Solar, ReNew Power amongst other companies.
Abhishek Pareek	Group Finance Controller	Manages the finance function across the Waaree group of companies, with experience serving as CFO at Shubhalakshmi Polyesters Limited.
Pankaj Vassal	President - Sales	Manages the retail sales operations of the company's franchise business, with prior experience at brands such as Havells, Pidilite, and Asian Paints.
Manoj Sinsinwar	Chief Legal Officer	Manages the legal functions of the company, previously associated with Sasan Power, Indu Towers, Sistema Shyam Teleservices etc.
Avadut Parab	Chief Technology Officer	He was recently appointed in Feb'24. Prior to joining WEL, he oversaw the implementation of several major projects, such as several full-cycle SAP implementations and enterprise-wide technology initiatives at Parle Agro
Manoj Patil	Head - Legal Contract and Compliance	Manages the legal functions within the group, previously associated With Zuari Indian Oil Tanking, Varroc Engineering etc.

Comparison between WEL, PEL & VSL

Company Brief- Waaree Energies engages in the production of different types of solar modules and has undertaken expansion for backward integration into the manufacturing of wafers and solar cells. Additionally, WEL possesses an EPC arm dedicated to solar power plants through its publicly listed subsidiary, Waaree Renewable Technologies. Premier Energies (PEL) engages in the production of solar modules and cells and is expanding its capacity in these segments. Vikram Solar (VSL) engages in the production of solar modules and is expanding its capacity in both modules and cell segments, the company also has a solar EPC segment.

Key Stats- In terms of operational capacity and absolute sales, WEL is >3.5 x the size of PEL and VSL, despite being the largest company, its sales/ EBITDA/ PAT growth has also been the highest at 80%/ 154%/ 203% over the last 3 years. WEL also demonstrated a significantly higher cash flow at INR 2,305 cr, attributed to more effective working capital management. Furthermore, WEL also has the largest order book among the three.

FY24 (INR cr)	WEL	PEL	VSL	3 Year	WEL	PEL	VSL
Order book (GW)	19.9	-	4.4	-			
Order book Value	35000	5926					
Volume (GW)	4.77	1.57	0.88				
Capacity (GW)	13.3	3.4	3.5				
Sales	11,398	3,144	2,511	Sales CAGR	80%	65%	16%
Realisation per MW	2.39	2.02	2.85	-			
EBITDA	1,574	478	399	EBITDA CAGR	154%	107%	31%
PAT	1,237	231	80	PAT CAGR	203%	114%	28%
EBITDA per MW	0.33	0.30	0.45	-			
CFO	2,305	90	152	Cum Pre-tax CFO/ EBITDA	2.00	0.57	1.06

Revenue Breakup- In terms of exports, VSL has the highest proportion, however this comes on the back of degrowth of domestic business in the last 3 years. Both WEL and PEL have scaled up exports in the last 3 years.

	FY24				3 Year CAGR		
INR cr	WEL	PEL	VSL		WEL	PEL	VSL
Total Sales	11,398	3,144	2,511		80%	65%	16%
Export %	58%	14%	62%		139%	266%	103%
India %	42%	86%	38%		49%	57%	-12%

DuPont Analysis- WEL possesses a more robust balance sheet in comparison to PEL and VSL. The financial leverage on WEL's balance sheet stems from customer advances and not debt. WEL has been maintaining the highest ROE amongst the 3 peers.

	FY24				3 Year Medians		
	WEL	PEL	VSL		WEL	PEL	VSL
PAT / PBT	73%	80%	74%		73%	92%	77%
PBT / EBIT	134%	76%	41%		134%	-31%	15%
EBIT / Sales	11%	12%	10%		10%	2%	6%
Sales / Total Assets	1.01	0.89	0.97		1.01	0.68	0.84
Total Assets / Networth	2.71	5.36	5.80		3.98	5.72	6.37
ROE	42%	51%	20%		42%	-5%	4%

Margins- VSL has the highest gross & EBITDA margin on account of higher exports. PEL has higher gross & EBITDA margin on account of cell manufacturing. At PAT level WEL has the highest margin, even if one adjusts for the exceptional item in FY24.

	FY24			3 Year Medians		
	WEL	PEL	VSL	WEL	PEL	VSL
Gross Margin	23%	25%	33%	23%	21%	22%
EBITDA Margin	14%	15%	16%	12%	5%	9%
PAT Margin (ex-exceptional)	11%	7%	3%	10%	2%	1%
CFO Margin	20%	3%	6%	23%	3%	9%
FCFF Margin	10%	-	3%	10%	-	3%

Capital Intensity- WEL exhibits greater capital efficiency with higher total/ gross/ net asset turns. It also has the best working capital management with high advances from customers.

	FY24			3 Year Medians		
INR cr	WEL	PEL	VSL	WEL	PEL	VSL
Total Asset turns	1.2	1.1	1.0	1.4	0.8	0.88
Gross FA turns	5.67	2.25	2.79	4.83	2.03	0.44
Net FA turns	7.86	2.63	0.20	6.11	2.44	0.31
Adj WCap to Sales	-11%	13%	34%	-11%	8%	32%
Receivable to Sales	23%	8%	16%	23%	10%	16%
Inventory to Sales	9%	1%	47%	5%	1%	47%
Advances Paid to Sales	3%	32%	0%	3%	32%	0%
Payable to Sales	18%	19%	26%	19%	19%	26%
Advances Received to Sales	28%	31%	3%	28%	31%	11%

Capex- PEL has had the highest capacity utilization compared to WEL and VSL. WEL has been expanding capacity despite low utilisation to remain market leader in terms of capacity.

Capacity Data	WEL			PEL			VSL		
	Module	Cell	Wafer	Module	Cell	Wafer	Module	Cell	Wafer
FY24 Capacity (MW)	12000			3360	2000		3500		
Effective capacity (MW)	11010	-		1670	950		1780	-	
Utilisation % in FY24	43%		-	60%	81%	-	48%		-
FY25E	14900	5400		4360	3000		3500		
FY26E	20900	5400		8360	7000		10500	3000	
FY27E	20900	11400	6000	8360	8000	2000	15500	3000	

Capital Structure- Despite being the largest player, WEL has the lowest gross and net debt. Going forward, debt for all 3 players is likely to increase on the back of aggressive capacity expansion.

	FY24			3 Year Medians		
INR cr	WEL	PEL	VSL	WEL	PEL	VSL
Total Debt	317	1,392	808	371	933	738
Total Debt / Equity	0.08	2.11	1.81	0.46	2.7	2
Total Debt/EBITDA	0.20	2.91	2.03	1.03	11.9	3.96
Total Debt/CFO	0.14	15.4	5.31	0.53	25.5	3.78
Net Debt / Equity#	-	1.5	-	-	2.0	-
Interest Coverage Ratio	9.3	3.1	1.7	8.1	0.4	1.0

Profit & Loss Statement- Although VSL & PEL boast higher gross margins attributed to a better geography mix and increased value addition in comparison to WEL, it is noteworthy that WEL exhibits superior PAT margins of 11% (adjusted PAT margin of 8.6%). WEL's exceptional gain is on account of order cancellation charges levied on customers- WEL has not lost these customers, they cancelled the previous high price orders and placed low price orders for which WEL has also received advances.

	P&L Statement of FY24				Common Size P&L % of Sales for FY24		
	WEL	PEL	VSL		WEL	PEL	VSL
Sales	**11,398**	**3,144**	**2,511**		**100%**	**100%**	**100%**
COGS	8,760	2,344	1,679		77%	75%	67%
Gross Profit	**2,638**	**800**	**832**		**23%**	**25%**	**33%**
Employee Cost	154	59	96		1%	2%	4%
SG&A	512	34	188		4%	1%	7%
Miscellaneous Expenses	56	78	100		0.5%	2%	4%
EBITDA	**1574**	**478**	**399**		**14%**	**15%**	**16%**
Depreciation	277	96	138		2%	3%	5%
EBIT	**1298**	**382**	**261**		**11%**	**12%**	**10%**
Interest	140	121	155		1%	4%	6%
Other Income	52	28	4		0.5%	0.9%	0.1%
Income from investment	183	-	9		2%	-	0.36%
Exceptional Income	341	-	-		3%	-	-
PBT	**1734**	**289**	**107**		**15%**	**9%**	**4%**
Tax Cost	460	58	28		4%	2%	1%
Consolidated PAT	**1274**	**231**	**80**		**11%**	**7%**	**3%**
PAT	**1237**	**231**	**80**		**11%**	**7%**	**3%**
Sales Per Share	433	69	97				
Adjusted EPS (Reported)	47	7	3			-	
Adjusted Book Value per share	154	14	17				
Number of Shares	26.3	45.1	25.9				

Balance Sheet- WEL has the strongest balance sheet of the three companies, with the lowest amount of debt and the highest customer advances.

	Balance Sheet as of FY24				Common Size Balance Sheet as of FY24		
	WEL	**PEL**	**VSL**		**WEL**	**PEL**	**VSL**
Total Equity and Liabilities	**11,231**	**3,537**	**2,585**		**100%**	**100%**	**100%**
Total Equity	**4,148**	**660**	**445**		**37%**	**19%**	**17%**
Equity Capital	263	26	259		2%	1%	10%
Total Reserves	3,778	615	187		34%	17%	7%
Liabilities	**7,082**	**2,877**	**2,140**		**63%**	**81%**	**83%**
Non-Current Liabilities	**1,659**	**991**	**718**		**15%**	**28%**	**28%**
Long-Term Borrowings	103	878	199		1%	25%	8%
Long Term Provisions	108	49	19		1%	1%	1%
Other Long-Term Liabilities	1,494	51	493		13%	1%	19%
Deferred Tax Assets / Liabilities	(46)	13	8		-0.4%	0.4%	0.3%
Total Current Liabilities	**5,423**	**1,886**	**1,422**		**48%**	**53%**	**55%**
Short Term Payables	2,014	975	647		18%	28%	25%
Other Current Liabilities	2,680	373	161		28%	11%	6%
Total Assets	**11,231**	**3,537**	**2,585**		**100%**	**100%**	**100%**
Non-Current Assets	**3,217**	**1,355**	**607**		**29%**	**38%**	**23%**
Gross Block	*2,010*	*1,394*	*899*			-	
Less: Accumulated Depreciation	*560*	*197*	*393*				
Net Block	**1,450**	**1,197**	**505**		**13%**	**34%**	**35%**
Tangibles	*1,443*	*1,197*	*499*		*13%*	*34%*	*15%*
Capital Work in Progress	1,341	20	28		12%	1%	1%
Long Term Loans & Advances	331	92	69		3%	3%	3%
Current Assets	**8,013**	**2,182**	**1,978**		**71%**	**62%**	**77%**
Current investments	71	-	-		1%	-	-
Inventories	2,586	1,009	393		23%	29%	15%
Trade Receivables	971	609	1,185		9%	17%	46%
Cash & Bank	3,779	403	116		34%	11%	4%
Short Term Loans & Advances	497	123	90		4%	3%	3%
Other Current Assets	109	38	194		1%	1%	8%
Total Debt	317	1,392	808		3%	39%	31%
Capital Employed	4,466	2,052	1,254		40%	58%	48%
Ex Cash Capital Employed	615	1,648	1,138		5%	47%	44%
Total Equity (Ex Cash)	298	256	330		3%	7%	13%
Cash & Investment (C&I)	3,850	404	116		34%	11%	4%
Contingent Liability	152	1,610	53		1%	46%	2%

Cash Flow Statement- In FY24, WEL generated a cash flow of INR 2305 cr, contrasting with INR 90 cr for PEL and 152 cr for VSL. WEL's higher CFO is largely attributable to enhanced working capital management. WEL raised equity capital in FY23 & FY24 and is raising funds through IPO. PEL did its IPO in Sept'24 and raised INR 1300 cr as fresh issue. VSL did a pre-IPO round of INR 715 cr in June'24 and has filed its DRHP for the IPO. All three companies have raised funds to fund capital expenditures for future growth initiatives

	Cash Flow Statement of FY24				Cash Flow as % of Sales for FY24		
	WEL	PEL	VSL		WEL	PEL	VSL
Cash flow from Operations	**2,305**	**90**	**152**		**20%**	**3%**	**6%**
Profit Before Tax	1,734	289	107		15%	9%	4%
Adjustments for Net Cashflow	**314**	**195**	**365**		**3%**	**6%**	**15%**
Depreciation	277	96	138		2%	3%	5%
Interest Expenses	124	84	155		1%	3%	6%
Interest and Dividend Income	(151)	(14)	(6)		-1%	-0.4%	-0.2%
Other Adjustments	64	29	79		1%	1%	3%
Adjustments for Changes in Operating Assets and Liabilities	**592**	**(369)**	**(310)**		**5%**	**-12%**	**-12%**
Trade & Other receivables	(670)	(562)	-		-6%	-18%	-
Inventories	123	(376)	(20)		1%	-12%	-1%
Trade & Other payables	1,026	605	(16)		9%	19%	-1%
Other Adjustments	112	(35)	(274)		1%	-1%	-11%
Cash generated from operations	**2,640**	**115**	**163**		**23%**	**4%**	**6%**
Tax Paid	(335)	(25)	(11)		-3%	-1%	-0.4%
Cash Flow from Investing Activities	**(3,340)**	**(447)**	**(64)**		**-29%**	**-14%**	**-3%**
Capital Expenditures	(1,337)	(449)	(71)		-12%	-14%	-3%
Investments other than Subsidiaries, JVs, and Associates	(2,117)	(6)	(4)		-19%	-0.2%	-0.2%
Interest and Dividend Income Received	125	7	5		1%	0.2%	0.2%
Increase/ Decrease in Loans given	(11)	2	6		0%	-0.05%	0.3%
Cash Flow from Financing Activities	**909**	**549**	**(81)**		**8%**	**17%**	**-3%**
Interest Paid	(121)	(78)	(143)		-1%	-2%	-6%
Equity Share Issue	1004	-	-		9%	-	-
Equity Dividend and Tax on Dividend	(1)	-	-		0%	-	-
Other financial activities	(16)	(1)	(9)		0%	-0.04%	-0.4%
Net Cash Inflow / Outflow	**(126)**	**192**	**7**		**-1%**	**6%**	**0.3%**
Opening Cash & Cash Equivalents	254	65	2		2%	2%	0.1%
Closing Cash & Cash Equivalent	**121**	**257**	**9**		**1%**	**8%**	**0.4%**
Free Cash Flow to Firm	1,093	(352)	86		10%	-11%	3.4%
Free Cash Flow to Equity	999	197	5		9%	6%	0.2%
Capex	(1,337)	(449)	(71)		-12%	-14%	-2.8%

DRHP- Peer Comp

KTAs from Waaree Energies Chikhli Plant Visit on (5th Oct'24)

Some soft aspects- Guest houses have been constructed near the plant, which are currently occupied by Chinese engineers and customers. The visit was subject to certain restrictions, including the sealing of phones to prevent unauthorized photography. Some questions remained unanswered, as the discussion was limited to information disclosed in the Draft Red Herring Prospectus (DRHP). The management suggested that these inquiries be addressed during conference calls—a practice I observed during the roadshows of Premier Energies as well.

Management Team

- **Sonal Srivastav**: CFO of Waaree Energies Ltd (joined in Sept'24; previously CFO of Vedanta and Holcim)
- **Nilesh Malani**: Chief Marketing Officer (CMO)
- **Jignesh Rathod**: Chief Operating Officer (COO)
- **Roshan Pandey**: Senior Manager, Customer Compliance
- **Mr. Saxena**: Responsible for Quality

Revenue Drivers

- **Order Book:** The company has an **order book of 20 GW amounting to INR 35,000 cr**, with execution timelines ranging from a few months to three years. Orders are confirmed only upon receipt of advances.
- **Export Production:** Export production has decreased to 70% from 80% in the previous FY, largely due to increased scrutiny from the US on Chinese raw materials.
- **Customer inspections-** The company has reported an increase in customer inspections, with a distribution of 60% domestic and 40% international clients. Additionally, there is at least one customer inspecting the facility daily.
- **Target geographic mix:** Management aims for a 50% revenue split between export and domestic markets and plans to diversify exports to include Europe, the Middle East, and Africa. A new subsidiary was established in Jebel Ali, UAE, to focus on the Middle East & African markets.
- **Supply Chain Stability:** Management emphasizes that US module manufacturing alone cannot meet the demand in the US market, and Waaree's stable supply chain makes it difficult for companies to switch suppliers.

Margin Drivers

- **Cell manufacturing:** Management believes that, moving forward, in-house cell production will enhance operating margins, as the realizations for domestically produced cells and modules are higher.
- **Polysilicon procurement:** Company is in discussions with Chinese firms from non-UFLPA regions to secure a seven-year contract for polysilicon procurement, with pricing structured as part fixed and part variable.

Capital Intensity

- **Capacity Overview**: Waaree has a **current module capacity of 13.3 GW** across five facilities in India and a 1.6 GW capacity set to begin production in the US in Q4 FY25. The Chikhli plant features 6

GW of module capacity and 5.4 GW of cell capacity (yet to commission), with land available for expansion to 10 GW each.

- **Plant Details**: The Chikhli facility includes 3 module plants with 13 production lines, 1 module plant is for flexible modules. It also has 2 cell plants with 3 lines of PERC and 8 lines of TOPCon. All the machinery is predominantly sourced from China, and the rejection rate is below 0.01%.
- **Capacity Utilization**: For FY24, **capacity utilization was reported at 78%** of effective capacity for the year.
- **Upcoming Cell Production Lines**:
  - **A 1.4 GW Mono PERC cell line** is scheduled to begin production in November 2024, with an anticipated stabilization period of 20-25 days to achieve an efficiency of 23.5%. The company has deployed 40 Chinese engineers on-site to oversee the commissioning and stabilization process. According to management, one of the competitors took 6-9 months to stabilize their cell line, as the machinery was originally designed for Chinese conditions and required reconfiguration to suit Indian conditions. This reconfiguration process was further complicated by the challenges posed by the COVID-19 pandemic.
  - **4 GW TOPCon cell line** is anticipated to begin production by the end of FY25. The capacity also features LECO technology which enhances cell efficiency by 0.3%.
- **Odisha plant capex**: The capex for modules, cells, and wafers aligns with figures in the DRHP, with no reported changes. Electricity subsidies are significant, especially given the high energy consumption of wafers and cells. PLI and state subsidies are likely to reduce capex costs by 30%.
- **Testing Lab**: Waaree operates one NABL-accredited lab at the Tumb facility and has established a new lab at the Chikhli facility, which is undergoing final NABL inspection on October 7-8, 2024. The Chikhli lab is the largest in India, featuring temperature-controlled and non-controlled testing environments.
  - It is used for R&D, continuous testing of modules, and specific customer testing requirements.
  - The lab conducts 48 different tests as per international standards and has a capacity to test 149 modules at one time.
  - The list of tests performed is- Impulse voltage, reverse current overload, bending test, robustness of termination, hail test, sun simulator, mechanical load, peel test, wet leakage current, insulation & continuity test, accessibility test, cut susceptibility, sharp edge test, visual inspection, module breakage, ignitability test, non-uniform snow load (the only lab which does this test in India), damp heat, salt mist, environment test, temperature cycle, humidity freeze, Letid test, PID test, UV test, hot & cold test.
  - Module tests are valid for 2 years, which is what most players do, however Waaree does testing on a continuous basis.
- **Depreciation policy:** The policy is aggressive and in line with changes in technology. Modules have a depreciation period of 3 years, and the main cell line has a period of 5 years.

Corporate Governance

- The name "Waaree" originates from Wari Hanuman, Maharashtra, where Chairman Mr. Hitesh Doshi was born.
- Management did not provide specific details on the businesses housed under Waaree Technologies a group company or specific details on capex planned under new subsidiaries like Waaree CES, Waaree Forever Energies, and Waaree Green Aluminium.

Competition

- A large conglomerate has initiated a 1 GW module line with HJT technology. However, the solar cell machinery has remained in the warehouse for two years and has not yet begun commissioning.
- Chinese cells currently cost approximately 4 cents, sold at 50% of production costs. Waaree can produce cells at around 8 cents, similar to Premier Energies. When wafer prices stabilize, Waaree's costs are expected to be slightly higher than those produced by Chinese manufacturers.

Technology

- Globally, only 20 GW of HJT cell line is currently operational, which provides real-world efficiency comparable to TOPCon, even for the top industry players. Also, HJT technology has not yet been proven to work effectively at scale. Additionally, the capex for HJT is currently three times higher than that of TOPCon on a per-GW basis.
- Waaree can transition from Mono PERC to TOPCon to Tandem to Black Contact technologies. Tandem cells provide efficiencies comparable to HJT, while Black Contact exceeds HJT efficiencies. The incremental capex for transitioning to Tandem and Black Contact technologies is lower than that required for a complete machinery replacement for HJT.
- Waaree has partnered with IIT Bombay for technology collaboration, facilitating procurement for their research initiatives. The R&D team includes PhDs and postgraduates from IIT Bombay and other prestigious institutions.

Government Policy Related

- **ALMM for Cells:** The first list is expected to be released by December 2024. Discussions are ongoing regarding the criteria for defining capacity, with module capacity based on the lower of stringer and lamination capacity. Also, any line which is not working during inspection is not considered.
- **US Container Inspections:** In the U.S., container inspections are conducted on a sample basis, with 1 in every 100 containers undergoing an initial review. During this process, authorities request the Bill of Materials (BOM) and supply chain verification. If any discrepancies are identified, the container is detained; otherwise, it is cleared for release. To date, none of Waaree's containers have been detained.
- **Equipment Imports:** The draft regulation for machine exports now excludes wafer and cell equipment intended for India, following the Indian government's initiation of visa issuance. Recently, Linton Technologies, a manufacturer of wafer equipment with headquarters in the U.S. and production facilities in China, received a 10 GW order for wafer machinery from an Indian company. This development indicates that there are currently no restrictions on export of equipment by the Chinese government.

Briefs on Distinct Types of Tests

- **Impulse Voltage**: Checks performance if struck by lightning.
- **Bending Test**: For flexible modules.
- **Robustness of Termination**: For the junction box on modules.
- **Hail Test**: Can withstand hailstorms at speeds of up to 82 km/h.
- **Peel Test**: Checks if lamination is peeling off.
- **Accessibility Test**: For worker installation of modules (not applicable for bifacial modules).
- **Sharp Edge Test**: Ensures edges are not sharp enough to hurt workers or cut wires.
- **Module Breakage Test**: Can withstand up to 45.5 kg of weight without breaking.

- **Ignitability Test**: Ensures that fire does not spread.
- **Non-Uniform Snow Load**: The only lab in India conducting this test, assessing functionality during snowfall.
- **Damp Heat**: Must withstand 85 degrees Celsius and 85% humidity for 1,000 hours.
- **Salt Mist**: Evaluates corrosion in coastal areas over a period of 56 days.
- **Temperature Cycle**: Performed across cycles of -40 degrees Celsius to 85 degrees Celsius for up to 600 cycles.
- **PID Test**: Ensures that the last module in an array can supply power to the transformer/inverter.
- **UV Test**: Checks for yellowing of glass/EVA, which indicates decreased module efficiency.
- **Module Testing Validity**: Tests are valid for two years, which is standard for most players; however, Waaree conducts testing on a continuous basis.

Global Solar Industry Updates (Oct'24)

Contents

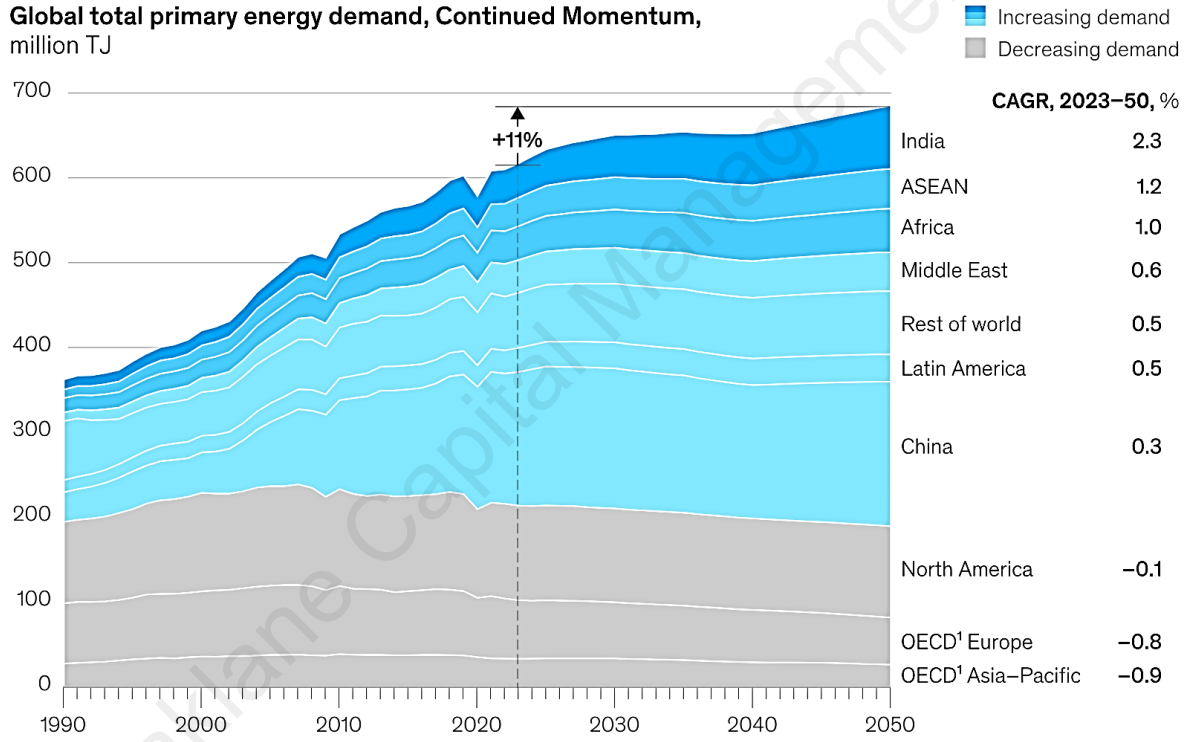
Global Energy Outlook

Overview

- Global energy demand is projected to grow until 2050, largely driven by emerging economies and energy-intensive sectors like data centres and AI. To fully transition to clean energy, the world must invest $10 trillion in energy generation and storage. Solar PV, a simple and standardized technology, has been expanding rapidly, but its current share of electricity generation stands at just 5%.
- Due to its declining cost curve, high likelihood of mass adoption, and one of the lowest levelized costs of electricity (LCOE), the demand for solar modules and related components is expected to rise in the coming years. Despite this growth, the sector may still experience cyclical fluctuations.

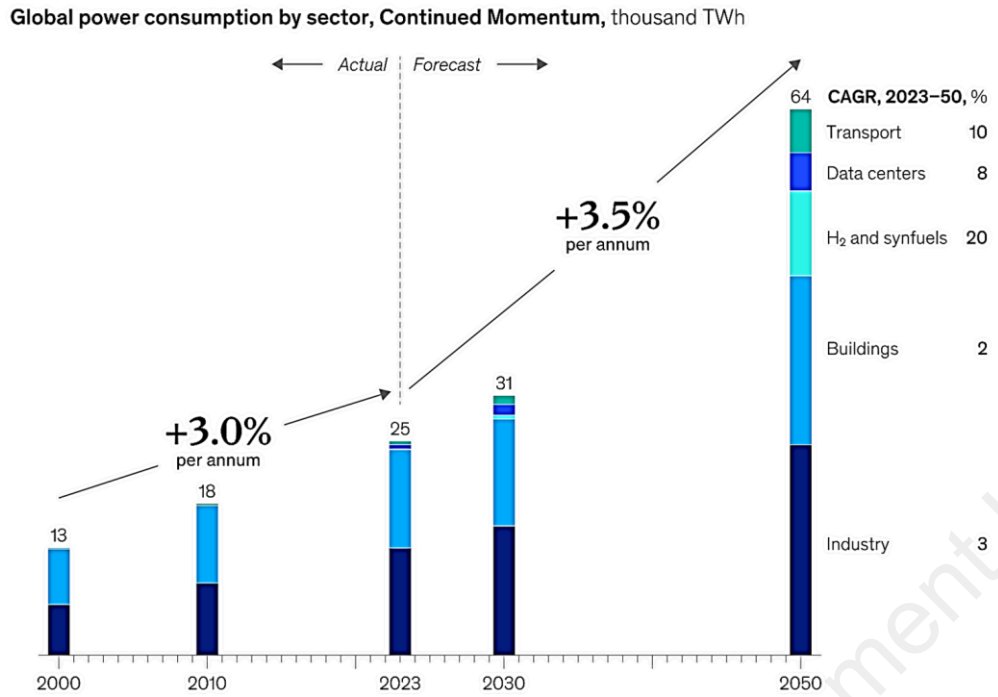
Global Energy Demand

- **Global energy demand is projected to continue to increase to 2050**- The rise in global energy demand is primarily fuelled by the rapid economic growth of emerging markets. These countries are experiencing increased industrialization, urbanization, and population growth, all of which contribute to higher energy consumption across various sectors. This growing demand is expected to continue shaping global energy trends in the coming decades.



Source: McKinsey

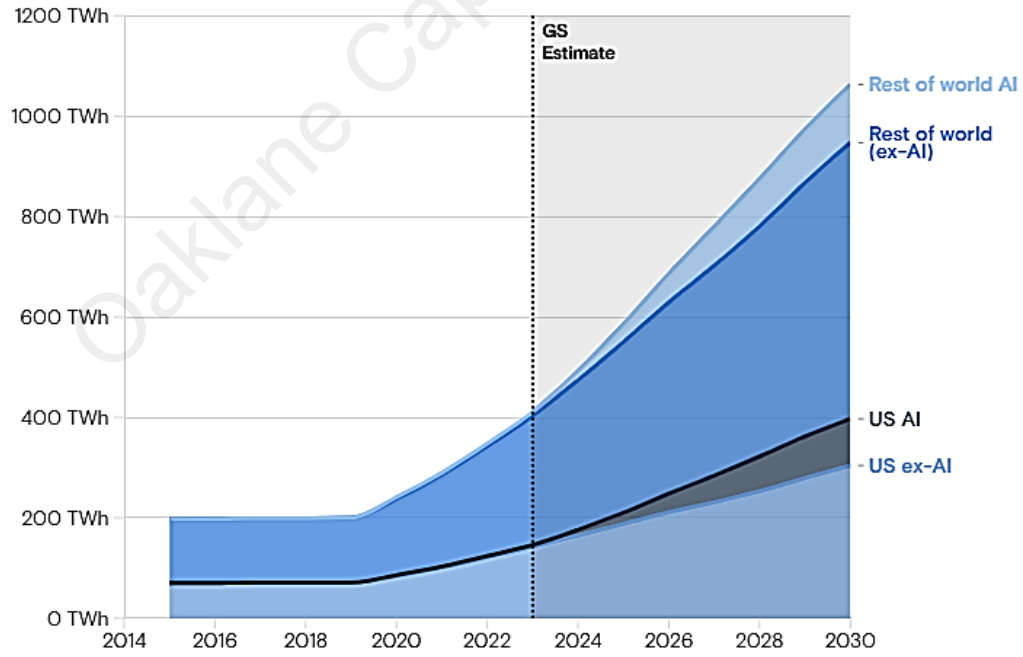
- **Growth in electricity consumption is expected to accelerate as new demand centres emerge**- new demand centres, including data centres, transportation, and hydrogen production, are projected to experience significant growth in power demand. Among these, the most notable is the rise of artificial intelligence (AI) and the accompanying expansion of data centres. The impact of AI on future energy demand is expected to vary considerably, influenced by the growth trajectories of its diverse applications and the advancements in other related technologies.



Source: McKinsey, IEA, IRENA

- **Energy needs of data centres, AI and mobile technology are rapidly growing-** On average, a ChatGPT query needs nearly 10 times as much electricity to process as a Google search
  - **Data Centres**- According to IEA, currently data centres account for 1-2% of global electricity consumption, projected to rise to 3-4% by 2030.
  - **AI**- Goldman Sachs expects AI to drive a 160% increase in data centre power demand by 2030, contributing 19% of that demand by 2028.
  - **Mobile Technology**- According to IEA, mobile networks currently consume 2-3% of global electricity, with the deployment of 5G expected to increase mobile power demand by up to 70% by 2030.

Data centre power demand

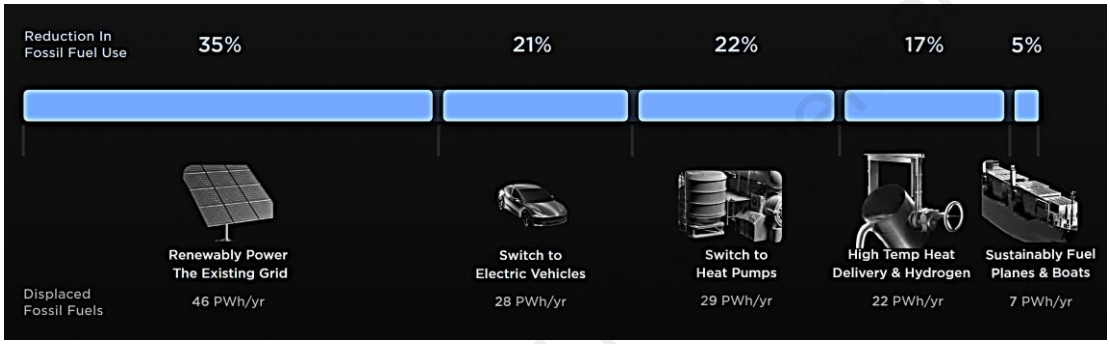


Source: Goldman Sachs

Global Renewable Energy Demand

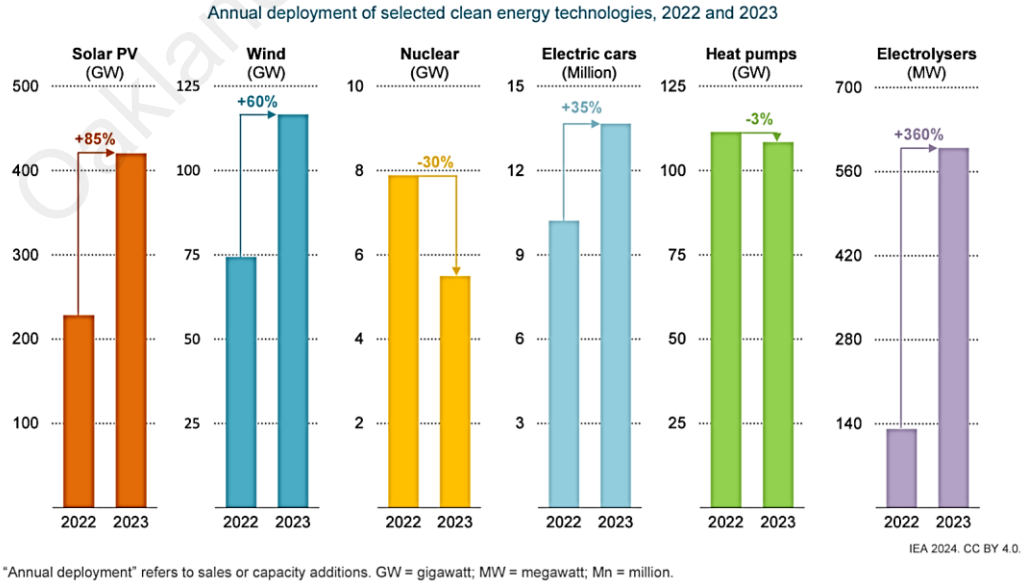
- **The Plan to Eliminate Fossil Fuels-** According to Tesla, achieving the elimination of fossil fuels requires the deployment of 30 TW of solar and wind farms, along with 240 TWh of vehicle and stationary storage. The direct land required for this initiative would be just 0.17% of the Earth's total land area, compared to 12.5% currently used for agricultural purposes. The total capex for this transition is estimated at $10 tn over the years, which is less than the projected $14 tn cost of continuing fossil fuel investments. If we expand our production capacity as outlined, it is feasible to achieve 100% sustainability by 2050. This would necessitate an annual deployment of 1 TW of solar and wind energy, along with 16 TW of vehicle and stationary storage each year.
  - **Repower the Existing Grid with Renewables**- 24 TWH stationary storage, 10 TW solar + wind
  - **Switch to Electric Vehicles**- 115 TWH vehicle batteries & stationary storage, 4 TW solar + wind
  - **Switch To Heat Pumps in Homes, Businesses & Industry-** 6 TWH stationary storage, 5 TW solar + wind
  - **Electrify High Temp Heat Delivery & Hydrogen-** 48 TWH stationary storage, 6 TW solar + wind
  - **Sustainably Fuel Planes & Boats-** 44 TWH vehicle batteries & stationary storage, 4 TW solar + wind

The Plan to Eliminate Fossil Fuels



Source: Tesla

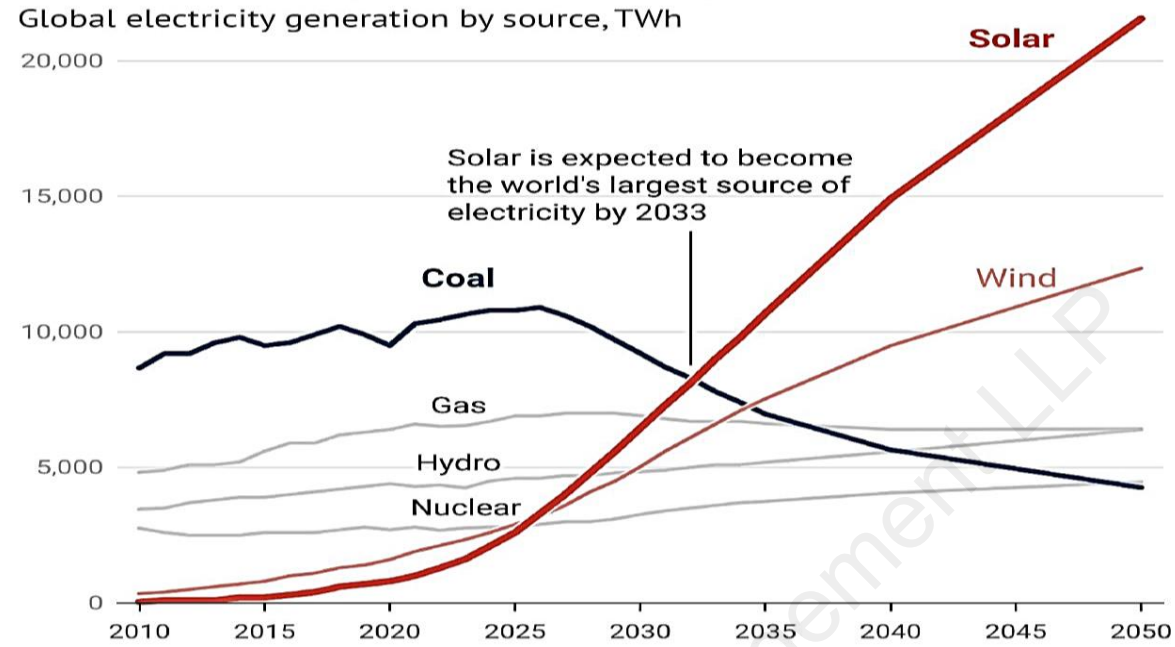
- **Clean energy deployment climbed new heights for some key technologies-** In 2023, solar PV capacity saw a significant surge, primarily driven by China, while global wind capacity additions returned to a growth trajectory across countries. However, nuclear capacity growth experienced a decline, though strong policy momentum persists. The sale of electric vehicles increased by 35%, with China being the largest market. Conversely, global sales of heat pumps declined by 3%, following two consecutive years of double-digit growth. The installed capacity of electrolysers is expanding but remains at a nascent stage.



Note: "Annual deployment" refers to sales or capacity additions. GW = gigawatt; MW = megawatt; Mn = million.

Source: IEA

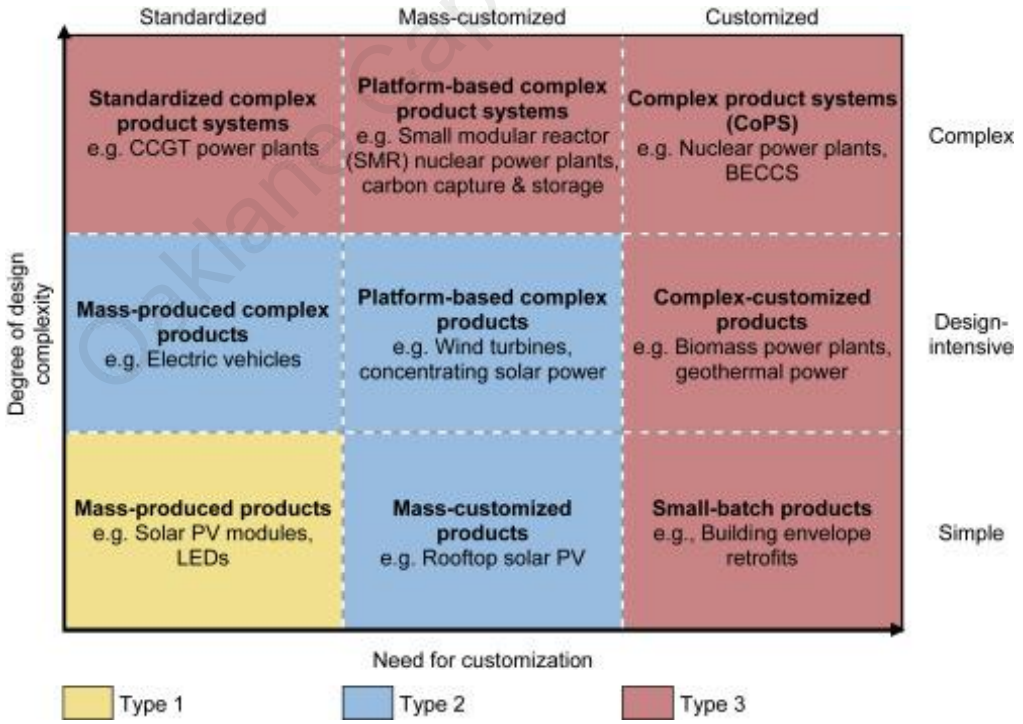
- **Electricity generation By Technology-** Solar generation is set to quadruple by 2030. Solar is expected to become the world's largest source of electricity by 2033. To meet net-zero targets, many countries will need to accelerate the expansion of renewable electricity generation.



Source: World Energy Outlook, IEA, Carbon Brief

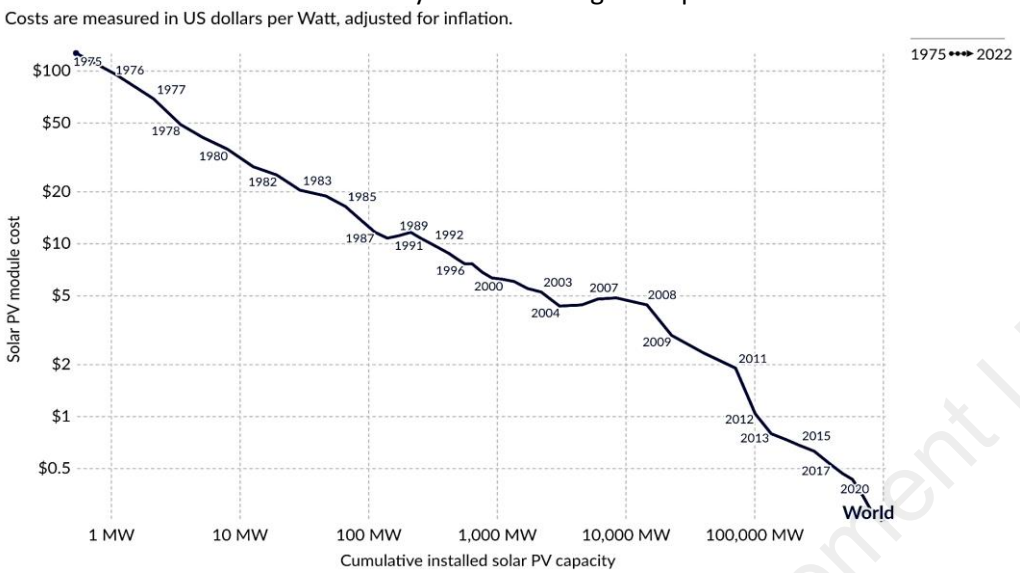
Global Solar Energy Adoption

- **Solar PV is simple & standardized technology-** A study by Malhotra and Schmidt indicates that standardized and simple technologies are more likely to scale quickly. Examples of such technologies include utility-scale solar PV modules and LEDs, which benefit from their simplicity and uniformity, enabling rapid adoption and expansion.



Source: Accelerating Low-Carbon innovation Malhotra and Schmidt (2020)

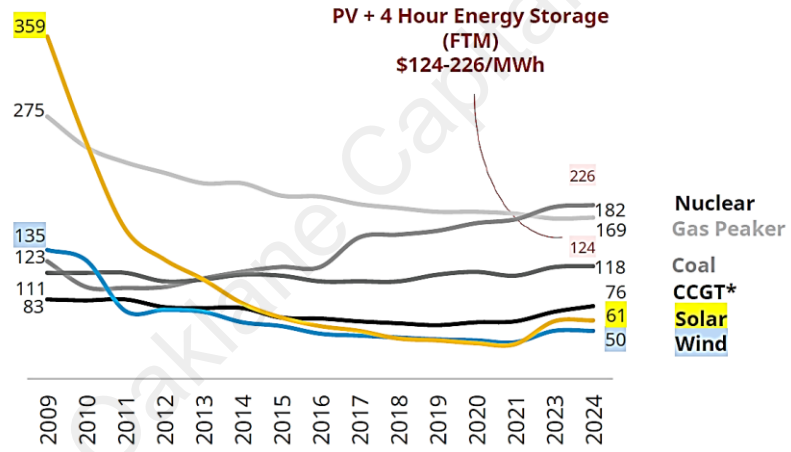
- **Falling cost curve-** The cost of solar panels has consistently decreased by approximately 20% with every doubling of global cumulative capacity. Since 1975, solar module prices have dramatically fallen from $106 per watt to the current level of just $0.10 per watt, highlighting significant advancements in cost-efficiency and technological improvements within the solar industry.



Source: IRENA, Nemet, Farmer & Lafond

- **"Solar + Energy Storage" Key to Energy Transition-** The current cost of solar energy combined with 4-hour energy storage is highly competitive, priced at $61 per MWh, which is only slightly above wind energy at $50 per MWh. In contrast, the costs associated with carbon-based technologies are increasing, further enhancing the appeal of renewable energy solutions as more economically viable options.

Mean Unsubsidized Levelized Cost of Energy (LCOE) and Levelized Cost of Storage (LCOS), $/MWh



Source: S&P Global, Wood Mackenzie, Lazard 2024 LCOE and LCOS reports. *CCGT = Combined Cycle Gas Turbine.

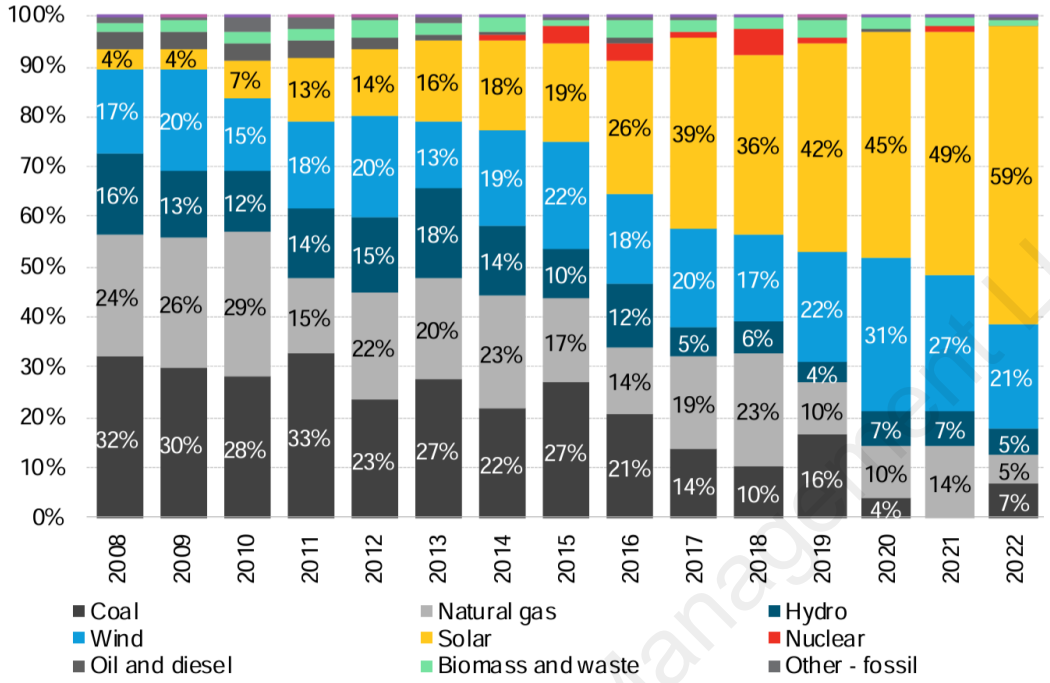
- Solar power is not only cost-effective at the outset but also proves to be the most economical option when accounting for overall costs, including any overruns.

Project type	Mean cost overrun (%)	Projects (A) with ≥50% overruns (%)	Mean overruns of A projects (%)
Nuclear power	120	55	204
Hydroelectric dams	75	37	186
Fossil thermal power	16	14	109
Wind power	13	7	97
Solar power	**1**	**2**	**50**

Source: Flyvbjerg Database

- **Rapid addition of solar power capacity-** In 2022, solar energy contributed to 59% of the 412 GW of new capacity installed, significantly advancing the global expansion of renewable energy. Remarkably, in 2023, solar power capacity additions reached 428 GW, exceeding the total power capacity added in the previous year. This notable growth highlights the rapid acceleration of solar energy deployment on a global scale.

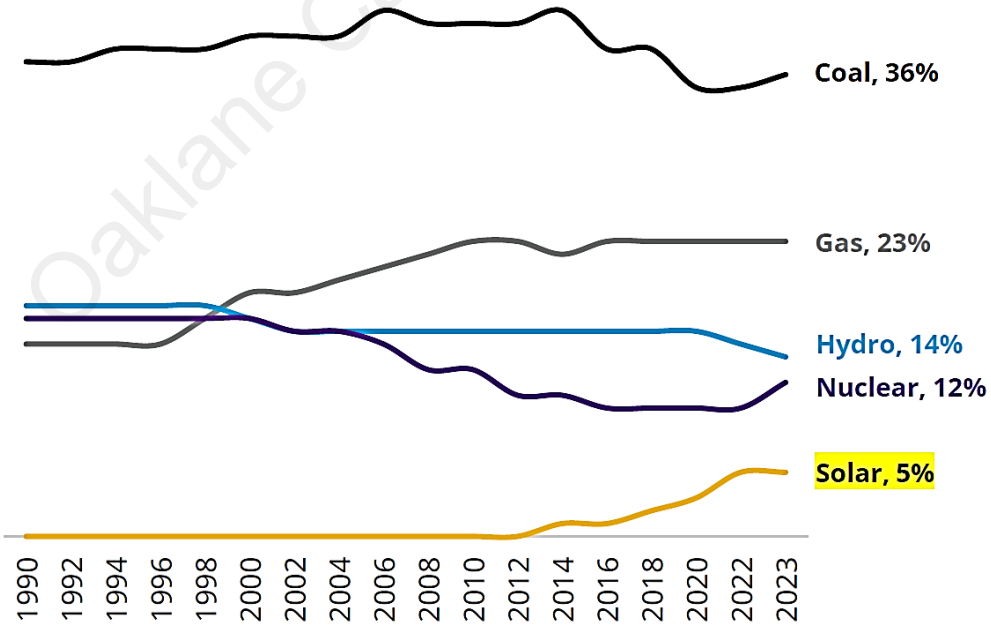
Share of global power capacity additions, by technology



Source: BNEF

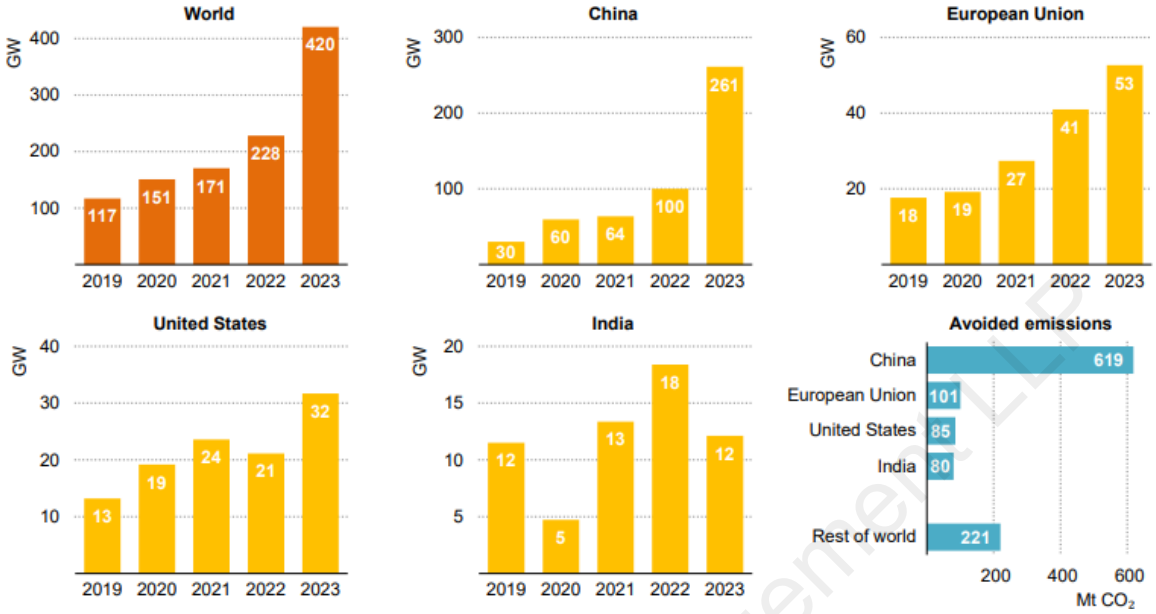
- **Massive headroom for Solar-** Despite significant capacity additions in recent years, solar energy remains largely underpenetrated, currently accounting for only 5% of global electricity generation by fuel type. This indicates substantial potential for growth and further expansion within the solar sector.

Electricity Generation by Fuel Type



Source: IEA, BNEF, S&P Global

- **Solar PV capacity additions and avoided emissions-** The global deployment of solar PV from 2019 to 2023 has resulted in a significant reduction in annual CO2 emissions, estimated at approximately 1.1 billion tonnes (Gt), which is equivalent to the total annual emissions of Japan.



Source: IEA

- **Rooftop solar in Australia-** According to GPE NEMLog, the rooftop solar on household and businesses has achieved a major milestone by supplying more than 50% of electricity demand for the first time on Australia's main electrical grid. Australia, today has more than 23 GW of rooftop solar and it is expected to grow to 100 GW in the coming decade.

Solar PV Demand & Supply

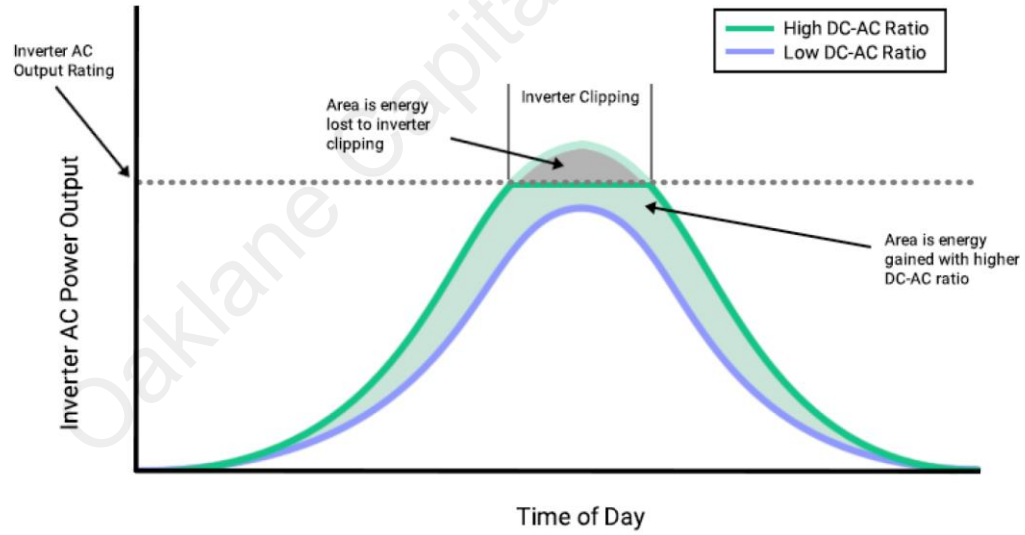
Global Solar PV Demand & Supply Overview

Overview

- Global solar manufacturing capacity is projected to surpass 1,100 GW by the end of 2024, more than double the anticipated PV demand. This oversupply has driven module prices to fall by over 50% since early 2023, resulting in negative net margins for integrated solar PV manufacturers in 2024. In countries like the U.S. and India, module prices remain higher than global averages due to tariff and non-tariff barriers on solar module imports, further impacting market dynamics.
- Despite China's dominance, there is notable capacity expansion in regions such as the U.S., Europe, India, and the Middle East, as these areas aim to become more self-sufficient in the solar value chain. These regions are investing in developing their own manufacturing capabilities across various stages of the solar PV production process to reduce reliance on imports and strengthen their energy security.

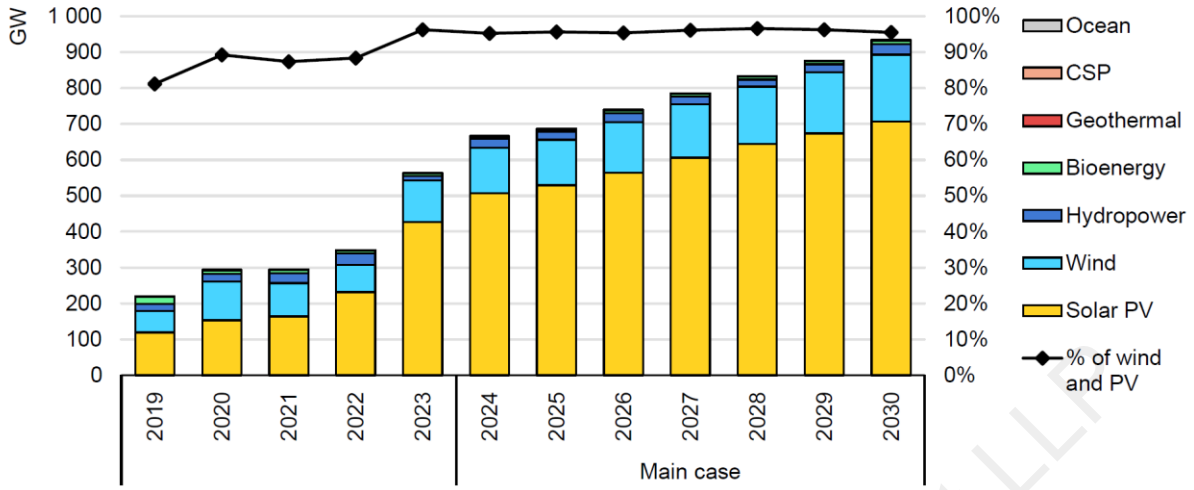
Global Solar PV Demand

- The demand for modules and cells would be much higher than capacity additions due to direct current (DC) overloading factor
- To reduce the levelized cost of power, it is common industry practice to pair inverters with oversized DC module capacity. A 1 MW DC solar plant typically does not produce a full 1 MW of power, as solar modules operate at peak efficiency primarily during noon and only in select months. By employing DC overloading, plants can enhance generation during non-peak hours. Globally, DC overloading is implemented at ratios ranging from 1.2x to 1.6x, depending on geographical and other contextual factors.
- The below chart shows energy gained with higher DC-AC ratio



- **Renewable capacity additions will continue increasing through 2030, led by solar PV-** In the main case, global annual renewable capacity additions rise from 666 GW in 2024 to almost 935 GW in 2030. Solar PV and wind are forecast to account for 95% of all renewable capacity additions through 2030 because their generation costs are lower than for both fossil and non-fossil alternatives in most countries, and policies continue to support them.

Expected renewable energy additions till 2030

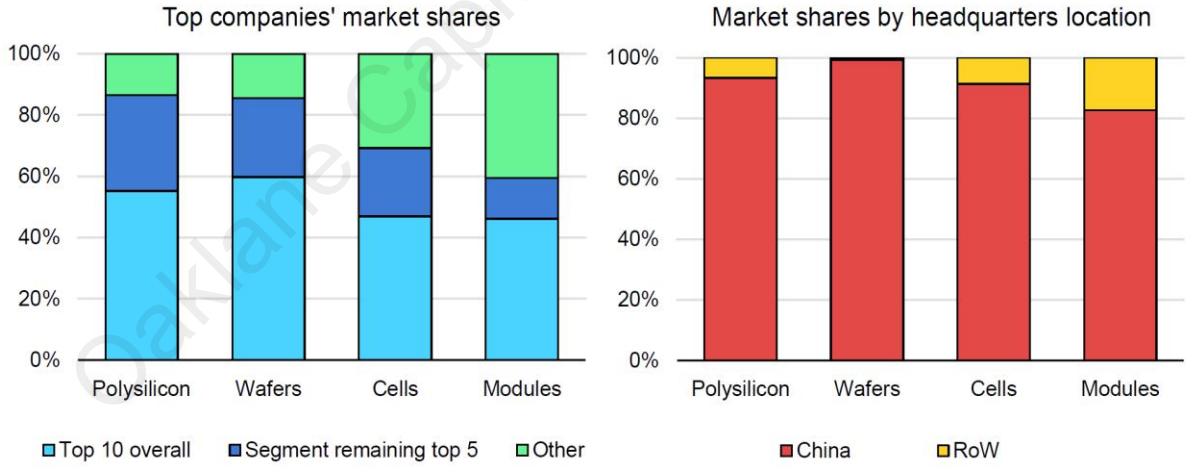


Source: IEA

Global Solar PV Supply

- China dominates the global solar PV manufacturing value chain, accounting for 80% or more of most parts of the production process. In 2010, China held only around 30% of the installed polysilicon manufacturing capacity, but today that figure has surged to approximately 94%. The wafer manufacturing stage, the most critical step in the process, is almost entirely controlled by China. The effective capacity is usually 75-80% of the rated capacity
- In 2023, the top ten companies across the supply chain controlled 45-60% of the market. When the largest remaining companies in each segment are included, the market share of top manufacturers reaches 85% for polysilicon and wafers, 70% for cells, and 60% for modules.
- Outside of China, India now boasts the largest solar module manufacturing capacity, surpassing Southeast Asian competitors.

Solar PV manufacturing capacity shares by largest companies, and by company headquarters



Source: IEA

- Global solar manufacturing capacity is expected to exceed 1,100 GW by the end of 2024, more than double the projected PV demand. This oversupply has driven module prices to drop by more than 50% since early 2023, resulting in negative net margins for integrated solar PV manufacturers in 2024.
- The challenging market conditions have led to the cancellation of approximately 300 GW of polysilicon and 200 GW of wafer manufacturing capacity projects, representing a combined value of around USD 25 billion.

- Chinese companies had set up capacities in SEA countries to by-pass trade barriers from the US. Now, with the AD/CVD investigations, these companies have set up 12.5 GW module capacity in the US as of Mar'24 and are building capacities in the Middle East, where the countries have alliances with the US. These capacities are as below:

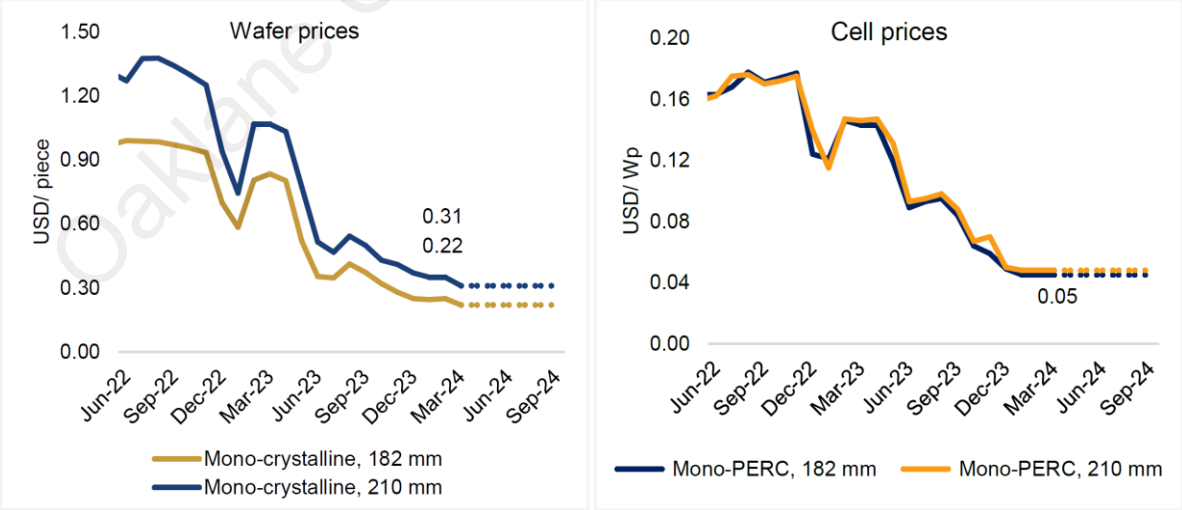
Company	Country	Polysilicon (KTPA)	Wafer (GW)	Cell (GW)	Module (GW)
GCL Technology	UAE	120	-	-	-
TCL Zhonghuan	Saudi Arabia	-	20	-	-
Trina Solar	UAE	50	30	5	5
Drinda	Oman	-	-	10	
Total		**170**	**50**	**15**	**5**

Source: CLSA

- Despite China's dominance, there is notable capacity expansion in regions such as the U.S., Europe, India, and the Middle East, as these areas aim to become more self-sufficient in the solar value chain. These regions are investing in developing their own manufacturing capabilities across various stages of the solar PV production process to reduce reliance on imports and strengthen their energy security.

Global Solar PV Prices

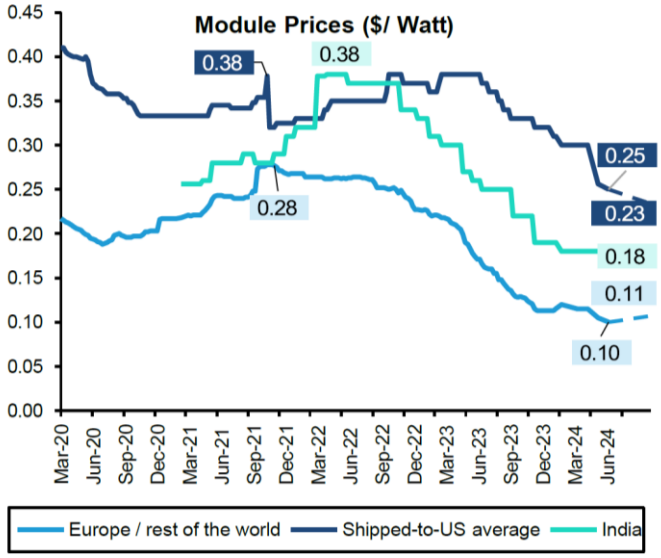
- On a global scale, the polysilicon base expanded by 68% year-on-year by the end of December 2022, reaching a range of 1000-1100 metric tons from the previous 600-650 metric tons. Weakened demand and lower consumption coupled with oversupply, resulted in a dramatic price drop of 71% to $8 per kg in March 2024, down from $28 per kg in December 2022. Consequently, downstream components also witnessed significant price reductions, with wafer prices plummeting by 50-55% to $0.31/piece.
- The oversupply of polysilicon also prompted the world's largest monocrystalline solar wafer supplier to cut the prices of its photovoltaic wafers twice between April and May 2023, reducing prices by 33% as cell manufacturers sought to fulfill their order requirements. Cell prices were also down 58%over December 2022 levels, reaching $0.05 per Wp in March 2024. Module prices fell by 52% to $0.11 per Wp during the same period. Module prices are expected to remain stable or decline marginally due to the supply glut in China coupled with subdued demand in international markets like the US and EU.



Source: Crisil

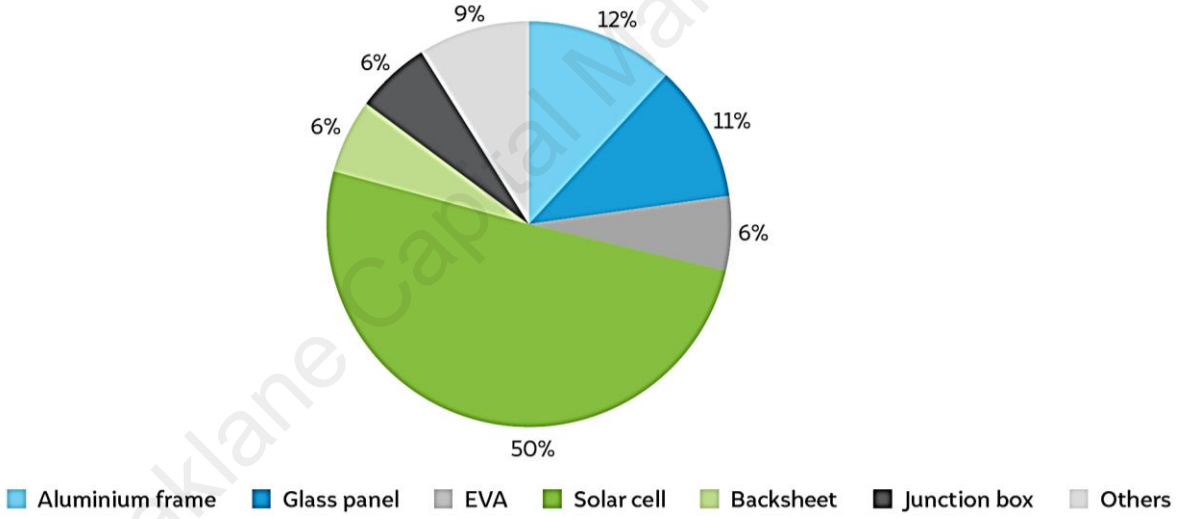
- Module prices experienced a remarkable surge of 22% in fiscal 2022 and a subsequent 7% increase in fiscal 2023. However, in fiscal 2024, module prices underwent a significant decline of 42% YoY and now at $0.11 per Wp in March 2024, and are expected to remain at that level. Prices of

modules shipped to US on the other hand are still at 0.25$/watt. Assuming a minimum of 70% AD/CVD tariffs, module prices in the US are expected to be near 0.32 $/watt by the end of 2024. Even within India, module prices today are around 0.14 to 0.18 $/watt depending on domestic vs imported cell.



Source: Bloomberg, Bernstein

- **Cost breakup of Solar Panel-** EVA, glass panels, and solar cells are among the costliest components in a solar PV module.



Source: Economic Assessment of Local Solar Module Assembly in a Global Market

China Solar PV Demand & Supply Overview

Overview

- According to Goldman Sachs, China's solar module capacity is currently at 200% of global demand, with projections indicating a decrease to approximately 138% by 2028. This suggests that incremental capital expenditures (capex) in the Chinese solar value chain will be lower than previously anticipated, with an estimated 15% reduction in capex for FY25 and a year-over-year decrease of 40%. Additionally, the limited prospects of global demand catching up with supply expose smaller manufacturers to bankruptcy risks, unless they are shielded by government policies
- According to CLSA, solar technology innovation is progressing slower than anticipated due to reduced willingness to invest in solar capital expenditures during the sector's down-cycle. Among the key technology introductions for 2024, only laser-enhanced contact optimization (LECO) is on track, while the adoption of 0 bus bar (0BB) and HJT technologies may proceed more slowly than expected. This situation could benefit Indian players, as capex planned around a three-year technology cycle may be extended by one to two years.
- The expected demand and supply for solar modules in China over next few years is as follows:

	2023	2024E	2025E	2026E	2027E
China Solar PV Demand					
China Solar Capacity Addition	260	290	340	408	450
DC Overload factor	1.3	1.3	1.3	1.3	1.3
Domestic module consumption	338	377	442	530	585
China Solar PV Supply					
Module	947	1197	-		
Cell	950	1191			
Wafer	960	1171			
Polysilicon	2300	3475			

Source: CPIA, Goldman Sachs, CLSA, Samsung Securities

China Solar PV Demand

- China's renewable capacity expansion is outpacing government goals, surpassing its 1,200-GW solar PV and wind target for 2030 six years early, in July 2024.
- In 2023, China added 260 GW of solar PV capacity. Assuming a DC overloading factor of 1.3x, this equates to domestic module consumption of approximately 338 GW
- China's renewable energy capacity is expected to expand by nearly 3,207 GW between 2024 and 2030, tripling the growth achieved from 2017 to 2023. Annual additions are projected to exceed 500 GW by 2030, with solar PV being the main driver, accounting for 80% of this increase.
- Today, the generation costs for new utility-scale solar PV and onshore wind installations are lower than coal-fired plants in nearly all provinces, further boosting the positive outlook for renewable energy development in China.
- China's renewable energy forecast has been revised upward by 24% from the 2023 report to reflect key policy shifts and evolving market trends.
    - Solar PV module costs have plummeted due to an oversupply, and declining interest rates since January 2023 have made solar PV more competitive with coal.
    - Recent power market reforms and green certificate systems have allowed developers to access higher prices, especially in provinces with more traded power and clearer green energy certificate regulations.
    - Additionally, the central government's Whole County PV pilot, alongside provincial financial support for residential solar and rising industrial electricity prices, has accelerated commercial and industrial solar PV deployment.

China Solar PV Supply

- Since 2022, new investments have driven China's solar PV manufacturing capacity far beyond local and global demand, significantly lowering module prices and boosting solar PV's competitiveness with regulated power prices. A strong domestic PV market is essential to absorb this overcapacity, especially as trade measures restrict growth in export markets.
- To address overcapacity and curb further additions, China's Ministry of Industry and Information Technology (MIIT) has introduced a detailed solar sector capacity control policy. This combination of policy measures and market forces, including industry-wide losses, aims to create a more balanced supply and demand within China's solar industry. These stringent norms may further delay expansion plans of new entrants
- Planned policy curbs
    - **Cap on Unit Power Consumption**: A cap has been established for unit power consumption in the polysilicon and ingot manufacturing sectors. The cap on planned capacity for polysilicon is set at 57 kWh/kg, while the cap on existing capacity is currently 60 kWh/kg. For ingot manufacturing, the cap on planned capacity is 23 kWh/kg, compared to the cap on existing capacity of 26 kWh/kg.
    - **Efficiency Standards for N type cells & modules**: The efficiency standards for N-type cells are at 26% for planned capacity and at 25% for existing capacity. Additionally, for modules, the efficiency standard is 23.1% for planned capacity, and 22.3% for the existing capacity
    - **Sector Consolidation**: CLSA estimates that MIIT's standards for the solar sector could accelerate consolidation by eliminating approximately 20% of existing capacity (polysilicon 400kt, wafer 200 GW, cell 200 GW, module 200 GW)

Solar PV Cycles in China in the last 14 years- Since 2010, the Chinese solar sector has undergone several boom-and-bust cycles. JP Morgan has closely examined the key drivers behind each of these cycles to better understand and identify indicators relevant to the current downturn.

- **Boom (2H10-1H11)-** Germany and Italy experienced robust solar demand growth, driven by favourable project returns. With substantial government subsidies from both countries, the project IRR in Italy exceeded 15% in 2011, making solar projects highly attractive to local developers and significantly boosting solar module demand. Meanwhile, China's solar demand also began to increase as the central government introduced subsidies under the Golden Sun Demonstration Project in July 2009, further contributing to global solar market growth.
- **Bust (2H11-1H13)-** The solar market faced significant demand disruption in Europe, primarily due to subsidy reductions in Germany and Italy in 2012 and 2013, because of the European debt crisis. As a result, new installations in Europe dropped by 22% YoY to 18 GW in 2012 and further declined by 48% YoY to 10 GW in 2013. This sharp decrease in demand led to overcapacity in the solar supply chain, causing profitability for solar manufacturers to deteriorate.
- **Boom (2H13-1H17)-** New solar demand surged from China, Japan, and the U.S., with these three markets contributing to 71% of global new installations in 2013. This growth was driven in part by substantial subsidies, particularly in Japan, where the government introduced solar subsidies following the Fukushima nuclear power plant incident. Simultaneously, the declining LCOE improved the financial returns of solar projects, boosting solar adoption. Additionally, China implemented favourable policies for its domestic solar manufacturers, countering EU and U.S. anti-dumping duties.
- **Bust (2H17-1H19)-** In 2017, China reduced its feed-in-tariff (FiT) for solar power, leading to deteriorating project returns and a decline in solar demand within China. At the same time, the EU extended its anti-dumping duties on Chinese solar modules for another 18 months. As a result, global solar demand decreased in 2017. Chinese solar manufacturers, who had expanded their production capacity between 2014 and 2016, faced overcapacity issues due to the sudden drop in demand. This resulted in intense price competition among solar module manufacturers and a severe deterioration in profitability. However, towards the end of 2017, China's solar demand

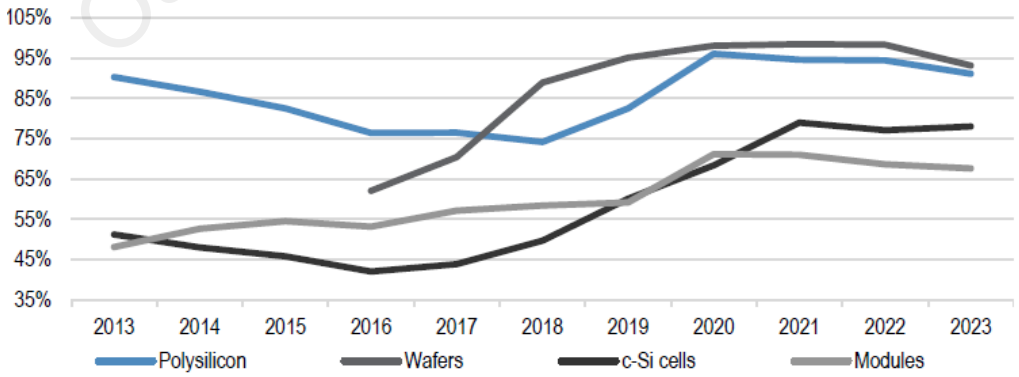
surged unexpectedly due to favourable subsidy policies, causing a short-term boom in the first half of 2018. Meanwhile, technological advancements became a crucial factor in reshaping the competitive landscape in solar manufacturing. The shift from multi-SI to mono-SI technology accelerated in 2018, with mono-SI players like LONGi gaining market share over multi-SI players such as Jinko Solar, aided by advancements in mono-SI technology. A significant turning point occurred on 1 June 2018, when China announced a slowdown in solar installations by reducing subsidies for solar power generation. This led to a sharp decline in domestic solar demand and further pressure on the profitability of solar manufacturers.

- **Boom (2H19 to 1H23)-** In the second half of 2019, solar power reached grid parity in many regions, driving demand growth based on economic merit rather than government subsidies. This marked a shift as subsidies became less significant for solar demand growth, while declining solar module prices enhanced returns on solar farm projects in key markets like China, Europe, and the US. By 2020, global efforts toward de-carbonization accelerated solar demand, with numerous countries announcing ambitious net-zero targets for the next 30 to 50 years. This sparked increased demand for solar installations worldwide. Additionally, the rise of ESG investment trends contributed to an influx of funds into solar manufacturers, further fuelled by the structural growth story of solar adoption. This combination of favourable market conditions led to a stock market boom for solar manufacturers from 2020 to 2022, particularly benefiting Chinese solar companies as more investors positioned themselves to capitalize on the industry's growth trajectory.
- **Bust (1H23 till now)-** In the first half of 2023, the US launched an AD and CVD investigation against Chinese solar module manufacturers, focusing on their production capacities in SEA. Concurrently, the US introduced the IRA, aiming to develop its own solar supply chain domestically through subsidies. These actions, combined with existing trade restrictions such as Section 201 and Section 301, have heightened geopolitical risks for Chinese solar companies, suppressing their share prices and limiting their valuation potential. However, over-capacity issues began emerging as early as the second half of 2023, even before the new US policies impacted actual shipments. The production capacity expansion seen during the boom period from 2020 to 2022 has now resulted in significant overcapacity within the silicon value chain. Despite solid demand for solar products, investors grew concerned over increased price competition and declining profitability across the supply chain. Consequently, Chinese solar manufacturers have experienced a sharp decline in share prices since the second half of 2023.

Read across from historical booms and busts to the current cycle

- **Increased concentration:** Compared to the market dynamics 10 years ago, the concentration ratio for each component of the silicon value chain has increased significantly, especially in solar cell and module production. This means that leading players now hold much larger market shares and enjoy stronger order intakes than before. The top players in the industry are now more resilient due to their larger market shares and established positions. Even when facing cash losses, these dominant manufacturers are less likely to exit the market.

Percentage of market supplied by the top ten firms at each step of the value chain, 2013-2023



Source: BNEF, JP Morgan

- **Strong previous boom cycle with cash rich balance sheets**: The most recent boom cycle was longer than previous ones, generating substantial cash flows for Tier 1 solar manufacturers. During this period, Chinese solar manufacturers raised significant amounts of capital through A-share, benefiting from regulatory support. This inflow of capital has led to stronger balance sheets and robust cash positions for major players, which should allow them to withstand more losses in the downcycle.
- **Oversupply as the Key Driver**: Unlike previous down-cycles, which were primarily driven by demand disruptions, the current downturn is the result of severe oversupply. Solar power has reached grid-parity in more regions, ensuring attractive returns for solar farm projects despite declining solar module prices. This dynamic makes the current cycle unique, as the oversupply issue takes longer to correct compared to a demand-driven cycle.
- **Technological Shifts and Competitive Dynamics:** As discussed earlier, the ongoing technological shift in solar cell manufacturing has significantly altered the competitive landscape, which may enhance market dynamics. Outdated production capacities are increasingly viewed as obsolete, and the anticipated reduction in solar supplies should alleviate price competition, potentially leading to improved profit margins. However, a notable divergence has emerged among major solar cell and module manufacturers regarding the future trajectory of solar cell technology. Despite being well-funded through A-share markets, these manufacturers exhibit differing strategies for R&D and production capacity expansion. Many companies are actively investing in new production equipment for TOPCon cell technology, including new entrants in the market. This influx of capital and technology acquisition has further exacerbated overcapacity issues and narrowed the technological advancement gap between leading and lagging players in the industry.
- **According to JP Morgan achieving a long-term cycle of normalized profitability may take as long as 8 to 10 quarters-** Historically, it has taken 5-7 quarters for solar manufacturers to recover from a down cycle. The first down cycle, from the second half of 2011 to the first half of 2013, lasted around 7 quarters. The second, from 2018 to the first half of 2019, varied across components, with some parts of the industry recovering in 3-5 quarters. In the current scenario, JP Morgan anticipates that recovery could take 8-10 quarters unless there is some external intervention. Some components of the silicon value chain may begin to see a turnaround by the second half of 2025. However, if government policies or other interventions are introduced, this recovery period could be significantly shortened. Given that the current down cycle began in the second half of 2023, it is anticipated that some components may show signs of improvement as early as the second half of 2025. The exact timing of the cycle turnaround will likely depend on factors such as the willingness of solar players to exit the industry and the pace of cash burn. In conclusion, for long-term investors, it may still be premature to seek opportunities now.
- **On the other hand, Goldman Sachs expects a cyclical inflection in the solar industry within the next 12 months, driven by capacity reductions from non-Tier 1 players, slower capex expansion from Tier 1 players, and resilient demand**. However, this downturn could be prolonged if local Chinese governments intervene to protect jobs. All industry players have faced significant losses since Q2, and a stress test suggests Tier 1 companies may only sustain free cash flow for 8-10 more months, with non-Tier 1 players in a worse position. Goldman predicts that one-third of current capacity across the solar value chain may shut down in the coming quarters, leading to a 46% and 34% year-over-year decline in solar capex for 2024 and 2025, respectively. Also, M&SA are on the rise, such as Tongwei's proposed acquisition of a majority stake in Tier 2 cell player Runergy at a steep discount. Meanwhile, Tier 2 companies like Akcome and Lingda have gone bankrupt, and major polysilicon players such as Hoshine are facing layoffs and salary cuts.

USA Solar PV Demand & Supply Overview

Overview

- For U.S. developers, purchasing domestically produced cells and modules would effectively cost 13.5 cents per watt, compared to 25 cents per watt for imported modules, thanks to tax credits.
- We are more confident in the near-term outlook, largely due to the lead time required to build additional capacity. However, this makes the long-term forecast more uncertain. The upcoming election will play a significant role, as the Inflation Reduction Act (IRA) subsidies and tariff structures could be subject to change. If tariffs increase, prices will rise, potentially incentivizing additional buildout—either in the U.S. or abroad, as companies seek to circumvent anti-dumping and countervailing duties (AD-CVD). However, in the near term, higher prices may negatively impact demand. On the other hand, if future IRA subsidies are reduced alongside higher tariffs, the anticipated U.S. buildout may not materialize, which would likely keep prices elevated and limit demand growth.
- The expected demand and supply for solar modules in US over next few years is as follows:

	2023	2024E	2025E	2026E	2027E
US Solar PV Demand					
US Solar Capacity Addition	35	41	46	50	53
DC Overload factor	1.3	1.3	1.3	1.3	1.3
US module consumption	46	53	60	65	69
US Supply					
Module	12	35	45	55	62
Cell	-	8	15	30	30
Wafer	-	-	8	15	20
Polysilicon	6	6	6	6	6
Thin Film	4	7	10	13	14

Source: CPIA, Goldman Sachs, CLSA, Samsung Securities

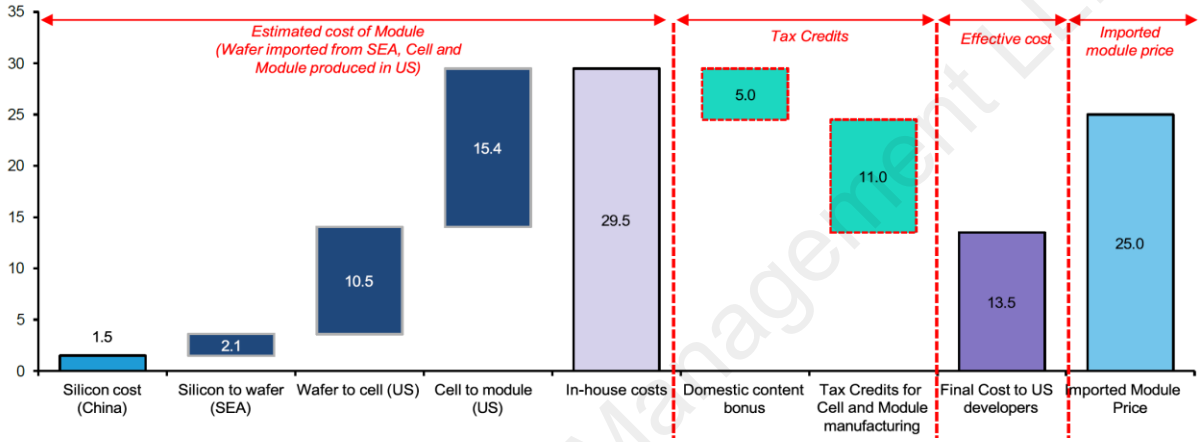
- While there have been numerous capacity announcements for both modules and cells, many have not yet begun construction, and some are likely to be cancelled. Any facility breaking ground after the upcoming election is expected to take approximately two years to complete, meaning new capacity would likely come online no earlier than 2027. Additionally, some manufacturers have officially cancelled plans for wafer and cell facilities, citing financial non-viability. Notable cancellations include Meyer Burger's 2 GW cell plant and Cubic PV's 10 GW wafer plant.
- We anticipate that over the next few years, the U.S. will cease importing solar modules and instead focus on importing solar cells to a limited extent, while primarily importing solar wafers. As a result, exporters will need to realign their supply chains and expand capacities to meet their export targets accordingly.

USA Solar PV Demand

- The United States is projected to add nearly 500 GW of renewable energy capacity between 2024 and 2030, with solar PV expected to account for 400 GW of this total. While supply chain issues and trade concerns persist in the near term, the Inflation Reduction Act (IRA) continues to drive expansion, with solar PV seeing the largest growth
- Solar PV leads capacity additions, with utility-scale installations increasing steadily throughout the forecast period. However, a contraction in residential solar growth is expected this year, driven by the introduction of new net metering rules in California, the largest residential market in the U.S., as well as the impact of high interest rates on project economics. On the other hand, the federal investment tax credit, along with state- and utility-level incentives for net metering, continues to drive growth in distributed solar PV.
- While the Inflation Reduction Act (IRA) has provided long-term production and tax incentives to support growth, significant market challenges remain. First, supply chain constraints have caused

project delays for both wind and solar PV. Although logistics and pricing issues have eased, the lingering effects of earlier delays are still evident, particularly in the short term. Second, grid constraints and backlogs in connection queues are becoming a growing concern. Lastly, siting restrictions are increasingly affecting the development of both solar PV and wind projects, with some counties implementing stricter land-use guidelines, potentially limiting the available areas for new installations.

- Additional challenges for solar PV include the expiration of the moratorium on anti-dumping and countervailing duties (AD/CVD) on solar modules imported from Cambodia, Malaysia, and Vietnam, as well as an increase in tariffs on solar cells manufactured in China. These higher tariffs could adversely impact project economics, potentially slowing the pace of solar development.
- Effective module cost after tax credits in US- for U.S. developers, purchasing domestically produced cells and modules would effectively cost 13.5 cents per watt, compared to 25 cents per watt for imported modules, thanks to tax credits.



Source: BNEF, Bernstein

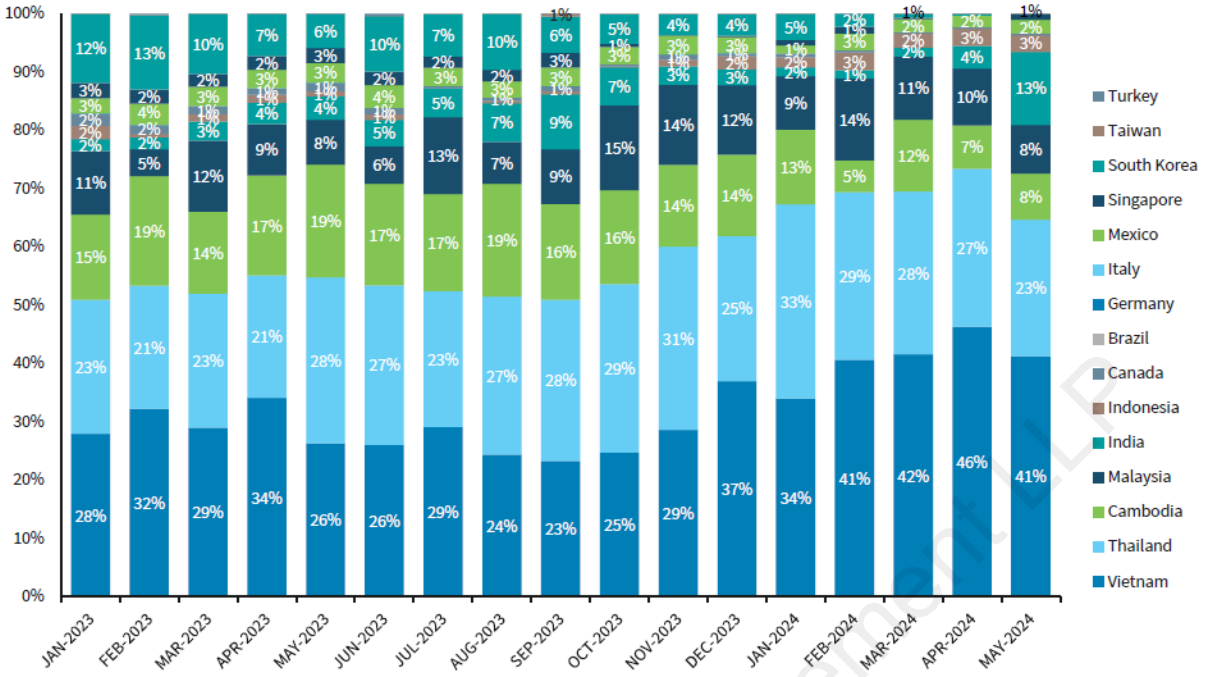
USA Solar PV Supply

- In the United States, the Inflation Reduction Act (IRA) and import restrictions are key drivers of growth. As a result, module assembly capacity is projected to reach 42 GW in 2024, including over 7 GW of thin-film PV technology. However, growth in other segments of the supply chain, such as wafers, polysilicon, and cells, is expected to be slower, with several projects delayed or cancelled due to the high competitiveness of imported products.
- Currently, there is no direct supply of solar modules from China to the U.S. Instead, exports are routed through manufacturing capacities in Southeast Asia (SEA). Therefore, any potential AD or CVD tariffs imposed on SEA exports would be more significant than the existing 50% tariff on solar modules originating directly from China.
- Solar cells, up to an annual limit of 12.5 GW, are exempt from tariffs regardless of their country of origin. At present, most U.S. solar cell imports come from China and SEA.

US c-Si module imports

- Southeast Asian imports have accounted for 80-90% of U.S. crystalline silicon (c-Si) module imports. However, this supply is currently at risk due to the ongoing anti-dumping and countervailing duty (AD-CVD) investigation.
- India's share of total imports has increased significantly, rising from low single digits to 13% in May 2024. Indonesia has also seen growth, moving from a steady 1% to a consistent 2-3% in 2024. In contrast, South Korea's share has decreased from the low double digits to around 1-2%. This decline is primarily attributed to Hanwha Qcells shifting its strategy towards U.S. manufacturing, reducing reliance on imports.

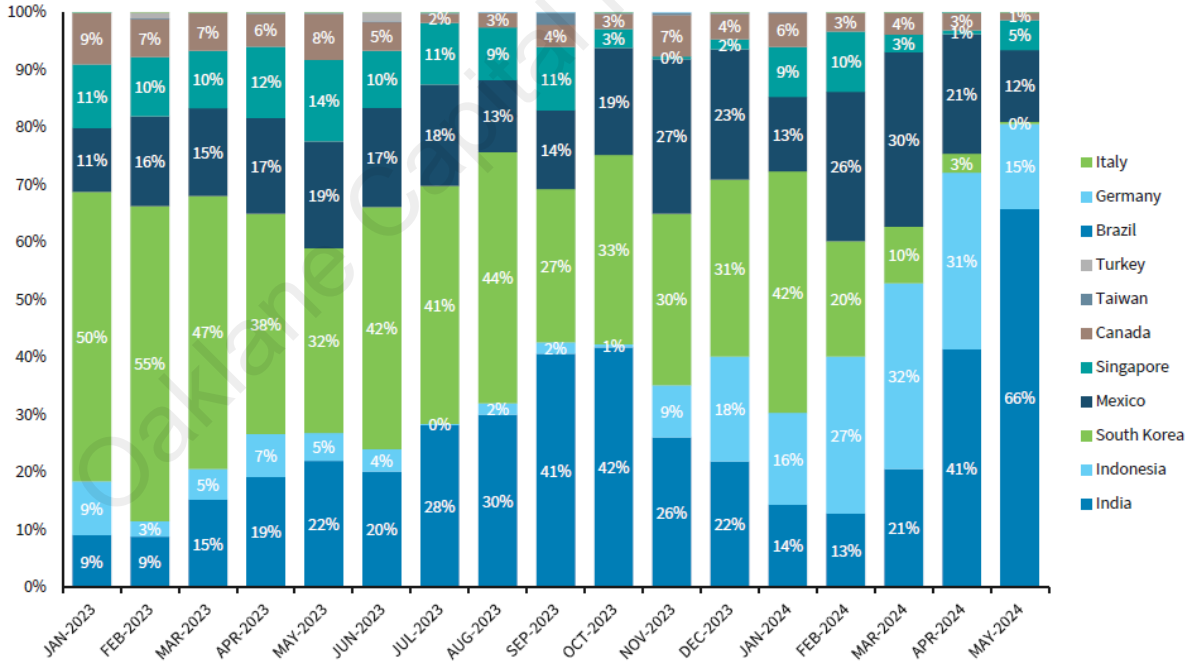
US c-Si module import share by country, January 2023 - May 2024-



Source: US International Trade Commission, Barclays Research

US c-Si module import share by country, ex-SE Asia, January 2023 - May 2024

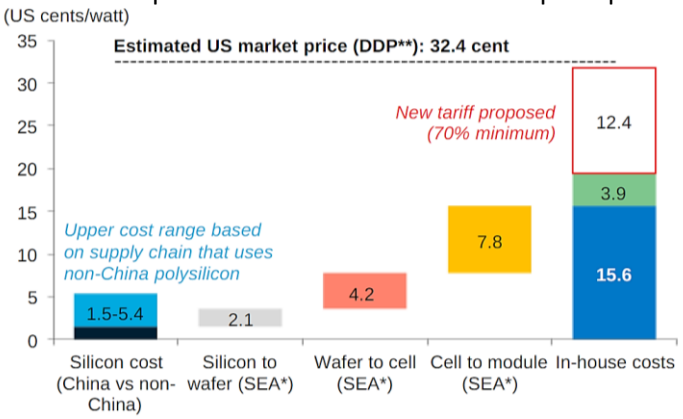
- Excluding the four Southeast Asian countries—Cambodia, Malaysia, Thailand, and Vietnam—India, Indonesia, Mexico, and South Korea are the largest exporters of crystalline silicon (c-Si) modules to the United States.



Source: US International Trade Commission, Barclays Research

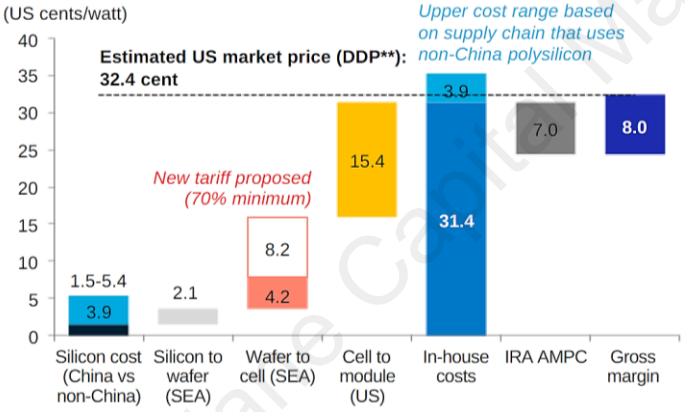
Economics of US supply with IRA benefits and tariffs under AD/CVD

- If an AD/CVD of minimum 70% is levied on cells & modules from SEA countries, module prices in US are expected to increase to 32.5 cents per wp.



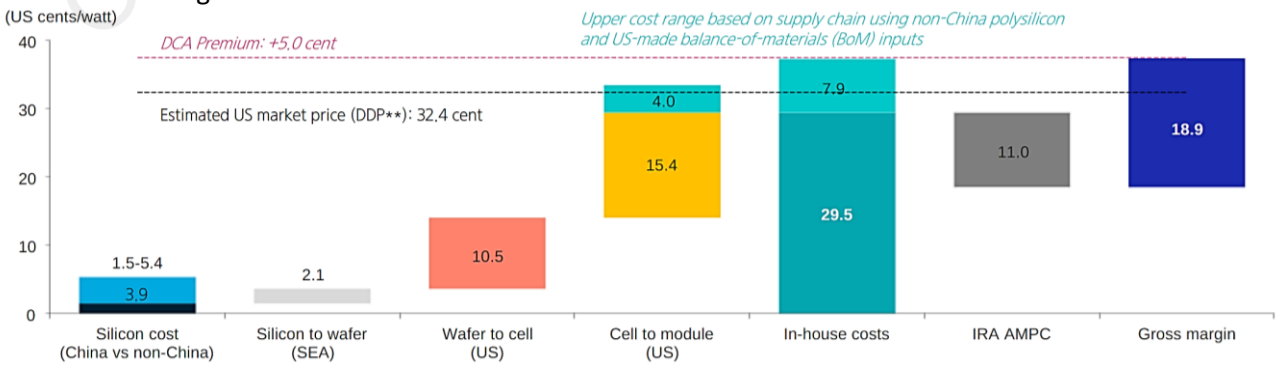
Source: BNEF, Samsung Securities

- The 10% US-made content bonus for US made cells should create a huge gap in gross profit between cell & module manufacturers vs only module manufacturers.
- Module manufacturers in the US have an estimated gross profit of 8 cents per wp for a gross margin of 25%, if cells are procured from SEA countries with AD/CVD above 70%. If the cells are procured from countries like India, gross profit can be 11 cents per wp for a gross margin of 34%. If cells and modules are both made in US, they will have a gross profit of 19 cents per wp taking their gross margins to 51%.
- **US module manufacturers'** profitability outlook after imposition of anti-dumping / countervailing duties. The profitability will be higher, if cells are procured from non-SEA countries like India.



Source: BNEF, Samsung Securities

- **US cell & module manufacturers'** profitability outlook after imposition of anti-dumping / countervailing duties



Source: BNEF, Samsung Securities

Key tariff & non-tariff barriers for import of solar PV in US

- Currently, there is no direct supply of solar modules from China to the U.S. Instead, exports are routed through manufacturing capacities in Southeast Asia (SEA). Therefore, any potential AD or CVD tariffs imposed on SEA exports would be more significant than the existing 50% tariff on solar modules originating directly from China.
- Solar cells, up to an annual limit of 12.5 GW, are exempt from tariffs regardless of their country of origin. At present, the majority of U.S. solar cell imports come from China and SEA.

Tariff/sanctions	Regions	Tariff Amount	Status	Component
Antidumping	China	249.96%	Active	Cell and module
Section 201	All except selected developing countries	14% (ex-bifacial modules)	Active	Cell and module
Section 301	China	25% (50% for cell)	Active	Wafer/cell/module
UFLPA	Xinjiang	Import ban	Active	Polysilicon
Section 201	All except selected developing countries	14% on bifacial modules	Active	Cell and module
Antidumping, countervailing duties	Malaysia, Cambodia, Vietnam and Thailand	125.37% for Cambodia,81.22% for Malaysia, 70.36% for Thailand and 271.28% for Vietnam	Petitioned	Cell and module

Source: US government, Bloomberg, CLSA

India Solar PV Demand & Supply Overview

Overview

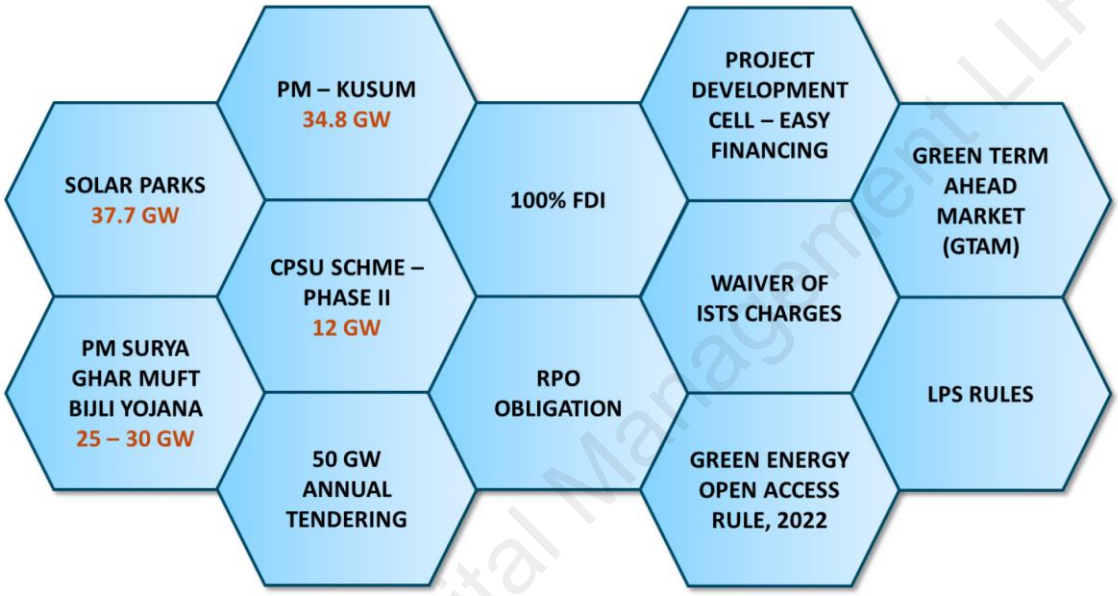
- China currently dominates the solar industry with 95% of global wafer, 85% of cell, and approximately 80% of module manufacturing capacity. However, both the U.S. and India are keen to avoid using Chinese modules. As a result, global module prices hover around 10 cents per watt, while in the U.S., they are significantly higher at 25 cents per watt, and 18 cents per watt in India, reflecting a substantial price arbitrage for what is essentially a commoditized product. Despite these cost differences, both governments remain firm in their intent to block imports from China. Currently, the only right to win for module manufacturers is a US sales contract and a TOPCon facility.
- This situation is expected to drive strong returns across the entire PV value chain in India over the next two years. The solar module industry, comprising an assembly of various components, is projected to face overcapacity in the Indian market. In contrast, solar cell manufacturing is more capital-intensive, and technology driven. Current players in the solar cell sector are likely to experience higher returns over the next few years; however, by 2028, this segment is also expected to encounter oversupply challenges. At present, it seems like vertically integrated companies involved in polysilicon, ingot, and wafer production are poised to differentiate themselves and gain a competitive advantage over their peers.
- **Export perspective**- Regardless of tariffs or AD/CVD on solar modules from China or SEA, countries such as the U.S. will still need to rely on cell/wafer imports due to limited domestic manufacturing capacities. In terms of revenue wp, solar cells generate about 50% of the revenue and wafers generate about 20% of the revenue compared to modules at current prices. Additionally, the current EBITDA margin for solar cell production is 30-35%, significantly higher than the 20% margin for module production.
- **Domestic market**- The Approved List of Models and Manufacturers (ALMM) for solar modules is expected to significantly reduce imports and establish efficiency benchmarks for eligible modules. Additionally, the Ministry of New and Renewable Energy (MNRE) is considering extending the ALMM framework to include solar cells and wafers. If implemented, this move would provide a competitive advantage to integrated players with end-to-end manufacturing capabilities, as they would be better positioned than pure-play module manufacturers to navigate these regulatory changes.
- The expected demand and supply for solar modules in India over next few years is as follows:

	2023	2024E	2025E	2026E	2027E
India Solar PV Demand					
India Solar Capacity Addition	35	41	46	50	53
DC Overload factor	1.3	1.3	1.3	1.3	1.3
India module consumption	46	53	60	65	69
Export demand	3	6	9	14	17
Total demand	**15**	**34**	**44**	**63**	**77**
India Supply					
Module	40	63	85	100	110
Cell	6	13	32	42	47
Wafer	-	-	2	7	22
Polysilicon	-	-	-	-	-
Thin Film	-	3	3	3	3

Source: Frost & Sullivan

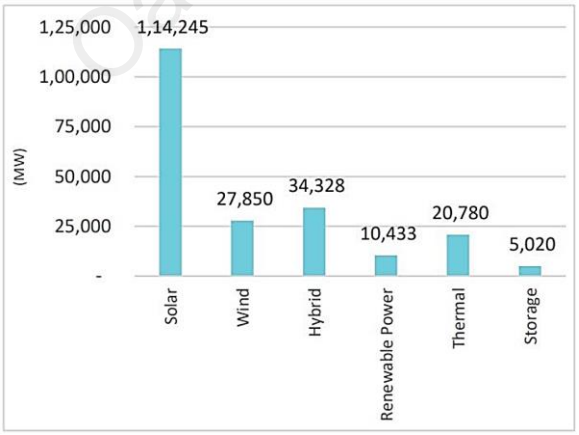
India Solar PV Demand

- The National Institute of Solar Energy (NISE) has estimated India's solar potential at approximately 748 GW, if 3% of the country's wasteland area is covered by solar PV modules. India has harnessed approximately 12% of this capacity, translating to about 93 GW.
- India receives an estimated 5,000 trillion kWh of energy received annually across the country. Most regions experience solar radiation levels of 4 to 7 kWh per square meter per day. Solar PV power can be harnessed on both utility and distributed scales to meet energy demands for electricity, heating, and cooling in both rural and urban areas. Additionally, the abundant availability of solar energy enhances energy security, particularly considering the current geopolitical landscape.
- The Indian government has implemented several policy initiatives aimed at boosting solar power generation and consumption across the country.



Source: Frost & Sullivan Analysis

- The Indian solar module consumption market is projected to grow at a compound annual growth rate (CAGR) of 40% over the next five years. Despite a brief decline in FY2023, where module consumption fell to 12.3 GW from 17.6 GW in the previous fiscal year, the market is poised for accelerated growth. In FY2024, the market is expected to recover and reach approximately 28.5 GW. By FY2028, it is anticipated that the market will expand further to 67.2 GW, driven by the government's ambitious goal of achieving 300 GW of installed solar capacity by CY2030. This growth is supported by various renewable energy projects currently in the tendering phase as shown in the below chart:



Source: CEA, Elekore, Nuvama Research

India Solar PV Supply

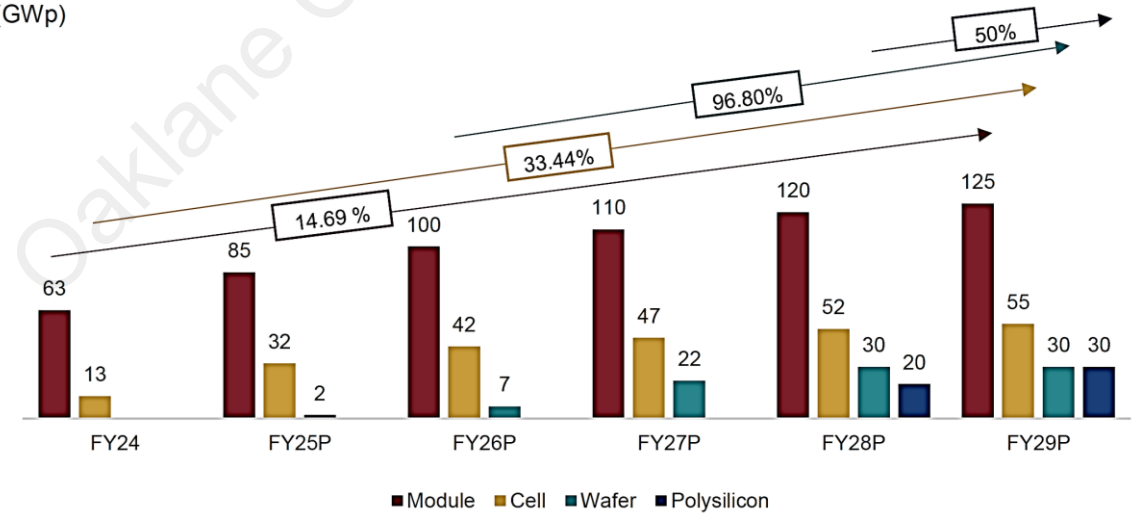
- Various supply side measures have put the Indian solar manufacturing sector on an accelerated growth trajectory in the last few years. With potential for solar power generation, India is actively developing its cell and module manufacturing capabilities.
- Since FY2017, India's solar module manufacturing capacity witnessed a phenomenal increase, from 4.2 GW to 39.5 GW at the end of FY2023 at a CAGR of 45.3%. The capacity has further increased to 64 GW in FY2024 and may cross 100 GW by FY2028. This positions India as the third largest solar module manufacturer in the world after China and Vietnam. India has a nameplate cell manufacturing capacity of 13 GW.
- The ALMM enlisted capacity is lower at 56.5 GW as of September 2024, with Waaree Energies boasting 21% market share in that. The top 10 players are as below:

Name of the Manufacturer	Enlisted Capacity (GWs / Year)	% of capacity	Name of the Manufacturer	Enlisted Capacity (GWs / Year)	% of capacity
Waaree Energies	11.9	21%	Goldi Sun	2.8	5%
Tata Power Solar	5.9	10%	Premier Energies	2.6	5%
Mundra Solar (Adani)	4.1	7%	Vikram Solar	2.3	4%
FS India (First Solar)	3.2	6%	Emmvee Energy	2.2	4%
ReNew	2.8	5%	Rayzon Solar	1.6	3%

Outlook for solar module manufacturing

- India is focused on establishing a strong presence across all stages of solar PV manufacturing over the next two to three years. In November 2020, the Government of India launched the PLI scheme to promote the manufacturing of high-efficiency solar PV modules, with an initial financial allocation of INR 45 billion. This allocation was later increased by an additional INR 195 billion as part of the Union Budget for FY2023.
- Crisil forecasts that India's solar PV manufacturing capacity will reach 125 GW by FY2029, with around 25% of this capacity being fully integrated from polysilicon to modules, primarily driven by the PLI schemes. Achieving this target is expected to require an investment of INR 1.17 trillion by FY2029.
- **India-Current and projected manufacturing capacity, GW**

(GWp)



Source: Crisil

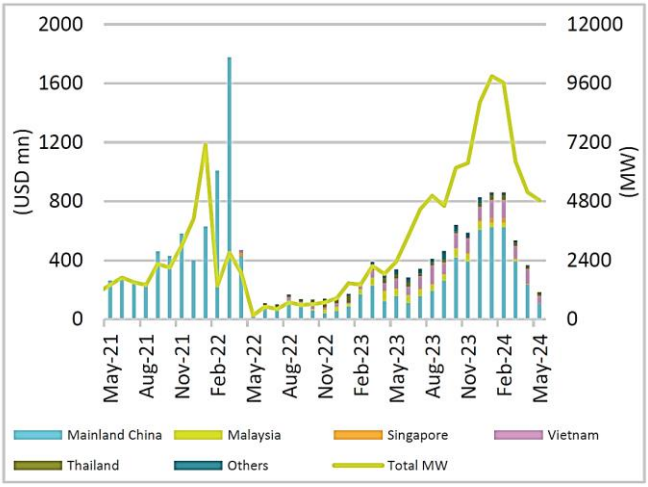
Right to win in polysilicon and ingot wafers

- **Low cost of capital-** Both polysilicon and wafer production are highly capital-intensive. According to estimates by the IEA, the capex for polysilicon production in India is approximately $140 million per gigawatt (GW), while in China, costs are 40% lower. Therefore, companies able to secure capital at a lower cost will hold a significant competitive advantage in this sector.
- **Low-cost consistent power supply-** In China, power accounts for approximately 50% of the cost of polysilicon production. As a result, most Chinese manufacturing facilities are located in provinces like Xinjiang and Inner Mongolia, where access to cheap power is readily available. In India, utilizing a captive distressed thermal power plant in the coal belt could be an ideal solution for reducing production costs. The Adani Group holds a clear advantage in this regard, and Reliance has also explored acquiring distressed coal plants, such as the SKS power plant. In the future, round-the-clock (RTC) renewable energy could serve as an alternative power source for polysilicon production.
- **Economies of Scale-** As a rule, the production costs for a large-scale polysilicon producer with a capacity of around 10,000 tons can be over 40% lower than those of a small-scale producer with a capacity of 1,000 tons. Larger plants benefit from economies of scale but require significantly more capex, highlighting the importance of raising capital at lower rates. This reinforces the competitive advantage for companies that can secure financing at a lower cost.
- **Technology-** The modified Siemens process is the predominant method for polysilicon production, while the Czochralski (CZ) process is utilized for ingot manufacturing. Currently, the equipment employed in these processes is largely standardized, and the stringent quality standards leave little room for significant modifications. Given that no Indian players possess the foundational technology required to initiate production, they will need to import standard equipment and collaborate with technology providers to establish manufacturing units. At this juncture, we believe that all players are essentially on equal footing in terms of technology.
- **Raw Material-** High-quality quartz is available in various states across India, including Andhra Pradesh, Rajasthan, and Gujarat. However, the production process also requires low-ash-content coal, which must be imported. Given the Adani Group's extensive network of ports, power plants, and cement operations, they possess significant expertise in coal procurement and supply chain management. This capability provides the Adani Group with a distinct advantage over competitors in securing the necessary raw materials for polysilicon production.

India Policy measures to boost manufacturing- The Indian government has implemented several policy initiatives to promote solar module manufacturing within the country. These initiatives include the Domestic Content Requirement (DCR) mandate, the Production-Linked Incentive (PLI) scheme, the imposition of Basic Customs Duty (BCD) on the import of solar photovoltaic (PV) cells and modules, the Approved List of Models and Manufacturers (ALMM), incentives for R&D, and support for training and skill development. GoI is also considering imposing ADD on solar cells & modules. Key government initiatives designed to bolster the domestic PV manufacturing industry are outlined as follows:

- **DCR**- mandates the use of solar cells and modules that are manufactured domestically, adhering to the specifications and testing requirements set by the MNRE. To further promote the use of domestically manufactured modules, the government has announced various schemes, including the CPSU scheme, the PM-KUSUM scheme, and grid-connected rooftop solar programs.
- **BCD-** On April 1, 2022, the Indian government imposed a Basic Customs Duty (BCD) of 40% on solar modules and 25% on solar cells. This measure aims to enhance domestic manufacturing of solar components and decrease India's reliance on imports. The BCD is applicable to all imports of solar modules and cells, irrespective of their country of origin.
- **PLI-** One of the ten sectors designated for the PLI scheme is high-efficiency solar PV modules, with the MNRE appointed as the implementing ministry. The initial financial outlay for the PLI scheme was set at INR 45 billion over a five-year period, which was subsequently increased to INR 240 billion.

- **ALMM**- it was introduced in 2019 to ensure the quality and performance of solar modules utilized in India. It comprises a list of certified solar cell and module types and their manufacturers, as approved by the BIS. Only modules included in the ALMM are eligible for use in majority of solar projects in India. India's PV cells, modules import reduced by 6% MoM in May and imports are likely to reduce going forward as only domestic manufacturers are part of ALMM

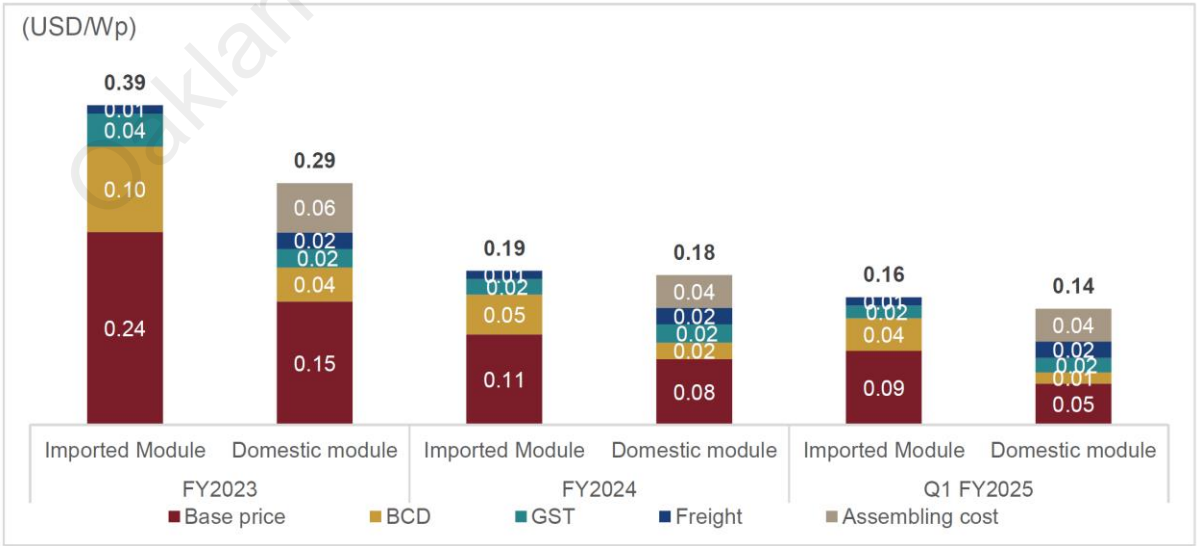


Source: Nuvama

Economics of India supply with ALMM and DCR norms

- Crisil projects that module prices in China will either remain stable or decline slightly over fiscal year 2025 due to an existing supply glut. In contrast, price for domestic module with imported cells are expected to stabilize at around $0.14 to $0.15 per watt peak following the implementation of the ALMM. In the medium term, prices may soften as domestic manufacturing scales up to meet local demand. While prices are anticipated to remain low with sufficient domestic production, a significant further decline is not expected, given the concurrent increase in demand.
- The price of domestic modules made from locally produced cells is currently at $0.22 per watt peak, reflecting lower cell manufacturing capacity in relation to the demand for DCR modules. This price is expected to remain stable at these levels for the next couple of years until substantial cell manufacturing capacity is established.

Cost Comparison of Imported vs Domestic module



Note- For domestic- using imported Cell. Source: Crisil

Technology & Process

Overview

- The solar photovoltaic (PV) manufacturing process begins with one of the basic raw material, sand (silica - SiO2). Metallurgical-grade silicon (MG-Si - >96%+ purity), is produced by heating silica in an electric arc furnace at high temperatures (SiO2 + C -> Si + CO2) to eliminate impurities. This MG-Si is then subjected to further purification through the Siemens process, achieving a purity level of 99.99999% (7N) or higher, resulting in polysilicon (higher purity material).
- Next, the polysilicon is crystallized into ingots using the Czochralski process. These ingots are then sliced into wafers. The wafers undergo several processes, including texturing, doping, etching, and applying silver paste connections, to transform them into cells. Cells are converted into modules by placing them on a back sheet, connecting them, and enclosing them with an aluminium frame and a front glass.
- The image below shows the module manufacturing process and capex, with complexity and capex increasing as we move upstream. For example, module assembly is relatively simpler and requires lower capex and scale compared to wafer production.

Breakdown of solar manufacturing value-chain and required investment for production:

	Polysilicon	Wafer	Cell	Module
Capex mn $ per GW	140	100	80	30
Minimum Plant Size	> 3 GW	> 1 GW	> 0.1 GW	> 0.1 GW

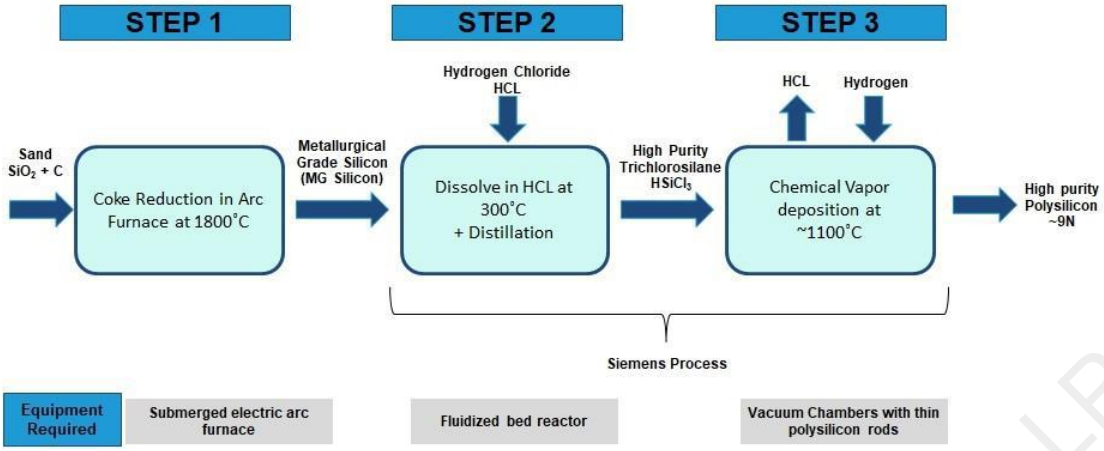
Source: IEA, Bernstein

- **Global equipment manufacturers-** All equipment used in the solar PV manufacturing chain is produced in China, as well as in other countries such as Germany, Japan, South Korea, and the United States. However, in terms of cost, companies outside of China struggle to compete with Chinese manufacturers unless they receive significant government support. Some key suppliers outside China for critical processes in solar PV value chain are:

Step	Process name	Company
Polysilicon	Chemical Vapor deposition	GT Advanced Technologies in USA, and German companies like- GEC GmbH, Schmid Silicon Technology GmbH, Silicon Products Technologies GmbH, SiTec GmbH
Ingot	Czochralski (CZ) Furnaces	Linton (HQ- USA, Production in China), PVA TePla AG (Germany), Ferrotec (Japan), S-Tech (Korea)
Ingot	Diamond wire cutting	Disec (S Korea), MTI (US), Precision Surfacing Solutions (Switzerland), Thermocompact (France), Well Diamond Wire Saws (Germany), and Japanese companies like- Komatsu NTC, Nakamura, Toyo Advanced Technologies

- **Technology leaders-** The solar PV cell was originally developed at Bell Labs in the United States. Until 2010, the U.S. and Germany were considered global technology leaders in the solar industry, while China had yet to emerge as a significant player. However, from 2010 onward, China rapidly scaled its solar PV value chain, becoming the world's largest manufacturer. In addition to their dominance in production, Chinese companies began investing heavily in technology, and they have since taken the lead in technological innovation within the solar industry. Outside of China, First Solar is the technological leader in CdTe based solar PV technology. However, for silicon-based solar PV, China holds the leadership position. Companies outside of China have been forming technical partnerships with Chinese companies to access the latest advancements in silicon-based solar PV technology

Polysilicon manufacturing process



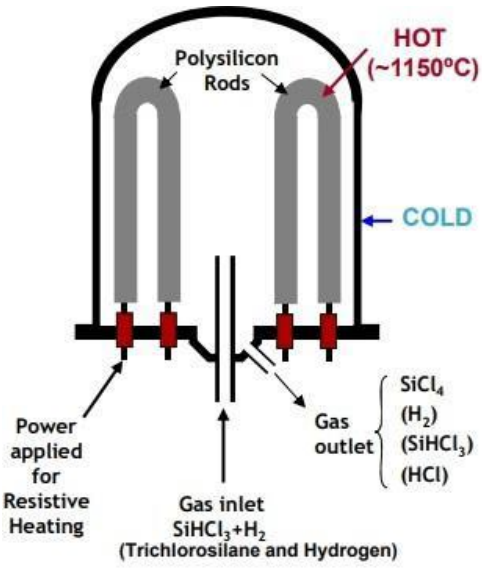
Source: Bernstein

There are 3 main steps -

- **Step 1: Metallurgical Silicon Production-** At this stage, two key raw materials are used: coal (for carbon) and quartz, which is essentially sand, a widely available resource. However, high-quality quartz with low concentrations of iron, aluminium, and other metals is required to produce electronic-grade silicon. The raw materials are heated to approximately 1800°C in an electric arc furnace, where the oxygen in the quartz reacts with the carbon to form carbon dioxide and silica. The chemical reaction is as follows: SiO2 + C → Si + CO2. The resulting product is metallurgical-grade silicon (MG-Si), which is 98% pure silicon.
- **Step 2: Distillation-** In the second step, powdered MG-Si (with a manganese concentration of less than 35 ppmw), is combined with hydrochloric acid (HCl) at 300 °C in a fluidized bed reactor (FBR). This reaction converts the MG-Si into trichlorosilane (SiHCl3), which is a liquid. During this process, impurities such as iron (Fe), aluminium (AI), and boron (B) react with chloride molecules to form their halides (e.g., FeCl3, AlCl3), which are subsequently removed during the distillation of the liquid. The resulting trichlorosilane (SiHCl3) is highly purified, containing impurities of less than 1 ppba. The reaction is as follows: Si+3HCl→SiHCl3+H2

Source: Wacker, Bernstein

- **Step 3: Chemical Vapor Deposition-** In the final step, pure trichlorosilane (SiHCl3) is reacted with hydrogen in a large vacuum chamber which is also a polysilicon reducing chamber called Chemical Vapor Deposition (CVD) reactor. The mixed gases are passed through pure silicon rods, which are heated to temperatures exceeding 1150°C. This results in the deposition of high-purity silicon on the rod surfaces, a process commonly referred to as the "growing" of silicon. Once the silicon rods reach the suitable thickness, they are removed from the reactor and broken into smaller pieces, which are then used as feedstock for the crystallization process.
  The reaction is as follows: $SiHCl3 + H_2 \rightarrow Si + 3\ HCl$



Source: Sandia national laboratories, Bernstein

- The process was initially developed by Siemens in the 1960s and has since undergone various modifications to adapt to changing technologies. Currently, approximately 90% of silicon produced globally utilizes a modified Siemens process, attributed to its capability of generating high-purity polysilicon.
- In China, most companies employ furnaces equipped with 36 and 48 pairs of silicon rods, while a few are exploring the use of 72-pair furnaces. The energy consumed during this process can be recycled for use in other stages, achieving efficiencies of up to 80%. The Siemens process has significantly optimized energy consumption, with the most efficient Chinese firms achieving a consumption rate as low as 60 kWh per kilogram of silicon.
- Some companies in China, such as GCL Technology, utilize Fluidized Bed Reactor (FBR) technology for polysilicon manufacturing. Below is a basic comparison between the modified Siemens process and FBR technology:

	Modified Siemens	FBR
Key materials	Trichlorosilane	Silane, dichlorodihydrosilane, trichlorosilane
Reaction temperature	1,050℃	700℃
Appearance	Rod	Granular
Unit power consumption	48-60kWh/kg	15kWh/kg
Unit water consumption	130t/t	90t/t
Donor impurity content (ppba)	<=0.3	<=0.2
Acceptor impurity content (ppba)	<=0.05	<=0.05
Minority carrier lifetime (μs)	>=1600	>=1600
Carbon content (ppba)	<=0.4	<=0.3
Total metal impurity content (ng/g,ppbw)	Surface metal impurity content≤1.0	Total metal impurity content≤0.5
Advantages	Mature technology, higher density	Low power consumption
Disadvantages	High power consumption	Higher powder content may affect purity

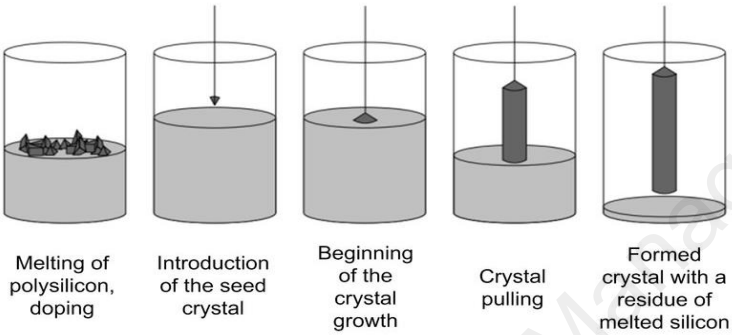
Source: CLSA

Ingot and Wafer manufacturing

- The next phase in the production process is ingot and wafer manufacturing. It begins with the growth of ingots, which are subsequently sliced to the required specifications. After undergoing additional processing steps, the final wafers are produced. The method used to grow ingots depends on the type of ingot being produced: multi-crystalline/quasi-monocrystalline silicon ingots are grown using the casting method, while monocrystalline ingots are produced through the Czochralski (CZ) process.
- **Multi-crystalline or quasi- monocrystalline silicon ingots** - Polysilicon is melted in a crucible and cooled from the bottom to solidify the mixture. This process can be carried out through either full melting or semi-melting methods. As of 2019, the best yield for both methods was around 68-69%, while for quasi-monocrystalline ingots, the maximum yield achieved was approximately 50%.

Quasi-monocrystalline ingots are produced using a casting method but incorporate a monocrystalline silicon seed during the casting process. This allows manufacturers to avoid investing in new infrastructure for production. However, while the resulting product is of higher quality than multi-crystalline silicon, it does not match the quality of pure monocrystalline silicon.

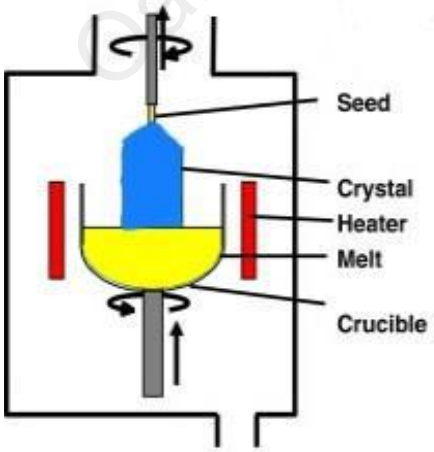
- **Monocrystalline silicon ingots -** The Czochralski (CZ) method is the most widely used process for ingot generation due to its simplicity and lower production costs. In this method, high-purity polysilicon is heated to approximately 1420°C, slightly above silicon's melting point. A monocrystalline silicon seed is then carefully placed on the liquid's surface, just barely touching it. The seed must have the same crystal orientation as the desired ingot, and it is initially pulled quickly to start crystal formation and reduce defects within the seed at the beginning of the process. The temperature difference initiates crystallization and growth. To ensure uniform doping, the seed crystal and the container holding the molten silicon are rotated in opposite directions. After the initial pull, the pulling speed is reduced to allow the crystal to grow in size. Once the cylindrical ingot is fully grown, it is removed from the melt and left to cool, during which the atoms align themselves according to the seed's crystal structure.
- **Czochralski (CZ) method- Step by step process**



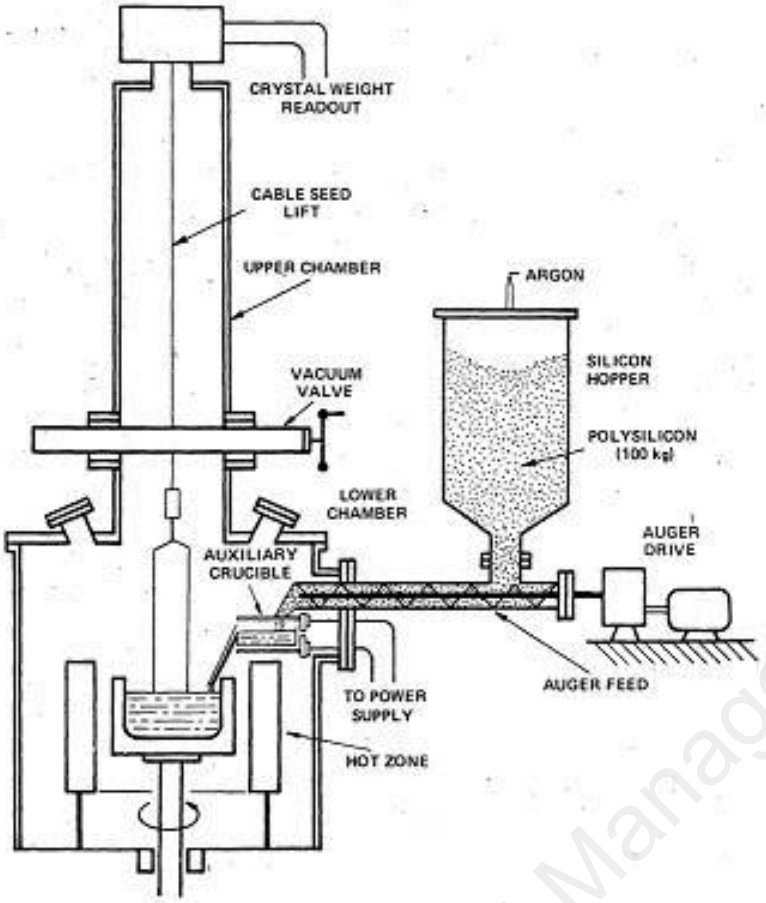
Source: A review and analysis of technologies applied in PV modules

- The Czochralski (CZ) method has undergone significant advancements over time, increasing the feed capacity from 950 kg in 2018 to 1600 kg, which has contributed to cost reductions. Traditionally, this method required recharging the crucible, meaning that companies needed to refill the material each time a rod was pulled before starting a new one. This limitation was addressed with the introduction of the Continuous CZ (CCZ) method, where polysilicon is continuously melted and pulled, resulting in better quality rods. Since the melting process occurs simultaneously with the growth process, cycle times are reduced. However, feeding solid silicon during the pulling of a single crystal poses a risk of solid particles floating and potentially touching the growth interface, which could disrupt the process.

Czochralski (CZ) method - Standard

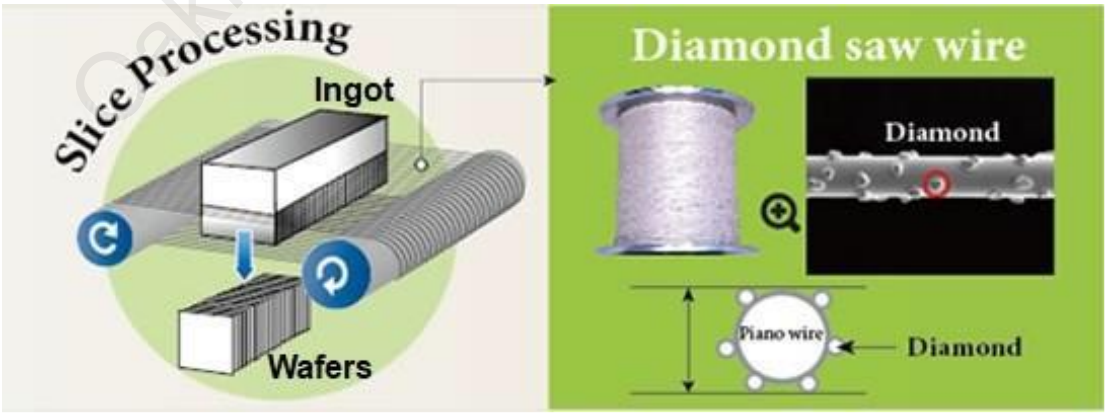


Continuous Czochralski (CZ) method with continuous feed



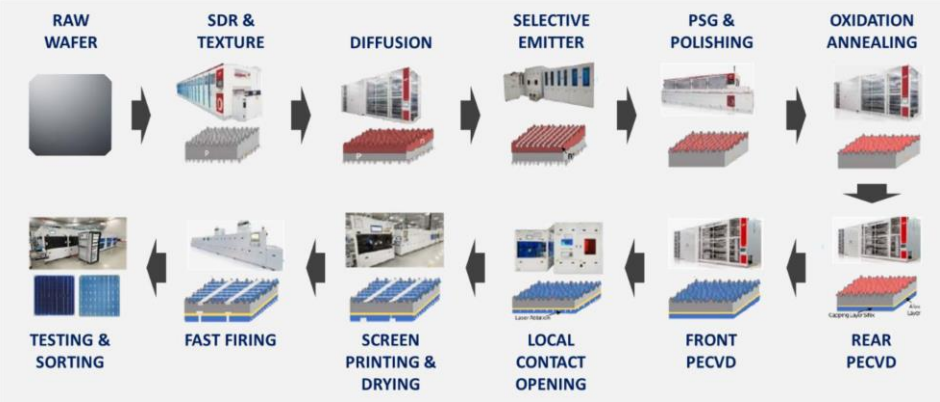
Source: US department of energy, Bernstein

- **Wafers**- Diamond wire cutting technology is the widely used method for slicing ingots into wafers. This technique uses diamond particles that are electroplated onto a steel wire. The wire, which is thinner than a human hair, used as a slicing tool, resembling a thread which is made of thin piano wire embedded with diamond granules. This method has proven to be faster, more cost-effective, and produces higher-quality wafers compared to older techniques. One such older method, nearly phased out, is motor cutting, where mortar and silicon carbide were placed on a steel wire, and friction between these materials was used to slice the silicon rod.
- **Diamond wire cutting tool used to thinly slice rectangular silicon ingots that are pre-cut to the dimensions of each wafer**



Source: Bernstein

Monocrystalline PERC solar cell manufacturing steps



Source: Frost & Sullivan

Steps for Cell Manufacturing

- **Wafer check-** Raw wafers are inspected for physical and visual defects. Any wafers with issues are either placed into a low-efficiency batch or removed from the production line. The typical rejection rate is around 0.2%.
- **Raw wafer (Gallium/ Boron doped)-** Wafers are passed through an inspection tool to detect any microcracks before moving to the next stage in cell processing.
- **SDR (Saw Damage Removal) and Texture to Reduce Reflection (Shine Removal)-** The solar cell manufacturing process begins with wafers undergoing chemical cleaning and texturing on wet benches. This process removes organic and metal contaminants while creating a textured surface resembling suede or pyramids. This texture helps reduce optical losses by minimizing reflection and extending the optical path, enhancing light absorption. The process involves precise chemical management for uniform etching, optimized surface texturing to capture more light, minimized surface reflectance to maximize absorption, and strict control over wafer purity to prevent contamination that could reduce efficiency.
- **Diffusion to Create the P-N Junction (Most Critical)-** After texturing, the wafers undergo a high-temperature diffusion process that forms the p-n junction, a vital component in solar cells that separates carriers of light-generated electric charge. This step requires maintaining uniformity in surface composition and junction depth, controlling the resistance of the silicon wafer (R-sheet) within a specific range for optimal efficiency, and minimizing marks or spots from the equipment to prevent electrical defects.
- **Selective emitter to provide low contact resistance-** After the diffusion process, a selective emitter laser is used to perform heavy doping (high concentration) in the contact part of the metal gate line. With heavy doping metal electrode and emitter (P-N junction) forms good ohmic contact and improves the efficiency of solar cells. Selective emitter technology requires meticulous laser control. This involves achieving target sheet resistance and uniformity for optimal cell efficiency. Precise laser power, speed, and frequency ensure uniform emitter formation, while controlling laser offset minimizes electrical defects that can lead to cell rejections.
- **PSG and Polishing to Separate the P-N Junction and Remove Phosphorous Glass-** PSG (PhosphoSilicate Glass) polishing represents a critical phase in solar cell production. Achieving uniform etching is essential to ensure consistent removal of the PSG layer across the wafer's surface. Furthermore, meticulous control is necessary to prevent water or chemical flow marks and to optimize the drying parameters.
- **Oxidation Annealing-** The wafer is heated in an oxygen-rich environment at approximately 400°C to improve front surface passivation and enhance contact adhesion. This oxidation process forms a thin silicon oxide (SiO2) layer on the silicon surface, effectively passivating defects and reducing recombination losses, which ultimately leads to higher conversion efficiency. Additionally, the

oxide layer enhances the adhesion of the subsequent anti-reflective coating (SiNx). This process also results in the wafer taking on a dark blue colour, which is the most heat-absorbent hue.

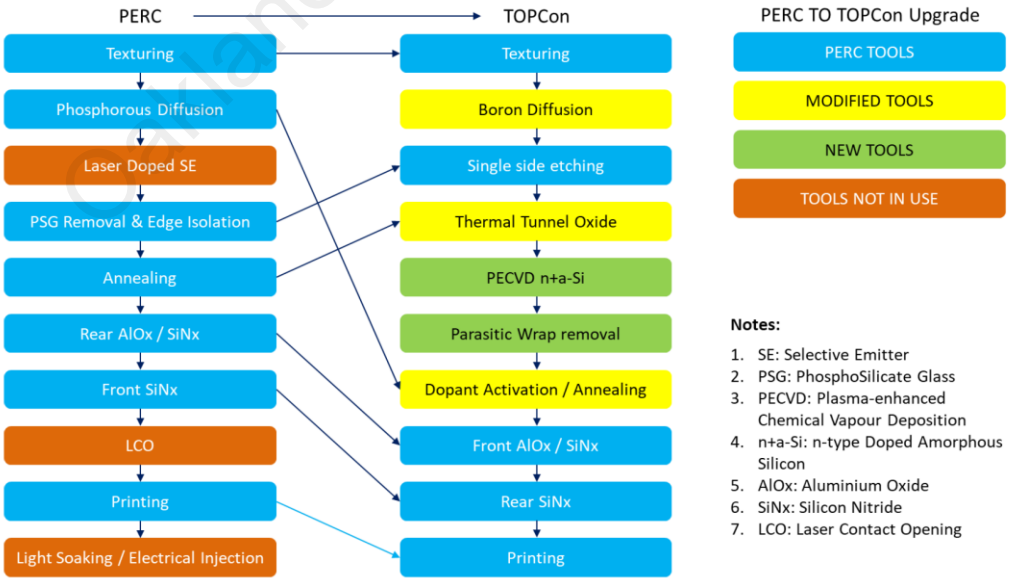
- **Rear PECVD (ALOX) for Rear Side Passivation and Back Surface Field-** Rear Plasma-Enhanced Chemical Vapor Deposition (PECVD) represents a critical yet complex stage in solar cell manufacturing. This process necessitates precise control over multiple parameters, including maintaining a uniform thickness and refractive index (RI) of the deposited anti-reflective coating, minimizing marks or spots caused by processing equipment, and rigorously managing impurities to prevent visual defects such as redness or rainbow effects. Each of these factors plays a significant role in influencing cell quality and rejection rates.
- **Front PECVD (SiNx) for Anti-Reflective Coating and Front-Side Passivation-** An anti-reflective coating, typically made of silicon nitride, is applied to the sun-facing surface of the wafer to enhance light absorption further. This process requires maintaining a consistent thickness and refractive index (RI) across the wafer surface. Strict impurity control is essential to prevent visual defects, such as redness and rainbow effects, which can significantly affect cell quality and increase rejection rates.
- **LCO (Local Contact Opening) of Rear Passivated Layer for Contact-** During the Laser Contact Opening (LCO) process, precise control of laser power, speed, and frequency is crucial for creating uniform openings in the cell's passivation layer. This meticulous approach minimizes electrical defects and ensures optimal cell performance.
- **Screen Printing and Drying-** Following this, metallization takes place using a screen-printing technique to apply silver metal paste on the front side and aluminium paste on the backside of the wafer. The process requires accurate paste deposition to ensure uniformity and proper finger formation, minimizing mismatches, controlling dimensions, and avoiding interruptions. These factors directly influence cell efficiency, yield, and rejection rates.
- **Fast Firing for Contact Formation and LID Regeneration-** The co-firing process occurs at high temperatures within a belt furnace to establish ohmic-contact electrodes. These ohmic contacts (low-resistance connections) between the metal electrodes and the silicon on both sides facilitate current flow.
- **Testing and Sorting (IV, EL, Colour, etc.)-** After the solar cells are completed, they undergo testing and sorting to prepare for assembly into solar modules.
- **IV Test (Current-Voltage)-** This test measures the cell's voltage and current output under simulated sunlight, assessing efficiency and identifying potential defects.
- **EL (Electroluminescence) Imaging-** This imaging technique reveals defects in the P-N junction and identifies areas of non-uniformity.
- **Colour Sorting-** Cells are automatically categorized based on their visual appearance, facilitating further sorting and grouping.
- **Counting-** The final count of cells is conducted both automatically and manually. Each packet is optimized based on weight and can hold between 135 to 150 cells, with Premier Energies typically packaging 140 cells per packet.
- **Final Product Acceptance:** A cell efficiency rate above 90% is considered acceptable.

Complexities Involved in Utilities Management for Solar Cell Manufacturing- The manufacturing of solar cells requires several high-purity semiconductor-grade gases and chemicals at each production step. Effective utilities management is vital for ensuring safe, efficient, and high-yield solar cell production. Below are the key complexities involved:

- **Acid and Alkaline Exhaust Systems-** Certain manufacturing processes involve chemicals such as Potassium Hydroxide, Hydrochloric Acid, Hydrogen Peroxide, and Hydrofluoric Acid, which emit alkaline and acidic fumes that must be effectively exhausted and treated using scrubbers. Neutralization and proper treatment of these exhaust fumes generated during various processes are essential for maintaining environmental compliance.

- **Waste Gas Management-** Thermal tools such as Diffusion, Annealing, and PECVD utilize gases like Nitrogen, Silane, Ammonia, Nitrous Oxide, Methane, Hydrogen, Phosphine, Boron Trichloride, and Oxygen, which are released as waste gases after wafer processing. It is essential to treat these waste gases in thermal scrubbers to break them down into non-hazardous compounds while exhausting hot air and capturing non-hazardous materials.
- **Demineralized (DI) Water Management-** A 1 GW cell line consumes a substantial amount of water, approximately 1 million litres per day (MLD). This necessitates a comprehensive water treatment system that includes effluent treatment, water recovery through Reverse Osmosis (RO), and the generation of Ultra-Pure Water meeting stringent quality parameters—such as 18 MΩ·cm resistivity, Total Organic Carbon (TOC) levels below 10 ppb, and a bacterial count of fewer than 10 CFU/ml.
- **Safe and Efficient Gas and Chemical Handling-** The manufacturing process utilizes a range of semiconductor-grade (99.999%) gases, including Silane, Ammonia, Nitrous Oxide, Oxygen, Hydrogen, Methane, Phosphene, Boron Trichloride, and Nitrogen, as well as chemicals such as Hydrochloric Acid, Potassium Hydroxide, Hydrogen Peroxide, Trimethyl Amine, and Hydrofluoric Acid. Implementing robust procedures for the safe and efficient handling, distribution, and usage of these gases and chemicals throughout the process is essential. Additionally, the safe disposal of waste gases and chemicals through appropriate equipment, such as gas and chemical scrubbers and Effluent Treatment Plants (ETPs), is critical for the operation of a solar cell manufacturing line.
- **Power Management-** A 1GW cell line requires substantial power, approximately 10MW, along with associated switchgear and auxiliary equipment. Any interruption in power to the process tools can lead to the discarding of the entire batch under processing, resulting in significant losses and requiring considerable time to reset the entire process. To ensure uninterrupted operation, a 100% backup power system, including Diesel Generators (DG) and Uninterruptible Power Supply (UPS) for critical equipment, is essential for the safe operation of the plant.
- **Process Cooling Water-** Maintaining optimal temperatures within tools used in thermal processes and metallization equipment is crucial. Nearly all tools in the manufacturing process require cooling water at varying pressures and flow rates. Designing and maintaining such a system, including standby pumps to ensure 100% availability, presents significant challenges.
- **24/7 Utility Operation-** For optimal cell line operation and high productivity, uninterrupted utility operation is essential. The quality of these utilities directly impacts both cell yield and efficiency. Consequently, all systems are designed with redundancy to ensure 100% availability of utilities.

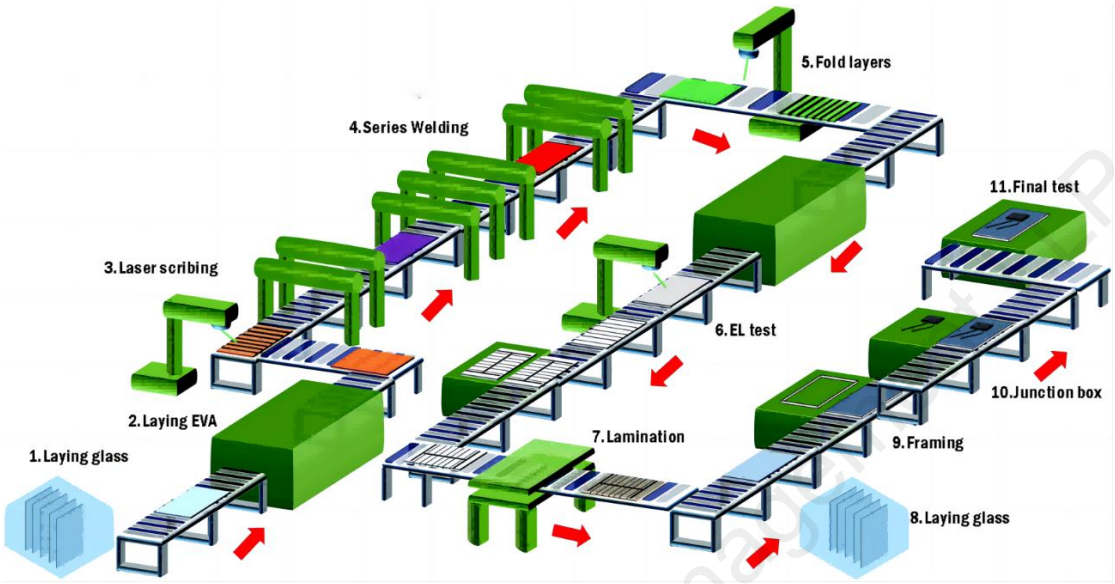
Upgrading from Mono Perc to TOPCon production line



Source: Stakeholder Interactions / Frost & Sullivan Analysis

Mono PERC/ TOPCon Module Manufacturing

- Module manufacturing, unlike the upstream components of the supply chain where technology and process used has a significant bearing on the components, is more of an assembly job where cells are combined with auxiliary packing materials like glass, EVA, aluminum frame etc. which then goes through processes like welding, lamination etc. to form final modules. The image below shows details of different steps involved in module manufacturing process.



Source: Maysunsolar

Solar module manufacturing process:

- **Laying Glass:** A sheet of tempered glass is placed on a conveyor belt to start the solar panel assembly. The glass serves as the front layer of the solar panel, providing protection and support.
- **Laying EVA (Ethylene Vinyl Acetate):** A layer of EVA is applied over the glass. EVA acts as an encapsulant for the solar cells, ensuring that they are securely laminated between the protective layers of the panel.
- **Laser scribing**: Laser scribing is used to create fine patterns on the EVA layer. This enhances the module's performance by improving light trapping and facilitating the alignment of solar cells.
- **Series welding**: The individual solar cells are connected in series through soldering. Conductive ribbons or wires are used to connect the positive and negative poles of adjacent cells.
- **Folding layers**: The layers of the panel, including the cells, EVA, and glass, are folded and pressed together to form a compact structure.
- **EL Test (Electroluminescence Testing):** An EL test is performed to detect any cracks or defects in the solar cells. During this test, the solar cells emit light when exposed to an electric current, making defects visible under special cameras.
- **Lamination:** The layers of the solar panel—glass, EVA, solar cells, and the back sheet—are laminated together in a high-temperature laminator.
- **Laying glass**: A second sheet of tempered glass or a protective back sheet is applied over the solar cells and EVA, forming the back layer of the solar panel.
- **Framing**: An aluminium frame is added to the edges of the solar panel for additional structural integrity.
- **Junction box**: A junction box is attached to the back of the panel to facilitate the electrical connection of the solar cells to external systems.
- **Final test**: The panel undergoes a series of final tests, including insulation resistance, voltage withstand, and power output verification.

DRHP- Technology / IC- Technology

KTAs from Waaree Energies FY24 AGM (Sept'24)

Company Brief

- The Waaree Group was founded in Mumbai in 1989, with a focus on instrumentation and the production of pressure gauges and valves. In 2007, they expanded into the solar energy sector, establishing Waaree Energies Limited as the flagship entity. Over the years the company has increased its module manufacturing capacity from 30 MW in 2007 to becoming the largest module manufacturer in India with 13.3 GW capacity in Sept'24.
- The company is a Fortune 500 company in India and has featured in BNEF Tier 1 company for 8.5 years. It has been a top performer in PVEL for the 3rd time and has also received the RETC high achiever award in 2024.

Risks

- Slower-than-expected growth in the solar sector is being influenced by challenges such as grid integration, which is a common issue in both the US and India. In India, specific obstacles include land acquisition, as approximately 4 acres of land are needed for every 1 MW of solar capacity.
- As the profitability of existing players has increased over the past few years, numerous Indian companies have announced capacity expansions in both module and cell manufacturing. This expansion raises the possibility of overcapacity in the Indian market. Similarly, with the implementation of the IRA in the US, the risk of overcapacity also exists in the U.S. market as manufacturers scale up production to capitalize on government incentives.

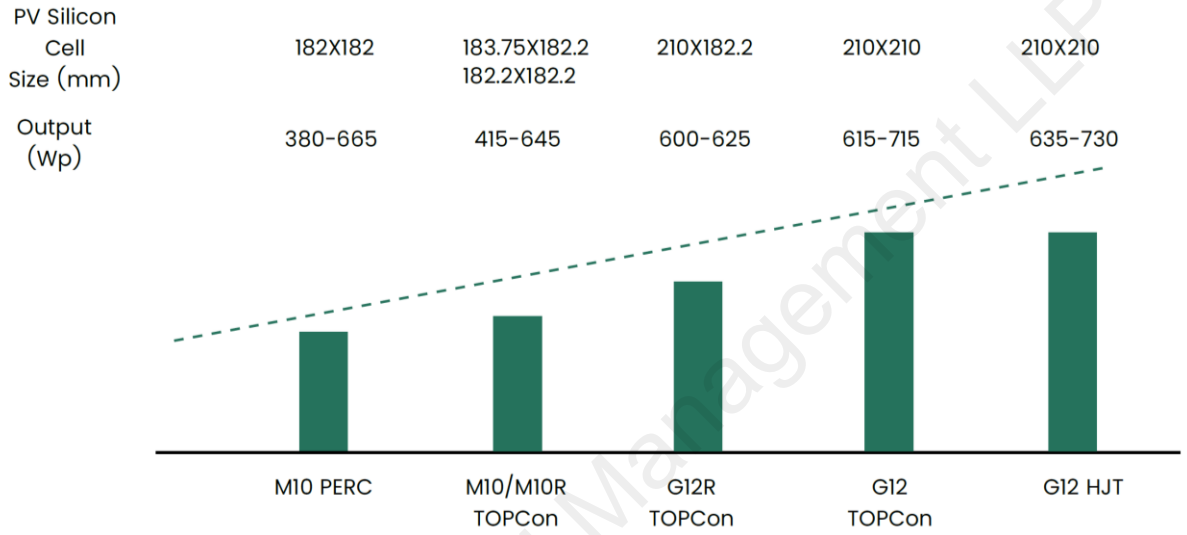
Revenue Drivers

- **Order book-** As of FY24, the company has an order book of 19.9 GW, scheduled for execution over the next 2-3 years. This order book translates to a revenue potential of INR 35,000 cr
- **Sales-** FY24 sales amounted to INR 11,398 cr, up 69% year-on-year. Exports account for 58% of sales. Solar modules contributed 92% of sales, while EPC (Engineering, Procurement, and Construction) contributed 7.5%. The production volume in FY24 was 4.77 GW.
- **Geography mix-** The company expects the domestic market to outperform exports, projecting a revenue mix of 55% from exports and 45% from domestic sales, driven by government tenders, IPPs, and programs like PM Surya Ghar and PM Kusum, while expanding export markets through its US operations and a new UAE subsidiary.
- **Realisations-** Exports are priced at 24-25 cents per wp (excluding transport), DCR modules at 22-24 cents per wp, and non-DCR modules at 16-17 cents per wp
- **Demand Drivers-**
  - A significant decline in solar module prices has been a major growth driver in the renewable energy sector. Prices dropped from USD 1.78 per wp in 2010 to USD 0.15-0.20 per wp by the end of 2023 due to technological advancements, economies of scale, and a demand-supply gap in global manufacturing. Management expects prices to stabilize between USD 0.21-0.24 per wp for FY25.
  - India's target to achieve 500 GW of renewable energy by 2030 implies an addition of 50 GW annually starting from FY26. Other initiatives like the PM KUSUM and PM Surya Ghar schemes will further boost demand.
  - Demand for new applications such as green hydrogen is expected to require 36 GW of solar energy by FY29 to support the production of 2-2.5 million tons of green hydrogen.
  - The availability of low-cost capital from both domestic and global lenders has been a significant growth driver.

- **Products-** The company has added manufacturing capabilities for HJT and flexible modules in FY24. Apart from modules they also sell off-grid and on-grid inverters.

Category	Efficiency	Performance Warranty
HJT	22-23.5 %	30 years
TOPCon	21-23 %	30 years
Mono PERC	19-21 %	30 years
Polycrystalline	20 %	25 years
Flexible	22 %	15 years
Special modules for BIPV, agriculture, floating PV		

- The company has a track record of consistently developing higher efficiency modules



- **Advances from customers-** WEL has advances worth INR 3142 cr on its balance sheet as of FY24, which is ~9% of the current order book.
- **Retail business-** The company operates 334 franchisees across India. It also has a network of Waaree Experts, who are trained electricians capable of installing solar panels in homes, creating job opportunities at the grassroots level.
- **EPC business-** In FY24, the company executed 704 MW of projects and managed a portfolio of over 500 MW for operations and maintenance (O&M). It currently has 2.3 GW of projects in the planning or execution phase.
- **New businesses-** The company has received Production Linked Incentives (PLI) for a 300 MW electrolyser manufacturing plant in Orissa and plans to set up another 300 MW plant in Gujarat. It is also exploring opportunities to venture into green hydrogen and green ammonia production.
- **Product quality-** The company holds 16 certifications from various global and Indian agencies for its modules. In addition, it has undergone audits by six different third-party auditors, and its products are insured by Munich RE and Ariel RE.

Margin Drivers

- The company reported EBITDA of INR 2,141 Cr and a PAT of INR 1,274 cr (including exceptional income of INR 340 cr, which came from 2 order cancellations).
- **Margins with backward integration-** The introduction of cell manufacturing is expected to increase margins by 2-3%, while adding wafer production could further contribute 1-2% to overall margins. Additionally, the company plans to manufacture aluminium frames to reduce costs and improve margins.

Capital Intensity

- **Capacity**- As of July 2024, the company has an operational solar module manufacturing capacity of 13.3 GW across 5 plants with 21 production lines.
- **5.4 GW cell factory-** The company's 5.4 GW cell plant is expected to be commissioned by the end of FY25. Out of this, 1.4 GW Mono PERC is said to start by the end of FY25 and 4 GW of TOPCon will start by Q1FY26. This expansion has been delayed by over 12 months due to restrictions on importing equipment from China and the unavailability of Chinese technicians to operate the plant.
- **6 GW Wafer to Module line**- A new 6 GW facility is being set up in Odisha, with the module line expected to become operational between FY26 and FY27. The cell and wafer lines will likely be commissioned by the end of FY27.
- **US Capacity -** The company's 1.6 GW US facility is expected to become operational in November 2024 (initially September 2024). The company aims to expand capacity to 3 GW by FY26 and 5 GW by FY27, depending on incentives offered by the US government.
- **Electrolyser-** the company plans to build a 1 GW scale manufacturing plant for electrolysers. It has received a PLI for 300 MW plant.
- **Batteries-** the company has applied for PLI, however there are no updates on it. Also, there is a lack of clarity as to will it be housed under Waaree Energies or a group company Waaree Technologies
- **Depreciation-** The company depreciates its plant and machinery over 3-10 years. Equipment specific to Mono PERC or TOPCon technology is depreciated faster than general-purpose machinery.

Capital Structure

- **IPO Plans**: The company plans to raise INR 3,600 cr through equity as part of its IPO. The funds from the IPO, along with existing cash, will be used for the wafer-cell-module plant in Odisha, electrolyser plants in Odisha and Gujarat, and the US module plant.
- **Debt and Cash**: As of March 2024, the company has gross debt of INR 317 cr and a net cash position of INR 3,320 cr. The company has secured debt worth INR 2,400 cr for capex in Odisha plant.
- **Debt Raising**: The company has passed a special resolution to raise up to INR 12,000 cr in debt by mortgaging its assets.

Corporate Governance

- **Workforce**: The company employs a total of 9,312 people, of which 2,512 are full-time employees, and 6,800 are contract labourers.
- **ESOPs-** WEL had created an option pool of 1 cr options in FY22. The total number of outstanding options is 11.94 lakh shares, of these vested and outstanding are 3.63 lakh shares. The vesting period is 25% options at the end of each year till 4 years.
- **Related Party Transactions (RPT):**
  - The company made a capital purchase of INR 38 cr from SGP Industrial and provided an advance of INR 30 cr.
  - It has INR 95 cr in receivables from Dhari Solar.
  - Paid INR 16 cr for Shree Swami Samarth Solar Park to a non-related party, though liabilities of INR 44 cr were payable to a related party of Waaree Energies.

- **Promoter Remuneration**: Promoters received the following remuneration:
  - Hitesh Doshi: INR 9.7 cr
  - Viren Doshi: INR 6.6 cr
  - Hitesh Mehta: INR 7.7 cr, with INR 59 cr in ESOPs
- **Material Subsidiaries** of the company are Waaree Renewable Technologies, Waaree Solar Americas and Indosolar. The company is also investing in aluminium frames for modules and electrolysers for green hydrogen, battery storage under different subsidiaries. Indosolar which was acquired by WEL in 2022 and is a 96% subsidiary, has filed representation with stock exchanges to allow trading of its shares which was suspended in 2020.

KTAs from Re Invest Expo (Sept'24)

Solar Industry Growth Potential-

- Solar has the potential to grow as large as the automobile industry, driven by the rapid expansion in demand and innovation.
- Solar module installations could reach 20 GW, with significant opportunities in India and the U.S. markets.

Technological Innovations in Solar Cells-

- HJT (Heterojunction Technology) combines crystalline silicon with amorphous silicon layers, offering high efficiency and low degradation. HJT uses a passivating layer to reduce energy loss, making it a strong competitor to Topcon technology.
- Tandem cells, particularly perovskite-based, can push efficiency beyond 30%. According to MIT, after AI, perovskite tandem cells are the most disruptive technology.
- Cells are not commodities but innovative products with features like passivating layers, automatic layer deposition, and laser-enhanced contacts.
- China leads with a massive 1200 GW solar cell production capacity.

Challenges for Domestic Solar Module Manufacturers-

- Policy Uncertainty- ALMM (Approved List of Models and Manufacturers) has been inconsistent, affecting industry stability. A continuous and predictable policy framework is crucial.
- Lack of domestic equipment manufacturing capabilities. NCPRD (National Centre for Photovoltaic Research and Development) is working to bridge this gap.
- High Capex for recycling, though technology itself is not difficult.

Policy & Incentives-

- The EU Parliament is concerned about policy distortions caused by China, suggesting member countries incentivize domestic production to mitigate this.
- Creating demand is the best way to incentivize innovation, as demonstrated by China.
- India has access to enough public funds, including a $1 trillion fund announced by the PM for research and development.

Re-engineering Solar Modules for Local Conditions-

- Current solar modules are optimized for 25°C, a condition not relevant for India. Local standards and re-engineered modules are required to suit India's climate.
- Standards need to reflect regional conditions for efficiency and performance.

Training and Manpower Development-

- Differentiation through the development of skilled manpower is critical training should cover product, process, and service aspects, including installation and maintenance.
- Collaboration with institutions like Fraunhofer, focused on application-oriented innovation, will enhance product competitiveness.

Supply Chain and Cost Competitiveness-

- European machine manufacturers struggle to compete with China, where costs are 25% lower.

- Reverse engineering might be a potential strategy to lower costs.
- First Solar's CdTe technology, based on the deposition process, could be a breakthrough but requires risk capital due to the potential for failure.

Energy Transition and Grid Management-

- Green electrons (solar energy) to green molecules (storage, hydrogen, etc.) requires a different skill set.
- Peak power demand varies across states, making ISTS (Inter-State Transmission System) critical for balancing and optimizing power flow throughout the year (e.g., MP from April to Sept, UP from Oct to Mar).

Premier Energies IPO Note (Sept'24)

Investment Thesis

- With 14 years of experience in cell manufacturing, the Premier Energies is the second-largest integrated solar cell and module manufacturer in India, after Adani. Setting up a module line requires just 30% of the capital needed for a cell line, making cell production more complex. Over the past seven years, 55 GW of module capacity has been added, compared to only 6 GW of cell capacity. New entrants typically need 2–2.5 years to establish a cell line, plus 6–9 months for stabilization, influenced by local climate but accelerated by expertise from other locations. This creates a strong entry barrier and competitive edge for experienced manufacturers.
- Battery prices have reached historic lows, a key factor that will significantly accelerate solar growth with battery storage, enabling round-the-clock or dispatchable power.

Revenue Drivers-

- **Revenue Segments-** FY24 sales stand at INR 3,144 cr, with a split of 86% domestic and 14% export. Premier Energies exports both solar cells and modules, focusing on ramping up exports, which will be a key growth driver going forward.
- **Order book-** Total order book is INR 5480 Cr as of June'24. INR 802 Cr for solar cells, INR 1197 Cr for non DCR modules, INR 3213 Cr for DCR modules, and INR 150 Cr for EPC.
- **Product Segments-**
  - **Solar modules**- The conversion cost from cell to module is the PV Infolink cell price plus $11 cents, resulting in variable realizations across different markets based on cell costs.
  - **Solar cells-** 50% of solar cells are utilized captively for DCR modules, 25% are sold to other Indian module manufacturers, and the remaining cells are exported.
  - **EPC (Engineering, Procurement, and Construction)**- This segment constitutes less than 5% of the business.
- **Indian module demand-** The current annual demand for solar power in India ranges between 35-40 GW, with 12-15 GW allocated for Domestic Content Requirement (DCR) modules. Currently, DCR manufacturing capacity stands at 7 GW. Large Independent Power Producers (IPPs) are allowed to establish plants utilizing Chinese solar cells, which contributes to lowering solar power tariffs. Consequently, India is importing approximately 25-30 GW of solar cells to meet this demand.
- **Realisations-** Blended at 0.26$ per WP for modules and 0.11$ per WP for cells. Realisation for export and DCR are between $0.25-0.28 per WP depending on FOB. Export realisations were $0.35 but have decreased as raw material costs have also come down. The conversion price of $0.11 remains intact for both exports and the domestic market. Domestic non-DCR realisations are at $0.16-0.17 per Wp, excluding GST, while domestic DCR realizations are at $0.24-0.25 per Wp, excluding GST.
- **Price variation clause**- The company offers both fixed and variable price contracts. Currently, 70% of the contracts are fixed pricing because they believe that solar panel prices have reached their lowest point and want to take advantage of it. However, delivery for these contracts may take 6 to 9 months. To mitigate raw material price risk, Premier purchases the necessary raw materials when an order is confirmed.
- **Customer concentration-** The top five customers account for 50% of sales.
- **Customer Categories-**
  - Independent Power Producers (IPPs)- NTPC, Bluepine, and others.
  - Original Equipment Manufacturers (OEMs)- Shakti Pumps.

  - White labelling- Panasonic, Luminous, etc.
  - Module manufacturers- Waaree, Vikram, etc
- **Domestic and International customers**
  - Domestic customers for modules- IPPs such as Jindal, OEMs for pumps like Shakti Pumps, and OEMs for rooftop solar like Panasonic and Luminous, along with government contracts.
  - Domestic customers for cells- Companies like Waaree for their DCR requirements
  - Exports- mainly cell exports to US module manufacturers
- **Quality-** The company ranks best in 2 categories of the PVEL scorecard. Adani, Waaree and Vikram are more than 5 out of 6 total categories.
- **Price Decline-** The decreasing prices of Chinese solar cells are enabling Indian module manufacturers to assemble products domestically, benefiting both the manufacturers and Independent Power Producers (IPPs).
- **Regulations-** The Indian government has communicated to manufacturers that Advanced Level Cell Manufacturing (ALCM) and Advanced Level Wafer Manufacturing (ALWM) regulations will be implemented for solar cells and wafers in the future.
- **Guidance-** The company anticipates sales in the range of INR 6,000-6,500 cr for FY25.

Margin Drivers

- **Financial Performance**- For FY24, the company reported an EBITDA of INR 507 cr and a PAT of INR 233 cr. The EBITDA per watt stood at INR 3, with an EBITDA margin of 15.93%, significantly improved from 7.7% in FY23. This margin increase is attributed to higher utilization rates, the start of operations at the cell plant, and better realizations in both export and DCR markets.
- **Raw Materials-** Currently, 50% to 60% of raw materials are sourced from China, down from around 75% to 80% previously. Wafers are imported from 3 to 4 suppliers in China. Most chemicals are obtained from Indian suppliers, such as Aditya Birla Chemical, Genpact, and Deepak Fertilizers, and must meet specific concentration requirements; otherwise, cell efficiency may decrease. Some gases, such as silane and trimethylamine, are imported by companies equipped to handle them, while other gases are sourced from Indian suppliers like Linde, with oxygen purity at 99.9999% and nitrogen purity at 99.99999%. Silver paste is procured from suppliers in China and Taiwan.
- **Power-** The 25-acre plant features a 6.6 MW solar rooftop installation, which accounts for 10% of its power consumption.
- **Waste handling-** 100% water is recycled (excluding 30% evaporation loss).
- **Guidance-** The guidance for FY25 indicates a PAT of INR 450-500 cr. Over the next 3-5 years, the company expects EBITDA margins to stabilize around 15-16%, with PAT margins around 7% as supply increases.

Capital Intensity

- **Capacity-** The company has a 3.3 GW module and 2 GW cell capacity.
- **Capital Expenditure -** The ongoing capex plan aims to establish 1 GW each of module and cell capacity by FY25, with a total investment expected to exceed INR 3,400 cr. The company is raising IPO funds to invest in TOPCon technology, targeting 4 GW cell capacity by 2027 and a new module plant by 2026. A joint venture is set to establish a 1 GW cell line in the US, and an MoU has been signed with a Taiwanese partner for a 2 GW wafer facility in India.
- **Plant Capex Details-**

  - **Module Plant**- Capex is approximately INR 250-275 cr per GW, with an incremental TOPCon capex of INR 100-150 cr per GW. It operates as a Class 1 clean room.
  - **Cell Plant**- The capex for the cell plant is around INR 850-900 cr per GW, requiring 18 months to set up and an additional 6-9 months to operationalize and stabilize. The estimated capex in the US is likely 1.5 times that of India, and the facility operates as a Class 1000 clean room, accommodating wafer sizes of 182 mm x 182 mm, 182 mm x 210 mm, and 210 mm x 210 mm.
  - **Wafer & Ingot Plant**- Capex for the wafer plant is around INR 75 cr per GW, while for the ingot plant, it is INR 275 cr per GW.
- **Conversion from wafer to module-** 72 cells are cut in half to 144 cells in a module, this is done to reduce resistive losses from traveling energy via current. Companies are developing technology for a cell cut in 3 pieces to further increase efficiency.
- **Technology-** The initial lines were purchased from China; the new lines are from Germany. They do not have an official technology partner for PERC or TOPCon**.** They work with German consultants, Universities, and Chinese & Taiwanese companies. Machines from Germany- RENA for chemical dipping, Maxwell for busbar printing. The microscope for QC is from the US bought for INR 1.5 cr
- **Depreciation-** Core equipment has a depreciation period of 5 years, while overall company assets (excluding land and buildings) depreciate over 7.5 years.
- **Subsidy-** The company benefits from a 25% subsidy on capex under the SPECs scheme and has opted not to participate in the PLI program.
- **Land-** The company owns a total of 120 acres across four plants located in Telangana.
- **Working capital-** WC as a % of sales at 27% as of 9MFY24. High WC because agreements with Indian IPPs are at a fixed price. Due to this, the company orders inventory to avoid raw material price fluctuation risk. Advances as % of the order book is 3%, as export sales are only at 17% of the total mix. Management has guided for working capital days of 60-70 days.

Capital Structure

- **IPO proceeds-** of the INR 1500 Cr fresh issue, 1200 Cr will be used in capex for module and cell line.
- Offer for sale of 2.82 Cr shares- 6.7% of pre-issue shares. Offer for sale of INR 1269 Cr at INR 500 share price.
- **Debt to equity** at 2.6 times. With total Debt as of 9MFY24 at INR 1410 cr. Of the new capex of INR 3400 Cr, 2300 Cr will be debt-funded. D/E will be 1.1x by FY25 and in 3 years it will be down to 0.75x.

Expansion Plans

- The company is expanding in modules, cells, and wafers but will not enter the polysilicon market in the near future. The internal plan is to achieve 20 GW of modules, 10 GW of cells, and 5 GW of wafers by 2028. While cells have higher margins, modules offer higher asset turnover and sales value. Wafers will be used for captive consumption and exports.
- Regarding U.S. capital expenditure in FY24, 99% of cell exports from India were made by Premier. Many module manufacturers are setting up plants in the U.S., but very few cell manufacturers are doing the same. All cells produced in the U.S. will be supplied to the joint venture partner's module factory. Additionally, the U.S. investigation into Chinese-owned companies in four Southeast Asian countries will benefit Indian players.

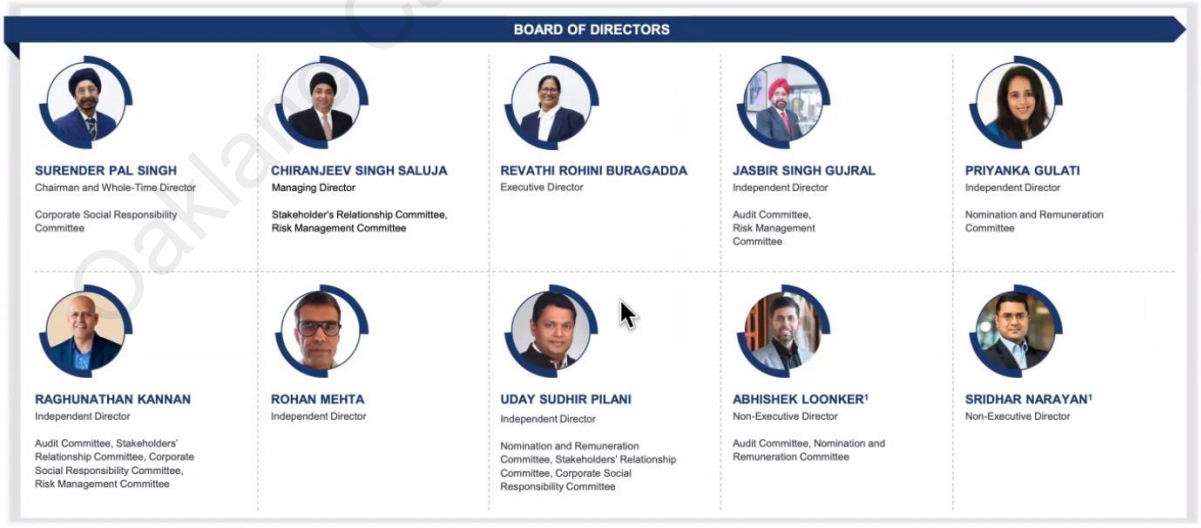
- The company plans to enter the battery storage, but nothing has been finalized yet. They intend to transition into a full-fledged energy company.

Corporate Governance

- **Group structure-** All subsidiaries are 100% owned except, PEIPL JV where Azure Power owns 26% share. This was for DCR modules when Azure was participating in SECI tenders.
- **Promoter-** Chiranjiv Saluja
- **Employees-** Cell plant- mostly skilled employees (engineers) for machine operation, they run the line for 24 hours with ~60 people employed per shift per GW.

Experienced Promoter-led senior management team with demonstrated execution capabilities

Board of Directors



Competition

- **Global demand supply-** China uses 50-60% of its capacity to meet domestic demand, which has collapsed due to the economic crisis. Currently, Chinese companies are selling cells and modules at a substantial loss, making it difficult for Indian companies to profit if they sell at these prices. Management hopes that Chinese companies will not be able to sustain these low prices and that prices will eventually increase. India's cost of production for cells is 10% higher than that of China while manufacturing costs for Southeast Asian companies are on par with those of Indian companies. The price of wafers in the U.S. is $0.60 per wp compared to $0.15 per wp in China. Additionally, a Chinese company is setting up a 20 GW wafer manufacturing unit in Laos, U.S.
- **Indian demand-supply-** Currently, the market favours domestic cell manufacturers and is expected to remain that way until FY26. It will be neutral from FY26 to FY29, after which it is anticipated to become a buyer's market. Backward-integrated players with technological prowess and low debt will be able to compete effectively.
- **Cell manufacturing entry barriers**
  - Capex per GW is INR 850 cr, with 50% allocated to utilities and 50% to machinery. The process requires 4-5 types of gases, 4-5 types of chemicals, and 1 million litres of ultra-pure water per day per GW, which must be recycled (using a plant from Membrane India). If any single component fails, the production line will stop functioning.
  - A module's efficiency is based on the cell which is of the least efficiency in that module. So, operating at high levels of efficiency is critical. Premier Energies has achieved a final product acceptance of 95% vs global standards of 90%, they have also achieved 23.5% cell efficiency in Mono PERC cell, which is the global standard.
  - Very few players- 4 GW Adani, 2 GW Premier, 0.5 GW with Tata, Jupiter, and Websol. Waaree in the process to stabilise 1.4 GW. Cell line setup takes 2-2.5 years plus 6-9 months of stabilisation. All players are currently into Mono PERC.
  - Capacity addition- planned cell capacity in India by FY28 is 60 GW. Premier is adding 1 GW by FY25 and another 4 GW by FY27, so it will have a total of 7GW cell manufacturing.
- RIL got into HJT technology and bought machinery from Norwegian REC. Today less than 10% of supply is HJT and the remaining is TOPCon or PERC. HJT efficiency is higher by 0.3% but capex is 2x of TOPCon.

Annexure

- 1995- Company started in 1995- Started by Mr. Surendra Pal Singh (Father of Mr. Chiranjeev). It was earlier in the business of Agri hand pumps and later migrated to Solar Lanterns, Street Lights, etc
- 1999 – Started Solar Module Manufacturing. The company used to buy cells from Germany. (Mr. Chiranjeev joined sometime before this)
- 2010-11 – DCR Government Scheme – bought a cell line from Germany and stabilized in India.
- 2021 – Investment from PE Rs 177cr (GEF Capital – ESG Fund) and diluted ~21% stake. Grew from 500MW to 2GW Cell today and expanded Module from 1.2GW MW and 3.36MW

SNEC Expo in China (June'24)

- **Current Industry Trend-**
  - China's solar industry is rapidly shifting from PERC to more efficient TOPCon technology (75% of China's cell capacity), with a massive 750GW TOPCon cell capacity. Due to better pricing and cost advantages, many manufacturers are phasing out PERC facilities.
  - HJT Technology- Though HJT offers higher efficiency than TOPCon, it remains costly and faces manufacturing challenges, with China currently having 100 GW of HJT capacity.
  - Despite the advances in HJT, the longevity of mono-perc technology remains at 12 months, and TOPCon has yet to complete multiple cycles to fully validate its operational stability.
- **China's Position**
  - With nearly 1000 GW of capacity and over 50% excess production, China is poised to maintain its status as the world's leading manufacturer of modules, cells, and other crucial technologies such as energy storage systems (ESS) and electrolysers. This situation suggests that prices for modules and cells are likely to stay low, providing stability for Indian module companies.
  - Chinese industry leaders such as Jinko, Trina, Longi, and JA Solar are currently experiencing financial strain due to significant overcapacity. However, these firms are expected to maintain their positions as the top 4 to 5 companies in the market, while the bottom 15 to 25% of competitors are likely to exit within the next 12 to 24 months. Consequently, the profit pool is anticipated to become increasingly concentrated among the top 5 to 7 players in the sector.
- **India's Opportunity**
  - India is anticipated to have cell manufacturing of 40 to 50 GW, which is currently only 5-6 GW, that also only nameplate capacity
  - Mono PERC technology will remain prevalent in the Indian market for the next 5 to 6 years due to DCR and ALMM requirements. While TOPCon technology is still emerging, market feedback indicates degradation rates ranging from 1% to 10%. Another challenge facing the industry is the choice between glass-to-back sheet and glass-to-glass configurations. The availability of glass for solar panels is a global concern, and glass-to-back sheet designs have shown degradation issues. Currently, Adani is the only company utilizing TOPCon technology in one factory.
  - Cell manufacturing margins in India are higher than China as the government is also promoting manufacturing in India. Margins for solar panel manufacturers are stabilizing due to higher capacity utilization and global market demand.
  - Current margins for modules are better than historical averages, supported by government policies protecting local manufacturing.
  - Despite fluctuations in solar cell prices globally, Indian manufacturers are well-protected due to government policies like the ALMM (Approved List of Models and Manufacturers) that support local manufacturing, ensuring stable cash flows and encouraging backward integration.
- **BESS-** Battery Energy Storage Systems (BESS) are essential and indispensable for the future of energy, yet current costs pose a significant barrier. For instance, establishing 1 MW of solar capacity costs between INR 2.75 and 3 cr, but incorporating a BESS increases the total expenditure to around INR 5.5 to 6 cr. To enhance market acceptance, it is crucial to develop more cost-effective technologies for energy storage.
- **Green Hydrogen-** Green hydrogen remains operationally challenging due to high costs and transportation issues. Currently, green hydrogen is priced at $7-8 per kg, compared to $2 per kg for grey and brown hydrogen.

Webinar with SECI Chairman RP Gupta (May'24)

Key takeaways

- At least 50 GW capacity will be added every year to reach 500 GW renewable energy capacity by 2030. However, if the tariffs increase substantially, the capacity addition will be slower. Reaching 500 GW will not be easy, as most potential areas are used up.
- Till now RE has not had a material impact on Grid stability, but going forward it will have. Hence, upcoming RE projects will be Round the Clock (RTC) or Firm & Dispatchable Renewable Energy (FDRE) which includes storage
- SECI promotes sodium ion batteries as it can be cheaper and energy density is not very important. Lithium ion can be preferred for mobility because of energy density.

Vision 2030

- India's goal is to achieve 500 GW of renewable energy by 2030. As of May 2024, India has 190 GW installed. Therefore, the country must add at least 50 GW each year to reach this target. Achieving 500 GW would mean that renewable energy will contribute to 40-45% of electricity production in India.
- 500 GW is not very easy-
    - All the most potential areas for solar and wind energy have been utilized.
    - Until now, renewable energy has not significantly impacted the grid, but this will change in the future. There is a need for energy storage to support renewable energy.
    - Upcoming projects will be along with storage.
- The central government mandated RPO (Renewable Purchase Obligation) for state Discoms. If the targets are not achieved, there will be heavy penalties
- A target of 5 million tons of green hydrogen production has been set for 2030.
- Module manufacturing is expected to reach 60 GW by the end of FY25, and cell manufacturing will also develop in the coming years. Additionally, there is a significant opportunity in transmission components.
- Supporting the domestic module manufacturing industry is strategic and essential from an energy security perspective. Relying on imports would create a situation like that of the oil and gas sector.
- India has one of the lowest tariff rates for renewable energy. However, the profitability might increase in the short term due massive addition of capacity. If the bids are very high, the government may reduce capacity additions, and the annual addition will go below 50 GW

Vision 2047

- The goal is to reach 1,900 GW of renewable energy generation.
- In the next 10-15 years, renewable energy with storage will be cheaper than Thermal energy.

Nuances on Power Storage

- Battery storage is integrated into Round-The-Clock (RTC) and Firm & Dispatchable Renewable Energy (FDRE) bids. These projects have a capacity utilization factor (CUF) of 85-90%, compared to just 20-25% for standalone solar or wind plants, making them viable even with transmission costs
- New players will set up battery storage plants and become merchant traders on the exchange

- Firm & Dispatchable Renewable Energy is the latest product that can be given on demand- the price is similar to that of a new thermal energy plant.
- Current storage technology is suited for short-term storage, but there is no solution yet for long-term storage, such as storing energy from surplus months for use during leaner months. As this technology develops, the uncertainty of relying on renewable energy will decrease. As the reliability gap between conventional energy and renewables narrows, and technology becomes more affordable, adoption will accelerate.
- Pump storage is a localized solution but has disadvantages, such as being location specific. Additionally, it contributes to increased transmission costs.
- Stationary storage is mostly imported technology but can be deployed anywhere. For short-term storage, batteries are preferred due to their lower cost.
- SECI promotes sodium ion as it can be cheaper and energy density is not very important. Lithium ion can be preferred for mobility because of energy density.

Challenges for Renewable Energy

- Grid stability
    - Discom needs predictable energy which is through RTC and FDRE.
- Currently the transmission cost of renewable energy is 0. From June 2025, it will be 25% for 1st year, 50% for 2nd year, and after that 100%. This will result in fewer projects focused solely on solar or wind energy.
- Other Challenges
    - Land is a state subject. States are coming out with their own renewable energy policies. SECI tries to pursue states to get land parcels for renewable energy projects
    - Thermal capacity addition will be slow but will keep going on. Renewable energy capacity addition will be much higher, hopefully with a more predictable generation

KTAs from Waaree Energies DRHP (April '24)

Contents

Summary

Assumed IPO Price	**1300**	FY23 Sales	**6751**	FY23 Gross Margin	**24%**
M Cap	**37,601**	FY23 EBITDA	**835**	FY23 ROE	**43%**
Enterprise Value	**33,140**	FY23 PAT	**483**	FY23 ROCE	**43%**
FY24E EV/ EBITDA	**20**	FY23 CFO	**1560**	FY23 D/E	**0.49**
FY24E EV/ CFO	**17**	FY23 Capital Employed	**2768**	FY23 Fixed Asset Turns	**8.3**
FY24E P/E	**41**	FY23 Total Debt	**906**	Working Capital to Sales	**-5%**

Note- Assumed IPO price is 1300 and size of fresh issue is INR 3600 cr

Key Stats

	Sales	EBITDA	PAT	ROE	Debt/ Equity	WC % of Sales
10 Yr CAGR/ Median	37%	35%	34%	12%	1.07	-1%
5 Yr CAGR/ Median	38%	50%	82%	19%	0.49	0%
3 Yr CAGR/ Median	50%	108%	126%	19%	0.96	-5%
FY23	6751	835	483	43%	0.49	-5%
Q1FY24	3328	467	336	-	-	-

Company Brief

- Established in 2007, Waaree Energies Ltd. (WEL) serves as the flagship entity of the Waaree group, specializing in the production of solar PV modules, solar EPC projects, and the trading of solar products.
- Founded in 1989 by Mr. Hitesh Doshi and his family, the Waaree group initially began with Waaree Instruments Ltd and has since diversified into multiple business sectors. Presently, the group is overseen by Mr. Hitesh Doshi and Mr. Viren Doshi, in collaboration with a team of seasoned professionals.
- Since our initial analysis in October 2022, the company has delivered on its growth guidance, demonstrating remarkable growth with a 2.4x increase in revenues to INR 6751 cr (guidance of INR 7155 cr) and a 6.4x surge in Profit After Tax to INR 483 cr in FY23 exceeding its guidance of INR 171 cr. This strong growth trajectory persisted, as evidenced by the company's reported revenues of INR 3328 cr and PAT of INR 336 cr in the first quarter of FY24.
- With an operational capacity of 12 GW and a substantial order backlog of INR 50,000 cr as of Dec'23 (assuming INR 2.5 cr realization per megawatt (MW)), compared to INR 24,000 cr in August 2022, the company's robust sales performance is poised to continue. Positioned aptly to capitalize on the burgeoning growth opportunities in the renewable energy sector and bolstered by its presence in lucrative and rapidly expanding markets like India and the US, the company is well-equipped to sustain its performance in the medium term.
- In December 2023, the company submitted its DRHP intending to raise INR 3600 cr through a fresh issue (the company revised the fresh issue size from INR 3000 cr to INR 3600 cr through an EOGM on 13th March 2024), alongside an OFS totalling around INR 416 cr (up to 32 lakh shares). The anticipated post-issue number of shares is 28.94 cr vs 26.17 cr pre-issue number of shares, all with a face value of INR 10. While the IPO date and price remain undisclosed, we anticipate these details to be finalized by March 2024. For this report, a tentative price of Rs 1300 per share is assumed, aligning with the prevailing trading price in the unlisted market.
- At an IPO price of INR 1300, the implied market capitalization of WEL stands at INR 37,601 cr with a FY23 PE ratio of 78x and FY24E PE of 41x, with a conservative PAT estimate of INR 928 cr for FY24. Additionally, WEL holds a 74.46% stake in Waaree Renewable Technologies, which itself has a market capitalization of INR 13,941 cr as of 27th March 2024. The value of WEL's stake is INR 10,380 cr. Adjusting for this investment, WEL's implied market capitalization reduces to INR 27,221 cr with an FY23 PE of 61x and FY24E PE of 33x, implying a greater margin of safety.

RHP- Company Brief / IC- Company Brief

Investment Thesis

*Large TAM * Industry growth * Leadership position in India * Management Quality * Size & Scale of Company * Financial Strength*

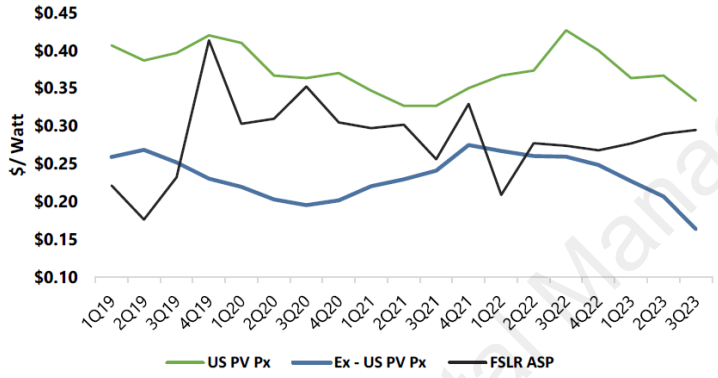
- ***Large TAM & Industry Growth*** – We project the Total Addressable Market (TAM) for WEL to encompass the solar PV module markets in the United States and India, expected to exceed 300 gigawatts from 2024 to 2028, indicating a substantial addressable market size of $85 billion (source: IEA). Furthermore, the solar industry in India is emerging as a sunrise sector, benefiting from a favourable macroeconomic cycle that includes decarbonization, and a favourable regulatory environment (China + 1). Environmental, Social, and Governance (ESG) considerations, and a diminishing cost per watt. Presently, solar energy is not only recognized as an ESG investment but is also acknowledged as a cost-effective power solution, as indicated by Lazard.
- **Leadership position in India & Globally (ex-China)-** WEL holds the distinction of being the largest module manufacturer in India and the second largest globally, excluding China. WEL is also the largest exporter of modules from India. With a current capacity of 12 GW, the company aims to augment this capacity to 20.6 GW by FY27. This expansion is strategically planned to uphold and strengthen WEL's dominant position in the market.
- **Management Quality-** Over the past decade, global business models in the solar industry have been established and matured. However, this period was challenging for Indian players, and those who persevered have acquired valuable insights and expertise in navigating the industry landscape during this downcycle. WEL's management successfully emerged out of this downcycle and has demonstrated its execution capabilities by successfully increasing the capacity from 2 GW in FY22 to 12 GW as of June 2023.
- **Size & Scale of the Company-** WEL has achieved a commendable financial performance, reporting sales of INR 6,751 cr and a PAT of INR 483 cr in FY23. The company has demonstrated an impressive 3-year CAGR of 50% for sales and 126% for PAT, underscoring the management's adeptness in scaling operations and executing strategic initiatives. The pivotal factor contributing to this success lies in the effective execution of operations and proficient logistics management. The inherent challenges in scaling, particularly in the realm of logistics, make it noteworthy that only a limited number of players have been able to establish capacities exceeding 1 GW.
- **Financial Strength-** In conjunction with governmental incentives such as the Production-Linked Incentive (PLI) and various state schemes, WEL has successfully procured equity and debt capital under advantageous terms. Furthermore, maintaining advances at 5% of the order book has resulted in a negative working capital cycle for the company. This strategic financial approach positions WEL favourably for future growth and facilitates forthcoming capacity expansion initiatives.
- **Key Monitorables-** 1) IPO timeline 2) Capital allocation 3) Capacity utilisation 4) Per unit realisation 5) Commissioning of new plants including that of wafer & cell 6) Changes in terms of trade of working capital 7) Change in regulations and incentives from various governments

RHP- Investment Thesis / IC- Investment Thesis

Risks

- **Slower than expected growth in solar PV installations-** If newly installed solar PV capacity, both in India and in the US, falls short of expectations, it would result in a slowdown in demand for modules and lower realisations. This will have a direct impact on both sales and margins of the company
- **Solar PV Price Dynamics**- Global module prices witnessed a decline from $0.22 per watt-peak (Wp) in Dec '23 to $0.15 per Wp in Nov '23 due to oversupply from China and excess inventory in the European market. Despite this, WEL's realization for export orders in Feb '24 stood between $0.29 to $0.32 per Wp, aligning with the US module price of ~ $0.30 per Wp. However, there is a potential for further decline if US module prices converge with global module prices at $ 0.15 per Wp. Meanwhile, realizations per unit in the domestic IPP market range around $0.20-$0.22 per Wp. A substantial decrease in realizations per Wp can give rise to challenges affecting both revenues and profit margins.

US Module Px v. Ex-US v. FSLR



Source: Jefferies

- **Competitive Intensity-** The declared expansion of capacities by leading global entities exceeds 270 GW, potentially augmenting the competitive dynamics within the industry (Some of the wafer & cell facilities in China are outdated, Longi has requested the government to crack down on low prices and ensure panel quality). On the back of incentives from the IRA, IEA forecasts US module manufacturing capacity to increase to ~50 GW by FY26 from the current 8 GW capacity. Demand in the US is also likely to be around ~50 GW p.a. by FY26 compared to FY24's expected demand of ~32 GW. If the supply in both the United States and India significantly exceeds demand in these respective countries, it could lead to further reductions in the realizations per Wp.
- **Risk associated with changes in US government policies**- the current regulatory environment favours manufacturers outside of China. This is evidenced by anti-dumping duties of up to 239% and countervailing duties of up to 18.5%, contingent on different suppliers from China. Furthermore, the US has implemented a ban on solar modules with cell components manufactured in specific provinces in China. Any significant shift in the US stance towards China could potentially exert a substantial impact on WEL's ability to secure orders under favourable terms.
- **US blocking module imports-** At present, WEL imports its entire solar cell inventory, with Longi being one of its suppliers, sourcing from its manufacturing facilities situated in Malaysia and Vietnam. Previously, modules originating from these same facilities encountered obstruction by US customs authorities due to suspected forced labour in the production of polysilicon, a crucial component utilized in the module manufacturing process. It is important to underscore that as of the present time, no shipments from Indian enterprises have been detained by US customs authorities.

- **Execution risk**- pertains to the managerial competency in achieving large-scale production and operating capacity at optimal utilization levels. It also encompasses proficiency in handling requisite logistics, including the effective management of > 30,000 containers per 1000 MW.
- **Order Delay or Cancellation Risks**- Any delay in order delivery or cancellation/modification of orders by customers could strain WEL's financials.
- **Most Favoured Customer Clause**- Certain agreements in the US include a most favoured customer clause, wherein if any other customer in the US secures aggregate beneficial pricing for the same product from the company, WEL is obliged to provide the products at such favourable terms to the most favoured customer.
- **Customer Concentration Risk**- A significant portion (76%) of revenues is derived from the top 10 customers, increasing vulnerability in the event of contract terminations

Customers	Q1FY24	2023	2022	2021
Top 1	21%	16%	18%	14%
Top 5	57%	52%	34%	31%
Top 10	76%	66%	43%	40%

- **Provisions for Delayed Deliveries (Liquidated Damages)-** Liquidated damages and claims, penalties for delayed delivery, are offset from revenues, affecting sales, margins, and return ratios. Any substantial delays in deliveries could result in the company incurring delay charges, further impacting its financial metrics. It should be noted that currently all exports are routed via Inland Container Depot, Navkar Terminal in Tumb.

INR Cr	Q1FY24	2023	2022	2021
Provision for penalties	209	82	-	-
% of Sales	6.3%	1.2%	-	-

- **Increase in freight cost-** In FY22, freight costs were elevated due to the COVID-19 pandemic, and WEL had to bear the additional costs. Consequently, it is imperative to normalize the freight costs for FY22 before conducting comparative assessments with other fiscal periods. Notably, during this period, Chinese entities defaulted on delivery as they were not willing to pay the escalated freight expenses. This circumstance provided WEL with an opportunity to cultivate favourable relations with its clientele. Presently, there exist two types of contractual agreements, wherein some contracts stipulate customer responsibility for freight, while others place this responsibility on WEL.

	Q1FY24	FY23	FY22	FY21
Freight Cost	56	296	214	89
Freight Cost % of Sales	1.7%	4.4%	7.5%	4.6%

- **Timely Commissioning of New Plant-** The 5.4 GW solar cell plant in Chikhli was supposed to be operational by FY24, however, there is a delay in operationalising the same and Care Ratings expects it to be operational by Sept'24 (DRHP mentioned it would be operational by June'24). For the 6 GW WCM project, the PLI incentive worth INR 1923 cr will only be received in full if the project is commissioned on schedule. According to Care Ratings, this project is running with a delay.
- **Risk of technological obsolescence-** associated with the potential challenge of securing new technology on favourable terms from the technology partners. The prospect of technological obsolescence looms should there be an inability to successfully negotiate a deal with the technological partner.

RHP- Risks / IC- Risks

Revenue Drivers

INR Cr	Q124	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15	CAGR		
											3 Yr	5 Yr	10 Yr
Order Book (MW)*	20170	18060	3280	410	-	-	-	-	-	-	-	-	-
Order Book*	50425	45150	8200	1025	-	-	-	-	-	-	-	-	-
Advances	2474	2329	594	52	-	-	-	-	-	-	-	-	-
Advances as % of Order Book	5%	5%	7%	5%	-	-	-	-	-	-	-	-	-
Net Sales	3328	6751	2854	1953	1996	1591	1341	992	829	551	-	-	-
Net Sales YoY %	-	137%	46%	-2%	25%	19%	35%	20%	50%	76%	50%	38%	37%
Export %	73%	68%	23%	25%	12%	13%	12%	3%	7%	6%	172	38%	-
Domestic %	17%	20%	56%	42%	77%	71%	79%	97%	93%	94%	-5%	95%	32%
Franchise %	6%	10%	20%	20%	12%	16%	4%	0%	0%	0%	43%	4%	-
EPC & Others %	4%	2%	1%	14%	-	-	-	-	-	-	-	-	-
Production Volume (MW)	1160	2630	960	810	-	-	-	-	-	-	-	-	-
Realisations per MW	2.87	2.57	2.97	2.41	-	-	-	-	-	-	-	-	-

* Order book as of Dec'23, realisation per MW is assumed at INR 2.5 cr per MW i.e. $0.3 per Wp

- **Order book details**
  - **Indian plant-** The aggregate order volume and value stands at 16.41 GW and INR 41000 cr respectively, against the capacity of 12 GW, encompassing domestic, export, and franchise orders from the plants in India. Delivery fulfillment is anticipated to conclude by the conclusion of the FY26. Notably, export orders to the US constitute approximately 82% of the total 16.41 GW.
  - **US plant-** A contractual commitment has been established with SB Energy, outlining the supply of 3.75 GW of solar modules from the new plant coming up in the US. This agreement spans a duration of 5 years from the commencement of the plant's operations in the United States. The customer is entitled to acquire modules at the lower of two determining factors: a) the stipulated contractual price, or b) the rate at which WEL sells to other customers.
  - **EPC-** The unexecuted order book as of February 2024 stands at 2.4 GW.
- **Exports-**
  - 68% of FY23 revenues came from exports, US accounted for >99% of these exports. Currently 85% of the prevailing order book originates from the United States. The superior revenue realization in the U.S. compared to India is attributed to the higher module prices of $0.30 per Wp in the U.S, in Feb '24 WEL's export realisations were between $0.29 to $0.32 per Wp. The export realisation is based on cost + fixed margin, the management has suggested WEL charges 0.25$ per Wp over the cost of cell which is currently 0.05$ per Wp. Furthermore, solar power producers in the U.S. are obliged to secure committed module purchases as a prerequisite for borrowing. This practice strategically positions companies such as WEL to secure substantial order books spanning multiple years, facilitated by customer advances.
  - WEL has successfully supplied 850 MW of modules to Acciona for its four projects in the U.S. Additionally, a three-year agreement has been formalized with Acciona for the supply of 1500 MW of modules for its U.S. projects (Acciona is a Spanish utility giant with renewable capacities across the world, its FY23 revenues was $19 bn). The company boasts a diverse clientele, including prominent entities such as CIM Group, Novel, Sunpower, Solar Proponent, Idemitsu, and several other Fortune 500 companies
  - Chinese solar modules are subject to an anti-dumping duty of 239% in the United States. However, US Department of Commerce has observed that manufacturers from China are routing their products through South East Asian countries to evade this duty. Consequently, the US government has imposed an anti-circumvention duty of 254%, which includes both

anti-dumping and countervailing duties, on these entities. Notably, these companies have been granted an exemption from this duty until June 2024. Should this duty come into effect from June 2024 onwards, it is anticipated that the supply of solar modules from South East Asian countries to the US will experience a substantial decline. Consequently, this scenario presents WEL with a significant market opportunity to expand its operations.

- **Domestic Sales-** The domestic segment contributed 20% to the revenue in FY23 but has been declining due to an increased focus on exports. However, with the government's emphasis on renewables, this market is anticipated to witness robust growth in the future. In India, Crisil anticipates an annual module requirement ranging between 40-44 GW over the upcoming five years, factoring in a 40% DC overloading allowance. With the implementation of the Approved List of Models and Manufacturers (ALMM) mandate, which requires government-sponsored or subsidised projects or government or its agencies procuring power for own consumption or distribution or subsidised solar PV rooftop and PM KUSUM; to buy modules only from the enlisted vendors. It is expected that WEL will experience an upswing in orders from the domestic market. This projection is based on the company holding the largest (29%) approved capacity within the ALMM framework. It is pertinent to note that the ALMM mandate will be applicable from 1st April 2024, plants where modules are on site but not yet installed will be approved on a case-by-case basis. ALMM is not applicable for captive generation or open-access private projects by private parties. With the government's focus on rooftop solar with the new PM Surya Ghar Muft Bijli Yojana, WEL is likely to benefit as the cells also have to be made in India for this scheme. Premier Energies, a competitor of WEL recently won an order of 608 MW for INR 1700 cr which implies a realisation of $ 0.336 per Wp.
- **Franchise Sales-** this segment accounted for 10% of FY23 revenues. Gujarat stands as the foremost market for WEL in retail sales, with Maharashtra, Rajasthan, Kerala, and Uttar Pradesh comprising the top five states in terms of market presence. WEL is actively broadening its geographical reach by establishing a presence in new cities and towns, particularly in Delhi, Gujarat, Maharashtra, Andhra Pradesh, Telangana, Karnataka, and Tamil Nadu. Typically, the contractual agreements with franchisees span a duration of three years with an option for renewal. Post the expiration or termination of these agreements, franchisees are precluded from engaging in competitive activities or soliciting employees, clients, vendors, agents, etc. Additionally, WEL has entered into a financing arrangement with SBI to facilitate funding for small businesses and MSMEs intending to establish rooftop or captive solar power plants.

INR cr	Q1FY24	2023	2022	2021
No of Franchisees	284	253	373	290
Sales per franchise	0.7	2.7	1.6	1.3

- **EPC and O&M business- This is a small segment contributing only 2% of revenues.** This business is housed under a material subsidiary (74.5% stake) Waaree Renewable Technologies, a listed entity with a market cap of INR 14,696 cr as of 13th Mar'24. A standard Engineering, Procurement, and Construction (EPC) solar project encompasses activities such as design, civil works, equipment procurement and installation, and commissioning. However, due to constrained returns, the scope of EPC solar projects has evolved to now include Operations and Maintenance (O&M) services as well. The company, boasting over a decade of experience as an EPC contractor, has successfully commissioned 1.1 GW of projects as of June 2023. Additionally, it has an unexecuted order book of 2.4GW as of February '24. In Dec'23, the company also signed an agreement with 5B Industries Pty Ltd (an Australian solar pioneer with a new technology for installation) whose solar module blocks installation can be 10x faster, more cost-effective and easier to maintain. They are also trying to reduce the manufacturing cost of this 5B Maverick Technology.

	Q1FY24	2023	2022	2021
Bids participated	2	14	34	22
Bids won	1	3	-	3
% of Bids won	50%	21%	0%	14%

- **Freight as a service-** In contracts where freight is arranged by WEL and recovered from the customers, the same is treated as a separate performance obligation and revenue is recognized when such freight services are rendered. However, the specific percentage of freight services in relation to the total sale of services remains undisclosed.

	Q1FY24	FY23	FY22	FY21
Sale of Services	187	472	104	-

- **Product Portfolio-**
  - **PV Modules-** WEL offers a diverse range of photovoltaic (PV) modules encompassing multicrystalline, Mono PERC, and TopCon technologies. These modules include monofacial, bifacial, building-integrated photovoltaic, and flexible modules, available in various wafer sizes. The company provides modules spanning from 70W to 715W tailored to meet the distinct requirements of diverse customer segments.
  - **Inverters-** offers both on-grid & off-grid inverters
  - **Solar Products-** offers products like solar street lights, solar mobile chargers, solar backpack
  - **New Products-** WEL is working to launch new offerings like- electrolyser for green hydrogen, thermal energy storage systems in partnership with Brenmiller Energy, selling carbon credits in the US market
- **Product Quality-** WEL's panels underwent an extended third-party testing process by PVEL PQP, yielding excellent results that align with major international competitors. This outcome holds significant importance for project bankability and lender approval. Additionally, WEL is prominently featured in the top performer scorecard issued by PVEL, a globally recognized leader in photovoltaic testing known for establishing quality standards for solar equipment. In the 2023 scorecard for bifacial mono PERC modules, WEL received the best certification for six out of six parameters akin to Jinko Solar & Trina Solar, whereas competitors like First Solar, Adani Solar, and Vikram Solar were certified as the best for five out of six parameters. The product performance has adhered to committed standards, evidenced by the absence of any warranty claims from operational projects.

Outlook

- The management is guiding for doubling of revenues in FY24 to INR 14000 cr backed by strong growth both in US and India. This is underscored by the company's robust performance, achieving INR 3,328 cr in Q1FY24 alone. We have a more conservative estimate of FY24E revenues at INR 11,990 cr
- Due to heightened demand from domestic utilities in the United States, coupled with the ongoing trade tensions between the United States and China and the implementation of a friend-shoring policy, WEL has successfully obtained orders from U.S. utility companies. These orders are substantiated by the support of reputable lenders, thereby guaranteeing consistent and timely cash flows.
- Prominent global brokerage firms such as Jefferies express optimism towards companies like First Solar, particularly those outside of China's module manufacturing domain. This optimism is rooted in the fact that module realizations in the United States remain above $0.3 per Wp double the module price of $0.15 per Wp globally. The US being a key revenue growth driver augurs well for WEL's export realisation, where capacity additions in the medium term, are likely to fall short of demand, supporting module prices.
- On a global scale, First Solar ranks as the largest non-Chinese module manufacturer followed by WEL. Nevertheless, First Solar has fully sold out its capacities until 2026, thereby removing direct competition for orders slated for delivery in that timeframe.

RHP- Revenue Drivers / IC- Revenue Drivers

Margin Drivers

Margins (%)	Q124	2023	2022	2021	2020	2019	2018	2017	2016	2015	Delta		
											3 Yr	5 Yr	10 Yr
Gross M	21%	24%	19%	17%	18%	23%	22%	22%	20%	14%	6%	1%	4%
EBITDA M	14%	12%	4%	5%	5%	9%	8%	11%	10%	5%	7%	4%	15%
EBIT M	12%	10%	2%	3%	3%	6%	6%	8%	8%	4%	7%	4%	13%
PBT M	14%	10%	4%	3%	3%	7%	3%	5%	2%	5%	7%	3%	10%
PAT M	10%	7%	3%	2%	2%	5%	2%	3%	0%	2%	5%	2%	7%

- **Margins-** EBITDA margins inched up in FY23 to 12% from 4% in FY22, it further improved in Q1FY24 to 14%. This increase can be attributed to higher capacity utilization and a decline in RM prices.
- **Raw material**- The company currently lacks any long-term contractual agreements with its suppliers. Instead, it employs back-to-back arrangements with the majority of its suppliers, a strategic approach aimed at mitigating the impact of price risk associated with long term agreements. Notably, any fluctuations in material prices are directly passed on to clients. However, it is observed that export realizations closely align with the prevailing module prices in the United States, hence the global module prices have limited impact on company revenues and thereby margins. The imported raw materials primarily originate from three key countries: China, Thailand, and Malaysia.

INR cr	Q1FY24	2023	2022	2021
Cost of Imported RM	2102	6794	2140	1220
% of Sales	63%	101%	75%	62%
Cost of Imported RM from China	916	2341	1717	925
% of Sales	28%	35%	60%	47%
Cost of Imported RM from top 3 countries	1996	5747	2069	1108
% of Sales	60%	85%	72%	57%

- **Top 5 Suppliers-** the procurement of raw materials is conducted on a spot basis through the issuance of purchase orders. The company maintains a diversified sourcing strategy for raw materials, with the top five suppliers collectively contributing to 42% of total sales.

INR cr	Q1FY24	2023	2022	2021
Purchases- top 5 Suppliers in India	71	366	168	381
% of Sales	2%	5%	6%	20%
Purchases- top 5 Suppliers outside India	1410	3593	838	590
% of Sales	42%	53%	29%	30%

- **Warranties & other liabilities-** The sale of modules typically includes a 12-year warranty covering manufacturing defects and a 30-year warranty addressing output performance. The company has secured product liability insurance coverage. Other customer liabilities extend to claims associated with non-conformity of products with agreed specifications, defects, and inaccurate product specifications.

	Q1FY24	2023	2022	2021
Warranty Expense & Provision	100	98	55	38
% of Sales	3.0%	1.5%	1.9%	1.9%
Other Customer Liability	126	88	0	5
% of Sales	3.8%	1.3%	0.0%	0.2%

Outlook- The margin guidance for FY24 indicates gross margins within the range of 23-24%, EBITDA margin in the range of 16-18%, and PAT margin ranging from 9-10%. Fluctuations in polysilicon prices may affect the margins. For our calculations, a conservative EBITDA margin of 13.5% has been considered, with an increment as the company commissions cells and wafer plants.

RHP- Margin Drivers / IC- Margin Drivers

Capital Intensity

	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
Sales / Ex Cash Capital Employed	10.0	6.2	4.5	8.6	4.4	2.5	2.0	2.0	2.1
Total Assets Turnover	1.4	1.6	1.8	2.3	1.7	1.2	1.0	1.0	1.0
Gross FA turnover	7.0	5.8	7.3	11.4	4.3	2.2	2.1	4.2	10.1
Net FA turnover	8.3	6.4	9.2	16.7	5.1	4.6	5.5	4.8	13.7
CWIP to Gross Block	43%	18%	1%	18%	0%	13%	9%	25%	-
Capex/Depreciation	5.25	11.45	6.04	2.16	1.52	0.53	4.23	1.32	-
Depreciation to Avg Gross Block	17.0%	8.7%	12.1%	15.4%	9.9%	4.6%	5.9%	8.2%	7.8%
Depreciation Rate on Plant & Machinery	19%	8%	9%	-	-	-	-	-	-

The company's operations are asset-intensive but entail low working capital needs.

- **Current Capacity & proposed expansion-** The current operational capacity stands at 12 GW, distributed across four distinct plants and 19 production lines spread across 136 acres of land. The company has strategic plans to augment this capacity to 20.6 GW by incorporating additional capabilities through the establishment of three new plants located in Uttar Pradesh, Odisha, and Texas.

MW	FY27E	FY26E	FY25E	FY24E	FY23	FY22	FY21	FY20
Module Capacity								
Surat, Gujarat*	230	230	230	230	230	230	500	500
Tumb, Gujarat	1000	1000	1000	1000	1000	1000	1000	1000
Nandigram, Gujarat	1100	1100	1100	1100	1100	1280	500	500
Chikhli, Gujarat	9660	9660	9660	9660	9660	6490	2000	-
Noida, UP	1000	1000	1000	-	-	-	-	-
Dhenkanal, Odisha	6000	6000	-	-	-	-	-	-
Houston, Texas	1600	1600	1600	-	-	-	-	-
Total Module Capacity	**20590**	**20590**	**14590**	**11990**	**11990**	**9000**	**4000**	**2000**
Effective Capacity	-	-	-	-	6500	2080	1540	-
Capacity Utilisation	-	-	-	-	40%	46%	53%	-
Cell Capacity								
Chikhli, Gujarat	5400	5400	5400	-	-	-	-	-
Dhenkanal, Odisha	6000	-		-	-	-	-	-
Total Cell Capacity	**11400**	**5400**	**5400**	**-**	**-**	**-**	**-**	**-**
Wafer Capacity								
Dhenkanal, Odisha	6000	-	-	-	-	-	-	-
Total Wafer Capacity	**6000**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

***** The Surat facility's capacity was derated because better quality modules were produced from the same line, reducing its stated capacity.

- **Capex in India-** The comprehensive expenditure for the establishment of the 6 GW Ingot Wafer, Cell & Module (WCM) project is outlined at INR 9,050 cr. Under a long-term lease agreement spanning 76 years, the company has secured an allocation of 595 acres of land in Dhenkanal, Odisha. The development plan includes the construction of four buildings, collectively covering an area of 2 million square feet.
- **Capex in the US-** A module plant with a capacity of 1.6 GW is anticipated to commence operations in the United States during FY25. Subsequent expansion plans involve incrementally increasing this capacity to reach a total of 5 GW. Additionally, the company envisions the incorporation of a 5 GW cell manufacturing facility. A planned investment of $1 billion in the United States is targeted to be realized by FY27.

- **Subsidies & incentives-** Upon the timely commissioning of the project, the company is slated to receive a PLI amounting to INR 1923 cr over a span of 5 years. Additionally, various state incentives are anticipated, encompassing capital investment subsidy, stamp duty exemption, employment subsidy, power tariff reimbursement, electric duty exemption, state GST exemption, and land subsidy. However, it is crucial to note that the realization of these state incentives is contingent upon the actual investment amounts, energy requirements, and the magnitude and nature of employment generated. In the US, under the IRA Act, the company is projected to receive an incentive of approximately $0.07 per Wp. The extent to which this incentive will be realized, whether in full or partial, is subject to confirmation from the management.
- **Depreciation Policy-** The FY22 annual report indicated a specified useful life of 3 years for the Chikhli plant and machinery. However, it is noteworthy that this particular statement is conspicuously absent in both the FY23 annual report and the DRHP. Additionally, the management has not provided any explanatory note regarding this omission.
- **Depreciation rate-** The management has communicated that the evolution of solar module manufacturing technology occurs at intervals of 3-5 years. Historically, adopting new technologies involved incremental capital expenditures, including the transition from the current Passivated Emitter Rear Cell (PERC) technology to the next-generation Tunnel Oxide Passivated Contact (TOPCon) technology, which was also categorized as incremental capital expenditure. However, it is emphasized that as the industry progresses towards technologies such as Heterojunction (HJT) or Perovskite, substantial new plant and machinery investments will be necessary. Consequently, the rationale for anticipating higher depreciation lies in the anticipation of increased capital expenditure associated with the shift to HJT or Perovskite technologies.

Guidance- The company plans to increase capacity from 12 GW of module to 20.6 GW module, 11.4 GW cell, and 6 GW wafer manufacturing by FY28 totalling a capex of more than INR 15,000 cr. Funding for this capacity expansion will be derived from a combination of internal accruals, fresh equity infusion, customer advances, and debt financing. With an increase in the order book, the management anticipates a gradual increase in capacity utilization, reaching 60-65% by FY24 and further elevating to 70% by FY25.

Working Capital Management & Guidance – The management anticipates that the working capital cycle will persist at its existing levels and does not foresee any substantial alterations within the next five years.

	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
Current Ratio	1.1	0.9	1.2	1.3	1.3	0.8	0.8	0.9	1.0
Net Working Capital % of sales	**-5%**	**-14%**	**5%**	**4%**	**0%**	**-2%**	**-3%**	**-3%**	**4%**
Inventories	40%	19%	19%	12%	6%	7%	6%	8%	14%
Trade receivables	5%	3%	6%	7%	14%	6%	13%	7%	14%
Advances Paid	6%	3%	1%	-	-	-	-	-	-
Trade payables	21%	19%	18%	15%	19%	16%	23%	18%	24%
Advances Received	34%	21%	3%	-	-	-	-	-	-
Cash Conversion Cycle (Days)	**-20**	**-20**	**17**	**8**	**-3**	**-8**	**-11**	**-1**	**34**
Inventories	88	58	57	31	23	21	24	32	34
Trade receivables	11	13	24	32	34	29	35	30	54
Advances Paid	14	7	2	-	-	-	-	-	-
Trade payables	53	57	61	56	59	59	70	63	54
Advances Received	79	41	5	-	-	-	-	-	-

RHP- Capital Intensity / IC- Capital Intensity

Capital Structure

	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
Total Debt	906	421	408	126	107	504	413	421	403
Total Debt / Equity	0.49	0.96	1.04	0.37	0.41	2.87	1.84	2.06	2.35
Total Debt/EBITDA	1.09	3.81	4.26	1.36	0.78	4.56	3.93	5.29	14.89
Total Debt/CFO	0.58	0.60	5.69	1.51	1.01	4.95	3.65	9.51	-
Net Debt / Equity	-0.46	-0.20	0.46	-0.11	-0.37	2.15	1.31	1.40	1.00
Interest to Avg Debt	12%	10%	12%	29%	18%	12%	13%	12%	4%
Interest Coverage Ratio	8	2	2	2	2	1	1	1	2

- **Credit Rating-** In April'24, Care Ratings upgraded the Long Term rating to Care A (Stable) from Care A- (Stable), for Short Term the rating is Care A2+.
- The company maintains low leverage, indicated by its debt/equity ratio of 0.49. Debt is primarily allocated to capital expenditures, as working capital is predominantly financed through customer advances. Additionally, strong cash flow from operations of INR 1560 cr in FY23 has supported its financing requirements.
- **Equity**- There is a proposed fresh issue amounting to a maximum of INR 3600 cr, coupled with a secondary offer for sale comprising up to 32 lakh shares. Within the OFS, the promoter, Waaree Sustainable Finance, intends to offer 27 lakh shares, while Chandurkar Investments, a non-promoter entity, is set to offer 4.5 lakh shares, and Samir Surendra Shah, also a non-promoter, plans to offer 0.5 lakh shares. WEL has raised equity capital of INR 2118 cr from inception to Oct'23, a detailed capital history of the company has been given below. If all granted ESOPs are vested, it will lead to a dilution of about 1.2% of the offer number of shares.

Capital History	Month	Amount (INR cr)	Issue Price	No of Shares added	Post issue No of Shares
Public Issue (E)	Mar'24	3,600	1300	2,76,92,308	28,94,31,220
ESOPs	Oct'23	1.3	70	1,91,022	26,17,38,912
Private Placement	Jul'23	1,000	550	1,81,81,819	26,15,47,890
Private Placement	Oct'22	1,040	225	4,62,27,579	24,33,66,071
Bonus	Feb'18	-	-	12,13,15,992	19,71,38,492
Rights Issue	Dec'14 to Jan'15	1.1	40	2,62,500	7,58,22,500
Allotment of Equity to Others	Feb'09 to Mar'14	69	10	6,91,55,670	7,55,60,000
Stock Split	Oct'08	-	-	57,63,897	64,04,330
Allotment of Equity to Others	Jun'03 to Oct'08	6.4	100	6,40,233	6,40,433
Subscription to the MOA	Dec'90	0.0	100	200	200
Total Capital Raised before IPO		**2,118**			
Total Capital Raised post IPO (E)		**5,718**			

Source: Ace Equity

- **Debt-** Up until the fiscal year 2023, the company maintained a low level of indebtedness. Going forward, there is an anticipated increase in debt, attributable to project financing of INR 5518 cr for the 6 GW WCM project in Odisha and the 1.6 GW module project in the United States. Nonetheless, considering the robust cash flows of the company, it is expected that servicing the increased debt will not pose a challenge.
- **Advances from customers-** As of June 2023, WEL holds INR 2474 cr in advances, and this figure is anticipated to grow further as the company secures additional confirmed orders from customers. Advances will be utilized to finance both the capex and working capital requirements of the company.
- **Capex in India-** The company secured a project loan of INR 5518 cr from the State Bank of India (SBI) for the 6GW Ingot Wafer, Cell & Module (WCM) project in Dhenkanal, Odisha. A sum of INR 2500 cr will be sourced from the fresh issue as part of the Initial Public Offering (IPO), with the remaining balance to be funded through internal accruals.

- **Capex in the US-** The funding for this initiative will be sourced from internal accruals, debt instruments, and customer advances.

RHP- Capital Structure / IC- Capital Structure

Financials

Strong Growth – FY23 marked a significant milestone for the company, with reported revenues more than doubling from INR 2854 cr in FY22 to INR 6751 cr in FY23. This growth trajectory has continued over the last nine months, with a promising outlook underscored by the robust order book and favourable renewable energy policies globally. From FY17 to FY22, growth had been commendable at 24% CAGR.

CAGR	Q1FY24	FY23	1 yr	3 yr	5 yr	10 yr
Sales	3328	6751	137%	50%	38%	37%
EBITDA	467	835	654%	108%	50%	35%
EBIT	435	671	895%	118%	52%	33%
PAT	336	483	541%	126%	82%	34%

Healthy Profitability – Buoyed by margins, return ratios saw a notable improvement in FY23. Before FY23, the return on equity (ROE) ranged from 2% to 38%. The trend of healthy return ratios is anticipated to persist, driven by sustained robust margins and higher asset turnover resulting from improved capacity utilization.

	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
ROA	10%	4%	4%	5%	9%	2%	3%	0%	2%
Ex Cash ROCE	108%	31%	15%	33%	31%	17%	19%	15%	9%
ROCE	43%	19%	15%	22%	24%	15%	16%	11%	10%
Ex Cash ROE	3642%	131%	10%	22%	133%	24%	23%	17%	-68%
ROE	43%	19%	12%	13%	38%	12%	12%	2%	9%
PAT / PBT	74%	67%	69%	69%	78%	59%	51%	21%	45%
PBT / EBIT	101%	175%	105%	87%	103%	50%	64%	29%	123%
EBIT / Sales	10%	2%	3%	3%	6%	6%	8%	8%	4%
Sales / Total Assets	0.91	1.28	1.51	2.13	2.02	1.25	0.91	1.00	0.68
Total Assets / Net worth	3.99	5.09	3.29	2.76	3.05	6.12	4.85	4.06	4.71

Cash Flow Analysis – Cash flow generation has been robust over the past two years and has remained positive since FY16. The company finds itself in a unique position where working capital is partly funded by customer advances, effectively reducing the capital requirement for growth.

	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
CFO	1560	701	72	83	106	102	113	44	-
CFO Margin	23%	25%	4%	4%	7%	8%	11%	5%	-
FCFF	728	215	(106)	17	(9)	48	(2)	26	-
FCFF Margin	11%	8%	-5%	1%	-1%	4%	0%	3%	-

Sensitivity Analysis for FY28E

- By FY28, WEL is projected to attain a module capacity of 20.6 GW, a cell capacity of 11.4 GW, and a wafer capacity of 6 GW.
- The subsequent table illustrates sales sensitivity across various realization levels and capacity utilization rates. With a realization of INR 2 cr per MW and a 75% capacity utilization, the company could potentially achieve a revenue of INR 31,500 cr in FY28.

Sales Sensitivity (INR cr)		Capacity Utilisation				
		55%	65%	75%	80%	85%
Realisation per MW (INR cr)	1.5	16,987	20,075	23,164	24,708	26,252
	1.8	19,818	23,421	27,024	28,826	30,628
	2.0	23,060	27,252	31,445	33,541	35,638
	2.3	25,480	30,113	34,746	37,062	39,378
	2.5	28,311	33,459	38,606	41,180	43,754

- We anticipate that, through partial backward integration by FY28, WEL could achieve a conservative EBITDA margin of 15.5% and a PAT of INR 2,312 cr, resulting in a PAT margin of 7.4%, excluding the PLI subsidy of INR 385 cr receivable from FY26 for a period of 5 years and totalling to INR 1923 cr.

PAT Sensitivity (INR cr)		Capacity Utilisation				
		55%	65%	75%	80%	85%
Realisation per MW (INR cr)	1.5	631	990	1,349	1,529	1,708
	1.8	960	1,379	1,798	2,008	2,217
	2.0	1,337	1,825	2,312	2,556	2,799
	2.3	1,619	2,157	2,696	2,965	3,234
	2.5	1,948	2,546	3,145	3,444	3,743

Guidance & Outlook

- FY23 marked a turning point for WEL, as the company successfully capitalized on the US export opportunity and the surge in demand for renewable energy. The outlook remains strong for renewable energy, as evidenced by the financial performance in Q1FY24
- The company has delivered on its growth guidance, demonstrating remarkable growth with a 2.4x increase in revenues to INR 6751 cr (guidance of INR 7155 cr). Q1FY24 sales stood at INR 3328 cr, and based on our conservative projections, FY24 revenues are estimated to reach INR 11990 cr, growing by 78% over FY23.
- WEL also significantly exceeded its FY23 PAT guidance of INR 171 cr, reporting a robust 6.6x year-on-year growth to achieve a PAT of INR 483 cr. Furthermore, Q1FY24 PAT amounted to INR 336 cr, with management guiding to surpass INR 1000 cr PAT in FY24. We have a more conservative estimate of PAT at INR 928 cr
- With a robust order book of INR 50,000 cr to be executed by FY26 and an order pipeline of INR 1 lakh cr, management has forecasted revenues of INR 21000-22000 cr in FY25 at current realization and a PAT of INR 1500 cr.
- Growth is expected to stem primarily from the export market, particularly the US. Capital expenditure is already in place for current orders, and the company is expanding its capacity to cater to the next phase of growth.

Earnings Quality Checks

1. **Restatement of cash flows-** During FY23, WEL acquired approximately a 20% stake in Waaree Renewable Technologies from WEL promoters for INR 149 cr. This additional investment in Waaree Renewable Technologies was initially categorized under Cash Flow from Investing in the FY23 Annual Report. However, it was later restated as Cash Flow from Financing in the Draft Red Herring Prospectus (DRHP). This restatement to Cash Flow from Financing is based on the commonly prevailing practices. Majority of the companies report this entry under cash flow from investing in standalone statements and under cash flow from financing in consolidated statements, the same can also be noted in the books of Titan for acquisition of non-controlling stake in the subsidiary Caratlane

2. **Other Operating Income & Other Income as % of PBT-** Overall, other operating income and other income collectively represent 36% of Profit Before Tax (PBT) in FY23. Among these, the only significant gain that may not be sustainable is the profit from forex fluctuations, which accounted for 7% of PBT in FY23.

	Q1FY24	FY23	FY22	FY21
PBT	**457**	**677**	**118**	**66**
Other Operating Revenue	**7**	**143**	**11**	**11**
Duty Drawback	2	129	2	5
Scrap sale	5	13	5	3
Franchise Fees	0	1	3	4
Other Income	**87**	**109**	**92**	**30**
Interest Income	31	51	9	17
Govt Grant	1	3	3	4
Profit on sale of invt	1	7	1	0
Gain on change in fair value of invt	2	0	0	0
Profit on FX Fluctuation	51	48	21	5
Others*	0	1	58	3
Duty Drawback % of PBT	**0%**	**19%**	**2%**	**7%**
Profit on FX Fluctuation % of PBT	**11%**	**7%**	**18%**	**8%**

3. **Cash Flow Conversion –** The cash conversion ratio has consistently been at a healthy average of 1x until FY21, experiencing a significant increase in the past two years. This notable uptick can be attributed mainly to the influx of high customer advances.

	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
Pre-Tax CFO / EBITDA	2.0	6.6	1.0	1.0	0.9	1.3	1.2	0.7	-
Adj CFO / PAT	3.0	8.6	1.5	1.8	0.8	2.3	2.7	0.7	-

Cumulative INR Cr	3 yr	5 yr	8 yr
PBT	862	1023	1132
Adjustments for net cash flow	387	525	729
Working Capital Investments	1231	1150	1156
Taxes	-148	-176	-229
Capex	-1550	-1734	-1910
FCFF	837	845	949
Pre-Tax CFO / EBITDA (x)	2.38	2.12	1.90

4. **Cash tax rate of Waaree Renewable Technologies-** The cash tax rate for Waaree Renewable Technologies, a 74.8% subsidiary of WEL, appears unusually low. A considerable portion of the Profit and Loss (P&L) tax comprises current tax. We are uncertain whether this variance in cash tax and P&L tax is due to government policies being leveraged or for other reasons.

	H1FY24	**FY23**	**FY22**
P&L Tax Cost	10.9	21.7	12.3
Cash Flow Tax Paid	1.8	5.3	3.6
PBT	40.3	77.0	21.2
P&L Tax Rate	**27%**	**28%**	**58%**
Cash Flow Tax Rate	**4%**	**7%**	**17%**

RHP- Financials / IC- Financials

Audit Comments under CARO

- **Title deeds not yet transferred**
  - **Auditor Remark-** The auditors have observed that the title deeds for immovable properties are registered under the name of WEL. It is important to note that the transfer of title deeds for seven land parcels, acquired from Shri Swami Solar Park Pvt Ltd in September 2022, with a total value of INR 6.2 cr, is currently underway and remains pending as of June 2023.
  - **Company's submission-** The land parcels were acquired during the year through a business transfer agreement and the company is currently in the process of transferring the title to its name.
  - **Oaklane Opinion-** We consider this issue to be immaterial, and we anticipate that the deed transfer should be completed within the next few months.

- **Discrepancy in receivables reported to banks**
  - **Auditor Remark-** The auditors have pointed out a substantial variance of INR 447 cr between the carrying amount of receivables in the company's accounts (INR 320 cr) and the quarterly returns filed by the company with the bank (INR 767 cr) for FY23
  - **Company's Submission-** The differences between declared amounts vis a vis book balances were reconciled as part of the financial reporting closure process. Statements for the period ended June 30, 2023, and for the year ended March 31, 2023, and March 31, 2022, were subsequently revised and submitted to respective Banks which are in line with the books of accounts
  - **Oaklane Opinion-** Despite the company's justification and resubmission efforts, these discrepancies indicate lapses in internal control procedures

- **Undisputed statutory dues pertaining to income tax**
  - **Auditor Remark-** The auditors have indicated that the company experienced significant delays in settling certain statutory obligations. These delays resulted in interest penalties totalling INR 16 cr since F21, with INR 11 cr incurred specifically in F23. The auditor also stated "*no undisputed amount payable in respect of these statutory dues were outstanding, at the year-end, for a period of more than six months from the date they became payable"*
  - **Oaklane Opinion-** We find these delays surprising, considering the company's stable cash flow generation. This may suggest shortcomings in the company's internal control procedures.

- **Disputed statutory dues**
  - **Auditor Remark-** The auditors have also pointed out that the company has multiple disputed statutory dues. These are for central sales tax, value-added tax, entry tax, and income tax, which are sub judice under different authorities. The total for this is INR 8 cr for different years between FY15 and FY18
  - **Oaklane Opinion-** These disputed statutory dues are not material in our opinion

- **Theft of raw material**
  - **Auditor Remark-** During FY23, an incidence of theft of raw material amounting to INR 15.8 cr was noticed at Chikhli plant of the Company. Such theft also included the raw materials received for Job-work. An investigation has been performed by the local police and management of the Company which identified that theft has been perpetrated by a subcontractor's employee. However, the auditors have asserted that, except for the theft of raw materials amounting to INR 15.8 cr (of which INR 5.2 cr has been recovered), there has not been any significant fraudulent activity within the company.
  - **Company's Submission-** The Company has made a provision amounting to INR 10.6 cr towards loss of Raw material inventory (including provision towards raw material inventory received for Job work) and strengthened the internal controls related to inventory movement, physical verification, and physical security at plant by installing additional CCTV cameras and other measures. The Company has submitted an insurance claim for losses for which survey and claim assessment is in process by the Insurance Company.
  - **Oaklane Opinion-** This further suggests shortcomings in the company's internal procedures. It is worth mentioning that the company has taken cautious measures to avoid such incidents in the future.

RHP- CARO

Capital Allocation

	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
Source of cash flows INR cr	**1881**	**279**	**237**	**106**	**164**	**116**	**111**	**115**	**-**
Cash Operating Profit %	45	60	40	100	100	66	94	69	-
Net Borrowings %	-	40	60	-	-	34	-	5	-
Equity %	55	-	-	-	-	-	6	26	-
Allocation INR cr	**-507**	**80**	**-220**	**-106**	**-78**	**-5**	**-165**	**-45**	**-**
Working Capital %	(142)	669	10	22	74	-462	-3	52	-
Capital Expenditures %	170	(621)	89	16	70	271	72	48	-
Invt in JVs and Associates %	29	52	1	19	-176	291	-	-	-
M&A %	-	-	-	-	-	-	-	-	-
Dividends & Buybacks %	0	(1)	-	-	-	-	-	-	-
Net Debt Repayments %	43	-	-	43	131	-	31	-	-
Surplus INR cr	**1,373**	**359**	**18**	**1**	**86**	**111**	**-55**	**70**	**-**
ROCE	**43%**	**19%**	**15%**	**22%**	**24%**	**15%**	**16%**	**11%**	**10%**

- **Capacity Expansion-** The company has scaled up its module capacity from 1.5 GW in FY19 to 12 GW in June 2023, with plans to further increase it to 20.6 GW by FY27, aiming to maintain its dominant position in the Indian market. The management's approach to capital expenditure is cautious and typically hinges on confirmed orders, such as the 1.6 GW module plant in the US, backed by a 3.75GW confirmed order from a customer. They plan to augment module capacity and add cell capacity in the US contingent upon market conditions and government incentives.
- **Backward Integration-** In Q1FY25, the company will commence operations at a 5.4 GW solar cell plant, aiming for a total of 11.4 GW cell capacity and 6 GW Wafer capacity by FY27, with the objective of enhancing gross margins by 5-6% points. This strategic move is also geared towards quality control, ensuring timely supply of RM, and reducing lead times for manufacturing.
- **Technology upgradation-** The company is gradually phasing out its existing multi-crystalline modules facility in favour of higher efficiency Mono PERC & TOPCon modules.
- **New products/ segments-**
  - WEL has entered into a MoU with the government of Odisha for the establishment of a 1.2 MMTPA Green Ammonia plant in Jagatsinghpur, with an investment of INR 12,480 cr.
  - Furthermore, WEL has executed a with the government of Odisha for the establishment of a 1 GW green hydrogen electrolyser manufacturing facility in Khurda, with a committed investment of INR 435 cr. The preference is to make electrolysers using Alkaline technology. Anticipated technology collaborations are projected to materialize in early FY25, with the product rollout expected within the same fiscal year. Regrettably, efforts to secure PLI for this initiative were unsuccessful.
  - Collaborating with Brenmiller Energy, the company is planning to venture into thermal energy storage systems.
- **Value Added Distribution –** VADD to shareholders has witnessed a substantial improvement in recent years, primarily attributed to enhanced profitability

	FY23	FY22	FY21	FY20	FY19	FY18	FY17
Value Added (VADD)	878	210	140	140	200	131	121
Total Income	6751	2854	1953	1996	1591	1341	992
Value Added (%)	**13%**	**7%**	**7%**	**7%**	**13%**	**10%**	**12%**
VADD To Employee (%)	13%	24%	30%	35%	20%	25%	16%
VADD To Lenders (%)	9%	19%	22%	24%	28%	44%	43%
VADD To Tax (%)	20%	18%	15%	13%	11%	13%	20%
VADD To Shareholders (%)	57%	38%	33%	28%	41%	19%	21%

RHP- Capital Allocation / IC- Capital Allocation

Corporate Governance

- **Upcoming IPO-** The expected IPO size is INR 4016 cr split into fresh issue of INR 3600 cr and OFS of INR 416 cr (assumed at price of INR 1300). The lead bankers to the issue are Axis Capital, IIFL Securities, Jefferies, Nomura, SBI Caps, Intensive Fiscal and ITI Capital.

- **Shareholding Pattern-** Currently the promoters own 72.3% of the company, which will dilute to 64.5% after the fresh issue and OFS.

	Pre-Offer No of Shares	Pre Offer %	Post Issue No of Shares	Post Issue %
Promoters	18,92,91,083	72.32%	18,65,91,083	64.47%
Non Promoters	7,24,47,829	27.68%	10,28,40,137	35.53%
Total	26,17,38,912		28,94,31,220	

- The current **Statutory Auditor is** SRBC & Co and the **Internal Auditor is** KPMG.

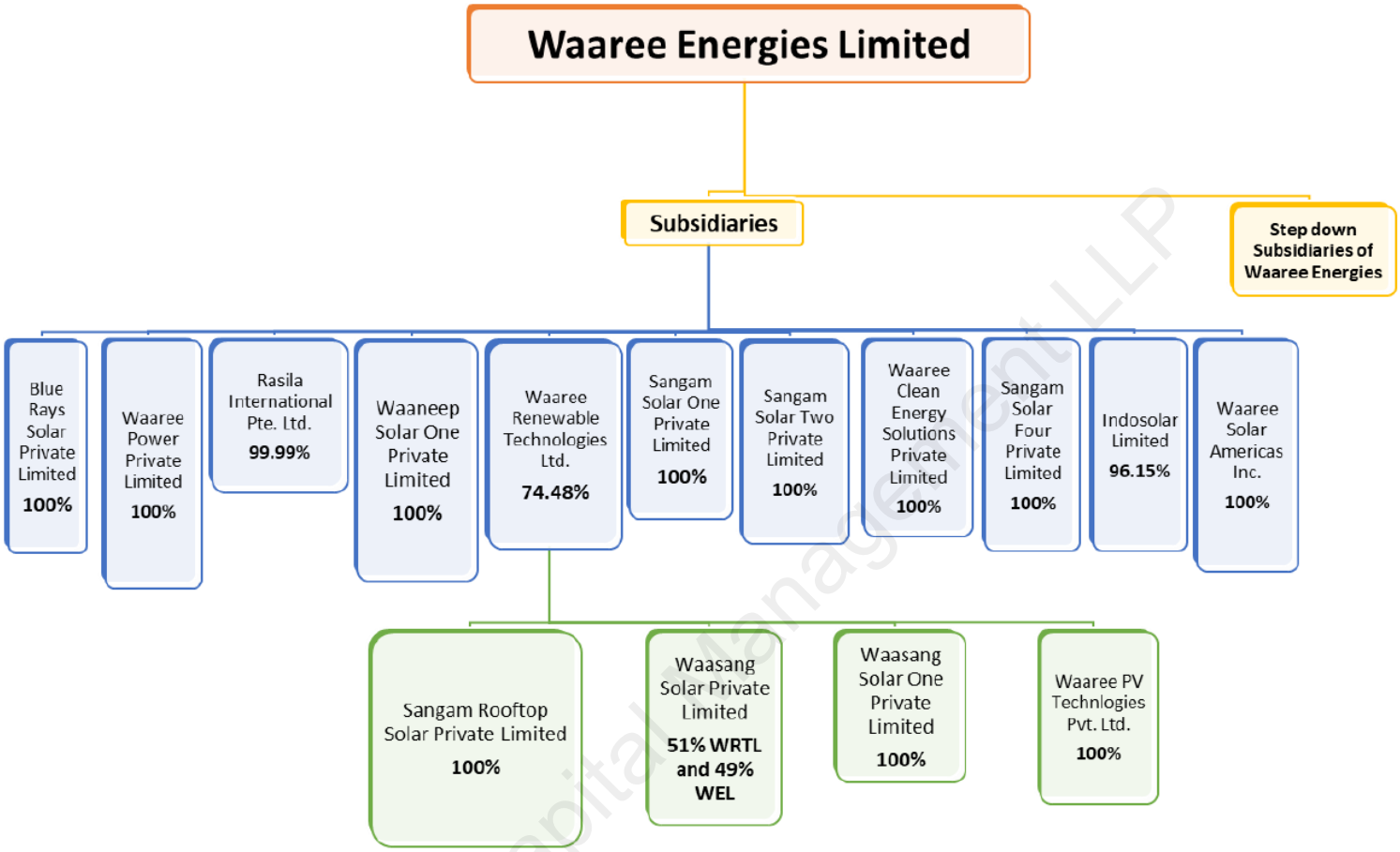
- **Board of Directors-** WEL boasts a diversified board of directors, comprising a total of eight members, of which four serve as independent directors. We have given below the composition of board committees. Additional information regarding the concise profiles of board of directors can be found in the annexure.

Board of Directors		Committees				
Name	**Title**	**Audit**	**Nomination & Remuneration**	**Stakeholder Relationship**	**CSR**	**Risk Mgmt.**
Hitesh Chimanlal Doshi	Chairperson, Managing Director	-	-		Chair	Chair
Viren Chimanlal Doshi	Whole Time Director	-	-	Y	-	-
Hitesh Pranjivan Mehta	Whole Time Director & CFO	Y	-	Y	Y	-
Dr. Arvind Ananthanarayanan	Non-Executive Director	-	-	-	-	-
Sujit Kumar Varma	Independent Director		-	Chair	-	Y
Rajender Mohan Malla	Independent Director	Chair	Y	-	-	Y
Jayesh Dhirajlal Shah	Independent Director		Y	-	Y	-
Richa Manoj Goyal	Independent Director	Y	Chair	-	-	-

Change in top management- A succinct overview of the senior management team is provided in the Annexure.

- In Mar'24, WEL appointed Amit Paithankar as group CEO, who was previously the Group President at ReNew. The former CEO Vivek Srivastava resigned in Nov '23, later he joined Suzlon in Feb '24.
- In Mar'24, WEL also appointed Nilesh Malani as CMO, who was previously the CMO at Polycab.
- In Feb '24, WEL appointed Avadut Parab as the Chief Information Officer (CIO), who previously served at Parle Agro. His appointment is intended to strengthen and enhance the internal systems at WEL. A succinct overview of the senior management team is provided in the Annexure.
- On 26th Mar'24, Waaree Solar Americas appointed Gordon Brinser as the Chief Operating Officer (COO), who previously worked as the Vice President of Operations at Enersys, where he managed manufacturing sites and implemented LEAN manufacturing programs.

- **Subsidiaries-** The company has 11 subsidiaries and 4 step down subsidiaries. Of these Waaree Renewable Technologies (EPC company), Indosolar (establishing 1 GW module capacity) and Waaree Solar Americas (establishing 1.6 GW module capacity in US), Waaree Clean Energy Solutions (for electrolyser and green ammonia) are the key entities in terms of revenues or potential revenues.



- **RPT-** The company has engaged in transactions with related parties. Among these related parties, we would like to highlight three entities: SGP Industrial Infrastructure, Waaree Renewables Technologies, and Dhari Solar. Further details are provided in the subsequent section.

- **Workforce -** As of June 2023, the company employs 1019 staff members and utilizes the services of 6862 contract labourers. The attrition rate for FY23 stood at 16%, marking a decrease compared to previous years. In FY21, the high attrition rate was attributable to employee transfers between group companies. In FY22, attrition was elevated due to the competitive nature of the industry. Notably, the company disbursed a one-time 100% bonus to all employees in FY23.

	2023	2022	2021
No of Employees	888	538	471
Attrition Rate	16%	38%	25%

Guidance- Although there have been numerous transactions with related party entities in the past, some of which are questionable, the management has proposed moving forward to limit dealings with Waaree Renewable Technologies, a solar EPC company. Waaree Renewable Technologies Ltd is the sole listed subsidiary of the WEL, with WEL holding a 74.8% stake in it.

RHP- Corporate Governance / IC- Corporate Governance

Earnings Quality Checks

1. **Related Party Entities**
   - **Group companies-** The promoters are affiliated with 27 privately held companies. Among these, Waaree Technologies is publicly listed (Market Capitalization - INR 1453 cr as of 15th Mar'24), with the promoters holding a 60% ownership stake. Furthermore, noteworthy companies under their ownership include SGP Industrial Infra, Dhari Solar, and RCD Europe Ltd, all fully owned by the promoters of WEL. Additionally, four Companies/LLPs, namely Dhaata Solar LLP, Instarupy Finance Pvt Ltd, Patan Solar Pvt Ltd, and Waasol Energies LLP, although not explicitly listed in the Draft Red Herring Prospectus (DRHP), have primary directors affiliated with the promoter group, as evidenced by data obtained from Zauba Corp.
   - **Companies registered outside India**- Four companies are registered outside India, including Waaree Solar Americas, established for business operations in the United States, and RCD Europe, formed for the acquisition of Cesare Bonetti in Italy. However, the rationale behind the incorporation of Rasila International in Singapore and Waaree Qatar WLL in Qatar remains unclear.
   - **Financial Performance-** Among privately held companies, except for SGP Industrial Infra, which will be discussed subsequently, Itec Measures Pvt Ltd reports sales of INR 34 cr and a profit of INR 2 cr. However, it is noted that all other companies do not appear to engage in active business operations.

2. **SGP Industrial Infrastructure (SGP)-** Over the past three years, WEL has conducted acquisitions of land and buildings totalling INR 382 cr from SGP. The following points provide detailed information regarding these transactions.
   - **Principal Business-** In FY20, there was an amendment to the Memorandum of Association (MOA) of SGP, encompassing activities related to land acquisition, disposal, and construction into its primary objectives. Before this revision, the company primarily focused on manufacturing industrial valves and solar photovoltaic modules.
   - **Reporting of the transaction-** In WEL's books, the above-mentioned transaction was recorded as the acquisition of assets, while SGP recorded it as a sale due to the MOA amendment. Interestingly, the sales to WEL during FY22 amounted to INR 214 cr, surpassing SGP's total sales figure of INR 209 cr.
   - **Capital Advance & Purchase of Assets**- WEL provided advances to SGP amounting to INR 427 cr (comprising INR 67 cr, 189 cr, and 171 cr during FY21, FY22, and FY23, respectively), with INR 382 cr designated for the acquisition of land and buildings, and an additional INR 26 cr serving as a capital advance to SGP & loans receivable from SGP. The discrepancy of INR 19 cr remains unresolved due to the unavailability of SGP's annual report for the fiscal year ending March 2023.
   - **Purchase/ Sale of Land & building (FY23)**- Between April 2022 and February 2023, WEL acquired land valued at INR 122 cr from SGP. Unfortunately, the precise purchase date of this land by SGP is unknown. However, as of March 2022, SGP's books reflected a total inventory of INR 28 cr. Additionally, WEL procured a building valued at INR 79 cr from SGP. It is important to note that the financials for SGP's fiscal year 2023 are unavailable, thereby restricting access to total sales and Cost of Goods Sold (COGS) data for that period.
   - **Purchase/ Sale of Land & Building (FY22)**- In July 2021, WEL acquired land valued at INR 125 cr from SGP. SGP had previously purchased this land in November 2020, with its total inventory recorded in SGP's books amounting to INR 53 cr as of March 2021. Additionally, WEL procured a building worth INR 56 cr from SGP. Notably, in FY22, SGP reported sales amounting to INR 209 cr against a Cost of Goods Sold (COGS) of INR 109 cr. The rationale behind WEL's decision to acquire land from SGP rather than directly from the original land seller remains unclear.

- **Business transfer (FY22)-** In August 2021, WEL transferred its complete shareholding in Saswata Solar to SGP for a nominal consideration of INR 1 lakh. Consequently, Saswata Solar ceased to function as a subsidiary of WEL. As part of this transaction, WEL's investment in Saswata was converted into a loan amounting to INR 75 cr.
- **Purchase/ Sale of Products (FY21)-** In FY21, transactions between SGP and WEL accounted for 55% of SGP's total sales and 58% of SGP's overall COGS. One plausible explanation for this engagement is that, until March 2021, SGP possessed a solar module capacity of 500 MW. This suggests a potential scenario where SGP was involved in job work for WEL, leading to the observed high volume of purchase and sale transactions. However, there is a discrepancy in the amounts involved: purchases from SGP in FY21 amount to INR 217 cr in WEL's books versus INR 184 cr in SGP's books, while sales amount to INR 221 cr in WEL's books versus INR 200 cr in SGP's books.
- **Slump Sale (FY21)-** In FY21, WEL completed the acquisition of a 500 MW PV module manufacturing facility located in Nandigram, Gujarat, from SGP for INR 2 cr. Following this transaction, a strategic decision was made to allocate the exclusive responsibility of the valve business to SGP, while WEL assumed sole control over the solar business operations. While the strategic intent of concentrating specific business activities within distinct entities is recognized as positive, the rationale behind initially housing these operations under separate entities remains unclear.

3. **Dhari Solar Park (Dhari)-** Dhari awarded an EPC contract worth INR 120 cr in FY24 to Waaree Renewable Technologies, a listed subsidiary of WEL
   - **13th June 2023-** Dhari entered a contract worth INR 120 cr with Waaree Renewable Technologies, which is a publicly listed company and a significant subsidiary of WEL. It is worth mentioning that during this period, Dhari was owned by individuals who were not connected to the promoters of the Waaree Group.
   - **29th June 2023-**The promoters of WEL acquired a 100% stake in Dhari, making it a group company of WEL. Consequently, Dhari was included in WEL's financials, reflecting sales and outstanding amounts totalling 59 Cr in Related Party Transactions (RPT).
   - **9th September 2023-** Waaree Renewable Technologies sought approval for RPT totalling 61 cr with Dhari. This amount covered the outstanding balance of the INR 120 cr EPC contract initiated on June 13, 2023, as well as the 59 cr recorded as sales to Dhari

4. **RCD Europe (RCD)-** Despite WEL not engaging in any transactions with RCD, an investigation into this entity is warranted due to its involvement in the acquisition of a company in Italy and its mention in the Paradise Papers leak.
   - **FY14-** The Waaree Group acquired Cesare Bonetti, an Italian company, through RCD, a company registered in Malta, acknowledged as a tax haven. SGP is one of the shareholders of RCD.
   - **FY19**- The Italian government started recovery proceedings by commencing insolvency procedures against Cesare Bonetti Spa, Italy, a step-down subsidiary. Moreover, according to information from SGP's financials in 2019, the Cesare Bonetti brand was acquired by RAC Valves.
   - **FY20-** The complete investment totalling INR 7 cr and a loan of INR 127 cr were expunged from SGP's financial records, with authorization from the Reserve Bank of India (RBI). The request for RBI approval was submitted on June 19, 2019, as evidenced in SGP's financial reports for the year 2020.
   - RCD Europe was disclosed in Paradise Papers leak- https://offshoreleaks.icij.org/nodes/55054182

Auditors- WEL's auditing firm transitioned from SGCO & Co LLP, whose tenure concluded in July 2021, to Shah Gupta & Co in July 2021. However, Shah Gupta & Co resigned in September 2022 as WEL sought to engage a firm affiliated with one of the Big 4 audit firms. Subsequently, in September 2022, WEL appointed SRBC & Co LLP as its auditors, an entity associated with EY.

Company	Auditor
Waaree Energies Limited	SRBC & Co LLP
Subsidiaries	
Waaree Renewable Technologies Ltd	KKC & Associates LLP
Indosolar Limited	SGCO & CO LLP
Blue Rays Solar Private Limited	M. N. Sheth & Associates
Sangam Solar One Private Limited	M. N. Sheth & Associates
Sangam Solar Two Private Limited	M. N. Sheth & Associates
Sangam Solar Three Private Limited	M. N. Sheth & Associates
Sangam Solar Four Private Limited	M. N. Sheth & Associates
Waaneep Solar One Private Limited	Vishal Surti & Associates
Waaneep Solar One Private Limited	Vishal Surti & Associates
Privately Held Group Companies	
SGP Industrial Infrastructure Private Limited	SGCO & Co LLP
Waaree Technologies Ltd	R T Jain & Co. LLP

RHP- Related Party Transactions / IC- Related Party Transactions

Competition

- **Key Global Solar PV Suppliers-** The declared expansion of capacities by leading global entities exceeds 270 GW, potentially augmenting the competitive dynamics within the industry. On the back of incentives from the IRA, IEA forecasts US module manufacturing capacity to increase to ~50 GW by FY26 from a current 8 GW capacity. Demand in the US is also likely to be around ~50 GW p.a. by FY26 compared to FY24 expected demand of ~32 GW. The top countries exporting solar modules to the US in 11MCY23 are Vietnam (25%), Thailand (22%), Malaysia (15%), Cambodia (13%), India (10%).

Parameter	LONGi Solar	Trina Solar	Jinko Solar	JA Solar	Canadian Solar	Risen Energy	First Solar	Waaree*
No of factories	8 in China	4 in China, 1 each in Thailand & Vietnam	14 in China, Vietnam, Malaysia, and USA	12 in China and Vietnam	20 in Canada, China, Brazil, Thailand, and Vietnam	4 in China, 1 in Malaysia	2 in US, 1 each in Vietnam & Malaysia	4 in India
Years in PV module mfg.	23 years	26 years	17 years	18 years	22 years	21 years	25 years	16
Operational Capacity Dec'22								
Module	85	65	70	50	32	25	10	12 (Jun'23)
Cell	50	50	55	40	20	-	-	-
Wafers	133	7	65	40	20	-	-	-
Announced Capacity Expansion (Across China, Southeast Asia, India, US and other countries)								
Module	130	30	20	20	42	16	15	8.6
Cell	160	25	20	30	40	19	-	11.4
Wafers	290	7	10	30	30	-	-	6
Capacity in Southeast Asian Countries (Dec'23)								
Module	10	5	9	5	-	-	-	-
Module ExportCY22	46	43	45	40	21	16	9.3	1.5
Key Products and services	Solar PV modules, wafers, solutions for C&I, utility, and rooftop use	Solar PV modules, solar trackers, utility solutions, EPCM	Solar PV modules, energy storage systems, C&I, and rooftop solutions	Solar PV modules, energy storage systems for domestic and C&I use	Solar PV modules, energy storage inverters, EPC	Solar PV modules, energy storage systems, EPC	Solar PV modules, Solar power systems, O&M	Solar PV modules, Inverters, Batteries, EPC, O&M, rooftop solutions, solar water pumps
Key Tech offered	TOPCon, Mono PERC, bi-facial module, half-cut cells	Bi-facial PERC, TOPCon, HJT, half-cut cells	Half-cell, bi-facial and tilling ribbon technologies, PERC and TOPCon	TOPCon, Mono PERC, bi-facial module, half-cut cells	TOPCon Bifacial and Monofacial, HJT modules, Dual Cell PERC	Mono PERC, bi-facial PERC, bi-facial HJT modules, TOPCon	CdTe	TOPCon, Mono and poly crystalline PV modules, Mono PERC, Bifacial, Flexible modules, BIPV
MCap $mn	21,200	7,345	11,503	8,283	1,162	2,401	16,365	4,530
Sales TTM Dec23 $mn	19,747	15,992	16,721	11,457	7,614	4,983	3,319	823
PAT TTM Dec23 $mn	2,413	784	1,055	1,234	274	202	831	61
PAT Margin	12%	5%	6%	11%	4%	4%	25%	7%

*WEL Numbers for FY23. Mcap as of 27th Mar'23, & MCap for WEL assuming IPO price of INR 1300. Source: Tikr

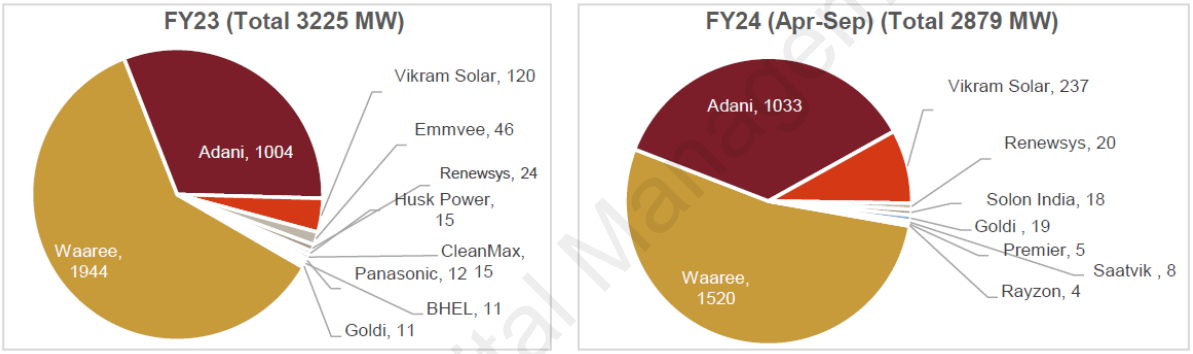
- **India Solar PV Supply -** China remains the primary module exporter to India, with Malaysia following suit. The capacity expansion by various stakeholders in India under the PLI framework are detailed in the annexure. Additionally, the enforcement of the Approved List of Models and Manufacturers (ALMM) would prove advantageous for Indian module manufacturers, as none of the major global players are currently enlisted in ALMM.
    - In FY27, it is anticipated that the total solar capacity in India will reach approximately 127 GW. Within this capacity, WEL is projected to constitute 16%, equivalent to 20.6 GW. The ensuing analysis presents a comparative overview of existing suppliers of solar modules in the Indian market.

Parameter	Waaree Energies	Vikram Solar	Mundra Solar PV	Premier Energies	RenewSys India	Emmvee Photovoltaic	RIL
No of factories	4 in Gujarat	1 each in West Bengal and Tamil Nadu	1 in Gujarat	2 in Telangana	1 each in Karnataka, Telangana, and Maharashtra	2 in Karnataka	-
Years in PV module mfg.	16 years	17 years	8 years	26 years	12 years	16 years	-
Operational capacity (as on Sept-23)							
Module	12	3.5	4	2.4	2.75	1.25	-
Cell	-	-	4	2	~0.1	-	-
Announced Capacity Expansion							
Module	8.6	2.8	10	3.4	2	1.75	10
Cell	11.4	2.8	10	1.25	1.9	1.5	10
Wafers	6	2.8	-	-	-	1.5	10
Capacity in ALMM Mar'24 (GW)							
Module	10.7	2.4	4.1	1.1	0.6	1.2	-
Market share of ALMM capacity	29%	6%	11%	3%	1%	3%	-
Key Products and services	Solar PV modules, Inverters, Batteries, EPC services, rooftop solutions, O&M Services, and solar water pumps	Solar PV modules, EPC services, solar O&M services, and water pumps	Solar PV cells and modules, EPC services, O&M services,	Solar PV cells and modules, EPC services, O&M services, and water pumps	Solar PV modules and cells	Modules, EPC, rooftop solutions, and solar water heater solutions	Solar PV cells and modules
Cumulative Installed capacity in EPC (GW)	1.1	1.4	-	0.7	-	-	-
Key Technologies offered	TOPCon, Mono and poly crystalline PV modules, Mono PERC, Bifacial, Flexible modules, BIPV	TOPCon, Mono PERC, mono-facial & bifacial, poly-Si modules	TOPCon, Multi crystalline, Mono PERC and Bifacial modules	TOPCon, Polycrystalline Si cells, mono PERC, poly Si modules	TOPCon, Mono/Multi PERC, Bi- facial	TOPCon, Mono PERC, polycrystalline modules, bi- facial module	HJT
NABL Accredited Lab	Modules	Modules	-	-	Encapsulants and back sheets	-	-

- **Current nameplate module capacities of Indian Players has reached ~40 GW.**

Installed Capacity June'23	MW
Waaree Energies	12000
Adani Mundra PV	4000
ReNew Power	4000
Vikram Solar	3500
Renewsys	2750
Goldi Solar	2500
Premier Energies	2400
Rayzon	1500
Saatvik	1500
Emmvee Photovoltaic	1250
Solex	1200
Pixon Green Energy	1000

- **Top 10 exporters from India (MW)-** WEL has been the leader, followed by Adani Mundra Solar.



Source: Industry, CRISIL Consulting

- **India Solar Rooftop segment-** WEL possesses a network of 284 distinctive franchises throughout India, distinct from conventional distributorship or dealership models. These exclusive affiliations facilitate comprehensive end-to-end product and service delivery to customers. Vikram Solar, on the other hand, maintains a distribution network spanning 40 cities, ensuring product availability in over 600 locations across India. Adani, in collaboration with Roofsol Energy, extends its distribution network to encompass more than 2500 towns throughout India.
- **India Solar EPC-** Prominent entities within the EPC domain include Waaree Renewable Technologies, Tata Power, Sterling & Wilson, Vikram Solar, BHEL, Prozeal Infra, L&T, and Jakson, among others. Many of these entities also maintain a presence in the EPC segment of rooftop solar installations

RHP- Peer Comp / Global- Competition / Premier Energies- Competition / DRHP- Peer Comp / IC-Competition

Valuation

At an IPO price of INR 1300, the implied market capitalization of WEL stands at INR 37,601 cr with a FY23 PE ratio of 78x and FY24E PE of 41x, with a conservative PAT estimate of INR 928 cr for FY24. Additionally, WEL holds a 74.46% stake in Waaree Renewable Technologies, which itself has a market capitalization of INR 13,941 cr as of 27th March 2024. The value of WEL's stake is INR 10,380 cr. Adjusting for this investment, WEL's implied market capitalization reduces to INR 27,221 cr with a FY23 PE of 61x and FY24E PE of 33x, implying greater margin of safety.

IPO Price*	1,300	1,400	1,500	1,600	1,700	1,800
Fresh Issue (INR cr)	3,600	3,600	3,600	3,600	3,600	3,600
Number of shares (E) (cr)	29	29	29	28	28	28
Market Cap (E)	37,601	40,217	42,832	45,448	48,063	50,679
FY23 PE	78	83	89	94	100	105
FY24E PE	41	43	46	49	52	55
WEL ex WRTL						
Market cap ex WRTL (E)	27,221	29,836	32,452	35,067	37,683	40,298
FY23 PE	61	67	73	79	85	90
FY24E PE	33	37	40	43	46	50

Valuation Comparison of Waaree Energies with Global Solar Module Players and Indian Renewable Energy Companies. (WEL IPO price assumed as INR 1300, implying a market cap of INR 37,601 cr)

EV to Sales- With an estimated FY24E EV to Sales ratio of 2.8x for WEL and 2.1x for WEL ex WRTL, the company is available at a discount to the industry median of 5.1x. It is available at a significant discount compared to the median of 8.4x observed among Indian renewable energy companies.

EV to Sales	FY24E	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
WEL (E)	2.8	4.9	-	-	-	-	-	-	-	-
WEL ex wRTL (E)	2.1	3.5	-	-	-	-	-	-	-	-
Median	**5.1**	**5.7**	**5.0**	**4.4**	**3.5**	**1.7**	**2.6**	**1.8**	**1.9**	**1.8**
First Solar	4.5	5.7	3.0	2.7	2.1	1.2	1.6	0.6	1.4	1.1
Longi Green	0.8	2.5	5.9	7.6	2.9	2.4	5.1	2.1	6.1	3.7
Trina Solar	0.6	2.0	4.2	1.9	-	-	-	-	-	-
Jinko Solar	0.7	2.0	-	-	-	-	-	-	-	-
Suzlon	8.4	8.8	2.4	3.5	4.6	1.7	1.9	1.7	1.9	1.4
Inox Wind	14.2	17.0	7.9	5.3	3.5	1.6	2.1	1.8	1.3	2.5
Adani Green	37.3	34.1	58.4	61.8	70.8	15.3	11.8	-	-	-
Borosil Renewables	5.1	4.6	9.8	12.5	11.7	2.0	3.2	4.0	3.9	1.8
SW Solar	7.3	6.9	1.5	1.4	0.8	1.1	-	-	-	-

EV to EBITDA- With an estimated FY24E EV to EBITDA ratio of 21x for WEL and 16x for WEL ex WRTL, the company is available slightly above the industry median of 13x. However, it is at a significant discount compared to the median of 60x observed among Indian renewable energy companies.

EV to EBITDA	FY24E	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
WEL (E)	21	40	-	-	-	-	-	-	-	-
WEL ex wRTL (E)	16	30	-	-	-	-	-	-	-	-
Median	**13**	**28**	**26**	**28**	**27**	**18**	**20**	**12**	**15**	**17**
First Solar	13	67	13	12	32	20	12	3	6	6
Longi Green	7	19	33	32	14	14	19	12	33	23
Trina Solar	7	25	51	27	-	-	-	-	-	-
Jinko Solar	7	28	-	-	-	-	-	-	-	-
Suzlon	60	68	22	29	-114	-35	21	11	15	18
Inox Wind	135	-136	-13	-41	-10	27	31	12	8	16
Adani Green	48	45	83	90	95	21	17	-	-	-
Borosil Renewables	92	46	31	29	54	18	21	30	34	17
SW Solar	-38	-29	-5	-10	27	10	-	-	-	-

Price to Earnings- With an estimated FY24E PE ratio of 41x, for WEL and 33x for WEL ex WRTL, the company is at above the industry median of 13x. However, it is at a discount compared to the median of 69x observed among Indian renewable energy companies.

Price to Earnings	FY24E	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
WEL (E)	41	78	-	-	-	-	-	-	-	-
WEL ex wRTL (E)	33	60	-	-	-	-	-	-	-	-
Median	**11**	**67**	**33**	**41**	**-4**	**-1**	**-9**	**17**	**12**	**17**
First Solar	20	169	21	47	-1515	-13	-16	7	12	17
Longi Green	9	26	47	42	20	16	27	17	64	53
Trina Solar	10	45	106	40	-	-	-	-	-	-
Jinko Solar	11	67	-	-	-	-	-	-	-	-
Suzlon	69	83	4	-41	-26	-1	-2	9	-21	-1
Inox Wind	-85	-35	-5	-10	-4	-7	-19	21	11	21
Adani Green	198	202	718	784	-9028	-103	-22	-	-	-
Borosil Renewables	598	179	45	52	223	34	50	18	36	14
SW Solar	-16	-12	-4	-9	19	8	-	-	-	-

Valuation comparison across the solar value chain

Source: Tikr. (Data as of 27th March 2024)

Company name	Mkt cap (USDm)	PE(x)		PB (x)		ROE		Dividend Yield (%)		EPS CAGR (%)	Net D/E
		2023E	2024E	2023E	2024E	2023E	2024E	2023E	2024E	2022-25E	2023E
Polysilicon											
Tongwei	15,862	5.8	11.5	1.7	2.0	28%	18%	6.3%	4.3%	-21%	-0.03
TBEA	10,684	4.6	11.6	0.6	1.1	17%	10%	3.7%	2.4%	-29%	0.14
Sub-Sector Avg		**5.2**	**11.6**	**1.2**	**1.6**	**22%**	**14%**	**5.0%**	**3.4%**	**-25%**	**0.06**
Wafer, cell, and module											
LONGi	21,200	8.5	14.0	2.3	2.3	25%	17%	1.8%	1.5%	2%	net cash
JA Solar	8,283	6.5	6.8	1.6	1.4	28%	22%	1.3%	1.5%	33%	net cash
Jinko Solar	11,503	10.9	12.2	2.6	1.9	23%	17%	2.5%	2.5%	52%	0.01
Trina Solar	7,345	9.2	13.4	1.6	1.4	20%	11%	3.0%	2.1%	14%	0.14
Maxwell	4,274	33.5	23.3	4.3	4.2	17%	20%	1.0%	1.3%	34%	-0.46
Sub-Sector Avg		**13.7**	**13.9**	**2.5**	**2.2**	**23%**	**17%**	**1.9%**	**1.8%**	**27%**	**-0.11**
Solar glass											
Flat Glass	8,628	14.5	12.1	1.9	1.5	5%	5%	0.0%	2.5%	16%	0.23
Xinyi Solar	6,775	12.7	8.7	1.7	1.4	12%	17%	3.6%	5.4%	18%	0.29
Sub-Sector Avg		**13.6**	**10.4**	**1.8**	**1.5**	**9%**	**11%**	**1.8%**	**4.0%**	**17%**	**0.26**
Solar inverter											
Sungrow	21,169	17.3	13.0	5.9	3.6	36%	32%	0.6%	0.7%	46%	-0.41
Ginlong	3,157	20.4	15.1	2.9	3.0	24%	22%	0.5%	0.7%	30%	0.13
Sub-Sector Avg		**18.9**	**14.1**	**4.4**	**3.3**	**30%**	**27%**	**0.6%**	**0.7%**	**38%**	**-0.14**
Solar Film											
Hangzhou First Applied	7,251	35.5	14.4	3.4	2.6	16%	20%	0.6%	0.9%	25%	-0.03
Shenzhen Gas	2,894	15.4	11.8	1.5	1.3	11%	11%	2.3%	2.6%	15%	0.24
Sub-Sector Avg		**25.5**	**13.1**	**2.4**	**2.0**	**14%**	**15%**	**1.5%**	**1.8%**	**20%**	**0.11**
Solar farm developers											
Xinyi Energy	1,161	8.9	8.1	0.7	0.9	10%	11%	4.9%	5.9%	16%	0.38
Three Gorges Renewables	18,617	18.1	15.2	1.7	1.5	9%	11%	1.7%	2.0%	12%	1.35
Sub-Sector Avg		**13.5**	**11.7**	**1.2**	**1.2**	**9%**	**11%**	**3.3%**	**4.0%**	**14%**	**0.87**
Sector Avg		**14.8**	**12.7**	**2.3**	**2.0**	**19%**	**16%**	**2.3%**	**2.4%**	**17%**	**0.15**

RHP- Valuation / IC- Valuation

Annexure

Waaree Energies major Events and Milestones of the company

1990-2007:

- Built a strong reputation for business scaling; Hitesh Chimanlal Doshi, Chairman & MD, achieved a significant milestone by successfully selling his prior venture, Waaree Instruments Limited to Baumer group

2007-2011:

- Embarked on the Solar Energy Sector journey, inaugurating a 30 MW module manufacturing line.

2011-2017:

- **2014**: Forged a strategic Joint Venture (JV) with Northeastern Electric Power Corporation Limited (NEEPCO) for a solar power initiative.
- **2017**: Purchased a 40% stake in Waaneep Solar Private Limited from NEEPCO, resulting in the complete ownership of Waaneep Solar Private Limited as its subsidiary.

2018-2021:

- Operationalized a 1GW photovoltaic modules plant, marking a substantial leap in manufacturing capacity.
- **2018**: Facilitated the transfer of Waaneep Solar PVT LTD to Hero Solar Energy Pvt Ltd.
- Successfully initiated and completed an international EPC project, commissioning the 49.5 MWp ground-mounted Song Giang solar power project in Vietnam.
- **2021**: Acquired a 500MW solar module manufacturing facility, elevating the total installed capacity to 2 GW.

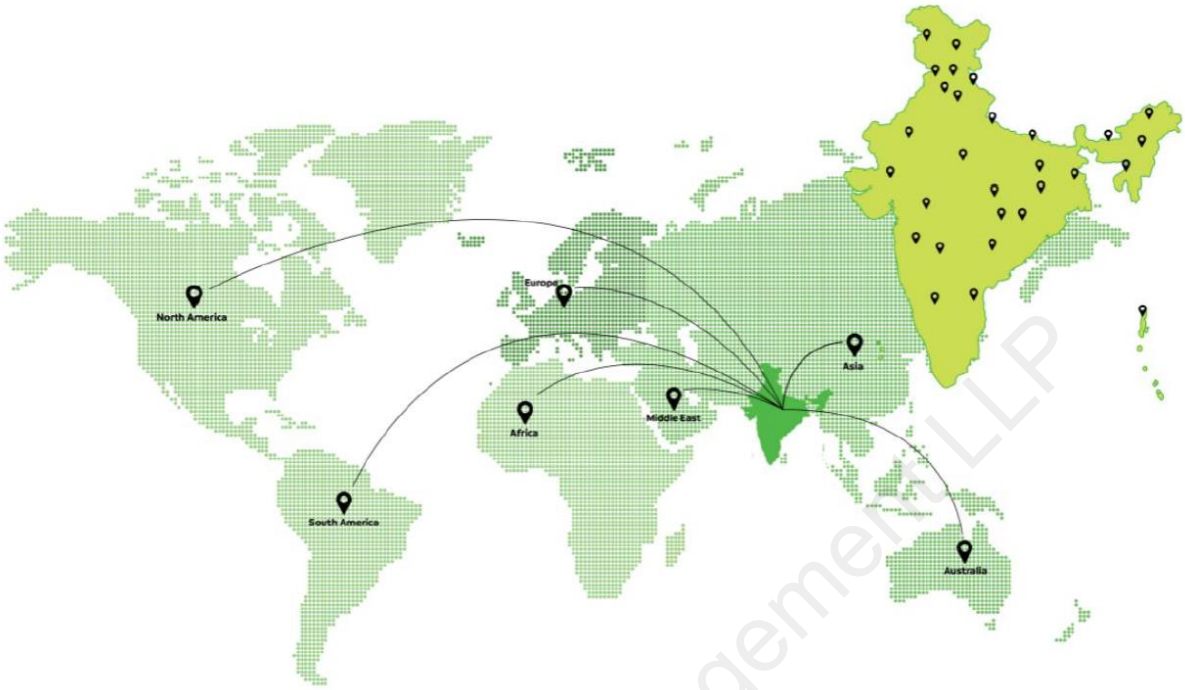
2021-2023:

- Secured funding through 2 equity rounds, amounting to INR 2040 cr.
- Expanded manufacturing capacity to 12GW.
- Commenced the construction of a 5.4GW cell manufacturing facility.
- Gained recognition by securing a Production-Linked Incentive (PLI) for a 6GW integrated ingots, wafer, cell, module manufacturing facility.
- Setting up a 1.6GW module facility in Texas, US

Key Certifications & Awards

- Established modules with high bankability & consistent Tier-1 Rating by Bloomberg
- Manufacturing Plant Certifications like ISO 9001:2015, ISO 45001:2018 & ISO 14001:2015
- Manufacturing Plants audited & certified by IEC System, UL Solutions (USA), RoHS compliance
- Products are certified, and insured by 3rd party insurers
- Received noteworthy accolades like 'RE brand of the Year' at the RenewX Awards 2023, 'Energy Company of the Year (Renewables)' by the ET 2023 & 'Leading Renewable Energy Manufacturer – Solar Modules 2022'

WEL operates globally, with a presence in India, the United States, South America, Africa, Australia, Europe, and the Middle East.



The company's retail platform

- WEL has pan-India distribution and a large network of channel partners, with over 280 franchisees. They target rooftop and MSME businesses through this network
- It deeply engages with channel partners by providing training, credit support, and lead generation assistance.
- Its initiatives include "Waaree Experts" for training electricians, "Waaree Prime" offering rewards for sales, and the "Surya Shakti Scheme" for financing MSMEs, all aimed at enhancing sales performance.
- WEL's D2C platform offers a one-stop digital solution for solar needs, including service requests.

Corporate Governance

Board of Directors- This table provides a succinct overview of the Board of Directors, with a more comprehensive focus on the profiles of the Executive Directors.

Name	Title	Brief profile
Hitesh Chimanlal Doshi	Chairperson, Managing Director	Instrumental in driving company growth since October 1999. Currently, his responsibilities encompass a wide range of crucial tasks, including overseeing the financial performance, investments, and various business ventures of Waaree group. With over 22 years in the engineering industry, he contributes substantial knowledge and expertise to the leadership team. He holds a doctorate in professional entrepreneurship in business project management from the European Continental University, reflecting a dedication to ongoing learning and professional growth. Was awarded "India's most powerful solar leader 2023" by Solar Quarter Power 100 India.
Viren Chimanlal Doshi	Whole Time Director	Since November 26, 2007, Viren has served as the crucial Whole-time Director, making significant contributions to the company's operational and strategic initiatives. Currently overseeing engineering, procurement, and construction processes for solar projects across the company, subsidiaries, and affiliated group companies, Viren brings over 15 years of extensive engineering sector experience, demonstrating broad technical knowledge and industry insights essential for navigating complexities and ensuring success in his role.
Hitesh Pranjivan Mehta	Whole Time Director & CFO	As CFO and Whole-time Director since April 1, 2011, significantly shapes the Company's strategic direction and growth. Responsible for leading short-term initiatives and long-term strategic planning, he plays a pivotal role in achieving overarching objectives. With over 23 years of diverse experience in engineering, solar, and oil industries, Hitesh offers valuable insights into industry trends and best practices. He is also a member of Institute of Chartered Accountants of India
Dr. Arvind Ananthanarayanan	Non-Executive Director	With over 18 years of applied physics experience, previously associated with BARC, holds M.Sc. and Ph.D. in physics
Sujit Kumar Varma	Independent Director	35 years of experience in the banking industry associated with SBI since 1987
Rajender Mohan Malla	Independent Director	Previously affiliated with SIDBI Venture Capital, IDBI Capital, and IDBI AMC, holds an MBA from the University of Delhi.
Jayesh Dhirajlal Shah	Independent Director	Seasoned chartered accountant with over 34 years of experience in taxation, audit, project finance, and compliance.
Richa Manoj Goyal	Independent Director	Managing partner at 'Richa Goyal and Associates,' practicing company secretary, and certified trademarks agent.

Senior Management Team- This table provides a succinct overview of the senior management team

Name	Designation	Brief profile
Amit Paithankar	Group CEO	Joined WEL in Mar'24, previously he was the Group President of ReNew, He was also the member of the management board of the company for over a year. A scientist for Swedish-Swiss multinational ABB for 4 years, Paithankar worked for the longest time for 20 years with the US-headquartered engineering services company Emerson. In his last position with Emerson, he was the VP for its Advanced Design Center and Managing Director for South Asia.
Nilesh Malani	Chief Marketing Officer	Before joining WEL, he was the CMO of Polycab. He has also worked with JSW Steel as its Head of Marketing and Head of Retail Marketing and Channel Sales. He has also worked with Castrol India Limited and Asian Paints.
Rajesh Ghanshyam Gaur	CS and Compliance Officer	Responsible for corporate secretarial and compliance functions, with previous experience at Ambuja Cements as a manager in the secretarial function.
Sunil Rathi	Director Sales	Associated with the company since Sep 2015, overseeing sales functions, with prior experience at Vikram Solar Ltd.
Jignesh Rathod	Director Operations	Associated with the company since 2007, responsible for overseeing the operational functions at the various factories.
Abhishek Pareek	Group Finance Controller	Manages the finance function across the Waaree group of companies, with experience serving as CFO at Shubhalakshmi Polyesters Limited.
Pankaj Vassal	President - Sales	Manages the retail sales operations of the company's franchise business, with prior experience at brands such as Havells, Pidilite, and Asian Paints.
Manoj Sinsinwar	Chief Legal Officer	Manages the legal functions of the company, previously associated with Sasan Power, Indu Towers, Sistema Shyam Teleservices etc.
Avadut Parab	Chief Information Officer	He was recently appointed in Feb'24. Prior to joining WEL, he oversaw the implementation of several major projects, such as several full-cycle SAP implementations and enterprise-wide technology initiatives at Parle Agro
Manoj Patil	Head - Legal Contract and Compliance	Manages the legal functions within the group, previously associated With Zuari Indian Oil Tanking, Varroc Engineering etc.

Comparison of Key Costs with Peers

Various Cost & Margin Comparison between Waaree Energies & its competitors

Gross Margin- in FY23, WEL demonstrated superior gross margins at 24% compared to industry median at 17%, primarily attributable to more favourable realizations. These gross margins align with those of Indian counterparts such as Mundra Solar and Vikram Solar.

	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
Median	**17%**	**18%**	**22%**	**20%**	**18%**	**17%**	**18%**	**18%**	**17%**
Waaree Energies	24%	19%	17%	18%	23%	22%	22%	20%	14%
First Solar	5%	25%	26%	18%	18%	19%	22%	28%	24%
Longi Green	15%	20%	24%	28%	19%	32%	25%	18%	16%
Trina Solar	13%	14%	15%	17%	15%	17%		19%	17%
Jinko Solar	10%	12%	14%	20%	15%	10%	16%	17%	17%
JA Solar	14%	15%	16%	22%	18%	16%	18%		15%
Canadian Solar	17%	18%	20%	23%	21%	19%	15%	17%	20%
Mundra Solar	24%	-	-	-	-	-	-	-	-
Mundra Solar PV	20%	32%	45%	-	-	-	-	-	-
Vikram Solar	22%	20%	24%	23%	20%	16%	18%	22%	23%
Solex Energy	19%	16%	26%	16%	14%	11%	13%	6%	12%

Employees Cost % of Sales- The personnel expenditure was 1.8% at WEL in FY23 and it has consistently remained below the industry median, signalling a positive impact from operational leverage

	FY23	FY22	FY21
Median	**2.0%**	**2.8%**	**3.0%**
Waaree Energies	1.8%	1.8%	2.2%
Mundra Solar	0.5%	-	-
Mundra Solar PV	2.0%	2.8%	3.7%
Vikram Solar	4.4%	6.3%	5.4%
Solex Energy	3.6%	2.8%	2.2%

*No data found for MNCs

Transportation, Freight, Duty & Handling Charges % of Sales- incurred heightened freight expenses due to the escalating global shipping rates, resulting in a freight cost of 8%, which was twice the industry median. Nevertheless, in FY23, this figure decreased to 4% despite a continued increase in shipping rates. Notably, WEL's freight expenditure surpasses that of most competitors, attributable to its elevated percentage share of exports.

	FY23	FY22	FY21
Median	**3%**	**4%**	**2%**
Waaree Energies	4%	8%	5%
Mundra Solar	7%	-	-
Mundra Solar PV	2%	2%	1%
Vikram Solar	2%	4%	2%

*No data found for MNCs, also data not comparable as duty cost, and exports as % of sales is different

Power & Fuel % of Sales- In FY23, WEL recorded a power & fuel cost of 0.7%, consistently aligning with the industry median. This alignment underscores the company's effective energy management practices.

	FY23	FY22	FY21
Median	**0.6%**	**0.4%**	**0.3%**
Waaree Energies	0.7%	0.3%	0.1%
Mundra Solar	0.6%	-	-
Mundra Solar PV	0.6%	1.3%	1.1%
Vikram Solar	0.6%	0.5%	0.4%
Solex Energy	1.4%	0.3%	0.1%

SG&A % of Sales- The cost is not directly comparable with MNCs, as it also encompasses employee cost for them. In FY22, SG&A was higher for WEL on account of higher freight cost.

	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
Median	**5%**	**6%**	**5%**	**7%**	**8%**	**7%**	**7%**	**7%**	**7%**
Waaree Energies	6%	9%	7%	6%	7%	4%	4%	4%	3%
First Solar	6%	6%	8%	7%	8%	7%	9%	6%	8%
Longi Green	5%	4%	5%	7%	7%	7%	8%	7%	6%
Trina Solar	5%	7%	7%	10%	8%	9%	-	10%	11%
Jinko Solar	5%	5%	5%	10%	9%	8%	9%	9%	8%
JA Solar	4%	5%	5%	9%	8%	7%	7%	-	21%
Canadian Solar	11%	13%	13%	13%	10%	11%	11%	8%	7%
Mundra Solar	2%	-	-	-	-	-	-	-	-
Mundra Solar PV	1%	1%	1%	-	-	-	-	-	-
Vikram Solar	5%	6%	5%	5%	4%	4%	2%	4%	3%
Solex Energy	5%	3%	2%	1%	1%	1%	3%	1%	2%

*SG&A for First Solar and other MNCs includes employee cost. Bifurcation of employee cost and other SG&A is not given in annual report

Depreciation % of Sales- In FY23 WEL exhibited a depreciation @2% of sales, slightly below the industry median. This variance can be attributed to the company's comparatively higher asset turnover in comparison to its competitors.

	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
Median	**3%**	**4%**	**4%**	**4%**	**3%**	**3%**	**3%**	**3%**	**3%**
Waaree Energies	2%	2%	1%	1%	2%	2%	3%	2%	1%
First Solar	10%	9%	9%	7%	6%	4%	8%	7%	7%
Longi Green	3%	4%	4%	4%	5%	4%	3%	5%	6%
Trina Solar	3%	3%	4%	4%	1%	0%	-	4%	5%
Jinko Solar	4%	4%	4%	3%	4%	4%	2%	3%	3%
JA Solar	3%	5%	7%	7%	6%	6%	6%	-	6%
Canadian Solar	3%	6%	6%	5%	3%	3%	3%	3%	3%
Mundra Solar	1%	-	-	-	-	-	-	-	-
Mundra Solar PV	7%	5%	4%	-	-	-	-	-	-
Vikram Solar	3%	3%	2%	2%	1%	1%	1%	2%	2%
Solex Energy	3%	0%	0%	0%	0%	1%	1%	1%	0%

EBITDA Margin- in FY22 WEL experienced lower EBITDA margins at 2%, primarily attributable to elevated freight costs. However, in FY23, these margins saw an increase to 10%, driven by normalized costs and enhanced capacity utilization.

	FY23	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15
Median	**9%**	**10%**	**12%**	**10%**	**8%**	**7%**	**9%**	**11%**	**12%**
Waaree Energies	10%	2%	3%	3%	6%	6%	8%	8%	4%
First Solar	2%	24%	21%	13%	8%	11%	17%	24%	20%
Longi Green	11%	17%	21%	23%	15%	26%	20%	16%	16%
Trina Solar	8%	8%	10%	9%	6%	6%	-	12%	10%
Jinko Solar	6%	10%	10%	10%	7%	5%	9%	10%	12%
JA Solar	12%	13%	16%	18%	13%	12%	16%	-	-
Canadian Solar	9%	10%	13%	14%	13%	10%	6%	11%	15%
Mundra Solar	12%	-	-	-	-	-	-	-	-
Mundra Solar PV	3%	13%	28%	-	-	-	-	-	-
Vikram Solar	9%	3%	11%	9%	8%	7%	9%	13%	14%
Solex Energy	7%	3%	4%	5%	5%	6%	6%	2%	5%

Working Capital as % sales- WEL working capital to sales ratio is consistent with global peers. In contrast, Indian counterparts exhibit a higher working capital demand due to lower % of exports, lower bargaining power with suppliers, and less effective working capital management when juxtaposed with WEL.

	FY23	FY22	FY21
Median	-3%	8%	1%
Waaree Energies	-5%	-14%	5%
First Solar	-16%	12%	21%
Longi Green	-13%	-7%	-5%
Trina Solar	1%	9%	-9%
Jinko Solar	-4%	-9%	-2%
JA Solar	-5%	-10%	-5%
Canadian Solar	-3%	8%	-6%
Mundra Solar	26%	-	-
Mundra Solar PV	23%	39%	35%
Vikram Solar	32%	13%	20%
Solex Energy	13%	31%	40%

WC = Inventories + Receivables + advances paid - payables - advances received

Source: Tikr

RHP- Peer Comp

Comparison between WEL & Suzlon

Company Brief- WEL engages in the production of solar modules and has undertaken expansion for backward integration into the manufacturing of wafers and solar cells. Additionally, WEL possesses an EPC arm dedicated to solar power plants through its publicly listed subsidiary, Waaree Renewable Technologies. In contrast, SEL is a vertically integrated manufacturer involved in the production of wind turbines and the operations and maintenance (O&M) of such turbines.

Key Stats- In FY23, both WEL & SEL operated on a comparable scale, achieving sales figures of INR 6,751 cr and INR 5,971 cr, respectively. Despite both companies attaining similar EBITDA amounts of INR 835 & 832 cr, WEL demonstrated a significantly higher cash flow at INR 1,560 cr, attributed to more effective working capital management. Furthermore, in terms of the order book, WEL's value is 1.8 times that of SEL's order book.

INR cr	WEL	SEL	3 Year	WEL	SEL
Order book (MW)	20170	3157			
Order book Value	50425	28413			
Volume (MW)	2630	664			
Capacity (MW)	12000	3150			
FY23 Sales	6751	5971	Sales CAGR	50%	26%
Realisation per MW	2.57	8.99			
FY23 EBITDA	835	832	EBITDA CAGR	108%	45%
FY23 PAT (ex-exceptional)	483	167	PAT CAGR	126%	N to P
EBITDA per MW	0.32	1.25			
FY23 CFO	1560	467	Cum Pre-tax CFO/ EBITDA	2.42	0.97

DuPont Analysis- WEL possesses a more robust balance sheet in comparison to SEL, which exhibited a negative net worth in the FY23 despite undergoing multiple fundraising activities. WEL reported a ROE of 43%, whereas SEL recorded a negative ROE during the same period.

	FY23		3 Year Medians	
INR cr	WEL	SEL	WEL	SEL
PAT / PBT	74%	100%	69%	96%
PBT / EBIT	101%	505%	124%	38%
EBIT / Sales	10%	10%	3%	9%
Sales / Total Assets	0.91	1.09	1.33	1.03
Total Assets / Networth	3.99	-ve	3.99	-ve
ROE	43%	-ve	19%	-ve

Margins- SEL achieved a gross margin of 37%, surpassing WEL margin of 24%, primarily attributable to higher value addition. WEL's ongoing backward integration into the manufacturing of wafers and cells is anticipated to enhance its gross margin by an estimated 4-6%.

	FY23		3 Year Medians	
INR cr	WEL	SEL	WEL	SEL
Gross Margin	24%	37%	19%	37%
EBITDA Margin	12%	14%	4%	14%
PAT Margin (ex-exceptional)	7%	3%	3%	-4%
CFO Margin	23%	8%	23%	16%
FCFF Margin	11%	9%	7%	15%

Capital Intensity- SEL exhibits greater capital intensity, as evidenced by its lower gross fixed asset turns of 2.1 compared to WEL higher turns at 6.3. Additionally, WEL demonstrates a more favorable working capital as a % of sales at -5%, attributable to advances received from customers, in contrast to SEL's figure of 32%.

	FY23			3 Year Medians	
INR cr	**WEL**	**SEL**		**WEL**	**SEL**
Total Asset turns	1.4	1.0		1.6	1.0
Gross FA turns	7.0	2.1		7.0	2.1
Net FA turns	8.3	7.1		8.3	7.0
Adj WCap to Sales	-5%	32%		-5%	32%
Receivable to Sales	40%	21%		19%	21%
Inventory to Sales	5%	34%		5%	34%
Advances Paid to Sales	6%	-		3%	-
Payable to Sales	21%	23%		19%	26%
Advances Received to Sales	34%	-		21%	-
Cash Conversion Cycle	-20	141		-20	141

Capex- Wind turbine manufacturing differs from mass production of solar modules. In the event that a turbine is completed but not delivered, SEL cannot commence the production of a new turbine due to space constraints. Consequently, the declared capacity and the actual operational capacity significantly diverge. Moreover, for both WEL and SEL, the potential increase in stated capacity is facilitated by the production of higher watt modules or higher megawatt turbines, without necessitating substantial capital expenditure.

Capacity Data	**WEL**				**SEL**
	Module	**Cell**	**Wafer**		**Turbines**
Capacity (MW)	12000	-			3150
Utilisation % in FY23	40%				21%
Capacity Expansion					
FY25E	14600	5400	-		-
FY26E	20600	5400			
FY27E	20600	11400	6000		

Capital Structure- Since its IPO in 2005, SEL has injected over INR 19,000 cr as equity, resulting in a positive net worth following the latest fundraising in FY24. SEL's debt stood at INR 11,900 cr as of March 2020, underwent restructuring, and was subsequently retired through the issuance of equity capital. Conversely, WEL has maintained capital efficiency, with the management indicating a commitment to avoiding unsustainable levels of debt in pursuit of high growth.

	FY23			3 Year Medians	
INR cr	**WEL**	**SEL**		**WEL**	**SEL**
Total Debt*	906	1905		-	-
Total Debt / Equity#	0.49	1.73		0.96	-1.79
Total Debt/EBITDA	1.09	2.29		3.81	7.7
Total Debt/CFO	0.58	4.08		0.60	4.91
Net Debt / Equity#	-0.46	1.42		-0.20	-1.67
Interest to Avg Debt	12%	10%		12%	10%
Interest Coverage Ratio	8.1	1.4		2.1	0.8

***Suzlon debt in H1FY24 was down to INR 146 cr. # Debt to Equity is -ve because equity is -ve

Capital Allocation- WEL has been channeling investments into expanding its capacities to support future growth initiatives, while SEL has directed its investments toward augmenting working capital and utilizing equity to retire existing debt obligations.

	FY23			3 Year Cumulative	
	WEL	**SEL**		**WEL**	**SEL**
Source of cash flows INR cr	**1,881**	**2,090**		**2,397**	**4,267**
Cash Operating Profit %	45	48		46	67
Net Borrowings %	-	-		11	-
Equity %	55	52		43	33
Allocation INR cr	**(507)**	**(2,245)**		**(647)**	**(4,062)**
Working Capital %	(142)	24		(190)	13
Capital Expenditures %	170	1		240	3
Invt in JVs and Associates %	29	(3)		17	(2)
M&A %	-	-		-	-
Dividends %	-	-		-	-
Buyback %	-	-		-	-
Net Debt Repayments %	43	79		33	86
Surplus INR cr	**1373**	**-155**		**1750**	**205**

Valuation- Not only WEL has had a better financial performance, capital allocation and governance, it is also available at a discount to SEL.

Valuation Ratios	**WEL**	**SEL**
Year End	FY24E	TTM Dec'23
Price*	1300	38.5
Market Cap	37,601	51,956
EV	33,140	51,891
EV / Sales	2.8	8.6
EV / EBITDA	20	57
EV / CFO	17	184
P/S	3.1	8.6
P/B	5.1	15.2
P/E	41	72
Earnings Yield	2.4%	1.4%
Dividend Yield	0%	0%
CFO Yield	5.8%	0.5%

Suzlon prices as of 27th Mar 2024 and tentative IPO price for WEL

Outlook- Both WEL and SEL exhibit promising growth prospects, driven by heightened emphasis on renewable energy and favorable regulatory developments. However, given the historical challenges and governance issues associated with SEL, it is inferred that WEL presents a more favorable investment opportunity.

Financial Statements of Waaree Energies (WEL) & Suzlon Energy (SEL)

Profit & Loss Statement- Although SEL boasts higher gross margins attributed to increased value addition in comparison to WEL, it is noteworthy that WEL exhibits superior PAT margins of 7% when compared to 2.7% for SEL excluding exceptional gain. Additionally, the sales per share for WEL stands at INR 277, while for SEL, it amounts to a modest INR 6.

	P&L Statement of FY23			Common Size P&L % of Sales for FY23	
	WEL	**SEL**		**WEL**	**SEL**
Sales	**6751**	**5971**		6751	5971
COGS	5151	3783		76%	63%
Gross Profit	**1600**	**2188**		**24%**	**37%**
Manufacturing Expenses	203	419		3%	7%
Employee Cost	118	609		2%	10%
SG&A	416	225		6%	4%
Miscellaneous Expenses	28	103		0%	2%
EBITDA	**835**	**832**		**12%**	**14%**
Depreciation	164	260		2%	4%
EBIT	**671**	**572**		**10%**	**10%**
Interest	82	421		1%	7%
Other Income	109	20		2%	0%
Income from investment	51	25		1%	0%
Exceptional Gain (Loss)	-21	2721		0%	46%
PBT	**677**	**2892**		**10%**	**48%**
Tax Cost	177	4		3%	0%
Consolidated PAT	**500**	**2887**		**7%**	**48%**
PAT after Minority Interest	**483**	**2849**		**7%**	**48%**
Sales Per Share	277	6			
Adjusted EPS (Reported)	22	2			
Adjusted Book Value per share	77	1			
Dividend Per Share	0	0			
Dividend Payout	0%	0%			
Number of Shares	24	1004			

Note: In Aug '23, Suzlon raised INR 2000 cr through QIB. By Sept '23, its debt had decreased to INR 146 cr, while total equity rose to INR 3409 cr. By Dec '23, Suzlon's interest costs had declined to INR 14 cr.

Balance Sheet- SEL has demonstrated significant capital consumption, evident in the approximate free reserves of around INR -18,000 cr and share premium reserves exceeding INR 10,500 cr. The restructuring and subsequent repayment of debt through equity capital in FY24 underscore SEL's capital-intensive nature. Conversely, WEL maintains a notably stronger balance sheet characterized by prudent leverage utilization and lower working capital requirements.

	Balance Sheet as of FY23			Common Size Balance Sheet as of FY23	
	WEL	**SEL**		**WEL**	**SEL**
Total Equity and Liabilities	**7420**	**5523**		**7420**	**5523**
Total Equity	**1862**	**1099**		**25%**	**20%**
Equity Capital	243	2454		3%	**44%**
Total Reserves	1558	-1355		21%	-25%
Free reserves	573	-17959		8%	-325%
Share Premium	973	10668		13%	193%
Other reserves	12	5937		0%	107%
Liabilities	**5558**	**4424**		**75%**	**80%**
Non-Current Liabilities	**629**	**1723**		**8%**	**31%**
Long-Term Borrowings	184	1517		2%	27%
Long Term Provisions	69	168		1%	3%
Other Long-Term Liabilities	328	38		4%	1%
Deferred Tax Assets / Liabilities	48	0		1%	0%
Total Current Liabilities	**4929**	**2701**		**66%**	**49%**
Short Term Borrowings	722	42		10%	1%
Short Term Payables	1432	895		19%	16%
Short Term Provisions	113	571		2%	10%
Other Current Liabilities	2584	848		35%	15%
Total Assets	**7420**	**5367**		**7420**	**5367**
Non-Current Assets	**1937**	**1224**		**26%**	**22%**
Gross Block	*1263*	*2612*		17%	49%
Less: Accumulated Depreciation	*272*	*1775*		4%	33%
Net Block	1044	716		**14%**	**13%**
Tangibles	*1030*	*716*		14%	13%
Capital Work in Progress	537	3		7%	0%
Long Term Loans & Advances	167	62		2%	1%
Other Non-Current Assets	188	441		3%	8%
Current Assets	**5483**	**4142**		**74%**	**75%**
Inventories	2709	1827		37%	33%
Trade Receivables	313	1170		4%	21%
Cash & Bank & Current Investment	1767	367		23%	7%
Short Term Loans & Advances	634	618		9%	11%
Other Current Assets	60	160		1%	3%
Total Debt	**906**	**1905**		**12%**	**34%**
Capital Employed	2768	3004		37%	54%
Ex Cash Capital Employed	1000	2637		13%	48%
Total Equity (Ex Cash)	94	732		1%	13%
Cash & Investment (C&I)	1767	367		24%	7%
Contingent Liability	69	192		1%	3%

Note: In Aug '23, Suzlon raised INR 2000 cr through QIB. By Sept '23, its debt had decreased to INR 146 cr, while total equity rose to INR 3409 cr. By Dec '23, Suzlon's interest costs had declined to INR 14 cr. =COP, CPA, CPL, CPW,

Cash Flow Statement- In FY23, WEL generated a cash flow of INR 1560 cr, contrasting with INR 467 cr for SEL, largely attributable to enhanced working capital management. Both WEL and SEL raised equity capital in FY23; WEL allocated it towards capital expenditures for future growth initiatives, while SEL utilized it to settle its restructured debt obligations.

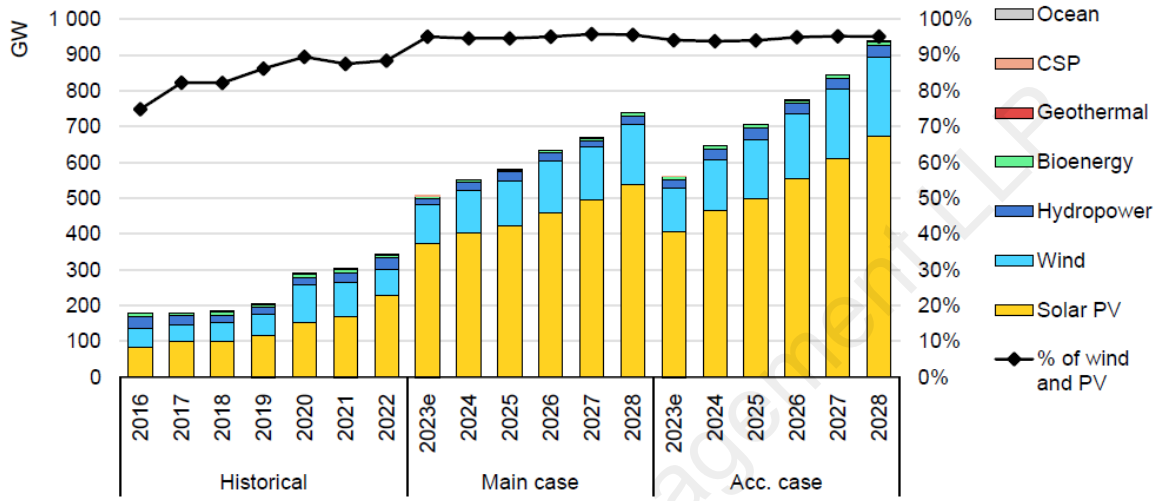
	Cash Flow Statement of FY23			Cash Flow as % of Sales for FY23	
	WEL	**SEL**		**WEL**	**SEL**
Cash flow from Operations	**1560**	**467**		**23%**	**8%**
Profit Before Tax	677	2,892		10%	48%
Adjustments for Net Cashflow	**264**	**(1,867)**		**4%**	**-31%**
Depreciation	164	260		2%	4%
Interest Expenses	58	383		1%	6%
Interest and Dividend Income	-51	-		-1%	0%
Other Adjustments	93	(2,510)		1%	-42%
Adjustments for Changes in Operating Assets and Liabilities	**720**	**(543)**		**11%**	**-9%**
Trade & Other receivables	-215	193		-3%	3%
Inventories	-2171	381		-32%	6%
Trade & Other payables	3668	(1,118)		54%	-19%
Other Adjustments	-563	1		-8%	0%
Cash generated from operations	**1661**	**482**		**25%**	**8%**
Tax Paid	-100	(15)		-1%	0%
Cash Flow from Investing	**-2242**	**85**		**-33%**	**1%**
Capital Expenditures	-862	(14)		-13%	0%
Investment in Subsidiaries, JVs & Associates*	-	77		0%	1%
Investments other than Subsidiaries, JVs, and Associates	-1264	10		-19%	0%
Interest and Dividend Income Received	30	12		0%	0%
Increase/ Decrease in Loans given	2	0		0%	0%
Cash Flow from Financing*	**791**	**(684)**		**12%**	**-11%**
Borrowings	-151	(1,339)		-2%	-22%
Interest Paid	-65	(425)		-1%	-7%
Equity Share Issue/(Buyback)	1040	1,080		15%	18%
Other financial activities	-181	0		3%	0%
Net Cash Inflow / Outflow	**109**	**(133)**		**2%**	**-2%**
Opening Cash & Cash Equivalents	**139**	**500**		**2%**	**8%**
Closing Cash & Cash Equivalent	**254**	**367**		**4%**	**6%**
Free Cash Flow to Firm	728	541		**11%**	**9%**
Free Cash Flow to Equity	351	(1,223)		**5%**	**-20%**
Capex	(862)	(14)		**-13%**	**0%**

*Investment in shares of Waaree Renewable Technologies is mentioned in Cash Flow from Financing, in our opinion it should be under Cash Flow Investing and hence we have recategorized it.

Global Solar PV Industry

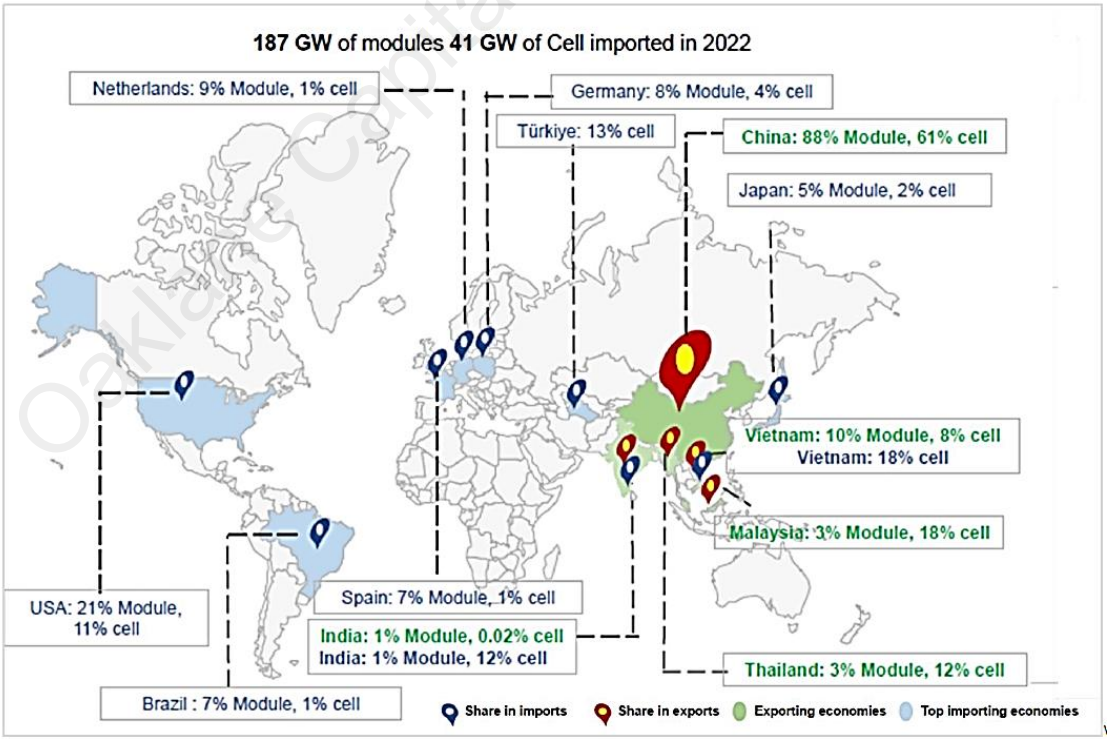
- **Global Solar PV Capacity Additions-** Globally, the installed capacity of solar PV has increased from 296 GW in CY16 to 1055 GW in CY22, representing a CAGR of 24%. The cumulative installed capacity of the top three countries are as follows: China with 392 GW, the US with 112 GW, and Japan with 83 GW. Looking ahead, IRENA anticipates that installed capacities will grow at a CAGR of 17.5% between CY22 and CY27, reaching 2359 GW in CY27.

Renewable electricity capacity additions by technology and segment



Source: IEA

- **India's exports face tough ASEAN competition, limiting market share in US. Indian exports are not competitive to countries which import from China**



Source ITC Trademap, CRISIL

- **N-type technology continues to upgrade, with opportunities in cost cuts and efficiency gains-** TOPCon may swiftly become a mainstream technology in the industry, the industrialization of HJT will likely accelerate and xBC is poised for a breakthrough in the higher-end market segment

Fig 37: Demand by cell technology type and forecasts (GW)

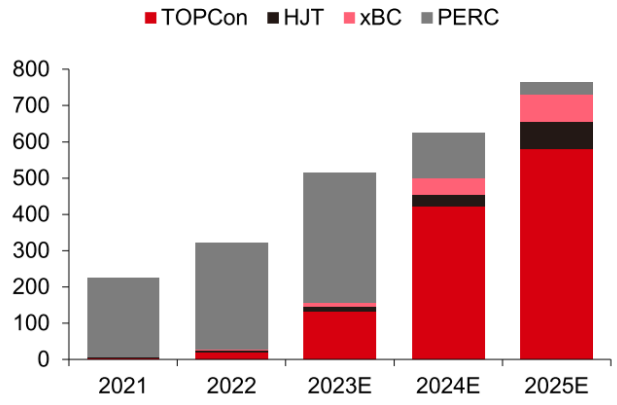
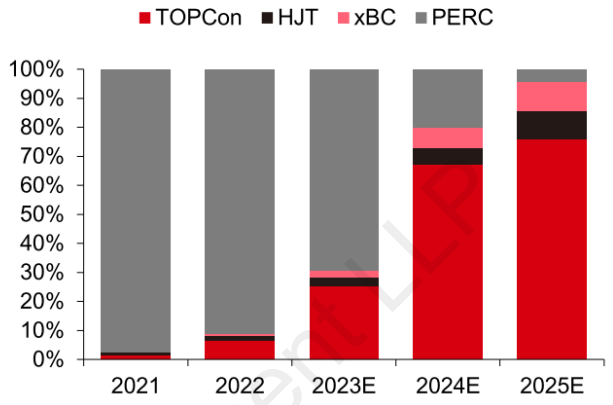


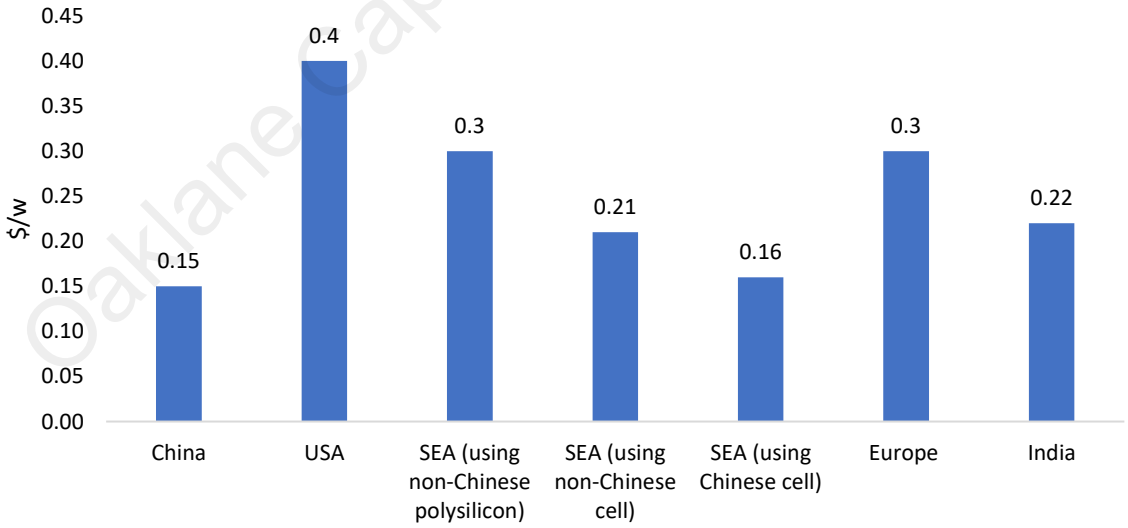
Fig 38: Market penetration rate by cell technology type and forecasts



Source: Infolink Consulting, CITICS Research

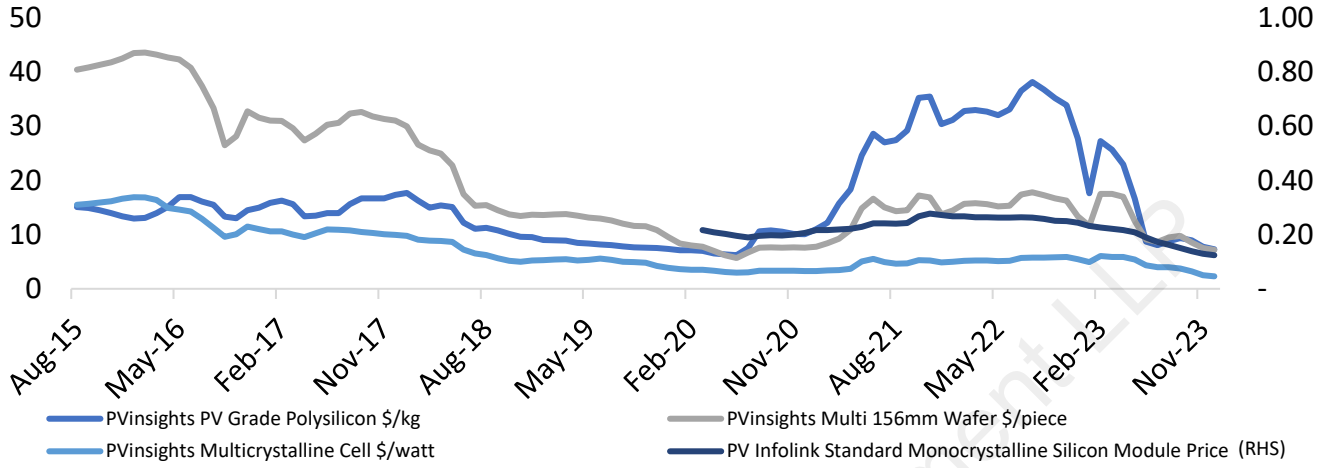
- **Total Manufacturing Costs for mono PERC Solar Modules by Country (Dec'23, $/w) –** China and Southeast Asian nations utilizing Chinese solar cells stand as the most economical producers of solar photovoltaic (PV) modules, with manufacturing costs of $0.15 and $0.16, respectively. In contrast, India's manufacturing cost is $0.22, exceeding China's by more than 45%. In FY23, with cell costs approximately at $0.12 per Wp, India's production costs amounted to $0.26 per Wp, which is 4% higher compared to WEL's production cost of $0.259 per Wp.

Country-wise solar module manufacturing cost (ex-works, Dec'23)



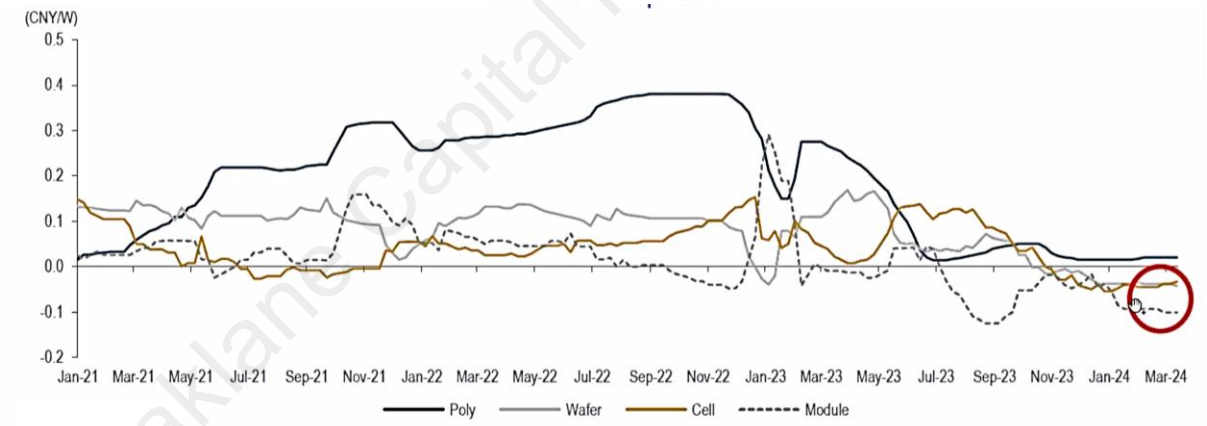
Source: Wood Mackenzie, TD Cowen

- **Global Solar Supply Chain Price movement**
  - **Polysilicon** price has fallen to $7.3/Kg from its peak $38.2/kg (-81%)
  - **Wafer** price has fallen to $0.14/Piece from its peak $0.36/piece (-60%)
  - **Cell** price has fallen to $0.05/Wp from its peak $0.12/Wp (-60%)
  - **Module** price has fallen to $0.12/Wp from its peak $0.28/Wp (-53%)



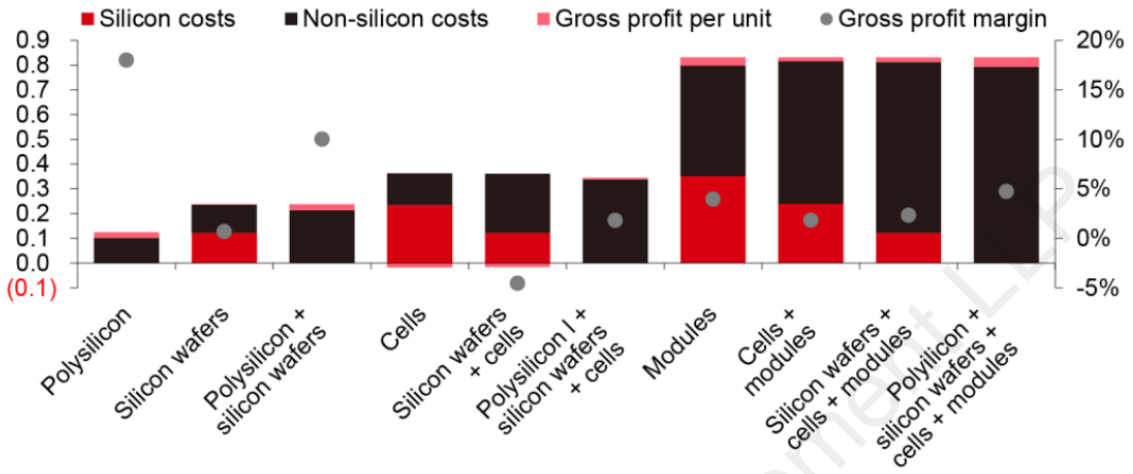
Source: Bloomberg, PV Infolink, PV Insights

- **Movements of Net Profit Margins across main PV industry chains-** Profits have markedly diminished across diverse segments, and certain sectors are encountering challenges stemming from prevalent industry-wide losses.



Source: PV Infolink, Dalwa

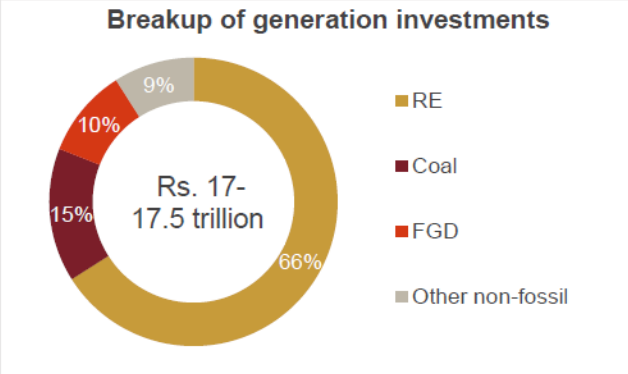
- **Theoretical estimates on the profitability at each segment of PERC cell production based on current spot prices (Rmb/W)-** Profitability throughout the solar PV industry value chain has reached an unprecedented low, and only a select few industry leaders, possessing distinct advantages in terms of cost, technology, and market position, are positioned to maintain profitability.



Source: Solarzoom, SMM, CITICS Research

Indian Solar PV Industry

- **Indian Power Industry-** Investments in power generation are anticipated to be primarily driven by renewable energy (RE) capacity expansions, trailed by coal power generation and flue gas desulfurization ("FGD") installations. It is expected that between 2024 and 2028, there will be a solar capacity addition of 130-140 GW.



Source: CRISIL

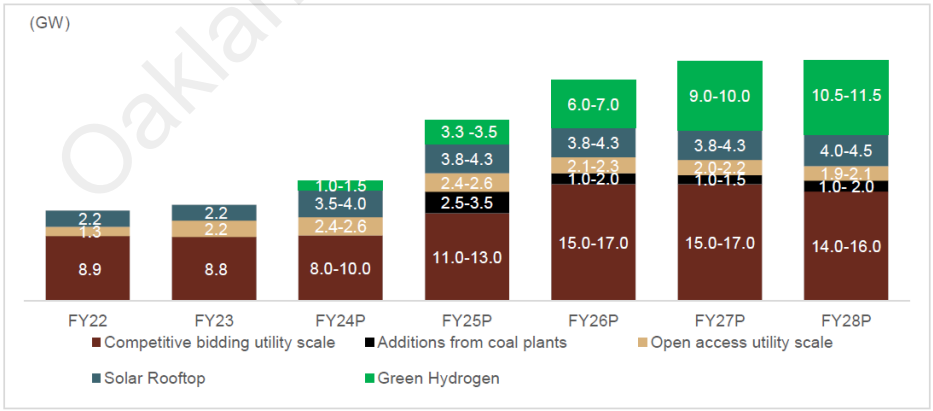
- **Renewable energy in India-** As of October 2023, the installed grid-connected renewable energy generation capacity, including large hydro, comprised roughly 42% of India's total installed generation base. Potential and cumulative capacity of RE (technology-wise)

Technology	Potential	Cumulative capacity (as of Oct 23)	Untapped potential
Wind	~696 GW (120 m hub height)	44.3 GW	93.6%
Solar	750 GW	72.0 GW	90.4%
Bioenergy	25 GW	10.26 GW	59.0%
Hydro	165 GW	51.8 GW	68.6%
Waste to energy	NA	0.6 GW	NA

Hydro: Large + Small hydro

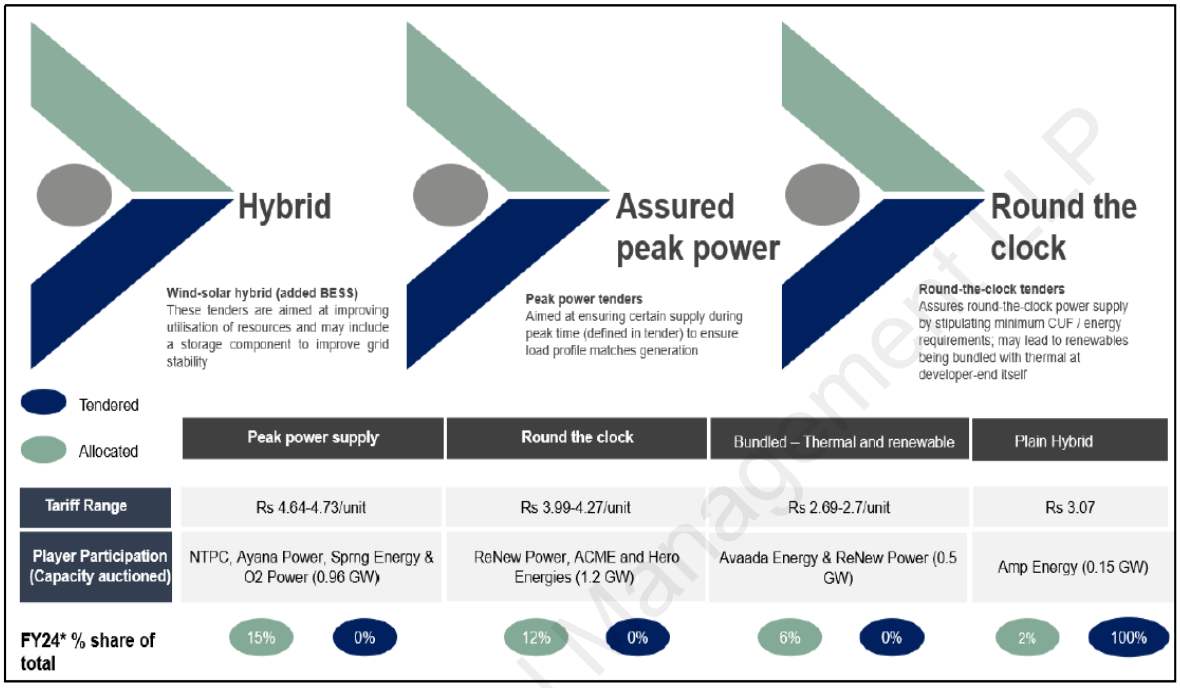
Source: MNRE, NITI Aayog, CRISIL

- Solar capacity additions of 130-140 GW expected over fiscals 2024-2028. It is projected that by fiscal year 2028, only 10% of India's domestic demand for solar PV products will rely on imports.



Source: CRISIL

- **Solar Energy cost-** The solar module accounts for approximately 55-60% of the total system cost, excluding land, while the inverter contributes another 6-7%. Land requirement stands at approximately 5 acres per MW. To achieve a 10-12% Internal Rate of Return (IRR), tariffs ranging from INR 2.8 to 3 per unit would be necessary, factoring in the imposition of Basic Customs Duty (BCD) and supply-side challenges. For the following three types of tenders, the tariff range is elevated due to increased capital and operating expenses resulting from storage requirements or the need to scale up plant capacity. Higher tariff range at around ~Rs 3-5 per unit mark required to maintain returns similar to regular tend

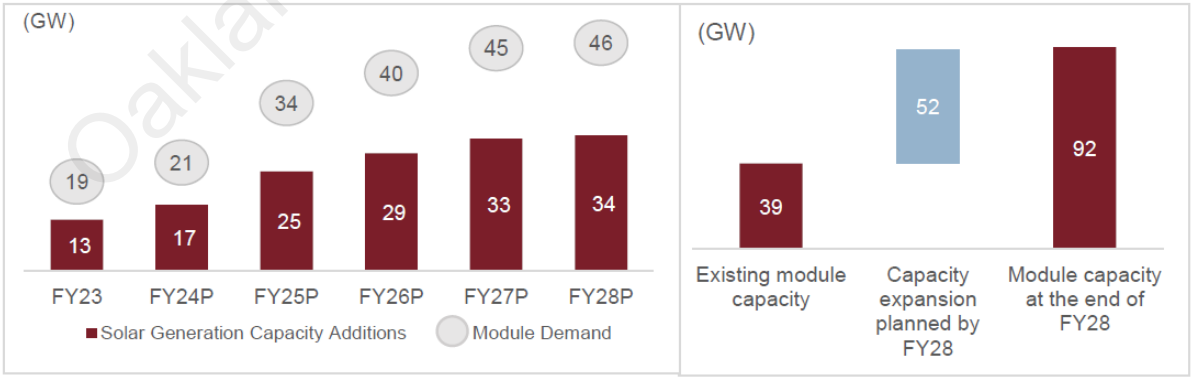


FY24: as of June 2023

Source: CRISIL

- **Solar Rooftop in India-** Grid connected rooftop has a capacity that totals approximately 11.1 GW as of August 2023. Commercial & Industrial segment account for 75-80% of rooftop solar market.

- **Solar PV modules Demand- Supply in India-**



Source: CRISIL

- **Companies expanding under 2 PLI schemes**

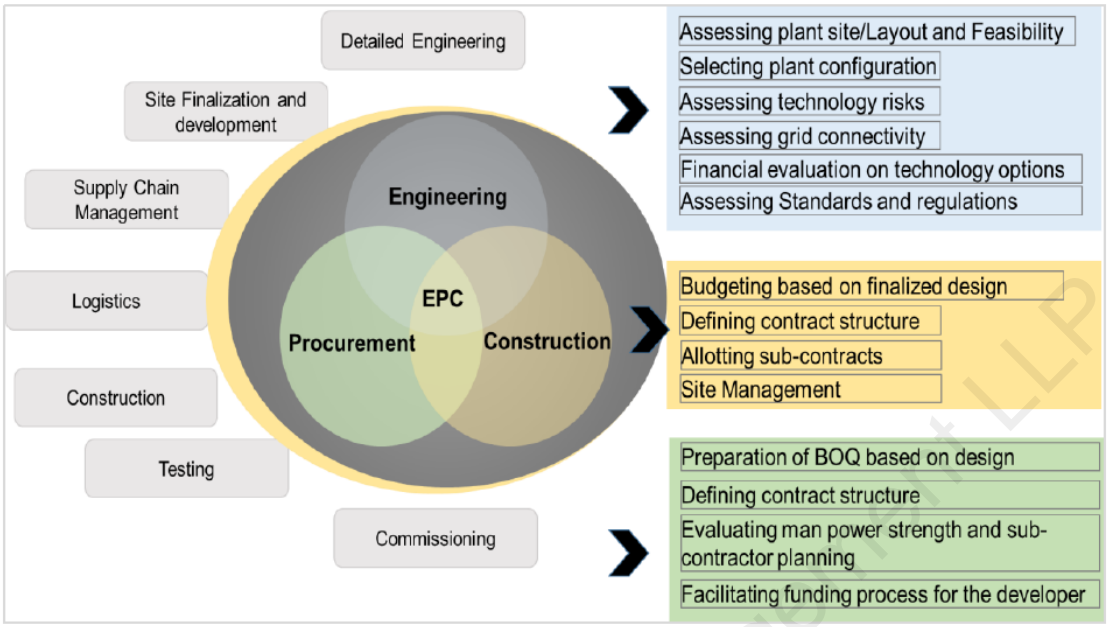
Company name	Polysilicon	Wafer	Cells	Modules
Shirdi Sai Electricals	4,000	4,000	4,000	4,000
Reliance New Energy Solar	4,000	4,000	4,000	4,000
Adani Infrastructure	737	737	737	737
Total PLI Tranche 1	**8,737**	**8,737**	**8,737**	**8,737**
Indosol (Shirdi Sai)	6,000	6,000	6,000	6,000
Reliance	6,000	6,000	6,000	6,000
First Solar	3,400	3,400	3,400	3,400
Waaree		6000	6,000	6,000
Avaada		3000	3,000	3,000
ReNew		4800	4,800	4,800
JSW		1000	1,000	1,000
Grew		2000	2,000	2,000
Vikram			2400	2,400
AMPIN			1000	1,000
Tata Power Solar			4000	4,000
Total PLI Tranche 2	**15,400**	**32,200**	**39,600**	**39,600**
Total PLI Tranche 1+2	**24,137**	**40,937**	**48,337**	**48,337**

Solar EPC Market in India

- A typical EPC solar project traditionally covers design, civil works, equipment procurement and installation, and commissioning. However, due to constrained returns, the scope of an EPC solar project has expanded to include Operations and Maintenance services as well. Most EPC players now offer integrated and customized solutions tailored to client requirements through a consultative approach. EPC services can be categorized into various subcategories based on the scale and type of installations, namely utility-scale and rooftop solar installations.

- The project works are divided into supply (material) contracts and services contracts, which are awarded to different entities instead of a single EPC contractor. Developers procure capital-intensive items such as modules, transformers, inverters, and cables, which constitute approximately 75%-80% of the project cost. Third-party contracts are then engaged for services such as civil works, commissioning, erection, and mounting of equipment, forming about 20%-25% of the project cost. However, certain solar module manufacturers prefer to procure the entire package, including services, rather than just the solar modules, as they also offer EPC services.

- **Checklist of an EPC model**



Source: CRISIL

- The key features of an EPC contract are the following:
  - Fixed construction price;
  - Fixed completion schedule;
  - Responsibilities and guarantees with respect to project performance and warranties;
  - Liquidated damages for delay and performance gaps;
  - Single point of responsibility on the EPC contractor; and
  - Termination and dispute resolution.
- Summary of standard market practices in the solar EPC Industry

Sr. No.	Key determinants under the EPC contract	Tentative ranges based on the industry
1	Performance ratio	75-80%
2	Warranties and guarantees on solar modules and inverters	5–10-year warranties on solar Inverters Performance warranty on PV modules for peak output wattage, >= 90% at the end of 10 years and 80-85% at the end of 25 years)
3	Warranties and guarantees on balance of plants	To be provided by the EPC contractor (or under pass through)
4	Liquidated damage costs /delay penalties	~0.5% to 1% per week of the Contract Price subject to the maximum limit of 5% to 10% of Contract Price
5	Advance bank guarantees	~10% of the contract value, to be released within three months of the end of the contract/tenure
6	Insurance cost	Can be a part of the EPC contract (*To cover execution risk*) or taken separately by the developer (*generation loss due to grid unavailability)*
7	Power during construction	To be provided by the developer *(grid interconnection)* or EPC contractor *(diesel-based power)*
8	Liasoning and regulatory approvals	The responsibilities can be shared or can be taken up by either of the parties

Source: CRISIL

Key Indian Government Policies

- **Domestic content requirement-** The DCR requires the utilization of solar cells and modules manufactured domestically, meeting the specifications and testing requirements established by MNRE through its approved list of models & manufacturers.
- **Approved list of models and manufacturers-** The ALMM, initiated in 2019, ensures the quality of solar modules used in India. It lists certified solar cell and module types and manufacturers approved by the Bureau of Indian Standards. Only modules on the ALMM are eligible for government-sponsored solar projects. This will likely come in effect for new projects from FY24
- **PLI scheme-** The PLI scheme provides incentives to qualifying manufacturers depending on their yearly production of high-efficiency solar PV modules and cells. The incentive is determined as a percentage of the manufacturing cost of the modules or cells, with a maximum cap set at ₹ 400 per watt for modules and ₹ 150 per watt for cells. 48GW PV Module Manufacturing to be commissioned in next 3yrs, with capital outlay of Rs.240 Bn in two phases. 6GW is allocated to Waaree for wafer to module manufacturing.
- **Basic customs duty-** On April 1, 2022, the government implemented a basic customs duty (BCD) of 40% on solar modules and 25% on solar cells as part of **Atmanirbhar Bharat**. This duty applies to all imports of solar modules and cells, irrespective of their country of origin.
- **Strong infrastructure support** for Solar sector like Solar Parks, availability of contiguous land parcels, low-cost financing & tech development
- **PM-Surya Ghar Muft Bijli Yojana** for installing rooftop solar in one cr households with a total outlay of INR 75,021 cr.

CRISIL Ratings webinar on the Renewables sector (Feb'24)

Key takeaways

- 108 GW of renewable capacity in next four fiscals due to a strong pipeline and pick up in auctions
- Solar remains preferred mode of capacity addition with tariffs in ranges of Rs 2.5 — 2.6 to give lucrative returns
- Rising renewable capacity, Govt focus and auction pace to pave way for 8 GW storage capex by FY 28
- Government grants and falling prices to bring standalone storage tariffs around Rs 8 for lucrative returns
- LPS and increasing share of central off takers reduced receivables by 70 days since March 2022
- High capex intensity to limit further leverage reduction of developers from levels seen in fiscal 24

Panel Discussion

Parag Sharma, Founder & CEO, O2 Power

Nikhil Dhingra, CEO, Acme Group

Manish Gupta, Senior Director and Deputy Chief Ratings Officer, CRISIL Ratings

- In FY23 15 GW bids were asked, in FY24 30 GW are already out (this is not installed capacity, installed capacity is much higher). So, for 50 GW bid, installed capacity will be 90 GW
- FY23 was not the best year for solar. As incremental capacity addition was not very high. Since Jan'24, 1.8 GW was added, and 2-3 GW is expected in Feb and March. FY24 installation can be around 14 GW. Wind will close around 3.5 GW
- FY25- solar 30 GW plus, and for wind 4-5 GW.
- FDRE- wind is 2-2.5x of solar. 100 MW of FDRE- 100 MW solar, 250 MW Wind and 25 MW of storage. FDRE is 3-4x costlier than standalone generation. Tariff is 4-4.5 rs per unit.
- Equity & debt capital is unlikely to be a constraint for growth. International debt funding has again opened up for large developers for diversification of sources. Domestic sources like large banks, PFC/REC have also opened up in last few years
- Have submitted to SEBI for derivatives market- merchant capacity can be hedged
- Receivables for Gencos- if incremental payments are not done in 75 days, power can be blocked
- Renewables is 18-19% of national electricity generation. Solar & Wind is 12-13%. When solar & wind reach 26-28% generation, India will need 14 GW hrs of storage. This is likely by FY28
- Solar module availability- if ALMM comes in April 2024, we might not be well positioned to cater to demand. It's a dynamic situation we have to see how ALMM regulation unfolds
- C&I segment policy- interstate open access is possible now as transmission charges have been reduced. C&I will grow because of this change
- Land- one of the top constraints for solar generation. Private land acquisition is a big bottle neck, which can constraint capacity development. Also land closer to connectivity hotspots is needed. Unlike other infra like road where govt provides land, in this the bidder has to acquired land

Policy Led Growth

- 75% of power capacity additions of 145 GW to be renewable (108 GW) till fiscal 2028

- Strong government support though Conference of the Parties (COP) commitments, increase in auctions, clarity on policy matters
- Solar projects to lead additions, with tariffs of Rs 2.5-2.6/ unit proving lucrative for developers
- Module supply not expected to be a constraint despite ALMM becoming effective April 2024
- Wind additions to ramp up, driven by policy support; tariffs of —Rs 3.2/ unit required to generate returns commensurate with solar

Strong government focus to drive additions

- High RPO targets for discoms
- Increase in renewable auctions
- Other policies for annual RE auctions, funding through bonds, solar parks to ease land availability and transmission plans to integrate 500 GW of RE

Solar preferred as module costs soften; Tariffs of Rs 2.5 — 2.6 lucrative

- Expect solar tariffs to remain around similar levels, going forward.

Module supply not expected to be a constraint for growth

- ALMM was postponed for 2 years as there was not enough PERC module capacity in India. Now the capacity has come up, so sourcing will not be a problem despite ALMM coming online

Wind additions supported by policy nudge and improved profile of wind OEMs; Tariffs to remain higher than solar at —Rs 3.2/ unit to generate equivalent returns

- Important for diversification of sources. Also, a part of new projects with hybrid generation
- Also supported as backward integration of wind energy is available in India
- However, wind will be limited compared to solar because of higher capital cost and resultant higher per unit price

A Push Towards Storage

Government push to pave way for 8 GW storage capex by fiscal 2028

Storage tariffs of Rs 7.5-9 per unit could provide IRRs of 16-18%

- Multiple types of projects like peak power, round the clock, FDRE and standalone storage

Lower Operating risk for players despite higher capex

Receivables for key developers down by 70 days since March 2022

- Receivables improved sharply after implementation of LPS scheme
- Contribution of central counter parties and states like Gujarat is increasing

Stable operating performance; high capex to limit leverage correction

KTAs from Waaree Energies FY23 AGM (Sept'23)

The entire board of directors, heads of departments, as well as second and third-level employees were in attendance. Unfortunately, the CEO, Mr. Vivek Srivastav, was unable to attend due to prior commitments. Additionally, second-generation promoters, namely Pujan, Ankit, Vrushali, and Rushabh Doshi, were also present at the meeting.

Industry View

- The anticipated global annual installation of solar modules was projected to reach 1000 GW by the year 2035, with an intermediate target of 400 GW by 2023. However, it is now conceivable that this goal may be attained well in advance of the initially estimated timeline.
- The current solar installation capacity in India for the current year stands at 71 GW. The anticipated growth rate for solar installations in India is projected to be a minimum of 30%, with the potential for even higher expansion.

Revenue & Margin Drivers

- **Order book-** An order book of $5 billion, equivalent to approximately 17 GW, is scheduled for execution over the next 2-3 years. Idle capacity has been maintained to accommodate any potential domestic demand as needed.
- **Module prices-** The initial cost of solar modules was $126 per Wp in 1970. It came down to $4.83 per Wp in 2007 when WEL entered this business. Presently, it has reduced to $0.12-0.30 per Wp depending on the market you sell to. The aspiration is to achieve a cost below $0.01 per Wp. Over the long term, it is anticipated that module prices will continue to decrease. This reduction in cost is expected to bolster demand, given its competitive advantage in affordability compared to other companies. *This is the response provided when queried about the impact of diminishing module prices on revenue and margins.*
- **Customers-** The predominant clientele in the United States consists primarily of Fortune 500 companies. Concurrently, efforts are underway to sell flexible modules tailored for the Swiss market. Presently, these flexible modules are already available and actively marketed in the United States.
- **Advances from customers-** The percentage varies between 5% and 20%, contingent upon whether the customer is domestic or an export client, aligning with industry standards observed among global peers.
- **Outlook for polysilicon prices-** Commencing from an initial value of $300, the price fluctuated to a low of $3 before subsequently rising to $40. Due to the inherent nature of being a commodity, it is challenging to provide a specific outlook. However, it is anticipated that the cost of solar energy generation will decrease, thereby fostering an increase in market demand.
- **Imported Raw material-** Presently, the imported content value constitutes 80-85% of total sales. However, this proportion is expected to decrease in the future because of strategic backward integration initiatives and the ongoing development of the solar photovoltaic industry within India.
- **Margins with backward integration-** The incorporation of cell manufacturing is projected to yield an increase in margins by 2-3%, while the addition of wafer production is anticipated to contribute an additional 1-2% to the overall margin.
- **New businesses-** We plan to initiate the establishment of a gigawatt-scale electrolyser facility within the upcoming 12-15 months.

Capital Intensity

- **Capacity Utilisation-** For FY24, the utilisation is anticipated to range between 55-60%, and in subsequent periods, there is a potential for it to escalate to 75%.
- **Capex per GW-** The estimated cost for the production facilities, including land and utilities, is approximately INR 150 cr for a 1 GW module. Similarly, for 1 GW of cells, the projected cost ranges between INR 700-750 cr, while for 1 GW of wafers, the estimated cost is around INR 800 cr.
- **5.4 GW cell factory-** Progress is proceeding as planned, and the anticipated operational commencement is expected to be achieved by the conclusion of December 2023.
- **6 GW Wafer to Module line**- Currently considering Gujarat, Rajasthan, and Orissa as potential states (though not yet finalized, negotiations regarding terms with these states are underway). *Approximately a week ago, during an interview with ET Now, it was suggested that the state of Orissa has been tentatively finalized, pending only the closure of financial agreements*. The timeline for this project is expected to span 30-36 months. All output from this project is designated for captive use, and the PLI for this initiative amounts to INR 1923 cr.

Link to interview- https://www.youtube.com/watch?v=yX-TcDvG7B0 8 min 15 seconds

Capital Structure & IPO timeline

- A debt amount of INR 2400 cr has been secured for capital expenditures; however, as of now, it remains unutilized. This is due to the utilization of customer advances and equity to finance the capital expenditures.
- Looking to obtain low-cost debt financing from US IDFC and other institutions in Europe and India for the 6-gigawatt project. No further updates are available currently. (Note: Tata Power has secured $425 mn funding from US IDFC)
- The Draft Red Herring Prospectus (DRHP) is currently in the preparation phase and is expected to be filed imminently, although no specific details are available at this time.
- The Initial Public Offering (IPO) is not subject to any immediate urgency or external pressure

Corporate Governance

- Inquiries were made regarding the strategic plans involving Waaree Technologies and the positioning of the energy storage business. The management responded by indicating that the focus of the current discussion is specifically on Waaree Energies, and consequently, details related to Waaree Technologies cannot be disclosed at this moment. Further clarification on this matter is sought.

Competition

- The count of participants in the Indian solar industry is anticipated to increase in the coming years, given the improved industry environment compared to the last decade. Players will need to enhance their scale to remain competitive under these evolving conditions.

Technology

- Having consistently remained at the forefront of technological advancements for the past 15 years, we are presently engaged in collaborative initiatives with academic institutions to pioneer the development of perovskite technology. This technology has been under discussion for the last four years, and it is estimated to require an additional 3-4 years before achieving commercial viability.

Initiating Note on Waaree Energies Ltd (May'23)

Contents

Disclaimer- The financial figures for FY23 presented in this report are from the unaudited data available as of May 2023. It is important to note that we have given the audited financials in the KTAs from the DRHP note.

Summary

Pre-Money Valuation	**12,500**	Sales	**6,814**	Gross Margin	**22%**
Post-Money Valuation	**13,500**	EBITDA	**866**	ROE	**40%**
P/E*	**29**	PAT	**470**	Capacity Utilisation	**49%**

For FY23 (INR cr). *Post money basis

Key Stats

	Sales	EBITDA	PAT	ROE	Debt/ Equity	WC % of Sales
10 Yr CAGR/ Median	37%	35%	34%	17%	0.7	-2%
5 Yr CAGR/ Median	40%	70%	81%	20%	0.8	-2%
3 Yr CAGR/ Median	50%	108%	130%	20%	0.9	-14%
FY23	139%	681%	484%	44%	-	-

Company Brief

- Established in 1989 by Mr. Hitesh Doshi and his family, the Waaree Group originated with Waaree Instruments Ltd and subsequently diversified into multiple business verticals. Presently, the group is under the management of Mr. Hitesh Doshi and Mr. Viren Doshi, alongside a team of seasoned professionals.
- Founded in 2007, Waaree Energies (WEL) stands as the flagship entity within the Waaree Group. The company specializes in the manufacturing of solar PV modules, solar EPC projects, as well as trading solar products.
- **Since our initial investment in October 2022 at a market cap of INR 5500 cr, the company has delivered on its growth guidance, demonstrating a remarkable growth with a 2.4x increase in revenues to INR 6814 cr (guidance of INR 7155 cr) and a 6.4x surge in Profit After Tax to INR 470 cr in FY23 exceeding its guidance of INR 171 cr.**
- With an operational capacity of 11 GW as of Mar'23 and a substantial order backlog of INR 45,000 cr (assuming INR 2.5 cr realization per megawatt (MW)), compared to INR 24,000 cr in August 2022, the company's robust sales performance is poised to continue. Positioned aptly to capitalize on the burgeoning growth opportunities in the renewable energy sector and bolstered by its presence in lucrative and rapidly expanding markets like India and the US, the company is well-equipped to sustain its performance in the medium term.
- At a price of INR 550, WEL's implied market capitalization is 13,500 cr with an FY23 PE of 29x and an FY24E PE of 15x on our conservative PAT estimate of INR 928 cr for FY24E. It appears that there is limited downside risk at present, even in the scenario where the company does not experience exponential growth.

RHP- Company Brief / DRHP- Company Brief

Investment Thesis

*Large TAM * Industry growth * Leadership position in India * Management Quality * Size & Scale of Company * Financial Strength*

- ***Large TAM & Industry Growth*** – We project the Total Addressable Market (TAM) for WEL to encompass the solar PV module markets in the United States and India, expected to exceed 300 gigawatts from 2024 to 2028, indicating a substantial addressable market size of $85 billion (source: IEA). Furthermore, the solar industry in India is emerging as a sunrise sector, benefiting from a favourable macroeconomic cycle that includes decarbonization, favourable regulatory environment (China + 1). Environmental, Social, and Governance (ESG) considerations, and a diminishing cost per watt. Presently, solar energy is not only recognized as an ESG investment but is also acknowledged as a cost-effective power solution, as indicated by Lazard.
- **Leadership position in India & Globally (ex-China)-** WEL holds the distinction of being the foremost module manufacturer in India and is the 2nd largest globally, excluding China. With a current capacity of 11 GW, the company aims to augment this capacity to 20 GW by FY27. This expansion is strategically planned to uphold and strengthen WEL's dominant position in the market.
- **Management Quality-** Over the past decade, global business models in the solar industry have been established and matured. However, this period was challenging for Indian players, and those who persevered have acquired valuable insights and expertise in navigating the industry landscape during this downcycle. WEL's management successfully emerged out of this downcycle and has demonstrated its execution capabilities by successfully increasing the capacity from 2 GW in FY22 to 11 GW as of Mar 2023.
- **Size & Scale of the Company-** WEL has achieved a commendable financial performance, reporting sales of INR 6,814 cr and a PAT of INR 470 cr in FY23. The company has demonstrated an impressive 3-year CAGR of 50% for sales and 130% for PAT, underscoring the management's adeptness in scaling operations and executing strategic initiatives. The pivotal factor contributing to this success lies in the effective execution of operations and proficient logistics management. The inherent challenges in scaling, particularly in the realm of logistics, make it noteworthy that only a limited number of players have been able to establish capacities exceeding 1 GW.
- **Financial Strength-** WEL has successfully procured equity and debt capital under advantageous terms. Furthermore, maintaining advances at 5% of the order book has resulted in a negative working capital cycle for the company. This strategic financial approach along with state & central government incentives positions WEL favourably for future growth and facilitates forthcoming capacity expansion initiatives.
- **Key Monitorables-** 1) IPO timeline 2) Capacity utilisation 3) Per unit realisation 4) Commissioning of new plants including that of wafer & cell 5) Changes in terms of trade of working capital 6) Change in regulations and incentives from various governments

RHP- Investment Thesis / DRHP- Investment Thesis

Risks

- **Solar PV Price Dynamics**- A substantial decline in realizations per watt peak (Wp) has the potential to adversely impact revenues & margin. Presently, the export realizations stand at approximately $0.35 per Wp
- **Raw material price-** A rise in raw material expenses can impact margins, this will be partially mitigated through the implementation of backward integration measures.
- **Risk associated with changes in US government policies**- the current regulatory environment favours manufacturers outside of China. This is evidenced by anti-dumping duties of up to 239% and countervailing duties of up to 18.5%, contingent on different suppliers from China. Furthermore, the US has implemented a ban on solar modules with cell components manufactured in specific provinces in China. Any significant shift in the US stance towards China could potentially exert a substantial impact on WEL's ability to secure orders under favourable terms. Also, Chinese companies can offer more favourable trade terms in the event of a slowdown in demand, which may subsequently be demanded from Indian companies as well.
- **Execution risk**- The management's proficiency in achieving production scalability and maintaining optimal capacity utilization levels is a key consideration. Additionally, their ability to handle necessary logistics, including the management of 30,000 to 40,000 containers per 1000 MW, is crucial. Any delays in operationalizing the solar cell plant are noteworthy aspects of assessment.
- **EPC business-** Vikram Solar, identified as an emerging participant in the industry, is currently facing challenges associated with its EPC business. In contrast, WEL has strategically positioned its EPC business within a subsidiary, maintaining a primary focus on the exportation of solar modules.
- **Low-capacity utilisation**- below optimum capacity utilization has the potential to result in negative operating leverage and a contraction of profit margins.
- **Yield on cells-** A reduced yield in cells can exert a significant and adverse influence on overall profitability.
- **Warranty-** Substandard product quality has the potential to initiate warranty claims, especially considering the extended warranty duration. Nonetheless, the company has insurance and reinsurance coverage in place for its products.
- **Working capital management**- Poor management of working capital has the potential to adversely impact cash flows, and historically, the company has relied heavily on a significant percentage of working capital credit lines.
- **Employee retention-** The potential recruitment of senior-level employees by Adani and Reliance poses a risk to execution, as these entities may offer three times the current salary along with additional perks and benefits. To address this concern, the management is formulating policies, and the stability observed at the Chief Executive Officer (CXO) level provides reassurance.
- **Risks in contract with customer**- Potential risks within customer contracts encompass various clauses such as escalation and pass-through mechanisms, cancellation terms, penalties for tardy deliveries, warranty specifications, and provisions for advances. Notably, the prevailing order book features a price escalation clause tied to an index, mitigating the risk associated with potential rises in raw material costs. Additionally, any costs incurred due to logistical delays are borne by the customer.
- **Risks in contract with supplier**- Contractual risks with suppliers include the absence of extended supply agreements with vendors, and a potential substantial impact from heightened material costs, particularly considering the narrow profit margins. To address this, the company is strategically implementing backward integration efforts to produce 60% of its solar cell requirements. Furthermore, the company has entered into multi-year agreements for the supply of solar cells and exclusively engages with the top 2-3 players in China.

- **Risk of technological obsolescence-** associated with the potential challenge of securing new technology on favourable terms from the technology partners. The prospect of technological obsolescence looms should there be an inability to successfully negotiate a deal with the technological partner.
- **Forex risk-** The company is exposed to unhedged foreign currency positions, and any unfavourable movements in foreign exchange rates have the potential to influence profit margins.
- **Cost of Capital-** If the company is not able to secure growth capital at favourable terms

Key Observations & Red flags

- The management demonstrates astuteness and has exhibited commendable performance in a sector that has faced considerable challenges over the past decade. The promoters appear to have a stable source of income beyond their business activities, allowing them to receive lower salaries from the company. A positive development is the appointment of Vivek Srivastava as the Group CEO, a seasoned professional with a reputable background from his tenure at Reliance Industries Limited (RIL). Under his leadership, contractual arrangements with customers and vendors have been reinforced, signalling that moving forward, any costs incurred due to logistics delays will be borne by customers. It is noteworthy that in the fiscal year 2022, WEL incurred a penalty of INR 160 cr due to logistics delays.
- Information obtained through channel checks indicates that there may be concerns about the long-term quality of the product, as warranties for module performance may be invoked. WEL provides a 10-year warranty for manufacturing defects in the product and a 25-year warranty for the output performance of modules, aligning with industry norms. It is noteworthy that the company has not received any warranty claims thus far.
- In the United States, it is customary for companies to provide a 5-20% advance payment for solar panels and solar cells. As per management indications, advances typically range from 20-30% of the order value, and for orders scheduled for delivery within one month, the standard practice is a 100% advance payment.
- WEL currently possesses a substantial order book totalling 17,482 MW, with a notable portion of 1,900 MW originating from a singular customer. Findings from channel checks indicate that Chinese companies boasting a capacity exceeding 25,000 MW generally refrain from accepting orders of such magnitude—specifically 2,000 MW—from a single company or country at once. This cautious approach is attributed to the potential impact on margins due to fluctuations in raw material prices. In contrast, WEL has undertaken such a sizable order, implementing price escalation clauses tied to an index to mitigate risks associated with raw material price changes.
- The surge in sales within the Rooftop segment was predominantly driven by a government initiative in Gujarat that offered subsidies ranging from 20-40% for installations. Notably, the increase in installations among MSMEs was facilitated by the sanctioning of over 100% of the required capacity. This allowed companies to utilize solar capacity for captive consumption while also having surplus capacity to sell back to the grid at a rate of INR 1.75. However, recent discussions with residents and MSME owners in Ahmedabad, Surat, and Rajkot reveal a decline in interest for rooftop installations following the withdrawal of subsidies by the Gujarat government. Consequently, the management is redirecting focus towards the Enterprise business.
- The long-term credit rating for the company stands at BBB+, reflecting an upgrade from BBB with a stable outlook. Additionally, the short-term credit rating has been recently upgraded to A2 from A3+. Historically, the company heavily relied on credit lines. However, the management has conveyed that this reliance is expected to decrease in the future. This shift is attributed to the anticipation that advances from customers and equity financing will diminish the utilization of short-term credit lines.

- WEL has appointed SRBC & Co, a partner of E&Y as its statutory auditor, replacing the previous auditor, Shah Gupta & Co. Additionally, KPMG serves as the internal auditor for the company.
- Waaree Renewables Technologies, formerly known as Sangam Advisors, was initially a shell company at the time of its acquisition by the Waaree group. Currently, it commands a market capitalization of INR 1000 cr on TTM sales of INR 228 cr and a PAT of INR 21 cr. The company operates in the Engineering, Procurement, and Construction (EPC) and Power Generation sectors.
- Waaree Technologies, which previously operated as a shell company, now holds a market capitalization of 150 cr. The company reported a revenue of INR 4.5 lakh in FY21, and it increased to INR 13 cr in FY22. The company is into energy storage business
- RT Jain & Co, the auditor for both Waaree Renewables Technologies and Waaree Technologies, is also the auditor for one other listed company, Supreme Engineering, which has a market capitalization of 55 cr. Additionally, Accord Fintech database indicates that RT Jain & Co audits two unlisted companies, CKP Leisure and CKP Products.

RHP- Risks / DRHP- Risks

Revenue Drivers

INR Cr	FY23 UA*	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15	CAGR		
										3 Yr	5 Yr	10 Yr
Order Book (MW)*	18060	3280	410	-	-	-	-	-	-	-	-	-
Order Book*	45150	8200	1025	-	-	-	-	-	-	-	-	-
Advances	2329	594	52	-	-	-	-	-	-	-	-	-
Advances as % of Order Book	5%	7%	5%	-	-	-	-	-	-	-	-	-
Net Sales	6814	2854	1953	1996	1591	1341	992	829	551	-	-	-
Net Sales YoY %	139%	46%	-2%	25%	19%	35%	20%	50%	76%	50%	40%	37%
Export %	-	23%	25%	12%	13%	12%	3%	7%	6%	172	38%	-
Domestic %	-	56%	42%	77%	71%	79%	97%	93%	94%	-5%	95%	32%
Franchise %	-	20%	20%	12%	16%	4%	0%	0%	0%	43%	4%	-
EPC & Others %	-	1%	14%	-	-	-	-	-	-	-	-	-

- Since our initial analysis in October 2022, the company has delivered on its growth guidance, demonstrating a remarkable growth with a 2.4x increase in revenues to INR 6814 cr (guidance of INR 7155 cr), this translates to a 3 yr Sales CAGR of 50%. Also, a 6.4x surge in Profit After Tax to INR 470 cr in FY23 exceeding its guidance of INR 171 cr registering a 3 yr CAGR of 130%
- The growth in demand for Solar PV from China, the US, and the European Union is expected to be primarily driven by utility-scale solar farms, supported by the resumption of postponed projects due to supply constraints and government initiatives. The geopolitical developments have proven advantageous for WEL, and the management has indicated that they can selectively accept or decline orders based on the current situation.
- WEL has notably benefited from the US-China trade war. While exporters from Cambodia, Malaysia, Thailand, and Vietnam have been observed attempting to circumvent the US anti-dumping duty from China, certain exporters from these countries will be required to provide evidence of non-circumvention after June 2024, or alternatively, pay the anti-dumping duty.
- While WEL does not have a significant presence in Europe as it primarily imports from China, there has been a recent uptick in European visitors to the WEL factory. Furthermore, the company is set to exhibit at a conference in Munich in June 2023, signalling an increased focus on the European market.
- The higher export realizations for WEL are attributed to its position as one of the few companies outside of China, alongside First Solar, that can supply solar products at scale. This unique market position allows them to command a premium in the export market.
- The disparity in selling prices of modules between Chinese and Indian players stands at 8-9%. However, for clients, this translates to a difference of 3-4% in overall project costs. This cost variation is perceived as an acceptable expense by clients who view it as an investment in risk diversification away from China. Notably, modules constitute 30-40% of the overall project cost for Independent Power Producer (IPP) projects in the United States.
- Regarding pricing, WEL employs a model where it charges an additional 25 cents per module over the cost of the cell. It is noteworthy that this pricing structure is recalibrated each month prior to the commencement of production.

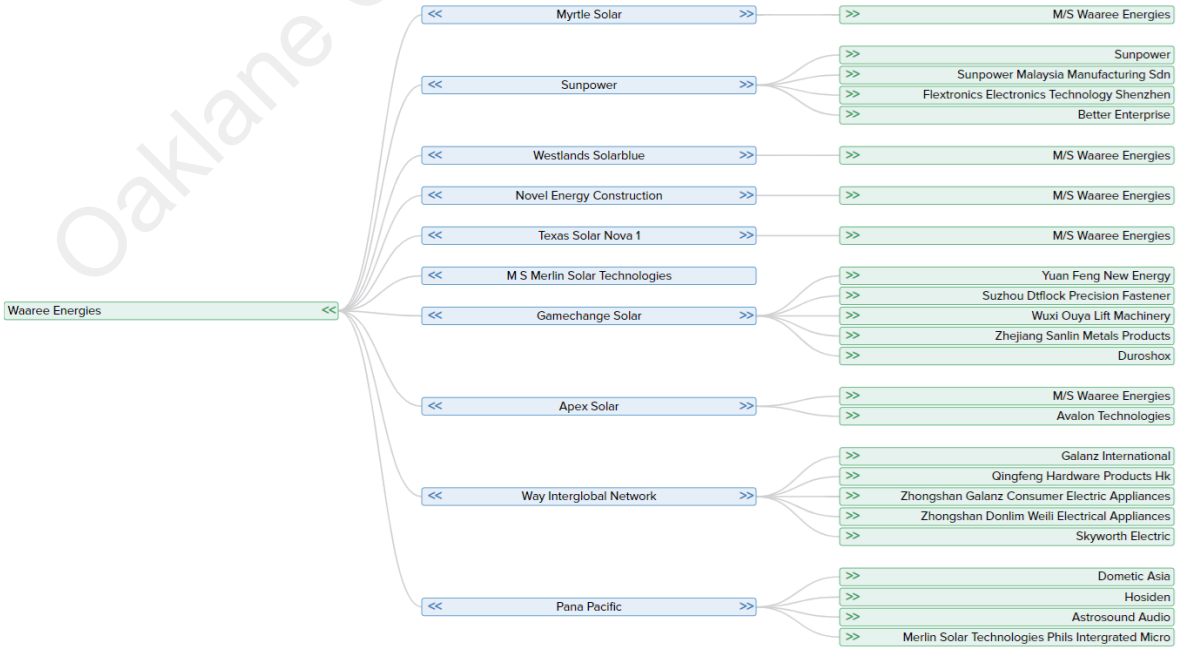
- The substantial opportunity within the solar sector has resulted in a significant increase in WEL's order book, reaching INR 45,000 cr in May 2023, as compared to INR 24,000 cr in August 2022. This order book is expected to be executed over time by fiscal year 2026, and the company has the capacity to take on additional orders for interim periods. Furthermore, the order pipeline for WEL currently exceeds INR 1 lakh cr.
- As of May 2023, WEL holds advances amounting to INR 4,100 cr. The management has specified that advances typically account for 20% of the order book, and approximately 5-7% of these advances are reflected in the financial records at any given time.
- The cash flow process involves 5% payment at the time of order confirmation, an additional 15% before the commencement of yearly production, and the remainder is secured in the form of Letters of Credit (LC). Consequently, the company receives the full 20% advance before delivering the initial shipment to the client. The management emphasized that they do not consider an order as a contract until the advance payment is received.
- Customer advances for First Solar have consistently ranged between 5-10% over the past seven years. It is important to note that First Solar supplies both modules and solar PV systems, making it not entirely comparable to WEL's business model. In the case of Canadian Solar, customer advances typically fall within the range of 5-20%, as indicated in their annual report.
- During FY21 and FY22, Chinese players failed to fulfil their contractual obligations amidst increases in raw material and freight costs. Consequently, WEL capitalized on this opportunity to gain market share and establish strong relationships with foreign customers.
- It has designated a dedicated 1 GW plant exclusively for fulfilling orders from Panasonic, and another 1 GW plant is specifically allocated for orders from Sun Solar.
- Excluding the retail segment, clients conduct round-the-clock inspections at the plant. Agencies designated by the clients are stationed within the facility, and they have been allocated cabins.
- Logistics currently operates as a profitable cost centre for WEL. The transportation of modules to the Inland Container Depot, Navkar Terminal, takes approximately 2 hours by road. Subsequently, the modules are transported to JNPT or Hazira port by train. Each 1 megawatt (MW) of capacity requires 3 containers, and the company anticipates the need to manage approximately 1500 containers per month going forward.
- The Indian solar opportunity is projected to be 395 gigawatts (GW) over the next 8 years. Reliance is anticipated to contribute significantly to this demand, with an estimated requirement of around 100 GW for solar photovoltaic (PV) projects.
- Franchisees of WEL function as comprehensive product and service providers, catering to the rooftop and Micro, Small, and Medium Enterprises (MSME) segments. These franchisees are exclusive to the company. Additionally, WEL has a credit line of INR 500 cr with State Bank of India (SBI) for channel financing.
- Products are marketed under the brand name "Waaree," which is owned by the promoters through Waaree Infrastructure and Agritech Pvt Ltd.
- **Guidance**- Our conservative estimate for revenue is INR 11,990 cr in FY24E, with a PAT of INR 928 cr. For FY25, management has guided for a revenue of INR 21,000-22,000 cr. It is anticipated that module prices will decrease, and this will be offset by increased volumes. Additionally, there is an expectation of further improvement in the product mix, with a focus on higher-wattage modules to contribute to the overall performance and profitability.

Key Clients

Top buyers from Dollar Business Export Data, Standard Chartered & Natixis are financiers for WEL's customers and hence their name comes in exports shipment data

Top 10 Buyers (USD Mn)	Total	%
Total	**324**	
Standard Chartered	**118**	**36%**
Natixis	**44**	**14%**
Westlands	**44**	**14%**
Cenibra	**41**	**13%**
APS Solar	**29**	**9%**
Fort Bend	**18**	**6%**
High Point	**17**	**5%**
Waaree Americas	**4.1**	**1%**
Gamechange	**3.4**	**1%**
Merlin	**3.3**	**1%**

Key Relationships from Import Yeti



Product Quality

- WEL's panels have been recognized as bankable products by PV Evolution Labs (PVEL), a globally renowned leader in photovoltaic testing. The third-party testing results for Waaree panels were excellent and comparable to major international competitors, as acknowledged by PVEL. Its name is also included in the top performer scorecard issued by PVEL.
- In the 2023 scorecard for bifacial mono PERC modules, WEL received the best certification for six out of six parameters, domestic competitors like Adani Solar and Vikram Solar were certified as the best for five out of six parameters. Global giants such as Jinko Solar and Trina Solar were also certified as the best for six out of six parameters.
- As per management, there have been no warranty claims to date, and they have reinsurance in place to cover potential warranty claims. This is not expected to have a significant impact in the short term. WEL considers Jinko, Trina, and Longi for internal benchmarking purposes.

Warranty Comparison

Company	1st Year Performance	Linear Degradation	Performance at 30th Year	Years	Type
Waaree Energies	98%	0.55%	82.05%	30	Mono PERC P type Bifacial
Adani Solar	98%	0.45%	84.95%	30	Mono PERC P type Bifacial
Vikram Solar	98%	0.50%	83.50%	30	Mono PERC P type Bifacial
Jinko Solar	97%	0.50%	82.50%	30	Mono PERC P type Bifacial
Canadian Solar	98%	0.45%	84.95%	30	Mono PERC P type Bifacial
First Solar	98%	0.50%	83.50%	30.5	Higher Quality

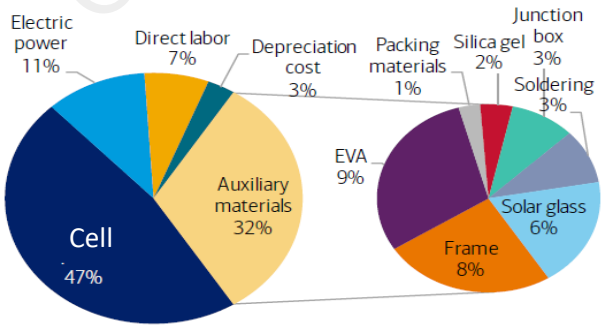
RHP- Revenue Drivers / DRHP- Revenue Drivers

Margin Drivers

Margins (%)	2023 UA	2022	2021	2020	2019	2018	2017	2016	2015	Delta		
										3 Yr	5 Yr	10 Yr
Gross M	24%	19%	17%	18%	23%	22%	22%	20%	14%	6%	1%	4%
EBITDA M	12%	4%	5%	5%	9%	8%	11%	10%	5%	7%	4%	15%
EBIT M	10%	2%	3%	3%	6%	6%	8%	8%	4%	7%	4%	13%
PBT M	10%	4%	3%	3%	7%	3%	5%	2%	5%	7%	3%	10%
PAT M	7%	3%	2%	2%	5%	2%	3%	0%	2%	5%	2%	7%

- The module represents the highest value addition in the solar supply chain, with customers providing specifications to module players, while cell and wafer players are not concerned with these specifications.
- Key materials required include solar cells, back sheets, encapsulants, glass, and aluminium panels. Over the past two years, input costs have increased due to supply chain disruptions, but it is anticipated that these costs will decrease over time. With economies of scale, WEL's margins are expected to increase.
- Currently, 75% of raw materials are sourced from factories outside China, and the goal is to reach 100% by the end of FY24. Currently, cells and glass are sourced from outside China, while items like EVA, junction boxes, and other small components come from China.
- EBITDA margins have been on an upward trend since 2020 and continued in FY23. This trend is attributed to a higher share of exports, lower raw material costs, operating leverage, and better realizations.
- The global supply of silica is forecasted to rise significantly, turning a sector supply shortage in 2022 into a surplus by 2023. This is expected to lower silicon ASP (average selling price) from $39/kg in 2022 to $11.5/kg by the end of 2023. Lower input costs for WEL are expected to increase gross margins, but it is crucial to monitor the average selling price going forward.
- A decline in polysilicon prices is expected to lead to cost savings for vertically integrated module production. Each $1.5/kg price decline in polysilicon is estimated to translate to 0.3 cents/W cost savings for modules. Analysts anticipate the module sector to regain profits in CY 2023.
- Module suppliers, working with end-users who are less price-sensitive than solar product manufacturers, particularly in overseas markets like Europe and the US, are expected to have increased bargaining power against upstream suppliers.

Jan'23 Module Cost Breakdown



Source: Citi Research

- In module manufacturing, the requirement for blue-collar employees is estimated to be 400-500 people per GW. If this process is automated, employee costs could potentially be reduced by half. However, the trade-off is that the capital expenditure (capex) for automation would double. The current feasibility of relying on a larger workforce is attributed to the relatively low employee cost, approximately Rs11,000 per month. Comparatively, China's efficiency advantage allows them to achieve similar productivity with around 80% of the employee count.
- Other costs:

	FY22	FY21	FY20	FY19
SG&A as % of Sales	*15%*	*13%*	*14%*	*14%*
Warranty Expense as % of Sales	*0.48%*	0.37%	0.43%	0.41%
Foreign currency expense as % of Total Expenses	-	63.5%	70%	66%
Bad debts as % of Receivables	0.3%	0%	3.2%	3%

- For warranty purposes, replacement is considered the best option due to the falling cost curve. The cost has reduced significantly, going from INR 300/W in 2007 to INR 30/W today.
- Insurance as a percentage of sales is expected to be around 0.5%. The cost of insurance is currently INR 0.15/W, a decrease from its previous level of 0.60/W. The responsibility for insurance can either be borne by the customer or WEL.
- Regarding forex, the company has transitioned from being a net importer to a net exporter. The hedge is currently below 30% due to natural hedging from export orders. If no natural hedge is present, the policy is to hedge 80% of the exposure.
- The current borrowing cost is approximately 13%. However, the company anticipates a decrease as it can borrow at 9% under a government scheme. With interest subvention at 4%, the effective borrowing cost is expected to reduce to 5% pre-tax.
- **Guidance-** the management has guided for FY24 gross margins at 23-24%, EBITDA margin at 16-18%, and PAT margin at 9-10%. These margins are subject to variation based on polysilicon prices.

RHP- Margin Drivers / DRHP- Margin Drivers

Capital Intensity

- Currently, WEL operates four manufacturing facilities encompassing six factories across India. These facilities are in Surat, Tumb (Umbergaon), Nandigram, and Chikhli.
- **Current capacity & proposed expansion**

	Modules	Cell	Wafer
Current Capacity	11 GW	-	-
CWIP	1 GW by June 2023	5.4 GW by Mar 2024	-
Proposed Capacity	PLI- 6 GW by April 2025 US- 2 GW	PLI- 6 GW by April 2025	PLI- 6 GW by April 2025
Cost per GW	INR 150 cr	INR 600 cr	INR 650 cr
Funding	Internal accruals, Pre-IPO 1000 cr, IPO- 1500-2000 cr + customer advances + debt		

	FY24E	FY23UA	FY22	FY21	FY20	FY19	FY18
Capacity (MW)	12000	9000	3000	2000	1500	1500	500
Effective Capacity (MW)	-	6500	2080	1540	-	-	-
Capacity Utilisation	50%	40%	46%	53%	61%	41%	60%
Fixed Asset Turns	-	-	6.7	9.2	14.7	12.7	-

- The current manufacturing capacity is based on PERC technology, which can be upgraded to TOPCon technology with an incremental capex of approximately INR 20-40 cr per gigawatt (GW). For HJT (Heterojunction) technology, a new capex of around INR 400-500 cr per GW is required, involving entirely new production lines.
- WEL plans to invest in the most efficient technology for the next cycle that will gain market share for the coming years.
- Under the second phase of the Production-Linked Incentive (PLI) scheme, WEL intends to invest a total of INR 8,500 cr for 6 GW of modules, cells, and wafers over the next two years. PLI will cover 25% of the capex, and state subsidies will contribute around 30%.
- Current capacity utilization is reported at 40%, but this figure is considered optically low due to a significant amount of capacity becoming operational toward the end of the fiscal year.
- WEL plans to establish a 2 GW starting facility in the US under the Inflation Reduction Act. The company will scale up based on incentives and demand, with customers providing long-term contracts and capital for building facilities in the US.
- The machines used in WEL's facilities are sourced from Chinese suppliers. Contracts with these suppliers involve paying 50% upon machine shipment and the remaining 50% over two years, based on plant running efficiency and product quality.
- While there are numerous suppliers for modules, cells, and wafers, the options are limited for polysilicon and ingots.
- WEL employs 10 people to perform tasks that would otherwise be automated, resulting in a cost saving of INR 2 cr per GW on fully automated equipment.
- The acquisition of Indosolar through NCLT in 2022 was primarily for its land. WEL plans to build an advanced technology cell facility of 1400 MW on this land. The company is investing INR 75 cr for capex to upgrade the plant's technology.
- The expected order execution for FY24 is 6000 MW, while the company has a capacity of 12000 MW. Management is in talks with clients to utilize idle capacity, with the expectation that utilization can increase to 85-90%.
- Technology is depreciated over 3-5 years, and maintenance capex is expected to be 2% of the gross block for the first two years, with support from the vendor who built the facility. After two years, maintenance capex is anticipated to be 5% of the gross block.

- Third-party audit assessments for exports have been conducted by Black & Veatch at the SG facility in Chikhli, Gujarat. WE: received a "Tier-1 PV Module Manufacturer" rating by Bloomberg New Energy Finance (BNEF) for the years 2018, 2019, 2020, 2021, and 2022.

- **Guidance-** The management anticipates increasing the capacity utilization to 60-65% by FY24 and reaching 70% by FY25. The funding for this capacity expansion will be facilitated through a combination of internal accruals, equity to be raised, customer advances, and debt.

Working Capital Cycle

- Presently, WEL enjoys favourable terms of trade with a negative working capital.
- **Receivables**: The company receives a 20% advance on orders. Typically, 90-100% of the payment is received before delivery, although some clients may withhold up to 10%, which is settled upon delivery. The management indicates that advances are influenced by demand and supply dynamics, and they expect advances to decrease over time.
- **Inventory**: Currently operating on a 3-month cycle, the inventory cycle is anticipated to reduce to a 2-month cycle, reflecting historical trends, as supply chains become more efficient.
- **Payables**: In certain cases, the company pays 100% advance for solar cells. The maximum advance paid to vendors is 40% of the advance received from clients.

	FY24E	FY23E	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15	FY14
Working Capital as % sales	-11%	-11%	-16%	1%	1%	-2%	-4%	-1%	-3%	3%	25%
Inventories	25%	25%	19%	19%	12%	6%	8%	6%	7%	10%	8%
Trade receivables	3%	3%	3%	6%	7%	14%	7%	14%	4%	10%	27%
Advance received	25%	25%	21%	3%	4%	4%					
Trade payables	20%	20%	21%	22%	15%	19%	18%	21%	14%	17%	9%
Advance paid	5%	5%	3%	1%	1%	1%					

The Working Capital to Sales ratio for suppliers to utilities in India and global Solar PV manufacturers is typically more favourable compared to other utilities suppliers.

WCap to Sales	2022	2021	2020	2019	2018
Waaree Energies	-16%	1%	1%	-2%	-4%
Bharat Heavy Electricals Ltd.	12%	30%	42%	44%	53%
ISGEC Heavy Engineering Ltd.	21%	20%	14%	21%	19%
Thermax Ltd.	-8%	-9%	2%	2%	-6%
First Solar	-20%	23%	22%	21%	30%
Canadian Solar	23%	32%	28%	18%	18%
Longi	NA	11%	6%	1%	15%

WCap = Inventory + Receivables + Prepaid exps to suppliers – Payables – Advances from Customers

- **Guidance-** The management anticipates that the working capital cycle will persist at its current levels and does not foresee any substantial changes within the next 5 years.

RHP- Capital Intensity / DRHP- Capital Intensity

Capital Structure

	FY22	FY21	FY20	FY19	FY18
Total Debt/Equity	0.8	0.9	0.4	0.4	0.7
Net Debt/Equity	-0.3	0.3	-0.1	-0.4	0.7
Net Debt/EBITDA	-1.4	1.3	-0.4	-0.7	2.7
Net Debt/CFO	-0.2	1.6	-0.5	-0.9	2.4

- Capex as per phase 2 of the PLI scheme is INR 8500 cr, and the company plans to raise INR 1000 cr by mid-May 2023. An IPO is scheduled for December 2023, aiming to raise INR 1500-2000 cr. A portion of the capex will be funded by customers.
- The US government is injecting funds to develop an alternative supply chain and offering long-term low-cost debt. The company is in discussions with these institutions to secure low-cost debt.
- There is no intention to raise money through CCPS (Compulsorily Convertible Preference Shares) as the goal is for investors to generate returns.
- The company is currently a net cash company with around INR 100 cr in working capital debt, and it does not plan to take on significant debt.

RHP- Capital Structure / DRHP- Capital Structure

Financials

Detailed analysis after FY23 Annual report is out

Strong Growth- FY23 marked a significant milestone for the company, with reported revenues more than doubling from INR 2854 cr in FY22 to INR 6814 cr in FY23. This growth trajectory is likely to continue over the next few years, underscored by the robust order book and favourable renewable energy policies globally. From FY17 to FY22, growth had been commendable at 24% CAGR.

CAGR	**FY23UA**	1 yr	3 yr	5 yr	10 yr
Sales	**6814**	139%	50%	40%	37%
EBITDA	**866**	681%	108%	70%	35%
EBIT	**690**	926%	119%	69%	33%
PAT	**470**	484%	130%	81%	34%

Healthy Profitability – Buoyed by margins, return ratios saw a notable improvement in FY23UA. Prior to FY23UA, return on equity (ROE) ranged from 2% to 38%. The trend of healthy return ratios is anticipated to persist, driven by sustained robust margins and higher asset turnover resulting from improved capacity utilization.

DuPont	FY24E	FY23UA	FY22	FY21	FY20	FY19	FY18	FY17	FY16	FY15	FY14
ROE	36%	40%	20%	13%	13%	34%	12%	26%	15%	22%	1%
PAT/ PBT	75%	75%	66%	67%	69%	80%	59%	65%	60%	65%	100%
PBT/ EBIT*	92%	92%	183%	127%	87%	100%	84%	113%	74%	116%	-8%
EBIT Margin	10%	10%	2%	3%	3%	6%	4%	6%	5%	5%	-3%
Asset turnover	1.2	1.0	1.3	1.5	2.1	1.9	1.4	1.3	1.5	1.2	0.7
Asset/ Equity	4.5	5.8	5.3	3.5	3.1	3.4	4.3	4.4	4.2	5.4	3.8

Cash Flow Conversion

- The cash flow conversion is robust, with a high EBITDA to pre-tax Cash Flow from Operations (CFO). The historical cumulative pre-tax CFO to EBITDA ratio is 2 times, primarily driven by the substantial customer advances received in FY22. The company incurs tax, and the cumulative cash tax to Profit and Loss (P&L) tax ratio is 0.9

	FY22	FY21	FY20	FY19	FY18	FY17	FY16
EBITDA	106	85	92	144	57	71	58
Pre-tax CFO	726	92	95	123	102	45	69
CFO	700	71	83	105	63	30	57
CFO Margin	25%	4%	4%	7%	5%	3%	6%
FCFF	255	-108	17	203	28	49	48
Cash Tax/ PBT	21%	31%	20%	17%	94%	21%	32%

- Subsidiary- Waaree Renewable Technologies is projected to report a Profit After Tax (PAT) of INR 60 cr in FY23 and anticipates achieving a PAT of INR 125 cr for FY24E.

Guidance & Outlook

- In FY23, WEL experienced a turning point, seizing the export opportunity to the US, resulting in a significant financial performance boost. The company successfully met its revenue guidance, achieving INR 6814 cr compared to the targeted INR 7155 cr, representing a growth of 2.4 times over FY22 revenues of INR 2,854 cr.
- Management had initially guided for a PAT of INR 171 cr for FY23 but surpassed expectations by delivering a substantially higher PAT of INR 470 cr, reflecting a remarkable 6.6 times growth over the FY22 PAT of INR 71 cr.
- With a robust order book of INR 45,000 cr to be executed by FY26 and an order pipeline of INR 1 lakh cr, the management has set ambitious targets for FY24, projecting a revenue of INR 14,000 cr and a PAT of INR 1,000 cr, however we have more conservative estimates with FY24E revenues at INR 11,990 cr and PAT at INR 928 cr. Looking ahead to FY25, the guidance includes a revenue target of INR 21,000-22,000 cr with an expected PAT of INR 1,500 cr. The company anticipates growth primarily from the export market, particularly the US. The necessary capex for current orders and future expansion is already in place to support the next phase of growth.

RHP- Financials / DRHP- Financials

Capital Allocation

- The management adopts a conservative approach to capital allocation, expanding operations based on confirmed orders, and will continue this strategy in the future. Any expansion plans will be considered only if a basic Return on Investment (ROI) is achievable; otherwise, the company will explore alternative investment avenues.
- Regarding forward integration, there are currently no plans for Independent Power Producer (IPP) ventures unless a suitable partner is identified. While solar inverters offer superior Return on Equity (ROE), there are no immediate plans to enter this segment.
- In terms of backward integration, the company has indirectly been involved in cell manufacturing for 6-7 years. The process involves purchasing equipment and gaining hands-on experience from hundreds of engineers from suppliers, supporting day-to-day operations for two years. In-house cell manufacturing is expected to enhance gross margins by up to 3-4 percentage points, and with wafer production, this margin improvement can be further increased.
- Backward integration
  - The easiest to most challenging stages of backward integration for WEL are as follows: frame, EVA (Ethylene Vinyl Acetate), wafers, and polysilicon.
  - The company envisions backward integration up to the silica stage but not in the immediate future.
  - Among these stages, the production of polysilicon and the manufacturing of ingots and wafers require the most significant capital expenditure.
  - While wafer production is considered relatively easier, it involves substantial power consumption, and it plans to establish this capability in the next 2-3 years.
  - For solar glass manufacturing, the company is exploring partnerships rather than direct investment.
  - Additionally, there are plans for a small investment in EVA to contribute to the ecosystem, like the model observed in the automotive ancillary ecosystem.
- WEL enjoys differential pricing under DCR (domestic cell requirement) with differential pricing. Over the past 8 years, they did not invest in capacity, as they did not perceive any unique selling proposition. The decision is being revisited considering government and policy support, anti-China sentiments, and customer advances.
- The debt-to-equity ratio has never exceeded 0.8x, and there are no plans to significantly increase debt for capital expenditure unless there is clear growth visibility and customer advances.
- Despite an opportunity to acquire Solaria in the US with an attractive deal, WEL declined, deeming it outside their domain.
- The company is working on developing research and development capabilities at the Nandigram plant to manufacture machines.
- The EPC (Engineering, Procurement, and Construction) business is performing well, and there are no plans to sell it.

Optionalities- WEL aspires to play a substantial role in the energy transition, aiming to extend its influence beyond solar. The company envisions achieving this broader impact within the next 5 years.

- **Batteries**- In the realm of batteries, the company has been operational for four years with some sales in the 2W category, targeting sectors such as telecom, resorts, and other users with significant power backup needs. WEL sees batteries as a substantial opportunity, akin to solar modules.

- Furthermore, the company is venturing into the manufacturing of Lithium-Ion Cells for Lithium-Ion Batteries. Advanced discussions for collaborations in this technology are underway, with plans to finalize terms within the next two months and commence the construction of a 1 GW plant.
- In the field of electrolysers, WEL has secured an order to supply hydrogen, set to begin in the next 6-7 months. The Green Hydrogen Project the company has undertaken serves as a learning platform for green hydrogen technology and the market. Depending on the outcomes, it may expand its involvement in this sector. Collaborating with Steinbeis and DSE Consortium, Germany, the company plans to establish a Green Hydrogen plant within the next 3-4 years. The company also aims to manufacture electrolysers for green hydrogen and explore solar thermal technologies to convert coal-fired plants into green power plants. It is noteworthy that 1 kg of hydrogen requires 55 kW of electricity, and solar energy could be utilized for hydrogen plant operations.

RHP- Capital Allocation / DRHP- Capital Allocation

Corporate Governance

Hitesh C Doshi
Chairman, Managing Director & Founder
- Initiated the Company's foray into Renewable Energy
- Serial Entrepreneur with proven record of value creation

Hitesh Mehta
Whole Time Director & CFO
- Chartered Accountant with 25+ years of profound experience
- Diverse portfolio of Strategic Finance, Treasury, M&A, JV's & Corporate Structuring

Vivek Srivastava
Chief Executive Officer
- 29+ years of domestic and international experience in Energy & Mobility
- Previously worked with Reliance Industries Limited and BPCL

Abhishek Pareek
Group Finance Controller
- 14+ years of versatile and rich experience
- Previously worked with Shubalakshmi Polyesters Ltd, Bothra Metals and Alloys Ltd, Finex Services and K.K Chhajer & Co.

Jignesh Rathod
Head Operations
- 22+ years of versatile and rich experience
- Associated with Waaree since Nov'07 and instrumental in setting up and leading plant operations

Sunil Rathi
Director Sales
- 32+ years of domestic and international experience
- Previously worked with Vikram Solar, Powenetics Ltd. and APLABS Ltd.

Nitin Kapadnis
President - Franchise Business
- 27+ years of varied and rich experience
- Previously worked with ESDS Software Solutions, Sify Technologies, Airtel, Reliance Communications, GTL Ltd and Satyam Infoway Ltd.

- The Waaree promoter family consists of four brothers, each holding equal equity in the company. In addition to their business endeavours, the family is actively engaged in charitable and development work. Mr. Doshi serves as the president of the non-profit organization JEET.
- **Doshi Family Structure-** overall large joint family of 18-20 members
    - Hitesh Doshi - Manufacturing
    - Viren Doshi - EPC
    - Pujan Doshi – Motors & Pumps
    - Ankit Doshi - Battery & Franchise
    - Kirit Doshi - Land Acquisition
    - Next generation is being groomed and have been given profit centres
    - Family Trust was set up by Khimji Kunverji & PWC
- Professionals manage cell manufacturing & legal
- Hitesh Mehta - IT & Finance
- The company is actively recruiting for various C-suite executives, regional heads, and divisional heads.
- The present allocation of 80% of the board's time is focused on discussions pertaining to growth, expansion plans, and matters related to corporate governance and related party transactions.
- Under Project ChakDe, KPMG has been engaged as a consultant to enhance professionalism within the company and provide strategic guidance for the upcoming phase of growth.
- The management recognizes that robust corporate governance is not only a regulatory requirement but also a crucial aspect for meeting the expectations and needs of their customers.
- The company has demonstrated strong execution capabilities, evident in its rapid scale-up from 2 GW to 12 GW within a span of three years.
- The company plans to increase its employee count from the current 9,000 people to 15,000 in the next few years.
- Company uses Zoho, SAP for internal processes
- EY as statutory auditor, KPMG as internal auditor
- The plans for the already listed subsidiaries of WEL are currently unclear. Options under consideration include merging with Waaree Energies or maintaining them as subsidiaries.

- Waaree Technologies Ltd, listed on the BSE, had failed to comply with certain legal requirements of SEBI and the Stock Exchanges in the past.

RHP- Corporate Governance / DRHP- Corporate Governance

Related Entities

- Ten subsidiaries; key ones (in terms of net assets & profits) are Blue Rays Solar Pvt Ltd, Saswata Solar Pvt Ltd, Waaree Renewable Technologies Ltd (74.5%) is listed on BSE.
  1. Blue Rays Solar Pvt Ltd
  2. Waaneep Solar One Pvt Ltd
  3. Rasila International Pte Ltd
  4. Waaree Renewable Technologies Ltd (Formerly known as Sangam Renewables Ltd)
  5. Sangam Solar One Pvt Ltd
  6. Sangam Solar Two Pvt Ltd
  7. Sangam Solar Three Pvt Ltd
  8. Sangam Solar Four Pvt Ltd
  9. Waaree Power Pvt Ltd
- Group Companies
  1. Mahavir Thermoequip Pvt Ltd
  2. Saswata Solar Pvt Ltd
  3. Waa Cables Pvt Ltd
  4. Waacox Energy Pvt Ltd
  5. Waaree Technologies Ltd (listed on BSE)
  6. Waaree ESS Pvt Ltd
  7. Waa Motor and Pumps Pvt Ltd
  8. Waaree Renewables Pvt Ltd (Formerly Cesare Bonetti India Private Ltd)
  9. Omntec Waaree ATG Pvt Ltd
  10. Sattva Investment Advisors Pvt Ltd
  11. Greentech Power Pvt Ltd
  12. Shalibhadra Energies Pvt Ltd
  13. Patan Solar Pvt Ltd

Related Party Transactions

- Major RPT - Waaree Renewables Private Ltd, Waacox Energy Private Ltd, Saswata Solar Pvt Ltd. Aggregate RPT
- WEL entered into a fixed-cost lump-sum turnkey contract on July 26, 2021, with Waaree Renewables Pvt Ltd for all infrastructure-related work in the establishment of new manufacturing facilities in Chikhli, Gujarat, with a total value of INR 137 cr.
- The land for new manufacturing facilities at Chikhli, Gujarat was acquired from Waaree Renewables Pvt Ltd, and the aggregate consideration paid was INR 87 cr.
- Solar Cell manufacturing via subsidiary Waaree Power Pvt Ltd which is 74% subsidiary. Azure Power holds the remaining 26%
- Promoters are selling their holding in Waaree Renewable Technologies to Waaree Energies, they have committed to **re-invest a significant portion of this sum back in Waaree Energies.**
- **Guidance-** The management has suggested going forward the only RPT will be with the EPC arm of Waaree group, which is a subsidiary of WEL

RHP- Related Party Transactions / DRHP- Related Party Transactions

Competition

Global Demand, Supply and Major players

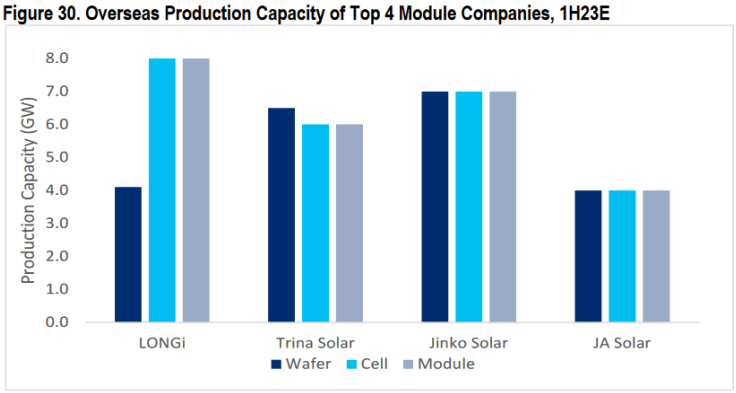
- The anticipated global demand for solar modules in FY23 is expected to reach 320 GW, with China accounting for 37% and Europe for 19%.
- US China trade war has resulted in non-Chinese companies gaining ground, but the dominance of China continues in the entire spectrum of solar module manufacturing.
- BOFA predicts a shift in supply dynamics, with modules expected to be in short supply and an oversupply of polysilicon. This shift may result in some margin redistribution from polysilicon players to module players.
- Major export markets for Chinese companies include the EU, Asia-Pacific, North & Latin America. While direct exports from China to the U.S. have decreased, exports from Chinese capacities located in Vietnam, Thailand, Malaysia, and Cambodia to the U.S. have increased. The U.S. government is expected to impose anti-circumvention duties on these companies from June 2024.

Demand - Supply	Polysilicon	Wafer	Cell	Module
Global Capacity (Dec '23E)	**2.3 Mn TPA**	**862 GW**	**810 GW**	**820 GW**
Capacity growth (2019-23E)	**37%**	**47%**	**40%**	**39%**
	China (79%)	China (97%)	China (85%)	China (75%)
	Europe (8%)	APAC (2.5%)	APAC (13%)	APAC (18%)
	APAC (6%)	Europe (0.5%)	Europe (0.6%)	Europe (3%)
Top 5 players Capacity	**75%**	**78%**	**49%**	**56%**
Major Players	GCL Poly (20%)	Zhonghuan (26%)	Tongwei (13%)	Longi (16%)
	Tongwei (19%)	Longi (23%)	Longi (10%)	Jinko (12%)
	East Hope (14%)	Shangii (12%)	JA Solar (9%)	Trina Solar (10%)
	TBEA (13%)	Jinko (9%)	Jinko (9%)	JA Solar (10%)
	Daqo (9%)	JA Solar (8%)	Trina Solar (8%)	Tongwei (8%)
	Wacker (Germany-4%)	JYT (7%)	Canadian Solar (4%)	Canadian Solar (4%)
	Hemlock (US-1%)	GCL Poly (6%)	Risen Energy (4%)	First Solar (US-1%)
Global Demand (2023E)				**320 GW**
Demand Growth (2019-23E)				**29%**
				China (38%)
				EU (19%)
				US (10%)
Oversupply/(Shortage)				
2023 E	17%	13%		-1%
Avg 2020-22	-5%	9%		2%
Global Trade Value (2022)	**3.2 ($bn)**	**2.9 ($bn)**	**3.1 ($bn)**	**39.3 ($bn)**
Chinese Exports Breakup (2022)				EU (53%)
				APAC (24%)
				Americas (16%)
US Imports (11M 2022)			Malaysia (61%)	Vietnam (40%)
			Vietnam (26%)	Thailand (16%)
			S Korea (4%)	Malaysia (16%)

Source: Citi Research

- The U.S. has earmarked $30 billion for manufacturing renewable energy components and electric vehicle batteries over the next decade under the Infrastructure Investment and Jobs Act (IRA). Since the implementation of the IRA, announcements for 22 GW of new photovoltaic (PV) manufacturing capacity have been made in the U.S.
- The European Union has set a target to achieve 30 GW of solar module production by FY25.
- Chinese companies are expanding their manufacturing capacities outside China to cater to the demand in the U.S. and other countries.

Figure 30. Overseas Production Capacity of Top 4 Module Companies, 1H23E



Source: Citi Research

Indian Demand, Supply and Major players

- Among Indian players, WEL currently boasts the largest module capacity at 11 GW. In terms of technology, both WEL and Adani Solar have invested in TOPCon, while Reliance has invested in HJT technology, which is more capital-intensive.
- Large Indian players like Adani and Reliance have substantial captive demand, potentially limiting export competition from these companies. However, if tax arbitrage permits, these companies could import for captive demand and export to the U.S.
- Aside from domestic competition, WEL must contend with module manufacturers from China and Southeast Asia for domestic demand, while facing global competition from a diverse range of module manufacturers in export markets. China remains the largest module exporter to India, followed by Malaysia.
- Global manufacturers like LONGi Solar, Trina Solar, JA Solar, Jinko Solar, and Canadian Solar possess several advantages:
  - They have a presence across the entire PV value chain, operating on a larger scale, which results in significant cost advantages.
  - Besides price competitiveness, these global suppliers are leaders in technological innovation, a crucial factor for enhancing the utilization of energy projects and contributing to the preference for imported modules.
- In FY26, of the projected 104 GW module capacity, WEL is expected to lead with 18 GW, followed by Reliance and Adani, both with 10 GW capacities.
- For cell capacity, WE: is expected to have 11.4 GW, while Reliance and Adani follow closely with 10 GW each out of the anticipated 38 GW total capacity.
- There are only a few GW-scale companies in India, with many smaller companies having capacities in the range of 100-500 MW and higher operational costs. To operate in the US market, WEL requires a recurring expense of INR 15-20 cr per annum for approvals in US, this might act as a barrier for small players

- Vikram Solar, an emerging player in modules and EPC, is reportedly facing challenges due to a government EPC contract. The company had proposed a merger with WEL, but WEL did not agree to the offer. Its decision not to proceed with the merger was likely influenced by considerations such as brand value, technology, and the limited benefits derived from the potential acquisition, apart from obtaining a factory shed.

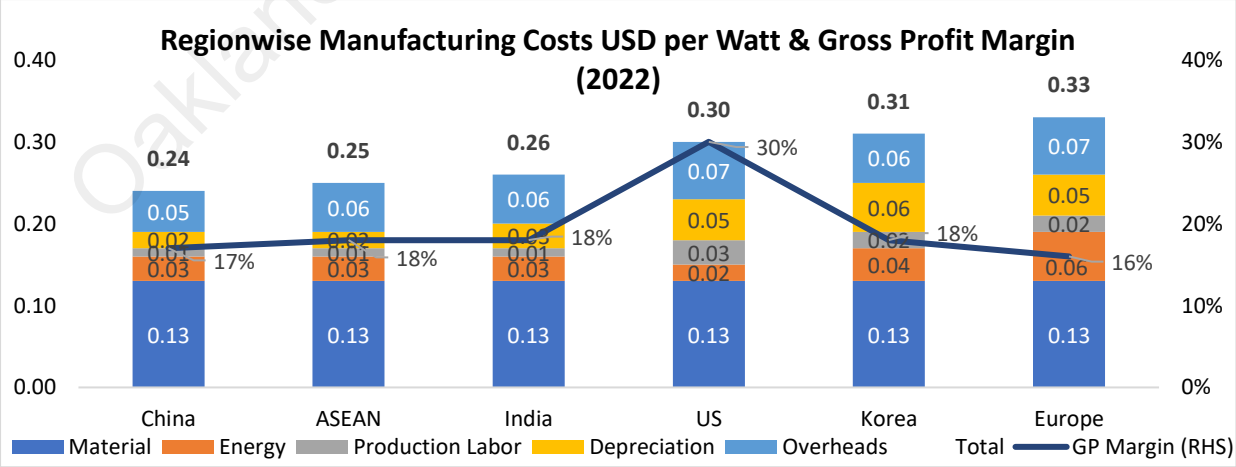
Demand- Supply	Polysilicon	Ingot/Wafer	Cell	Module
Nameplate Capacity	Nil	Negligible	6.6 GW	38 GW
Operational Capacity	Nil	Negligible	3-4 GW	19-20 GW
Number of Active Players	Nil	1	8+	70+
Expected Capacity 2026E	**38 GW**	**56 GW**	**59 GW**	**104 GW**
				Waaree (17%)
				Adani & RIL (10%)
Demand Projection CY23				**17 GW**
Top Suppliers to India 2022				Jinko (13%)
				Trina (12%)
				Longi (11%)
				Znshine (7%)
				Waaree (7%)

Source: JMK Research

Key Domestic Solar Module Manufacturers with ALMM Enlisted Capacity as of Feb 2023

Name of Manufacturer	MW	% Share
Waaree Energies	4,750	30%
Vikram Solar	2,337	15%
Mundra Solar (Adani)	1,662	10%
Goldi Solar	1,537	10%
RenewSys India	1,315	8%
Total ALMM Approved	**15,906**	

Total Manufacturing Costs for mono PERC Solar Modules by Country, 2022- With the backward integration into wafers and cells, the manufacturing cost difference between Indian and Chinese players is expected to converge and move towards 2%. In FY23, WEL's cost of production was $ 0.259 per Wp which is 4% lower than India's blended cost of production of $ 0.26 per Wp



Source: IEA. Data is ex-works for respective countries

RHP- Peer Comp / Global- Competition / Premier Energies- Competition / DRHP- Competition / DRHP- Peer Comp

Valuation

At 13,500 cr M cap, WEL is available at 29x FY23E PE and around 15x FY24E PE

Company name	Mkt cap (USDm)	PE (x)		PB (x)		ROE (%)		Yield (%)		EPS CAGR (%)	Net D/E
		2022E	2023E	2022E	2023E	2022E	2023E	2022E	2023E	2022-24E	2022E
Polysilicon											
Tongwei	25,846	6.4	11.3	2.9	2.6	57%	24%	5%	3%	-30%	0.05
Dago New Energy	3,916	2.2	3.0	0.8	0.6	53%	26%	0%	0%	-29%	
TBEA	11,866	5.8	9.8	1.6	1.5	31%	16%	5%	3%	-39%	0.13
GCL-Poly	7,071	3.1	3.6	1.1	0.9	40%	27%	0%	0%	-20%	
Wacker Chemie AG	8,423	6.3	18.3	1.6	1.6	31%	9%	5%	2%	109%	0.14
Sub-sector average	9,815	48	8.2	1.6	1.3	42%	20%	4%	2%	-2%	0.11
Weighted average		5.5	10.5	2.1	1.8	45%	21%	4%	2%	-10%	0.09
Wafer, cell and module											
LONG	46,919	19.1	18.6	5.5	4.4	27%	26%	1%	1%	7%	-0.25
JA Solar	20,221	23.9	17.0	5.3	3.2	24%	23%	1%	1%	33%	0.32
Trina Solar	17,835	33.3	18.7	4.9	3.1	18%	20%	1%	1%	55%	0.66
Jinko Solar	22,427	52.1	24.3	6.0	3.7	15%	19%	0%	1%	65%	0.21
Zhonghuan	22,338	21.4	17.8	3.9	3.3	19%	19%	1%	1%	19%	
Aiko Solar	6,685	20.2	13.1	6.1	4.1	30%	33%	0%	1%		
Canadian Solar	2,738	16.7	12.7	1.4	1.3	9%	11%	0%	0%		
Sub-sector average	19,880	26.7	17.5	4.7	3.3	20%	22%	1%	1%	36%	0.23
Weighted average		27.3	18.8	5.2	3.7	22%	23%	1%	1%	28%	0.08
Solar glass											
Flat Glass	1,198	19.3	14.5	2.8	2.5	17%	19%	2%	2%	29%	0.29
Xinyl Solar	10,213	20.9	17	2.7	2.5	13%	15%	2%	3%	27%	0.08
CSG Holdings	2,326	9.6	7.7	1.6	1.5	17%	18%	4%	5%	19%	
Sub-sector average	4,579	16.6	13.1	2.4	2.1	15%	18%	3%	3%	25%	0.20
Weighted average		18.8	15.2	2.5	2.3	14%	16%	3%	3%	26%	0.08
Solar inverter											
Sungrow	24,525	59.4	41.0	9.4	7.8	17%	21%	0%	0%	33%	-0.54
Ginlong	8,504	44.8	35.3	17.4	12.1	39%	40%	0%	0%	31%	0.58
Goodwe	6,633	79.0	34.0	20.0	12.4	26%	44%	0%	1%	96%	
Sector average	13,221	61.1	36.8	15.6	10.7	28%	35%	0%	0%	53%	0.02
Weighted average		59.6	38.6	12.9	9.5	23%	29%	0%	0%	43%	-0.21
Solar film											
Hangzhou First	12,228	33.9	22.1	6.0	4.9	16%	25%	1%	1%	32%	-0.03
Haiyou New Materials	2,101	294.6	19.3		4.4		22%		1%	372%	
Shenzhen Gas	2,942	20.0	16.2	1.6	1.5	8%	9%	2%	2%	25%	0.17
Sub-sector average	5,757	116.2	19.2	3.8	3.6	12%	19%	1%	1%	143%	0.07
Weighted average		63.3	20.7	4.5	4.3	13%	22%	1%	1%	72%	0.01
Solar farm developers											
Xinyl Energy	2,284	18.1	13.4	1.5	1.5	8%	11%	6%	8%	27%	0.27
Three Gorges	22,977	21.1	17.9	2.1	2.0	11%	12%	1%	2%	17%	1.18
Zhejiang Chint Electrics	8,988	12.9	11.6	1.8	1.6	14%	14%	2%	2%	9%	
Sub-sector average	8,597	17.3	14.3	1.8	1.7	11%	12%	3%	4%	18%	0.73
Weighted average		18.7	15.9	2.0	1.8	11%	12%	2%	2%	16%	0.81
Sector average		35.2	16.8	4.7	3.4	24%	21%	2%	2%	40%	0.22
Sector weighted average		27.9	19.3	5.0	3.8	24%	22%	1%	1%	23%	0.12

Valuation as of 9th March 2023

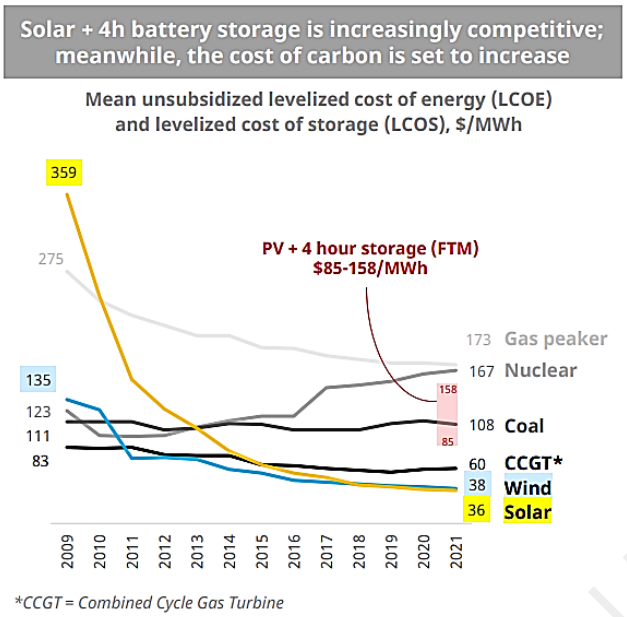
Source: Citi Research

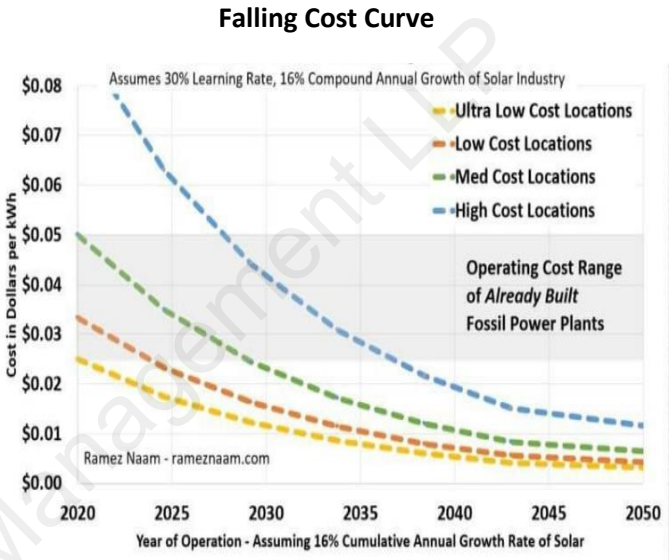
RHP- Valuation / DRHP- Valuation

Annexure

Global Perspective

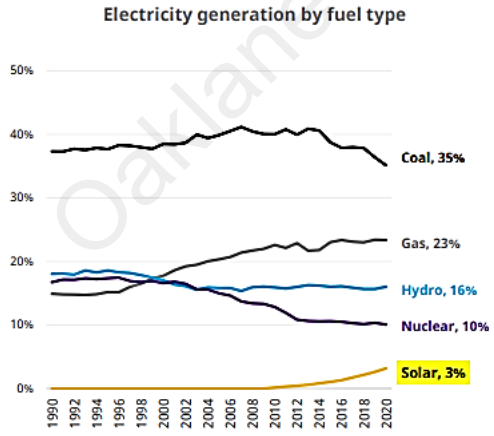
Currently Solar is the most environmentally and economically attractive source of electricity, critical for global decarbonisation

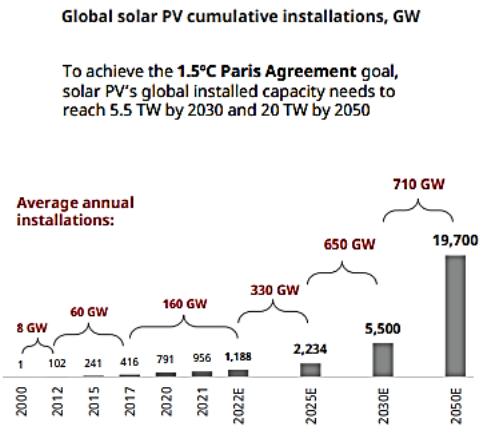




Source: Canadian Solar, Lazard 2021 LCOE and LCOS Reports

- With solar power still underutilized, there is a vast growth potential. Estimates suggest a surge from 1,000 GW in 2022 to 14,000 GW by 2050 in cumulative solar capacity.





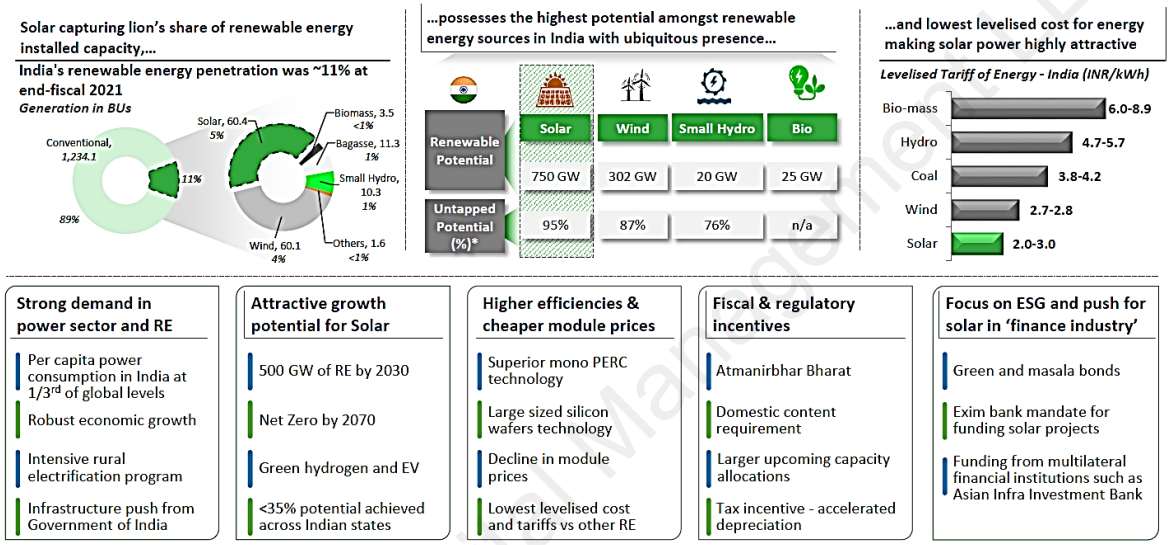
Source: Canadian Solar, BP Energy Outlook 2021, IHS, BNEF, IRENA World Energy Transitions Outlook

- Alternative fuel sources, including Green Hydrogen, rely on Green Power, with solar energy serving as a crucial provider.
- Efforts to enhance efficiency and expedite technology learning rates are underway, specifically improving efficiency for PV systems.

Diversified Commercial Applications

Indian Solar Market

- Triggers for exponential growth



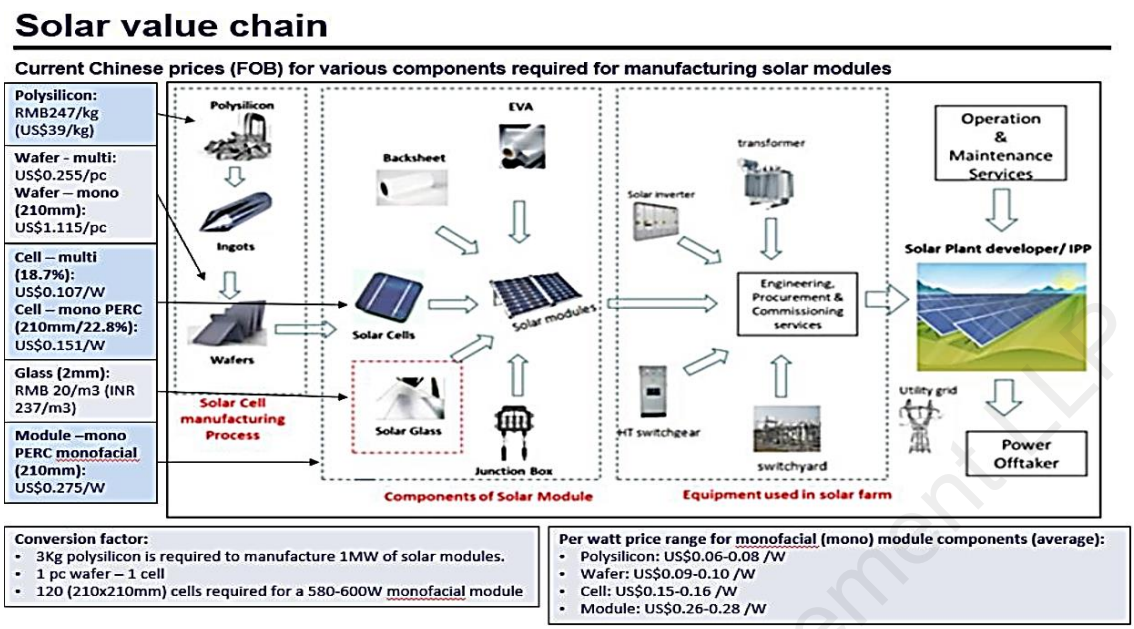
- India Potential- Potential and cumulative capacity of RE (technology-wise)

Technology	Potential	Cumulative capacity (as of March 2021)	Untapped potential
Wind	302 GW (100 m hub height)	39.25 GW	262.75 GW
Solar ground-mounted	750 GW	35.65 GW	714.35 GW
Bio-energy	25 GW	10.15 GW	14.85 GW
Small hydro	20 GW	4.79 GW	15.21 GW
Waste to energy	NA	0.17 GW	NA

Source: MNRE; NITI Aayog; CRISIL Research

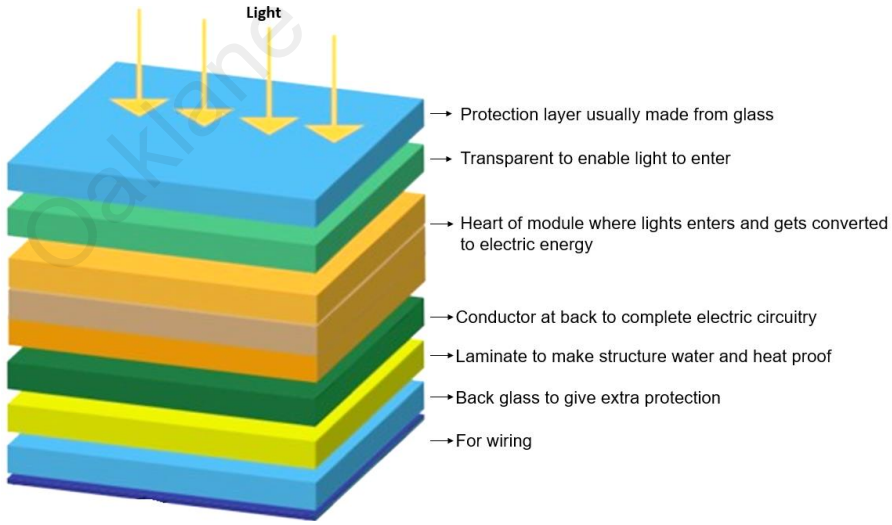
- Anticipated global demand escalation for modules is attributed to substantial contributions from the Middle East and Africa. Nevertheless, the formidable expansion initiatives announced by key industry players, including Jinko Solar, JA Solar, and GCL-Poly, may exert downward pressure on per watt peak prices.
- Crystalline silicon (c-Si) technology predominates in global and Indian solar photovoltaic (PV) deployments. This technological framework is expected to constitute a substantial share in India's ambitious goal of adding 100 GW solar capacity by December 2022.
- Currently, a notable 80-85% of solar modules are reliant on imports due to insufficient domestic capacity to meet burgeoning demands.
- Notably, India lacks a manufacturing foundation for polysilicon ingots and wafers, leading to the necessity for importing these components, thereby incurring elevated costs.

Solar Value Chain



The whole manufacturing process of a solar PV panel can be divided into broadly 5 stages

- The first phase of solar module manufacturing initiates with the utilization of raw material, specifically silicon, extracted from abundant sand deposits. While sand resources are globally plentiful, the conversion of sand into high-grade silicon necessitates a substantive investment. Following this, the refined silicon undergoes a transformation into ingots, representing the bulk form of crystalline silicon. These ingots are subsequently precision-sliced into round wafers. The subsequent manufacturing stage entails the meticulous processing of these wafers into cells, which are subsequently integrated into panels through the implementation of metal conductors. This intricate manufacturing sequence ultimately yields fully functional solar panels.
- **Polysilicon**: The production initiates with the purification of silica, extracted from quartz deposits. Subsequently, the silica undergoes a heating process with carbon in an electric arc furnace, resulting in the production of metallurgical-grade silicon. This metallurgical-grade silicon is further refined through a chemical reduction process to yield polysilicon, attaining a purity level of 99.999%.
- **Ingots**: The polysilicon is then melted down and solidified into a cylindrical shape called a silicon ingot.
- **Wafer production**: Silicon ingots undergo precision slicing into slender wafers utilizing a diamond wire saw. This process entails the cutting of the ingot into thin and consistently measured slices, usually ranging from 200 to 300 microns in thickness. Following the slicing procedure, the wafers undergo a thorough cleansing process employing chemical solutions. This step is essential for the elimination of impurities and surface defects, ensuring the pristine quality of the wafers.
- **Cell Production**: An application of phosphorus to one side and boron to the other forms layers crucial in establishing a p-n junction, an integral component for the optimal functioning of the solar cell. To enhance efficiency, an anti-reflection coating, typically composed of silicon nitride or titanium dioxide, is meticulously applied to mitigate reflection. Facilitating the flow of electricity, metal contacts are affixed to both the front and back of the cell. Subsequently, rigorous testing is conducted to ascertain conformity with prescribed electrical performance standards.
- **Module Assembly**: Solar cells are interconnected in series to create a module, sandwiched between an ethylene-vinyl acetate (EVA) layer and either glass or plastic. The EVA not only bonds the cells but also protects them from moisture and environmental factors, ensuring module durability.
- **Module Structure**



Other steps to bring the modules to the market

- **Testing**: Solar modules undergo comprehensive evaluations, including electrical performance, visual inspections, and durability tests, ensuring adherence to standards.
- **Packaging**: Approved modules are securely packed into boxes for shipment to customers, completing the manufacturing process.

Each manufacturing step demands precision and meticulous attention to detail to guarantee the final product aligns with requisite standards for efficiency and durability. Even minor defects can profoundly affect the panel's overall efficiency.

Figure 7. Gross Profit Margin Movement of Solar Product

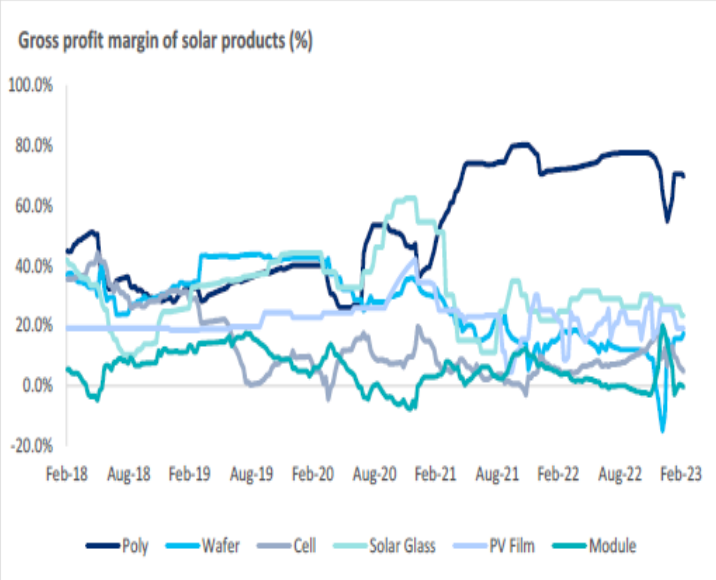
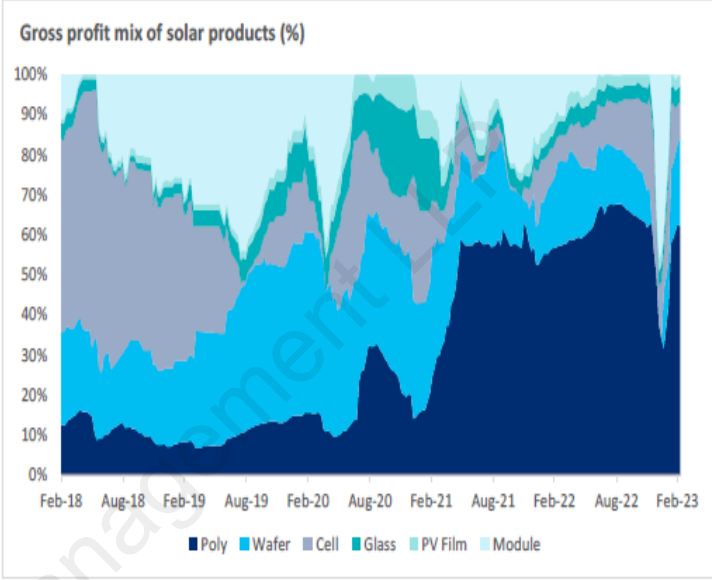


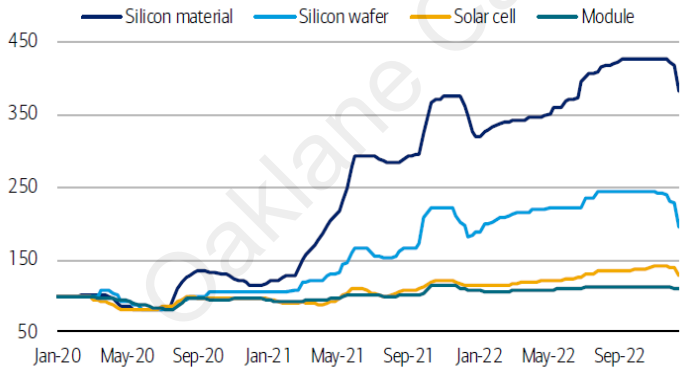
Figure 8. Gross Profit Distribution in Solar Supply Chain



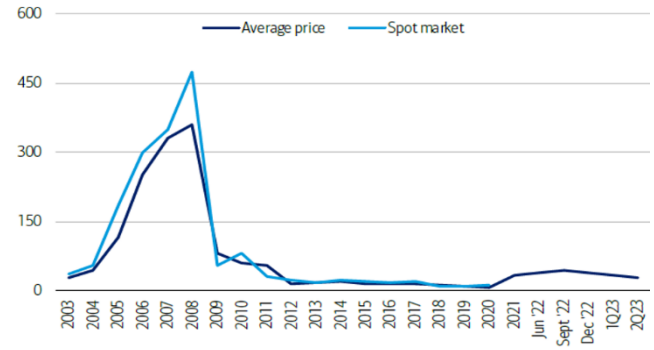
Solar PV Raw Material Prices across Value Chain

Rebased from Jan 2020- Silica prices are expected to mean revert because of over-supply in the market

Rebased from Jan 2020



Historical Silicon Price $/Kg from 2003-2021



Gross Profit Margin & Profit Pool across Value Chain

Source: Solarzoom, BoFA Global Research

Currently, gross margin and profit pool of polysilicon is the highest because of rise in polysilicon prices. However, this is likely to change in favour of module manufactures as polysilicon prices have started falling and are likely to come down to $20-25/ kg from $33/ kg in Mar 2023,

Source: PV Infolink, Citi Research

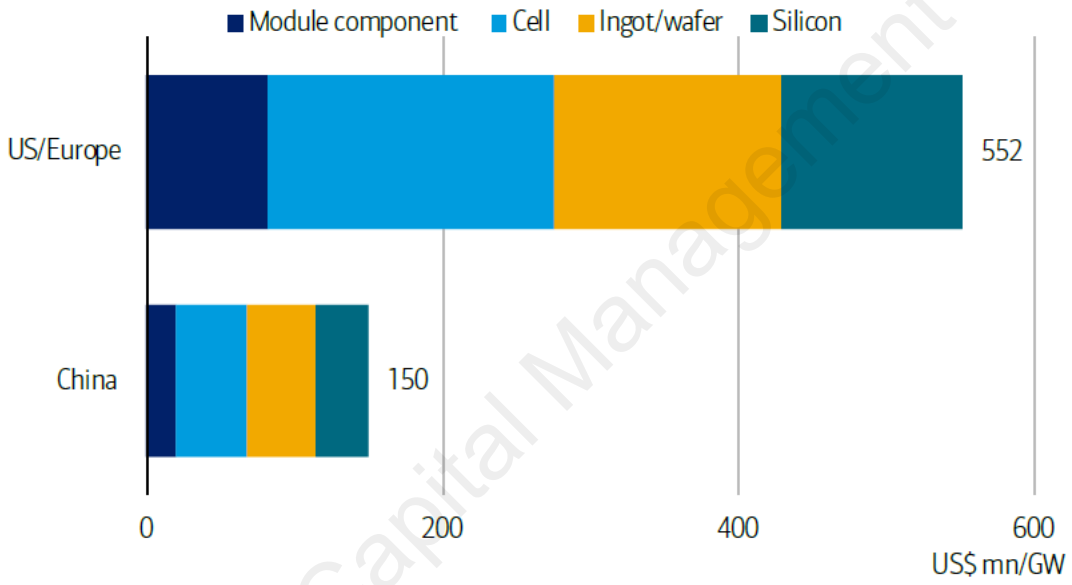
Capital Intensity & Energy Intensity across Value Chain

Across the Value Chain, China is the dominant player & its share is likely to stay high till 2027

	2021				2027E			
	Polysilicon	Wafer	Cell	Module	Polysilicon	Wafer	Cell	Module
China	79.4%	96.8%	85.2%	74.6%	89.2%	88.6%	79.5%	73.9%
Europe	8.0%	0.5%	0.6%	2.8%	2.4%	-	0.7%	2.0%
North America	5.6%	-	0.6%	2.7%	3.0%	3.6%	3.5%	5.8%
APAC	6.0%	2.5%	12.2%	15.3%	2.0%	2.8%	9.9%	10.7%
India	-	-	1.2%	3.1%	3.1%	4.7%	6.3%	6.8%
Rest of the World	1.0%	0.2%	0.2%	1.5%	0.3%	0.3%	0.1%	0.8%

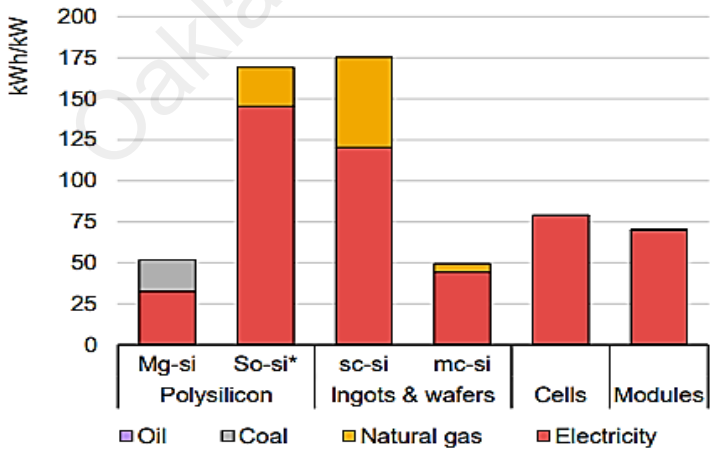
Source: IEA

Advantage China - Capex for setting up a facility is 3.7x higher in US and Europe compared to China



Source: BoFA Global Research

Polysilicon & Wafers are the most energy intensive processes in solar PV manufacturing



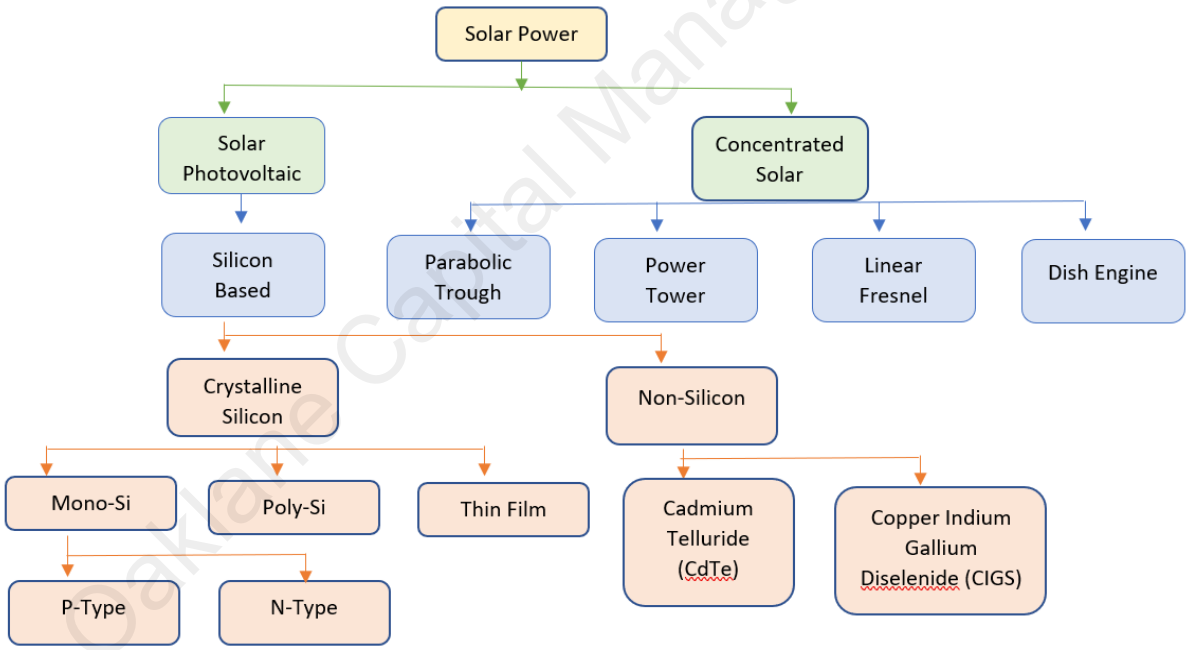
Source: IEA

Solar Power Technology

Summary

- Technological advancements occur every three years, with increasingly efficient technologies becoming the industry standard.
- Silicon, utilized in 95% of sold modules, stands as the second most abundant material globally after oxygen and finds common application in semiconductor chips.
- WEL also produces M12-sized modules, recognized for their superior efficiency.
- All WEL capacities are currently allocated to Mono PERC, and a prospective investment of INR 30 cr per GW could facilitate an upgrade to TOPCon technology. This advancement is anticipated to dominate the market in the coming years.
- HJT capacity in China is presently limited to 2 GW compared to 90GW for TOPCon out of 300 GW, with the remainder being PERC. Alignment of the HJT cost curve with the rest is projected to occur by 2027.
- The company actively collaborates with colleges and institutes to innovate and develop new technologies.

Understanding Solar Power Technology

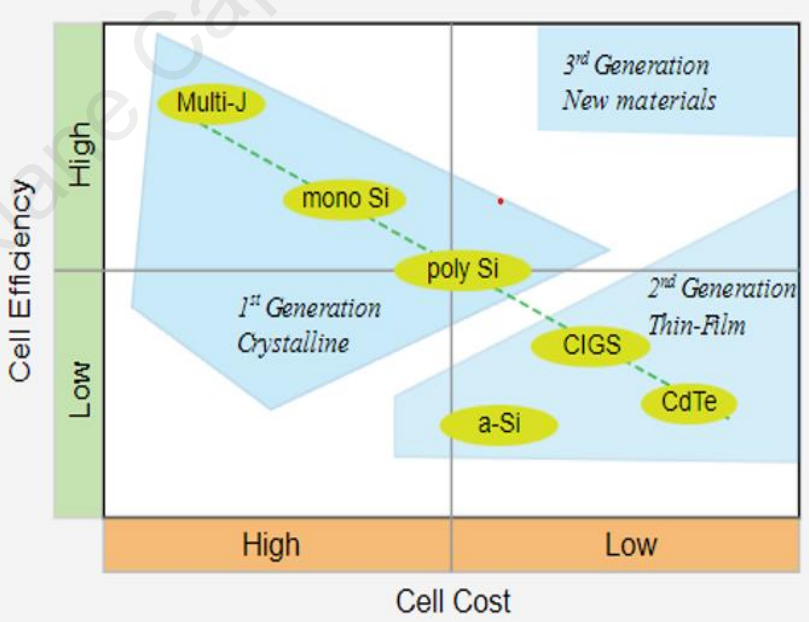


Source: CRISIL Research, IEA, US Department of Energy

Before delving into solar PV basics, it is crucial to note two primary solar power manufacturing technologies: Photovoltaics (PV) and Concentrated Solar Power (CSP). PV, being more cost-effective, is the prevailing choice for solar power generation.

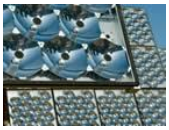
Types of Raw Material for Modules

- Solar PV technology bifurcates into two primary categories based on the primary raw material: crystalline silicon-based and non-silicon-based. The predominant share, exceeding 95% of global capacity, is held by crystalline silicon, with First Solar being the only large contributor in the non-silicon-based module sector.
- Within the crystalline silicon domain, the developmental trajectory has transitioned from polysilicon to multi-crystalline and presently to mono crystalline. Mono-crystalline, particularly in N-type cells, is gaining traction due to enhanced efficiency, especially on a smaller scale, superior performance in lower light conditions, and a higher Internal Rate of Return (IRR).
- CdTe (cadmium telluride) ranks as the second-most prevalent PV material post-silicon and finds application in thin film PVs. Another material, copper indium gallium diselenide (CIGS), is utilized in the same context. Despite their cost-effectiveness, these alternatives do not parallel the efficiencies achieved by silicon cells.
- Another material which Is gaining prominence is Perovskite which is also used in thin film cells. Though the efficiencies have matched silicon-based cells in labs, it is yet to become commercially viable for large scale usage.
- Additional materials, specifically organic compounds, are subjects of ongoing exploration in the PV sector.
- Polysilicon, manufactured through the Siemens process, dominates the market, with China assuming a prominent role due to cost competitiveness. The fluidized bed reactor (FBR) technology presents an alternative method in polysilicon production.
- Silicon is available in two grades: solar grade and electronic grade, with electronic grade silicon being of higher purity compared to solar grade.
- Polysilicon production stands as the solar PV manufacturing supply chain's most capital-intensive and time-consuming process. Establishing a polysilicon factory requires a minimum of two to four years. The substantial infrastructure investment renders any polysilicon facility with a capacity less than 3-4GW financially unviable.



Source: Green Rhino Energy

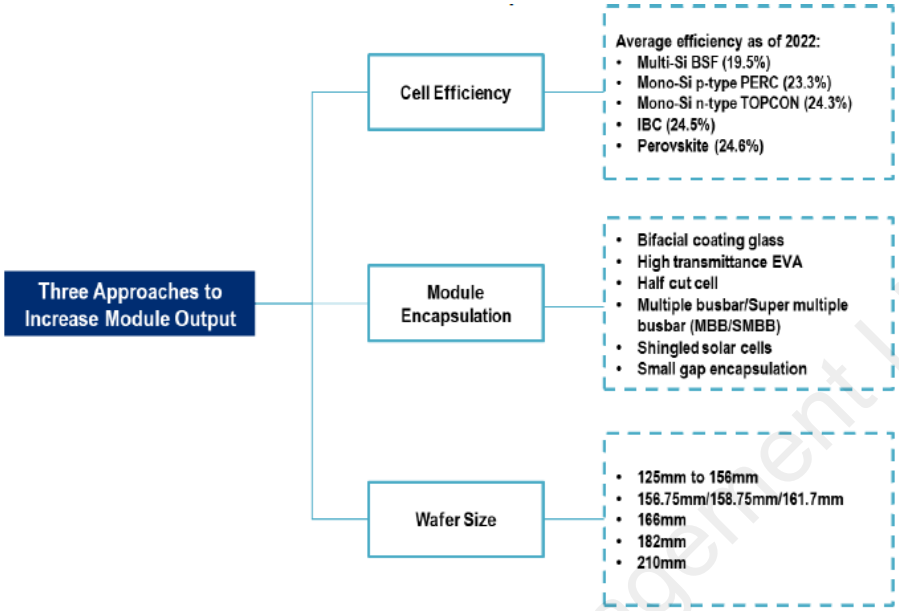
Detailed Comparison of Types of Modules for Solar Power Generation

	Crystalline Photovoltaics		Thin Film				Concentrating Photovoltaics (CPV)	
								
Description	Crystalline silicon wafers		Semiconductor is deposited directly on glass.				With the help of parabolic mirrors, light is focused on a small area, thus needing less semiconductor material.	
Module Efficiency	High		Low				High, but have some optical losses	
Performance under heat	Performance degrades with higher temperatures.		Up to 60% lower heat coefficient than crystalline silicon modules, making it a good choice in hot climates.				Depending on material used.	
Space required per kWp	Polycrystalline: 10m² - 30m² depending on cell spacing Monocrystalline: > 8m²		Glass-glass laminate ~ 25m²					
Amount of PV material needed	Polysilicon: 8g/W		CdTe: 0.22g/W				At concentration ratio of 500, approximately 900 times less photovoltaic material is needed.	
Panel Choice	Only 2 panel types		Many different panel types, can be rolled.				For free-standing, need tracking.	
Degradation	No known degradation.		Will depend on heat and material. Amorphous silicon can lose up to 30% within the first 3-6 months when its rated power is reached. They are stable thereafter.					
Direct or diffuse light	Direct light preferred, but diffuse light can be used too.		Both direct and diffuse light				Requires direct light only, as diffuse light cannot be concentrated	
Sub-Types	**Mono-crystalline**	**Poly- crystalline**	**CdTe**	**CIGS**	**a-Si**	**Multi Junction**	**Low Concentration**	**High Concentration**
	Purity 99.99999%	Purity 99.9999%	low temperature sensitivity	captures large spectrum	Amorphous Silicon	GaAs/CIS a-Si/mc-Si	with crystalline semiconductor	with multi- junction GaInP/GaAs/Ge or GaInP/GaAs with >30% efficiency
Environmental impact from production			Cd is itself a waste product from mining industry. Highly toxic. Must be recycled					
Efficiency (production / lab)	15-20% / 25%	13 - 15% / 21%	10% / 16%	12% / 20%	7% / 10%	36% / 40%		Cell: 35%, module: 24%
Companies	Sunpower Solarworld Isofoton	Sharp Kyocera Q-Cells Suntech Yingli Evergreen	First Solar Ava Solar Calyxo	Nanosolar GlobalSol Solibro	Unisolar Sontar	Spectrolab EMCore	Entech Solar Isofoton	SolFocus

Source: Green Rhino Energy

Increase Module Output

Companies and research institutes are consistently engaged in the development of new technologies aimed at augmenting the output of crystalline modules. Three principal approaches are being pursued for this purpose:

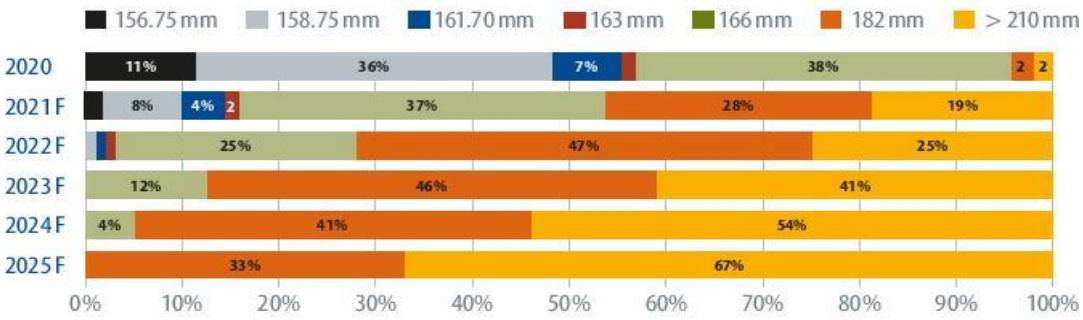


Source: CPIA, JA Solar

Wafer Size

- Wafers are conventionally produced through the Czochralski process, with the Float-zone method serving as an alternative.
- The potential module output is directly proportional to wafer size, emphasizing the preference for larger sizes to enhance productivity and efficiency. The evolution from a 4W cell to a current 10W cell is indicative of this trend.
- Increasing the surface area of the wafer by 15% results in a doubling of voltage and capacity utilization.
- Commercially viable wafer sizes:

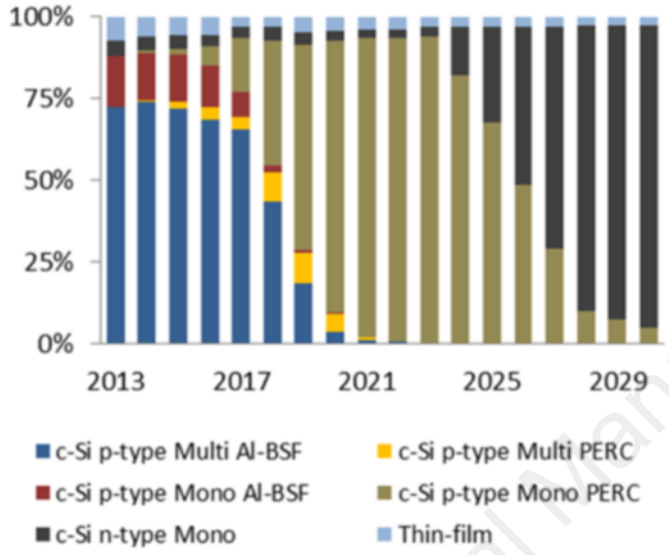
- Market Share of M12 is expected to increase given its higher output. WEL has started making M12 modules and has been exporting them



Solar Cell

Summary

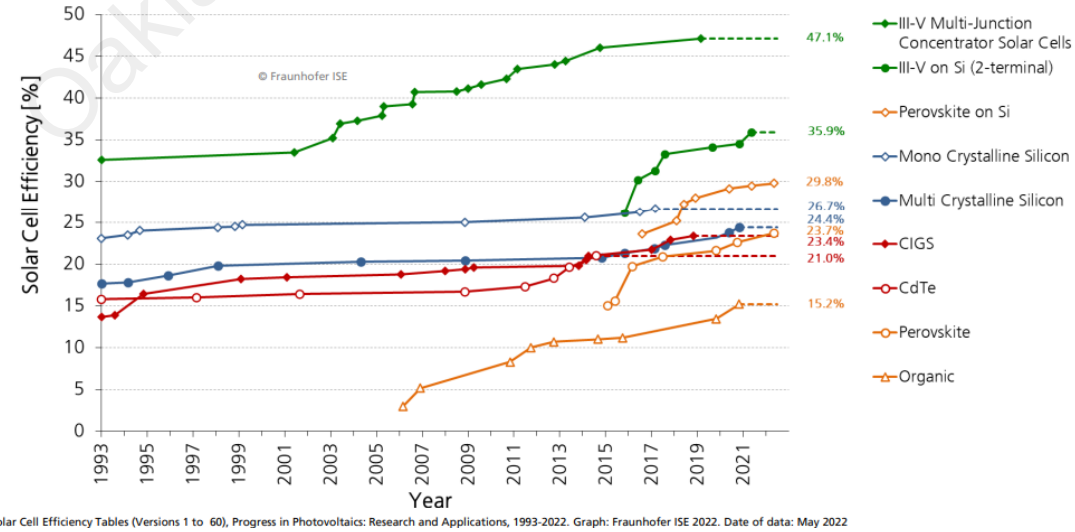
- Solar cells, also referred to as photovoltaic cells, harness the energy of light through the photovoltaic effect, converting it into electrical energy. Predominantly composed of silicon, these cells exhibit varying conversion efficiencies and costs, spanning from amorphous silicon (non-crystalline) to polycrystalline and monocrystalline (single crystal) silicon types.
- As previously discussed, monocrystalline technology stands as the most widely adopted due to its superior commercial viability. Within monocrystalline, two prevalent technologies are p-type and n-type cell technologies.
- The current and anticipated market share of different cell technologies is as follows:



Source: IEA

Cell Research & Efficiency overtime

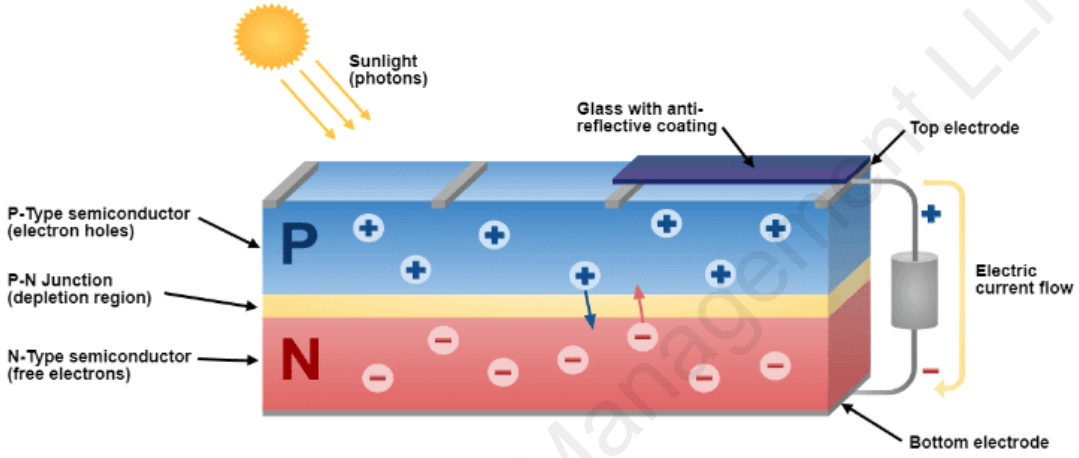
The chart notes a peak research cell efficiency of 47.1% in a four-junction cell, acknowledging its status as laboratory efficiency rather than practical industry yield. Among the technologies listed, only Mono-PERC and Thin film CDTE have achieved commercial viability. Current industry efforts are focused on making technologies like TOPCon, HJT, and HPBC commercially feasible.



Data: Solar Cell Efficiency Tables (Versions 1 to 60), Progress in Photovoltaics: Research and Applications, 1993-2022. Graph: Fraunhofer ISE 2022. Date of data: May 2022

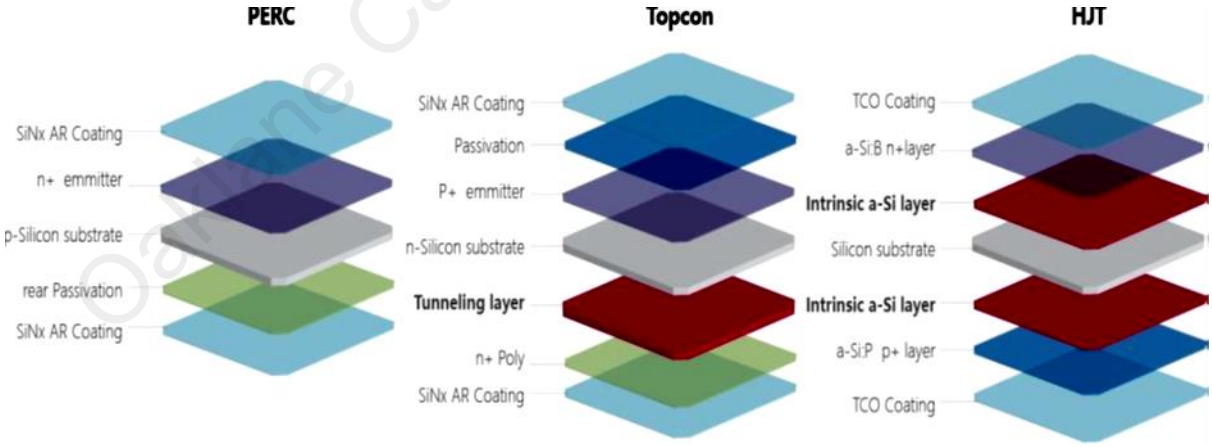
Why N type cell share is rising vs P type cell

- In P-type cells, the silicon base incorporates infused boron atoms, inducing an overall positive charge, thus denoting the "P" nomenclature. Conversely, N-type cells present a stark contrast, featuring a silicon base infused with phosphorus to establish an overall negative charge. The formation of a p-n junction, integral for electrical current flow, necessitates the introduction of boron into the top layer of N-type silicon cells.
- N-type cells are gaining prevalence within manufacturing practices due to their inherent advantages. Their resistance to boron-oxygen defects contributes to heightened operational efficiency and increased purity when compared to P-type counterparts. Furthermore, N-type cells exhibit enhanced effectiveness and resilience against light-induced deterioration (LID). However, a marginal performance loss of 1%–3% is observed during the initial exposure hours to sunlight.



Basic Comparison between P-type PERC vs N-type TOPCon & HJT

- Manufacturing of PERC & TOPCon is common, with a couple of additional steps in TOPCon.
- For HJT, the line has to be changed, and it has only 4 steps of production



- Both TOPCon and HJT technologies achieve power enhancement through passivation. TOPCon employs a tunnelling oxide layer, whereas HJT utilizes an intrinsic amorphous silicon film. The distinctions in these methodologies give rise to variations in their respective processes, consequently influencing the commercial costs associated with each.

- TOPCon is preferred over PERC because of better efficiency & lower degradation

Sl. No.	Module properties	p-Perc	n-Perc	n-TopCon	n-HJT
1	Bifaciality	70%	80%	80%	>90%
2	Micro crack resistant	No	No	Yes	Yes
3	Initial power degradation	High	High	Medium	Low
4	Long term power degradation rate	High	High	Medium	Low
5	LID/ LeTID/ PID	Yes	Yes	Yes	No
6	Low light performance	Good	Good	Good	Better

- However, a study by Dutch scientists has reported a higher degradation risk for n-type TOPCon cells vs p-type PERC cells.

Detailed Comparison of Different Cell Technologies

Technology type	PERC	TOPCon	HJT	IBC	PSC	HPBC
Full name	Passivated Emitter and Rear Contact	Tunnel Oxide Passivated Contact	Heterojunction Technology	Interdigitated Back Contact	Perovskite Solar Cell	Hybrid Passivated Back Contact
Wafer type	P-type	N-type	N-type	N-type	Non-silicon material	P-type
Key structure	Passivation layer (alumina or silicon oxide) back contact	Tunnel oxide and doped thin polysilicon fin	Amorphous silicon film and transparent conductive oxide	A diffusion layer with interdigitated n-type and p-type layers allowing for installation of rear side metal contacts	Hybrid organic-inorganic lead or fin halide- based material	A combination of alumina back contact, tunnel oxide polysilicon and back contact techniques
Theoretical maximum conversion efficiency	24.5%	27.5%	28.7%	29.1%	33.0% (single junction)	Not disclosed
Average conversion efficiency (2022)	23.3%	24.3%	24.5%	24.1%	24.6%	25.3%
Unit capex (Rmbm/GW)	120-150	160-150	350-400	300	Not available	220
Production steps	8 steps	10 steps	4 steps	10 steps	Not available	Not disclosed
Advantages	1 Mature technology 2 Low cost	1 Higher conversion efficiency than PERC 2 Higher bifacial ratio than p-type cell, 3 Lower degradation rate than p-type cell 4 Production line can be upgraded from PERC production line	1. Higher conversion efficiency than PERC and TOPCon 2 Higher yield rate with fewer production steps 3 Higher bifacial ratio than p-type cell; 4 Lower degradation rate than p-type cell	1 Higher theoretical conversion efficiency than PERC, TOPCon and HJT; 2 Reduced shading losses and increased power density, 3 Increased aesthetic (no visible contacts) 4 Potential efficiency upside from combination with other cell technologies	1 Higher conversion efficiency, 2 Potential efficiency upside from multi-junction with silicon solar cells 3 Process simplicity and low material cost 4 Higher tolerance to internal defect	1. Higher commercialized conversion efficiency than PERC; 2 Reduced shading losses and increased power density 3. Increased aesthetic (no visible contacts) 4 Enhanced resistance to cracking 5. improved temperature coefficient 0.29% C -0.34%°C for PERC); 6. Lower degradation rate than PERC cell 7. Lower cost with no boron diffusion
Disadvantages	1 Commercialized conversion efficiency close to theoretical limited; 2 Higher attenuation rate than p-type cell	1 More silver consumption (double sided) than PERC (e.g. 130mg VS 70mg per cell); 2 Lower yield rate than PERC with more steps 3 Boron diffusion more difficult than phosphorus diffusion	1. High equipment cost 2 More silver consumption (double sided) than PERC (e.g. 200mg VS 70mg per cell) 3 Use low-temperature silver paste with higher unit cost than PERC and TOPCon; 4 Use indium as target substance with additional material cost	1. High equipment cost, & 2 Low yield rate due to complex production process	1 Toxicity of lead in perovskite & 2 Inferior stability related to environmental influence (moisture, oxygen and thermal stress) and mechanical fragility than silicon solar cells	Not disclosed

Source: Citi Research

Solar Module

- The efficiency of a solar module is gauged by its capacity to convert a percentage of sunlight into electricity.
- The throughput of a module can be improved in the following ways:
  - **Bifacial coating glass**- This facilitates electricity generation from direct light on the front and light reflection at the rear.
  - **High transmittance EVA**- This minimizes power loss during the transmission of electricity from cells to the module.
  - **Half-cut cell**- By reducing cell size, more cells can be accommodated on the panel, thereby increasing energy output.
  - **Multiple busbar/ Super multiple**- This approach diminishes resistive losses by limiting the current flow in both the fingers and busbars.
  - **Bus bars**- Bus bars reduce system costs, improve reliability, increase capacitance, and eliminate wiring errors.
  - **Shingled solar cells**- Cells are cut into strips and applied like shingles on the roof, amplifying energy harvest, minimizing energy loss due to shading, and enhancing reliability.
  - **Small gap encapsulation**- This method mitigates module degradation over time.

Global- Technology / DRHP- Technology

Unit Economics

Vertically integrated manufacturers can withstand volatility in raw material prices

Unit Economics & Profitability	Polysilicon	Wafer	Cell	Module
Production Cost on Mar 23 Polysilicon spot price of 33$ / Kg				
RM ($ per watt)		0.011	0.015	0.020
Other Costs ($ per watt)		0.002	0.004	0.013
Total Costs ($ per watt)		0.013	0.019	0.033
Price ex VAT ($ per watt)	0.011	0.015	0.020	0.033
Gross Profit Margins with Polysilicon at 33$ / Kg				
Vertically Integrated				*10%*
Non-Vertically Integrated		*16%*	*6%*	*-1%*
Industry Gross Profit Margins (2022)	70%	16%	5%	13%
Longi (2022)		*19%*		*13%*
Jinko Solar (2022)		*12%*		*12%*
Capex For PERC tech ($mn per GW)	130	81	75	19

Source: Citi Research

Gross Profit Margin Sensitivity to Polysilicon Prices

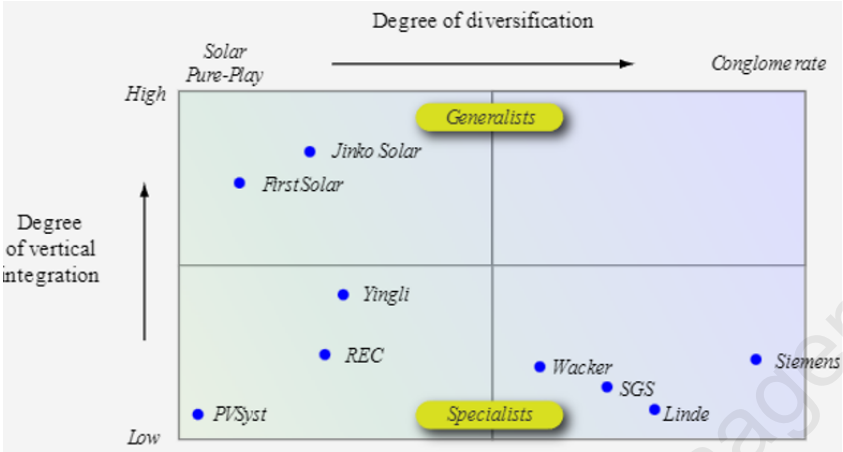
	Polysilicon Price	Wafer GP Margin	Cell GP Margin	Module GP Margin
Non-Vertically Integrated	$43 / Kg	11%	12%	-3%
	$33 / Kg	16%	6%	-1%
	$21 / Kg	16%	6%	13%
Vertically Integrated	$43 / Kg			10%
	$33 / Kg			10%
	$21 / Kg			21%

Source: Citi Research

Vertical Integration

Over the recent years, numerous Chinese entities have undertaken strategic initiatives involving either backward integration, establishing polysilicon manufacturing capabilities, or forward integration into module production. A notable instance is Adani's foray into polysilicon production, marking the first such venture in India with the establishment of capacity in Gujarat.

According to Citi, companies adopting a vertical integration approach within the module industry exhibit optimal positioning amid the sector's aggressive expansion. This strategic framework affords these entities advantages, including risk mitigation concerning raw material prices, seamless integration of novel technologies, improved quality control measures, and enhanced product traceability.



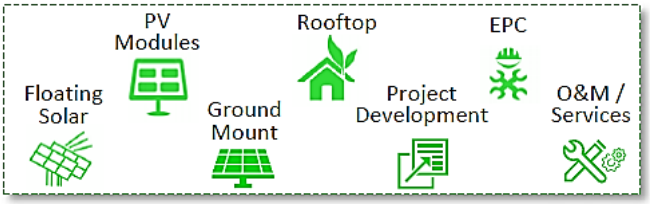
Resisting the allure of securing a competitive advantage and achieving a dominant market position through large-scale vertically integrated production capacity is a formidable challenge. The benefits derived from such integration, encompassing cost efficiencies and adept supply chain management, are undeniable. However, the pursuit of vertical integration is not without its inherent risks.

- Firstly, vertical integration introduces financial risk, particularly when weaker demand necessitates a reduction in production. The capital outlay required to develop in-house production capacity for specific materials or processes far surpasses the costs associated with procuring from specialized vendors.
- Moreover, research and development pose potential challenges within the realm of vertical integration. Remaining at the forefront of technology demands not only substantial capital investment but also entails the substantial accumulation and defense of patents—a formidable task, wherein specialized producers may hold an advantage.
- The management of vertically integrated supply chains is inherently complex. Balancing different segments of the production chain, each requiring distinct technological expertise, poses challenges for the management team.
- Chen from Yushan Energy notes, "None of the previously integrated producers had succeeded in ranking in top three of all its major products in the respective ranking. It seems that the efficiency, cost, and technology leadership constitute an impossible triangle in the solar PV industry."
- Historical experiences with vertical integration have been unfavorable. Around 2008, during a surge in polysilicon prices exceeding $400/kg, numerous solar companies pursued aggressive vertical integration strategies. While initially successful, the subsequent collapse of polysilicon prices from 2011, coupled with anti-dumping and anti-subsidy policies in the EU and the United States, led many leading companies such as Suntech, LDK, Yingli, and others into financial distress. These companies were burdened by heavy debt resulting from the integration strategy, compelling some to declare bankruptcy or undergo extensive reorganization.

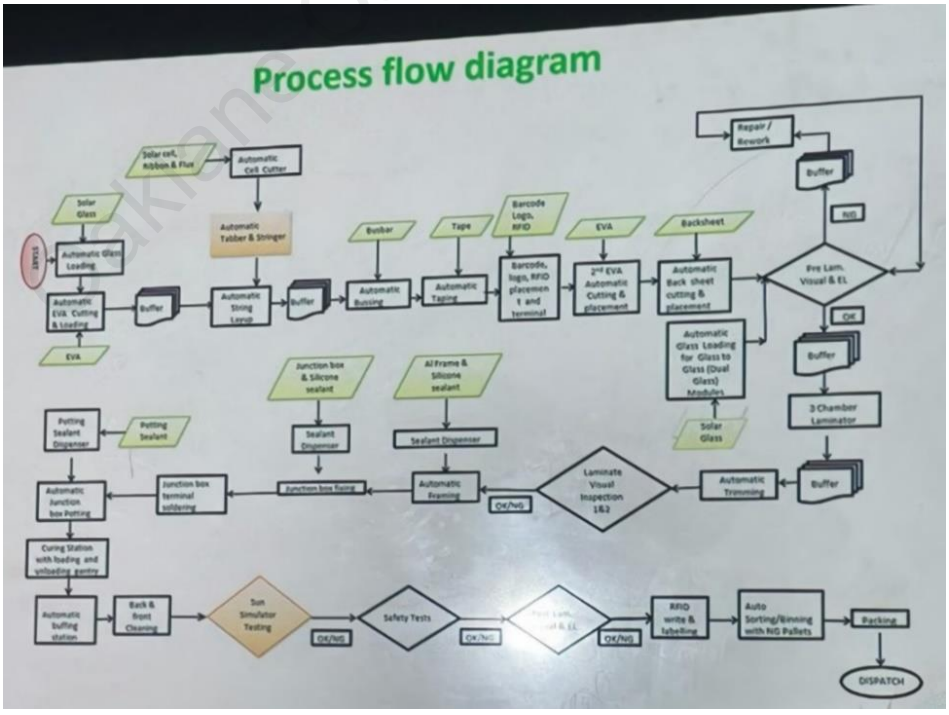
WEL's Business in Brief

Product & Product Quality

- The company provides end to end solar solutions with a wide product range of



- PV module manufacturing consists of the following PV modules: (i) multicrystalline modules; and (ii) monocrystalline modules, comprising Merlin flexible modules and mono PERC modules, which includes bifacial modules (framed & unframed), & BIPV (building integrated PV) modules.
- WEL has formally entered into an agreement with the US-based company Merlin Solar, establishing an exclusive distributorship for Merlin's foldable panel product within the Indian market. Merlin's foldable panel product boasts a substantial competitive edge, with a 2x margin and a 3x realization compared to existing panels.
- Furthermore, WEL is set to introduce a comprehensive range of lightweight and flexible panels, distinct from Merlin's foldable panel, which, as specified, is not earmarked for export.
- The process flow for module manufacturing involves:
  - **Solar Glass Selection:** Preference is given to imported solar glass due to superior quality, as the quality of Borosil is deemed less satisfactory.
  - **EVA Production:** Ethylene vinyl acetate (EVA), a polymer-based material, is employed for its UV protection properties. Presently, there are over 10 manufacturers of EVA in India.
  - **Sun Simulation:** Xenon lamps are used for sun simulation during the manufacturing process.
  - **Stress Testing:** Modules undergo stress tests, subjecting them to a load three times their standard capacity.
  - **Quality Checks:** Quality checks are conducted randomly, and the facility in Tumb (Umbergaon) includes a dedicated testing laboratory. Notably, this facility is the only manufacturing facility in India equipped with such testing capabilities.



- Other products
  - WEL engages in contract manufacturing for inverters and pumps. Leveraging its background in the instrumentation business proves advantageous in this venture. The primary focus is on the private sector.
  - Retail Operations: With 400 franchises and the inclusion of 10,000 electricians, retail constitutes approximately 20% of the business in FY22. The strategic plan aims to tap into a market where major players like Adani and Reliance currently lack a presence.
  - Battery Business: Currently at a seed stage, the battery business is incurring losses. The current operations involve assembly and battery pack activities.
  - Foldable Panels: Catering to a market with threefold pricing, particularly strong in the USA, the applications for foldable panels span diverse sectors such as golf carts, car glasses, gardens, and defense. These panels, distinguished by their lightweight and breakage-resistant attributes, enjoy exclusive distribution rights for India, granted by Merlin. While WEL engages in contract manufacturing for Merlin in the USA, it is restricted from selling these panels in the United States.
- EPC is a very good business. Waaree Renewable Technologies works with the government only if it can secure -ve WC. Presently, it is actively involved in EPC projects, including a 20 MW project with Maruti and a partnership with Chemfab.

Favourable Government Policies

Summary of Trade Tariffs Against China Solar Product Exports

Country	Policy	Subject product	Tariff rate				
US	Article 201 duty	Module (excl. bifacial module), cell (beyond 5.0GW quota)	30% (2018)	25% (2019)	20% (2020)	15% (2021)	15% (2022)
	Article 301 duty	Cell, module, solar glass, inverter, back sheet and frame	10% (2018)	25% (since 2019)			
	Anti-dumping and countervailing duties	Polysilicon solar cell and module	13.97-238.95%				
	Forced labor act	All solar product produced in Xinjiang	n/a			Withhold release order (Dec 2021)	
EU	Anti-dumping and countervailing duties	Solar cell and module	Anti-dumping 27.3-64.9 Countervailing: 0-11.5% (Exempted since Sep 2018)	n/a			
India	Safeguard duty	Cell (including those packaged in modules)	25% (30 Jul 2018 29 Jul 2019)	20% (30 Jul 2019 29 Jan 2020)	15% (30 Jan 2020 29 Jul 2020)	14.9% (30 Jul 2020 - 29 Jan 2021) 14.5% (30 Jan 2021 - 29 Jul 2021)	n/a
		Solar Glass (not on Xinyi Solar)	For Flat Glass: US$136.21/ton (since 2017.6)				
	Basic custom duty (BCD) - for all foreign countries	Solar cell and module	n/a				40% for module and 25% for cell (since Apr 2022)
		Inverter	n/a			20% for inverters (since Feb 2021)	
Turkey	Anti-dumping	Solar module	US$20-25/m2 (2017.04-2022.03)				
Canada	Anti-dumping and countervailing duties	Solar cell and module	Anti-dumping: 9.3%-154.5% Countervailing Rmb0 003-0.34/W				

Indian Government Policies to encourage Solar PV manufacturing

- Key incentives bolstering the solar energy industry in India encompass:
  - Preferential Tariffs: Solar power assets operating under long-term Power Purchase Agreements (PPAs) enjoy preferential tariffs.
  - Transmission, Wheeling, and Banking Facilities: The industry benefits from preferential charges on transmission, wheeling, and banking facilities.
  - Production Linked Incentive (PLI) Scheme: High-efficiency solar Photovoltaic (PV) modules are incentivized through the Production Linked Incentive (PLI) scheme.
  - Tax Incentives: Tax incentives contribute to the industry's favorable operating environment.
  - Accelerated Depreciation: Availability of accelerated depreciation further enhances the financial attractiveness of solar power assets.

- Steps taken for solar energy offtake
  - NTPC strategically bundles solar power with cheaper thermal power, presenting it to discoms to reduce the average power purchase cost of solar energy.
  - Central public sector undertakings (CPSUs) are incentivized to install solar power, thereby replacing existing consumption.

- The government has established a separate entity, Solar Energy Corporation of India (SECI), dedicated to promoting solar projects in the country. SECI conducts bidding procedures and oversees fund distribution from the Centre to developers. Additionally, SECI purchases solar power from developers and facilitates its sale to bulk consumers under tripartite agreements. A nominal trading margin (approximately ₹0.07/unit) is charged to the power buyer.
- Implementation of the Green Energy Corridor Scheme and the establishment of Renewable Energy Zones (REZ) aim to elevate the grid capacity planned for Renewable Energy (RE) integration to surpass 100 GW.
- The Government of India (GoI) has conferred renewable energy with "must-run" status, mandating the acceptance of all generated renewable power by the grid.
- In Fiscal 2016, the Central government amended the National Tariff Policy (NTP), proposing an increase in the solar Renewable Purchase Obligation (RPO) target to 10.5% by FY 22. However, stringent enforcement measures are lacking.

- Operational aspects of solar power
  - The creation of solar parks in the country minimizes construction and execution risks by providing a consolidated area with essential infrastructure and utilities, such as land, evacuation facilities, roads, water, and drainage.
- Financial Assistance
  - MNRE provides financial assistance for all rooftop projects constructed by the residential category of consumers: 70% for special category states and 30% for other states
- Steps for solar PV Modules
  - Basic customs duty of 25% on solar cells and 40% on solar modules, commencing April 1, 2022.
- Policies for Solar PV manufacturing
  - In 2019, MNRE issued orders for the enlistment of solar PV cell and module models and manufacturers after facility inspections. On March 10, 2021, an ALMM list for solar PV modules was released, currently limited to domestic players and excluding foreign participants.
  - One of the 10 sectors notified for PLI

Typical Solar Projects IRR

IRR for different types of projects in China

In contrast to self-owned residential projects, initiatives under the rooftop leasing model exhibit diminished equipment procurement costs and heightened Operational and Maintenance (O&M) efficiency. Consequently, these projects yield superior investment returns. The Internal Rate of Return (IRR) of such projects is significantly contingent on the geographical location. This reliance emerges from the substantial variation in land costs between metropolitan cities and smaller towns.

Figure 24. Key Assumptions for Provincial IRR Analysis for Solar Projects

Key assumptions	Unit	Utility-scale	Residential	C&I
Capacity	MW	50	50	50
Operation	Years	25	25	25
Initial capex - incl. VAT	Rmb/W	4.13	3.74	3.74
Energy storage capex	Rmb/Wh	1.5	0	1.7
On-grid tariff	Rmb/kWh	Provincial benchmark coal-fired on-grid tariff		
Retail tariff for sel-consumption	Rmb/kWh	-	Provincial retail residential tariff	Provincial retail C&I tariff
Output self-consumption	%	-	50%	80%
Tariff discount on self-consumption	%	-	80%	80%
Utilization hour	Hours	Provincial average solar utilization hours		
Degradation (1st year)	%	2.0%	2.0%	2.0%
Degradation (2nd year and after)	%	0.5%	0.5%	0.5%
Initial operating cost	Rmb/W	0.041	0.048	0.048
Inflation	%	3.0%	3.0%	3.0%

Figure 25. China: Provincial Power Tariff, Solar Power Utilization Hours

Province	Benchmark coal-fired on-grid tariff	Residential retail tariff (<1kV)	C&I (1-10kV) retail tariff (as of Mar 2023)	Average solar utilization
Beijing	0.3598	0.4883	0.8264	1334
Tianjin	0.3655	0.4900	0.7844	1343
Hebei (North)	0.3720	0.5200	0.5779	1330
Hebei (South)	0.3644	0.5200	0.5779	1330
Shanxi	0.3320	0.4770	0.5880	1394
Shandong	0.3949	0.5469	0.7001	1261
Inner Mongolia (West)	0.2829	0.4150	0.4832	1610
Liaoning	0.3749	0.5000	0.6898	1523
Jilin	0.3731	0.5250	0.7892	1657
Heilongjiang	0.3740	0.5100	0.7596	1724
Inner Mongolia (East)	0.3035	0.4850	0.6637	1610
Shanghai	0.4155	0.6170	0.8351	1221
Jiangsu	0.3910	0.5283	0.7078	1286
Zhejiang	0.4153	0.5380	0.8048	1255
Anhui	0.3844	0.5653	0.7021	1235
Fujian	0.3932	0.4983	0.6228	1033
Hubei	0.4161	0.5580	0.7987	1207
Hunan	0.4500	0.5880	0.7787	1102
Henan	0.3779	0.5600	0.7204	1049
Sichuan	0.4012	0.5224	0.8005	1573
Chongqing	0.3964	0.5200	0.8012	836
Jiangxi	0.4143	0.6000	0.7232	1051
Shaanxi	0.3545	0.4983	0.6644	1375
Gansu	0.2978	0.5100	0.6801	1506
Qinghai	0.3247	0.3771	0.4758	1498
Ningxia	0.2595	0.4486	0.5050	1552
Guangdong	0.4530	0.5921	0.7982	930
Guangxi	0.4207	0.5283	0.6602	1067
Yunnan	0.3358	0.4236	0.5440	1247
Guizhou	0.3515	0.4556	0.6851	1038
Hainan	0.4298	0.6083	0.7457	1184
Simple average	**0.3735**	**0.5166**	**0.6934**	**1337**

* Using retail C&I power tariff for 1-10kV grade for normal period for Mar 2023;
* Average provincial solar power utilization in 2022

Figure 26. Project IRR for Solar Projects by Province

Project IRR (unleveraged)	Utility-scale project	Residential project	C&I project
Beijing	5.3%	7.7%	15.2%
Tianjin	5.7%	8.0%	14.4%
Hebei (North)	5.8%	8.5%	9.3%
Hebei (South)	5.5%	8.3%	9.3%
Shanxi	4.8%	7.6%	10.1%
Shandong	5.9%	8.5%	11.4%
Inner Mongolia (West)	4.6%	7.5%	9.3%
Liaoning	8.0%	10.6%	14.8%
Jilin	9.2%	12.6%	19.5%
Heilongjiang	9.9%	13.2%	19.7%
Inner Mongolia (East)	5.6%	9.5%	14.7%
Shanghai	6.2%	9.5%	13.9%
Jiangsu	6.0%	8.5%	12.0%
Zhejiang	6.6%	8.7%	13.8%
Anhui	5.2%	8.2%	11.0%
Fujian	3.0%	4.5%	6.4%
Hubei	6.0%	8.4%	12.9%
Hunan	5.8%	7.9%	11.0%
Henan	2.7%	5.4%	8.5%
Sichuan	9.6%	12.3%	18.7%
Chongqing	0.3%	1.7%	6.4%
Jiangxi	4.0%	6.7%	8.8%
Shaanxi	5.6%	8.3%	11.9%
Gansu	4.4%	8.7%	13.7%
Qinghai	5.5%	6.7%	8.2%
Ningxia	2.9%	7.0%	9.1%
Guangdong	3.5%	5.3%	8.4%
Guangxi	4.4%	6.0%	7.8%
Yunnan	3.4%	4.9%	7.2%
Guizhou	1.6%	3.1%	7.5%
Hainan	6.2%	9.1%	11.5%
Simple average	**5.3%**	**7.8%**	**11.5%**

* Please see the table above for key assumptions of IRR analysis

Source: Citi Research, NEA, CPA, China Electricity Council, Provincial grid companies, BJX

Estimated ROE of a solar power plant operated by a public developer (%)

At a tariff rate of INR 3 per kwh, a solar power plant operated by a public developer can make an ROE of 11.7% with a leverage of 70%.

	ROEs at different solar tariffs (%)		
Capacity (MW)	100	100	100
Cost (Rs mn/MW)	40	40	40
PLF (%)	22	22	22
Generation (MU)	193	193	193
Tariff (Rs/kWh)	2.8	3.0	3.2
O&M (Rs mn/MW)	0.5	0.5	0.5
Interest rate (%)	8.5	8.5	8.5
Leverage (%)	70	70	70
Income statement (Rs mn)			
Revenues	540	578	617
O&M	(50)	(50)	(50)
EBITDA	**490**	**528**	**567**
Depreciation	(114)	(114)	(114)
Interest	(238)	(238)	(238)
PBT	**137**	**176**	**214**
Tax	(27)	(35)	(43)
PAT	**110**	**141**	**172**
RoIC (%)	**12.2**	**13.2**	**14.2**
RoE (%)	**9.2**	**11.7**	**14.3**

Source: Kotak Institutional Equities

Oaklane Capital Management LLP

Corporate Identity Number: AAA-6130, SEBI Registration Number INP000006624.

Corporate Office: North Court, Lane No. 12, Kalyani Nagar, Pune -411016, India.

Tel: 020 -4121 4014/ 6781 0188 | Email: ir@oaklanecapital.com | www.oaklanecapital.com

Principal Officer: Ashwini Desai | 020- 4121 4014 | Email: admin@oaklanecapital.com

Registration Details

Oaklane Capital Management LLP (***"Oaklane"***) is registered with the Securities and Exchange Board of India (**SEBI**) as a Portfolio Manager with registration number as INP000006624. Oaklane Capital Management LLP provides only portfolio management services. Oaklane does not provide services in the nature of acting as manager or co-manager to issue, acting as an underwriter to issue, merchant banking, investment banking, stockbroker, which will conflict with its operations of Oaklane as a portfolio manager. The author of this research report (i.e., research analyst) has complied with the qualification and certification requirements as provided in SEBI (Research Analyst) Regulations, 2014. The Research analyst is post graduate in Finance (MBA), a CFA Charter Holder and holds NISM-Research Analyst certification.

Disciplinary Actions

No material disciplinary action has been taken by SEBI against Oaklane Capital Management LLP in the past two financial years which may impact the investment decision making of the investor.

Research Analyst(s) Certification

The Research Analyst, with respect to each issuer and its securities covered by him/her in this research report, certify that:

a. All of the views expressed in this research report accurately reflect his or her personal views about all of the issuers and their securities; and

b. No part of his or her compensation was, is, or will be directly or indirectly related to the specific recommendations or views expressed in this research report. Oaklane is engaged in providing only PMS services and accordingly do not provide any conflicting services.

Disclosure of Interest and material conflict of interest

a. Oaklane is engaged only in providing portfolio management services. Associate(s) of Oaklane are not engaged in providing any services related to capital market.

b. Oaklane and its associates and / or its respective personnel and / or its advisors may in future engage in activities that may result in conflict which may not have been captured herein.

c. Oaklane and its associates have policies and procedures in place for addressing such conflicts. Oaklane, its associates and its directors/partners/employees shall exercise a standard of good faith in its dealings.

d. Oaklane Capital Management LLP and/or its associates have not received during the past twelve months any compensation from the subject company(ies) mentioned in this report.

e. Oaklane Capital Management LLP, its partners, its associates, research analysts, his/her relatives have invested in the subject company, and this may have potential conflict of interest at the time of publication of this report on the subject company. Oaklane Capital Management LLP provides only Portfolio Management Services and accordingly do not provide any services to the subject company. Neither research analyst or his/her relatives, nor research entity or its associates has any other material conflict of interest (*other than as identified*) at the time of publication of the research report.

f. Neither Oaklane Capital Management LLP nor its associates or the Research Analyst(s) or his/her relatives individually own one per cent or more securities of the company(ies) covered under this report, at the end of the month immediately preceding the date of the publication of the research report or on the date of the public appearance.

g. In the last twelve-month period ending on the last day of the month immediately preceding the date of publication of the Research Report or public appearance, Oaklane or it's associate(s) **have not:**

   i. managed/co-managed public offering of securities for the subject company.
   ii. received compensation for investment banking/merchant banking/brokerage services or for any other services from the subject company of this research report.
   iii. received any compensation or other benefits from the subject company or third party in connection with the research report.
   iv. engaged in any other transaction involving such securities and earn fees or other compensation as an advisor or lender/borrower to the subject company or may have any other potential conflict of interests with respect to any recommendation and other related information and opinions at the time of publication of Research Report or at the time of public appearance.

h. In the last twelve-month period ending on the last day of the month immediately preceding the date of publication of the Research Report or public appearance, the subject company is or was not a client of Oaklane or it's associate(s).

i. The Research Analyst principally responsible for the preparation of this research report ***or*** their relatives (as defined under SEBI (Research Analysts) Regulations, 2014):
   v. Has invested in the subject company covered under this report.
   vi. Did not receive any compensation from the subject company covered under this report, or from any third party, in connection with this report in the past twelve months or
   vii. Do not have any other material conflict of interest, other than identified above at the time of publication of this report.
   viii. Research Analyst(s) is/are not serving or has served as an officer, director or employee of the subject company covered under this report.

j. Neither research analyst not the research entity has been engaged in market making activity for the subject company.

Basis of Preparation of Research Report and Terms of its use

a. Oaklane is registered with the SEBI as a portfolio manager and provides only portfolio manager services. This report is provided only for general consumption. This Report has been prepared based on the facts, figures and information, which is already available in publicly accessible media. Such information has not been independently verified and **no guaranty**, representation of

warranty, express or implied, is made as to its accuracy, completeness, or correctness. While we would endeavour to update the information herein on a reasonable basis, Oaklane is under no obligation to update the information. Also, there may be regulatory, compliance, or other reasons that prevent Oaklane from doing so. Neither Oaklane nor its partners, employees, agents, or representatives shall be responsible or liable in any manner, directly or indirectly, for views or opinions expressed in this report or the contents or any errors or discrepancies herein or for any decisions or actions taken in reliance on the report or the inability to use or access our service in this report or for any loss or damages whether direct or indirect, incidental, special or consequential including without limitation loss of revenue or profits that may arise from or in connection with the use of or reliance on this report.

b. This research report has been prepared by research analyst(s) working with Oaklane Capital Management LLP to provide information about the subject company(ies) and sector(s), if any, covered in the research report and may be distributed by it solely for the purpose of information of the recipient of this report. This report and/or any part thereof, may not be duplicated in any form and/or reproduced or redistributed without the prior written consent of Oaklane Capital Management LLP. Securities of the Subject Company are not listed on date of publication of this research report, accordingly the provisions related to providing graph of daily closing price of the said security is not applicable.

c. While reasonable care has been taken in the preparation of this report, it does not purport to be a complete description of the securities, markets or developments referred to herein, and Oaklane Capital Management LLP does not warrant its accuracy or completeness. Oaklane Capital Management LLP shall not be in any way responsible for any loss or damage that may arise to any person from any inadvertent error in the information contained in this report. This report is provided for information only and is not an investment advice and must not alone be taken as the basis for an investment decision.

d. The investments discussed or views expressed, or recommendations/opinions given herein may not be suitable for all investors. The user assumes the entire risk of any use made of this information. The information contained herein may be changed without notice and Oaklane Capital Management LLP reserves the right to make modifications and alterations to this statement as they may deem fit from time to time.

e. This report is neither an offer nor solicitation of an offer to buy and/or sell any securities mentioned herein and/or not an official confirmation of any transaction.

f. This report is not directed or intended for distribution to or use by any person or entity who is a citizen or resident of or located in any locality, state, country or other jurisdiction, where such distribution, publication, availability or use would be contrary to law, regulation or which would subject Oaklane Capital Management LLP to any registration or licensing requirement within such jurisdiction. The security(ies) described herein may or may not be eligible for sale in all jurisdictions or to a certain category of investors. Persons in whose possession this report may come, are required to inform themselves of and to observe such restrictions.

g. Views of the Research Analyst on the subject company may vary based on fundamental and technical research.