



# **PV Supplier Market Intelligence Program Q3 2022 Report Sample**



# PV Market Intelligence Quarterly Report

The Clean Energy Associates' Supplier Market Intelligence Program (SMIP) is a quarterly independent, unbiased market intelligence report of the top PV module manufacturers in the world.

Access to timely, accurate information is strategically important, and its absence creates sizable risk. The program brings together objective, high-quality, multi-sourced and verified data to create the supplier market intelligence report. The report includes detailed information and analysis on capacities, technology, and efficiency roadmaps, as well as our own Manufacturing, Capacity and Technology (MCT) ratings for each supplier.

The quarterly report contains critical up-to-date operational data for the largest suppliers, such as Canadian Solar, JA Solar, Jinko Solar, Trina Solar, LONGi and Risen. CEA's research team utilizes high quality, verified data to create the SMIP report and deliver supplier insights straight from technical management teams.

CEA's Supplier Market Intelligence Program provides deep market intelligence on key module suppliers and industry players. Information on capacity, technology, product development and industry positioning is delivered to assist clients in assessing the risks and opportunities associated with many potential vendors and products in the highly dynamic solar industry.

- Covers all major industry players
- Timely, accurate, and detail oriented
- Drives supplier sourcing decisions
- Compares suppliers based on their scale, market reach, and track record

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## Q3 2022 PV SMIP

Production Updates

Special Topics And Market Trends

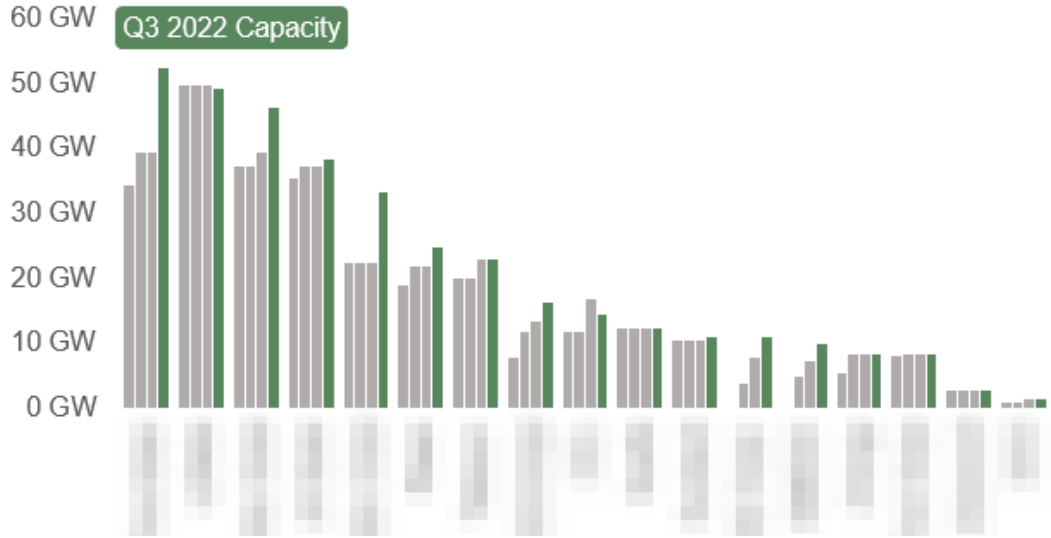
MCT Quarterly Ratings

# Production Updates

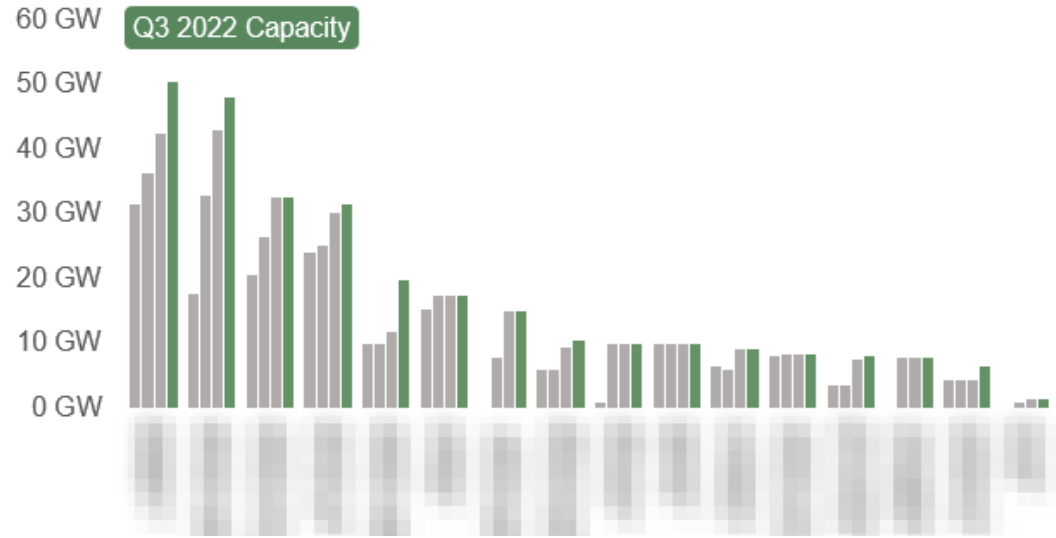
# PV SMIP Capacity Comparison

(GW of annual capacity by quarter)

Supplier Module Capacities by Quarter



Supplier Cell Capacities by Quarter



**Notes** | Capacity data is based on supplier statements and represents currently available manufacturing capabilities.

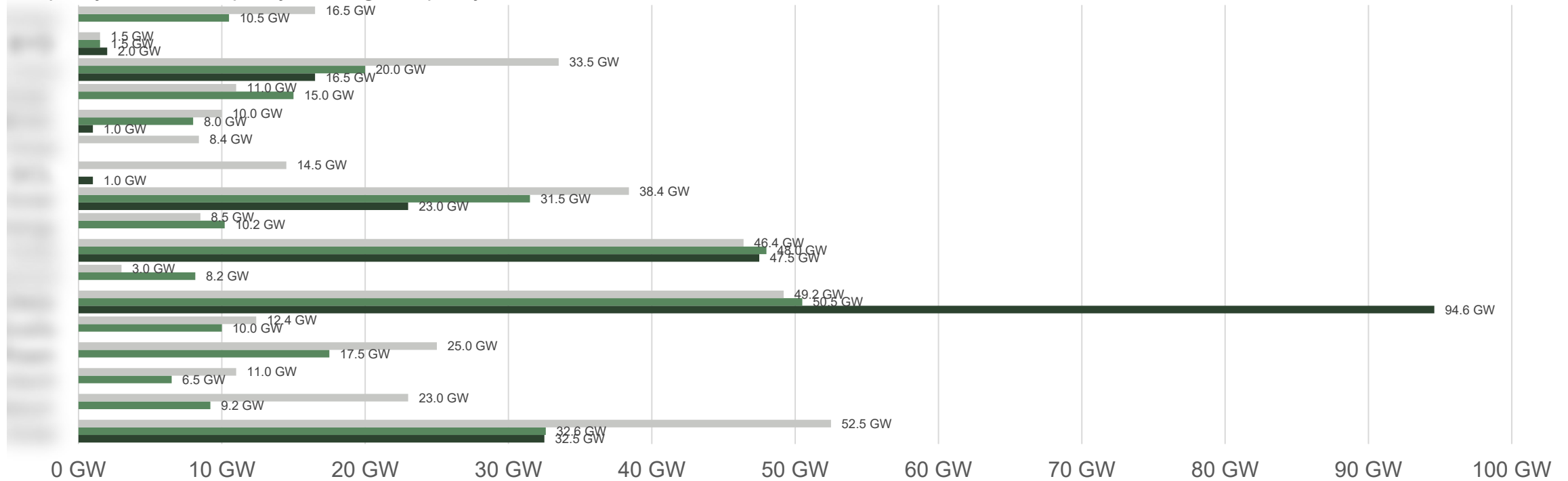
Module and cell capacity expansions increased significantly this quarter. Many suppliers continue to increase manufacturing capacity, especially for new factories catering to n-type TOPCon or HJT manufacturing.

# PV SMIP Capacity Comparison

(GW of annual ingot to module capacity as of Q3 2022)

Current Supplier Production Capacities | Total Vertical Integration

■ Module Capacity ■ Cell Capacity ■ Ingot Capacity

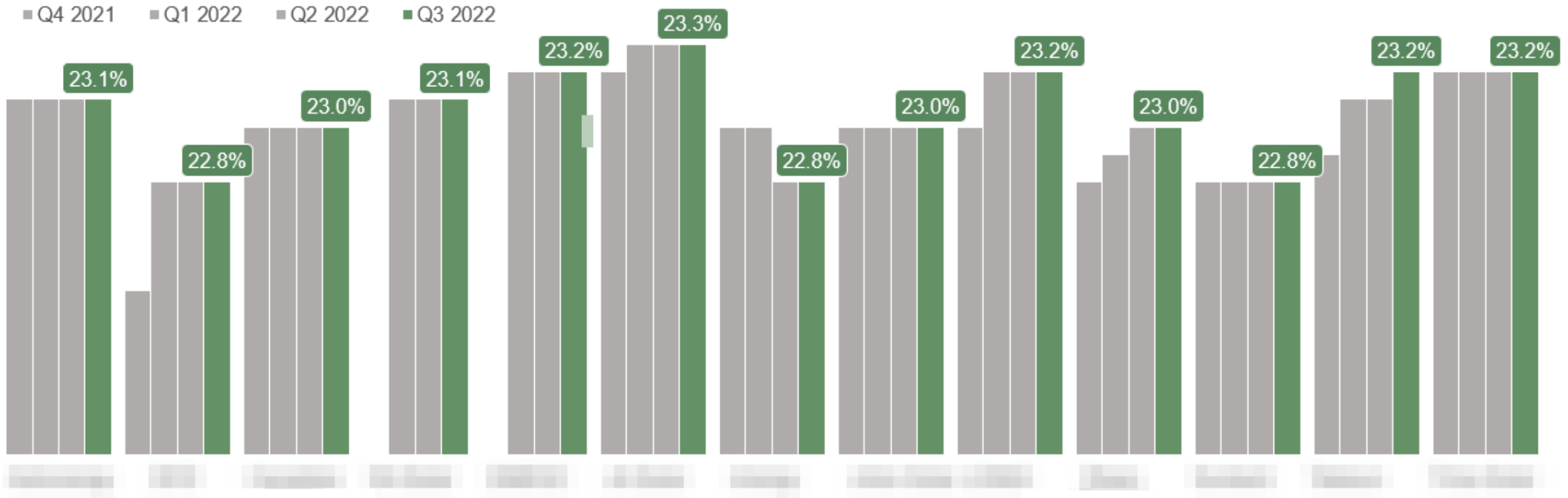


**Notes** | Capacity data is based on supplier statements and represents currently available manufacturing capabilities.

Only seven SMIP suppliers are vertically integrated from ingot to module production, with most others only holding cell and module capacity. With growing merchant wafer options, there is little need for most suppliers to expand upstream.

# PERC Cell Efficiencies

(%, quarterly mass production cell efficiencies)

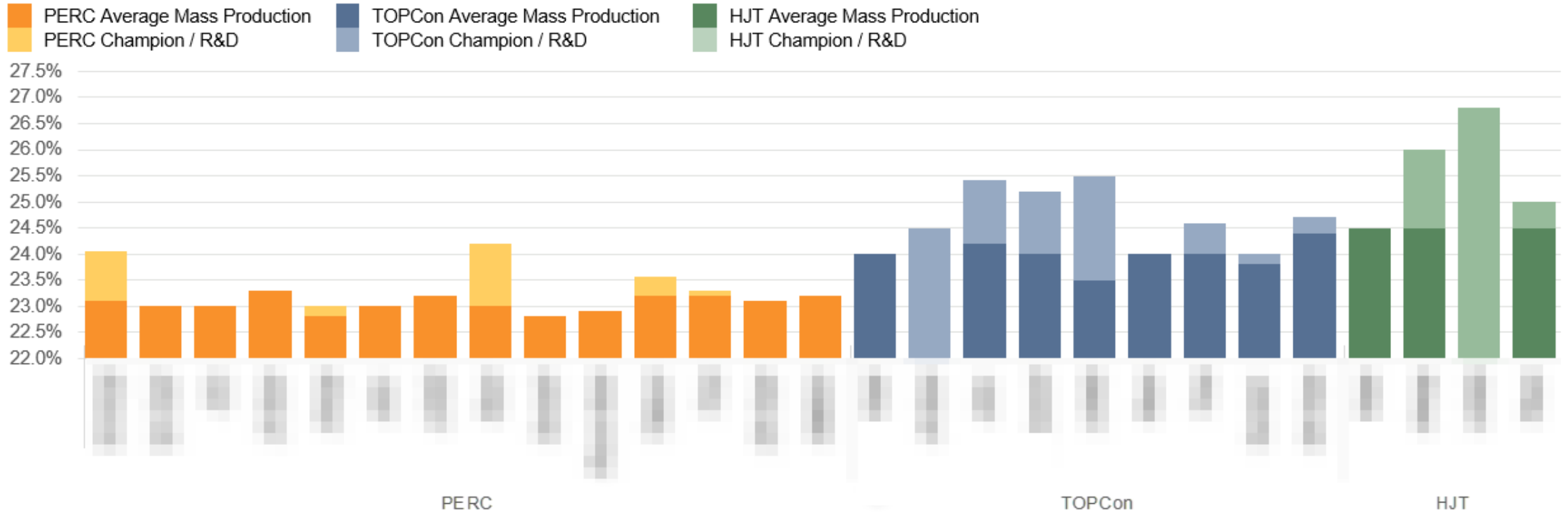


**Notes** | PERC cell efficiency data is based on supplier statements and represents currently available manufacturing capabilities.

Only *one supplier* is reporting PERC efficiency increases, as many suppliers are starting to focus R&D efforts on next-generation TOPCon and HJT efficiency improvements.

# Cell Efficiency Comparison

## (% Q3 2022 cell efficiency)



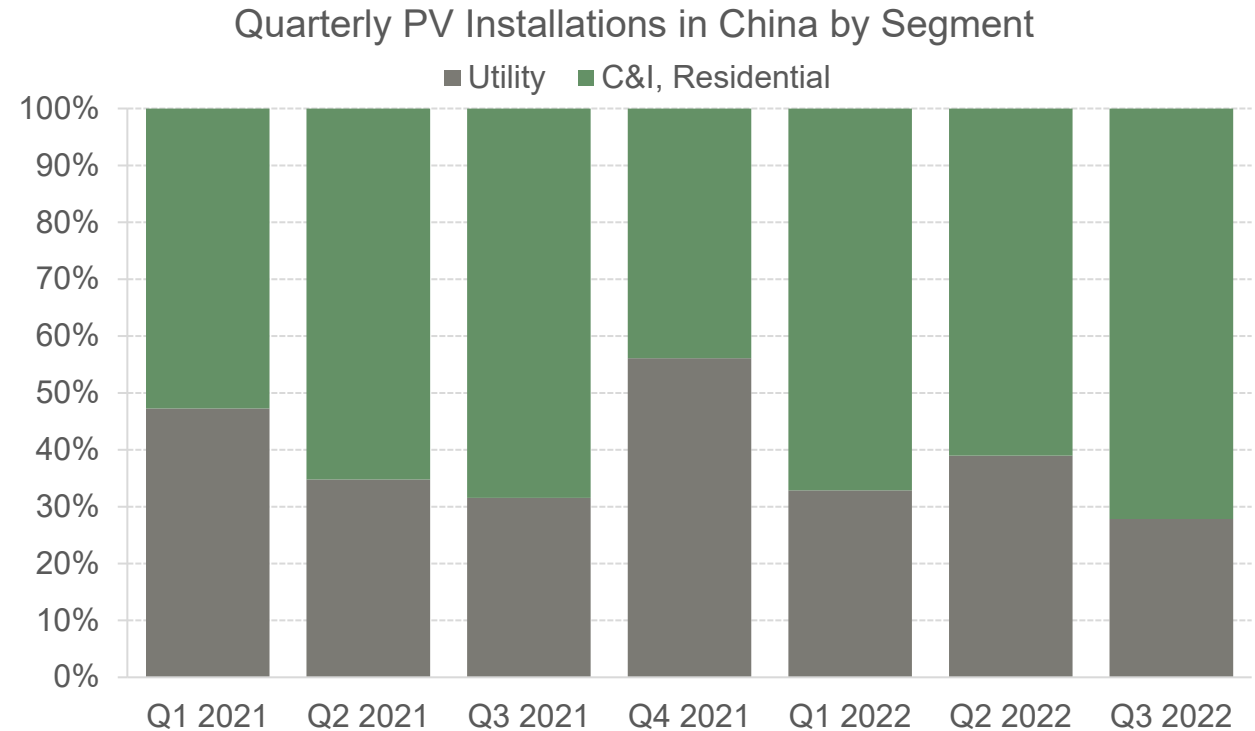
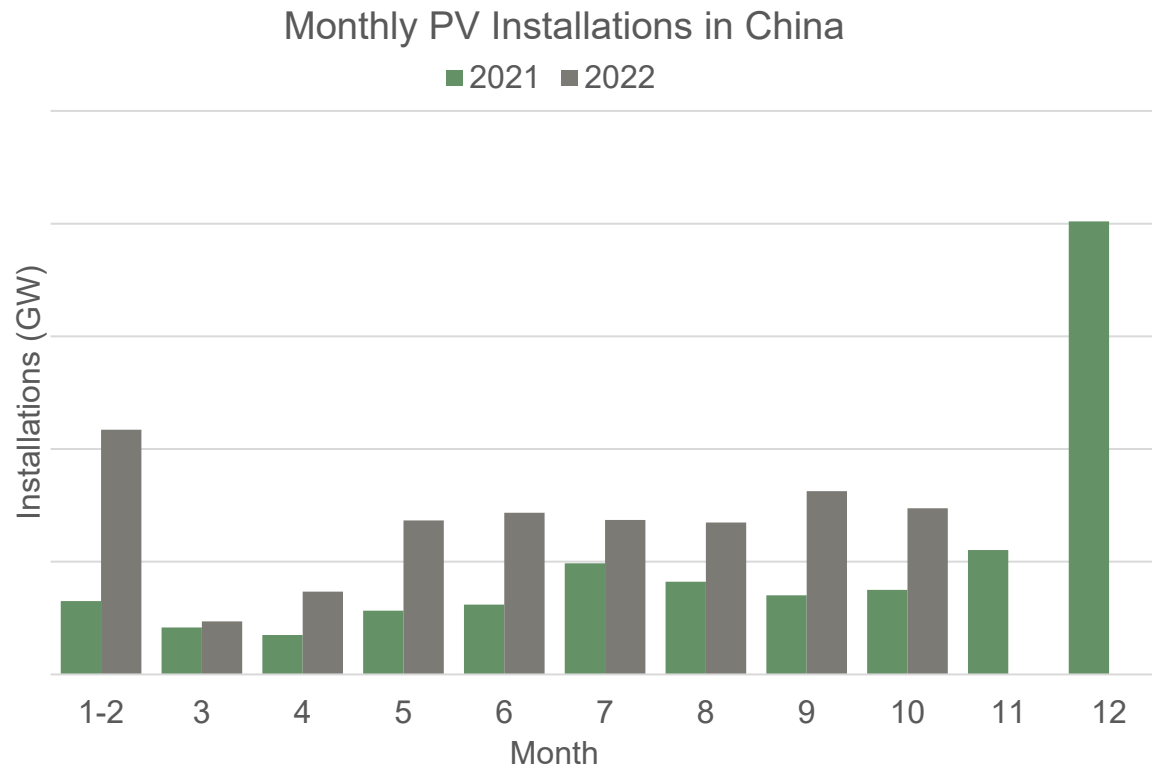
**Notes** | Cell efficiency data is based on supplier statements and represents currently available manufacturing capabilities.

While some suppliers still see additional gains for PERC cells, most have shifted their focus to exploring TOPCon and HJT, given promising efficiency potential based on champion efficiency levels.



# Special Topics And Market Trends

# China's PV Installations (GW)



**Notes** | PV installation data is reported by regional governments and compiled by China's Photovoltaic Industries Association.

Installations from January to October total 60 GW, surpassing installations in all of 2021 (55 GW). The last two months of 2022 will see a surge in utility installations, ending 2022 with up to 85 GW of installations.

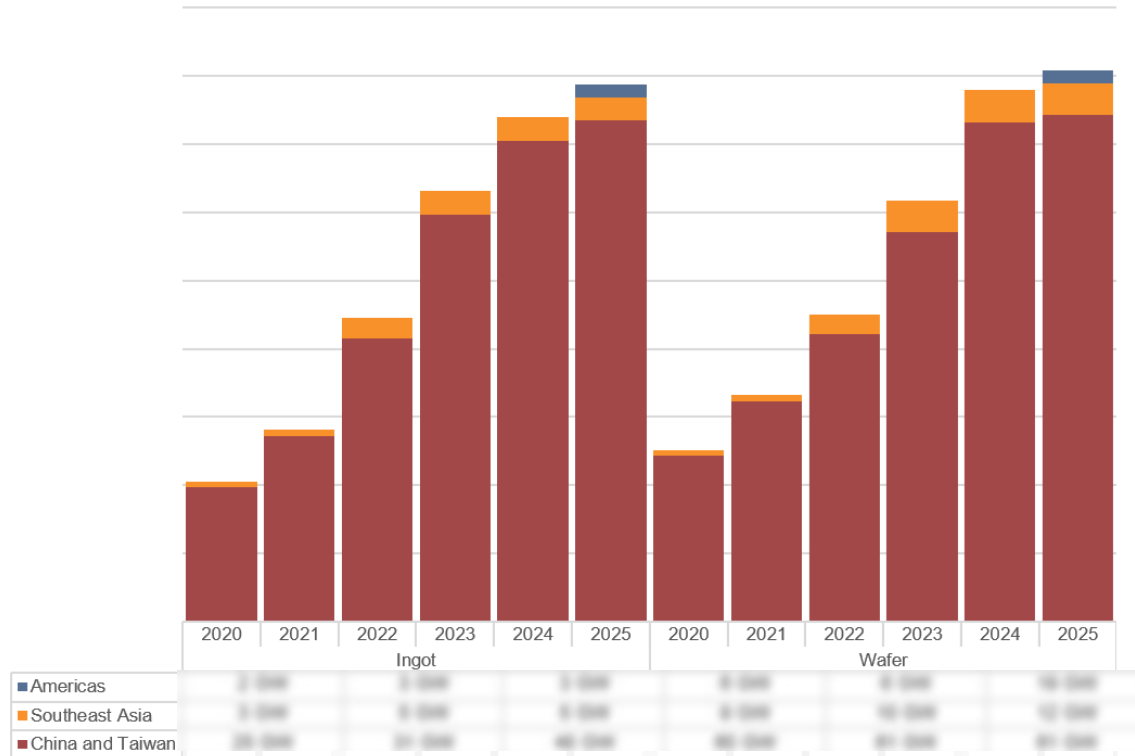
# Global Quarterly Polysilicon Production Capacities (GW)



End-of-year polysilicon capacities are expected to reach 309 GW in 2022 and over 560 GW in 2023 after accounting for ramp-up / maintenance. Manufacturing for 2023 exceeds expected global solar installations.

# SMIP Supplier Ingot And Wafer Capacities

(GW of end-of-year capacity estimates)



In Q3 2022, ingot and wafer capacities grew almost 30 GW compared to last quarter, primarily due to *one supplier's* new 15 GW integrated ingot and wafer facility in *China*, *another supplier's* 10 GW wafer facility in *China*, and *another supplier's* 8 GW ingot expansion in *China* and 5 GW ingot facility in *China*.

Among SMIP suppliers, ingot and wafer capacities total around 218 GW and 211 GW, respectively, with over 95% of this capacity housed in mainland China.

Limited non-China ingot capacity is available, but this figure will expand marginally as *one supplier* continues to ramp up its 7 GW ingot facility in Vietnam *two suppliers* start constructing their ingot and wafer facilities in Vietnam and Malaysia, respectively. Among the suppliers in this report, only *four suppliers* operate or plan to operate non-China ingot and wafer capacities.

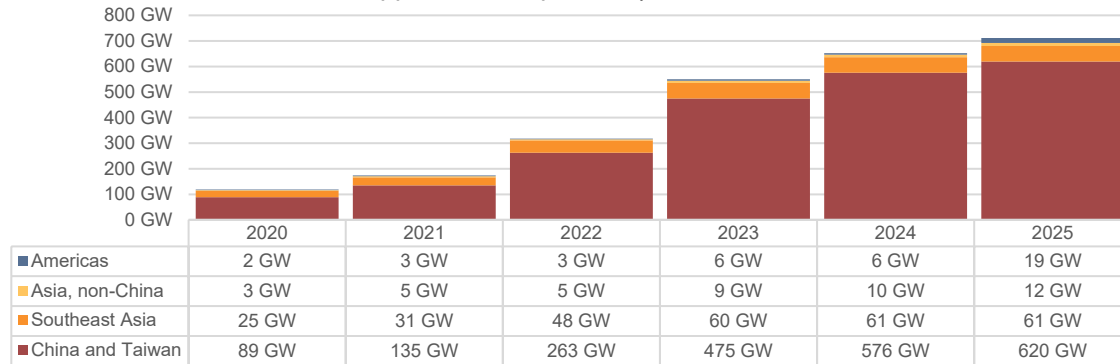
**Notes** | Capacity data is based on supplier statements and represents supplier stated manufacturing expansion goals, either under construction or planned.

As of Q3 2022, eight of the 17 PV SMIP suppliers have in-house ingot and wafer capacity, totaling 218 GW and 211 GW, respectively.

# SMIP Supplier Cell And Module Capacities

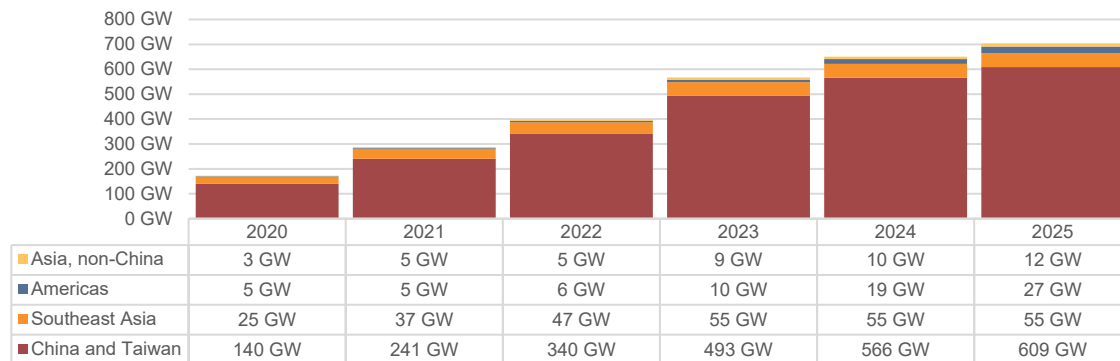
## (GW of end-of-year capacity estimates)

SMIP Supplier Cell Capacities | End-of-Year Estimates



Cell capacity held by SMIP suppliers as of Q3 2022 totaled 288 GW. 26 GW of new cell manufacturing capacities were bought online in Q3. Increases in cell capacity this quarter were led by *three suppliers*. Most of the cell capacities that came online are mono PERC cell technologies, but *one supplier* brought online 3 GW of IBC cell capacity. Total cell capacity among PV SMIP suppliers are further expected to grow to nearly 320 GW by the end of 2022. Another 7 GW of cell capacity may come online in Southeast Asia from *three suppliers* and others to hedge against lingering risks from the Uyghur Forced Labor Prevention Act and the anticircumvention investigation.

SMIP Supplier Module Capacities | End-of-Year Estimates



Supplier module capacities reached over 360 GW in Q3 2022, with newly added capacities totaling 41 GW. *One supplier* expanded the most, with 13 GW of new module capacity, followed by *another supplier* with 11 GW added and another *supplier* with 7 GW added. *Three suppliers* are making consistent strides in module capacity each quarter. The top five suppliers are now *supplier* (52 GW), *supplier* (49 GW), *supplier* (46 GW), *supplier* (38 GW), and *supplier* (33 GW). By the end of 2022, module production capacities among SMIP suppliers are forecasted to reach nearly 400 GW.

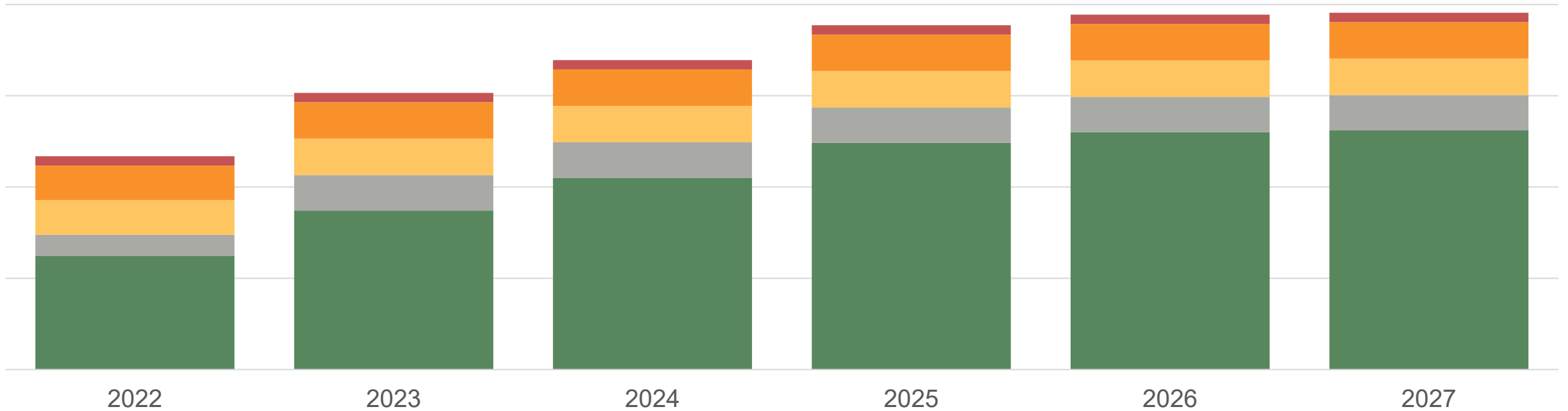
**Notes** | Capacity data is based on supplier statements and represents supplier stated manufacturing expansion goals, either under construction or planned.

By the end of 2022, the 17 suppliers surveyed are expected to hold nearly 320 GW of operational cell manufacturing capacity and could reach about 400 GW of module capacity.

# Non-China Module Capacity Outlook

(GW, end-of-year annualized capacity)

- Non-Named Countries
- Chinese Companies With Known AD/CVD Rates In Named Countries
- "Adverse Facts Available" Companies
- Exempt Companies In Named Countries
- Default Rate Companies

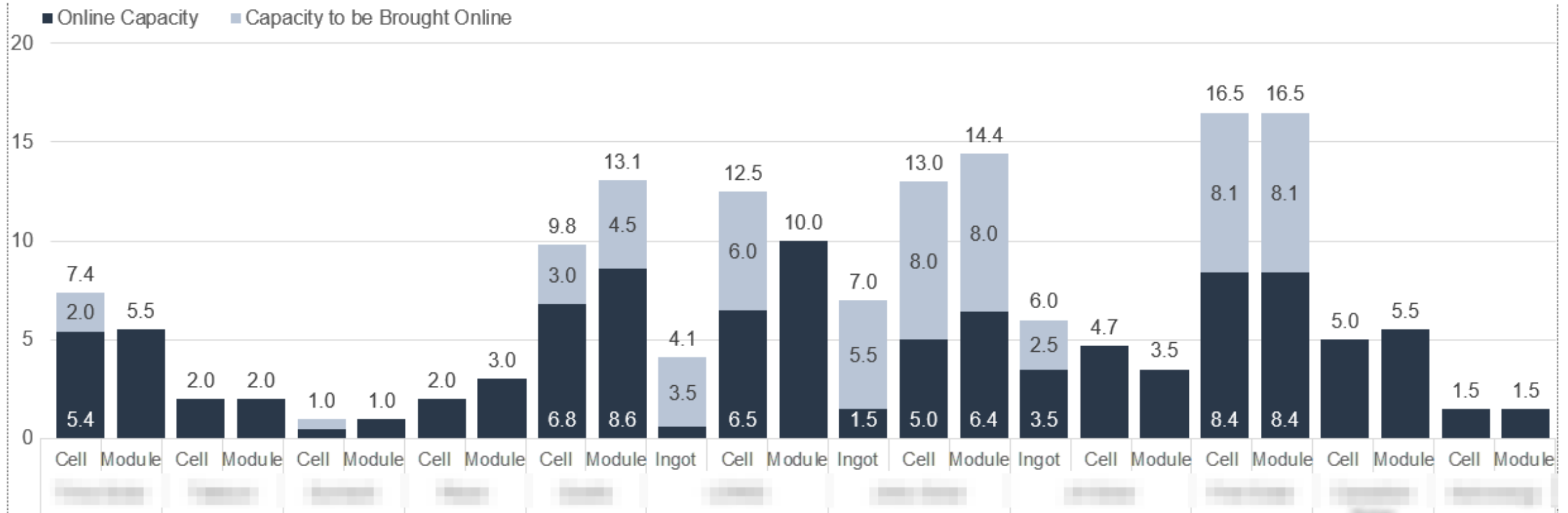


**Notes** | Data aggregated by CEA based on company announcements and disclosures. Data does not account for utilization, ramp times, or other potential production delays. Timelines are based on supplier statements or industry best practices if no timeline data was reported.

While there appears to be more than enough module manufacturing capacity outside the named countries to meet expected U.S. installations, almost all of this capacity is from non-bankable, non-established producers with little to no U.S. track record.

# Non-China Manufacturing Expansions

(GW, SMIP covered manufacturers)



Notes | Capacity data from supplier interviews and disclosures as part of CEA's Supplier Market Intelligence Program. Capacity represents currently online capacity outside China and total future planned non-China capacity.

SMIP companies currently have 5.6 GW of ingot/wafer, 48.3 GW of cell, and 51.9 GW of module capacity online outside China. These capacities will grow to 17.1 GW, 75.4 GW, and 76.0 GW respectively.

# Non-China Module Manufacturing Availability (SMIP covered manufacturers)

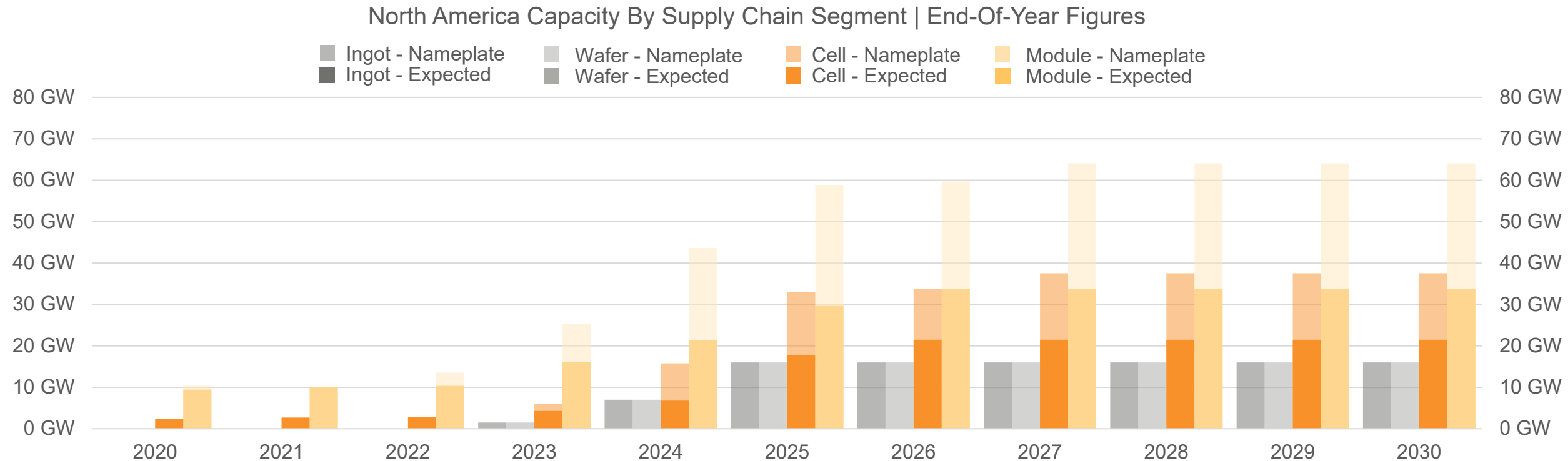
Supplier	166 mm Product Availability	182 mm Product Availability	210 mm Product Availability
Supplier 1	Products available via OEMs	No plans for this wafer size	Products launched
Supplier 2	Products available via OEMs	Products available via OEMs	Possible availability via OEM partners
Supplier 3	Products launched	Products launched	Products launched
Supplier 4	No plans for this wafer size	No plans for this wafer size	No plans for this wafer size
Supplier 5	No plans for this wafer size	No plans for this wafer size	No plans for this wafer size
Supplier 6	No plans for this wafer size	No plans for this wafer size	No plans for this wafer size
Supplier 7	Possible availability via OEM partners	Products launched	No plans for this wafer size
Supplier 8	Possible availability via OEM partners	Possible availability via OEM partners	Possible availability via OEM partners
Supplier 9	Products launched	Products launched	No plans for this wafer size
Supplier 10	No plans for this wafer size	No plans for this wafer size	No plans for this wafer size
Supplier 11	Products launched	Products launched	No plans for this wafer size
Supplier 12	Products launched	Products launched	Pending equipment upgrade decisions
Supplier 13	No plans for this wafer size	No plans for this wafer size	Products launched
Supplier 14	Products launched	Products available via OEMs	Planned availability
Supplier 15	Products launched	Products launched	Planned availability
Supplier 16	No plans for this wafer size	No plans for this wafer size	Products launched

- Products available now are indicated in green.
- Products planned to be made available with target launch dates are indicated in light green.
- Products potentially able to be made available in the future are indicated in yellow.
- Products that will not be made available at this time are indicated in red.

Most suppliers offer non-China 182 mm or 210 mm products. *One supplier* launched 210 mm products this quarter, but other suppliers need additional time to finalize 210 mm offerings due higher equipment upgrading costs.

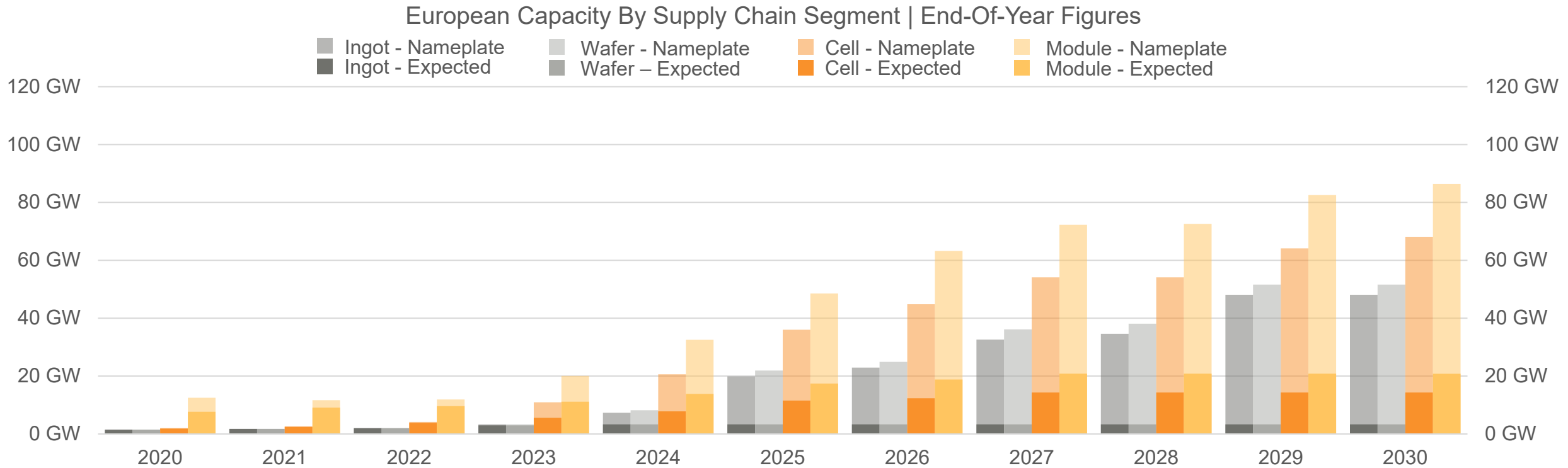


# North America Solar Manufacturing (GW)



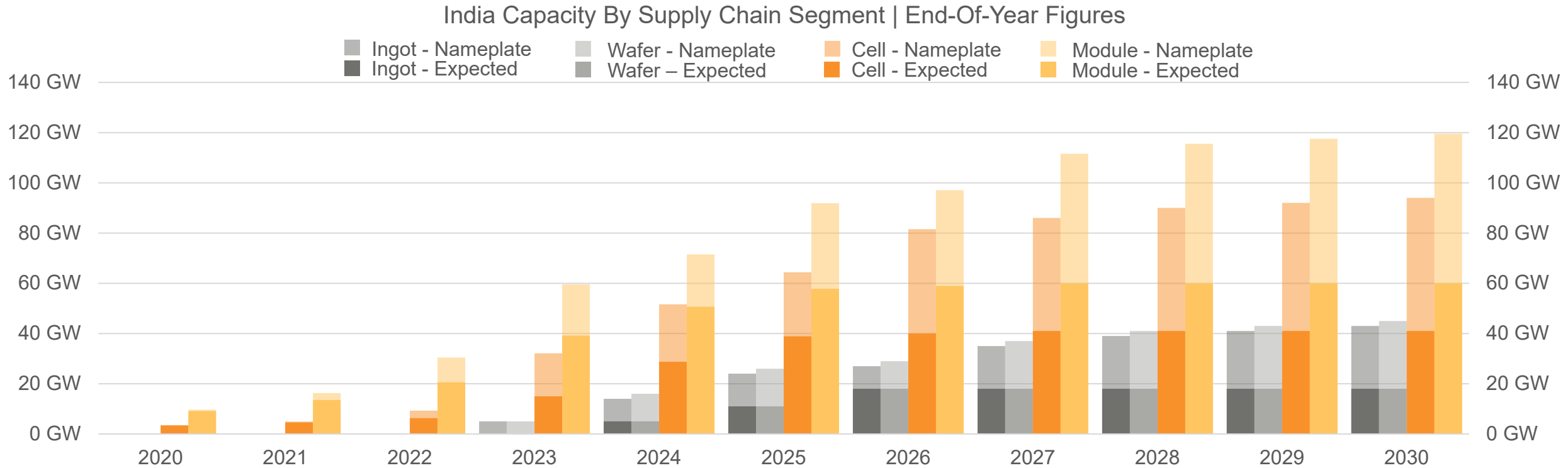
Module production in North America is concentrated among a few suppliers in the United States and primarily focused on the residential, commercial, and industrial sectors. There is currently no crystalline silicon cell production capacity in North America. However, several suppliers have announced cell manufacturing expansion plans in the United States after the Inflation Reduction Act was signed into law in August 2022. No ingot or wafer production facilities are currently located in North America, but several suppliers have recently announced ingot and wafer plans after the Inflation Reduction Act was passed. Projected module, cell, and wafer capacities based on company announcements will reach approximately 49 GW, 30 GW, and 23 GW by 2027, respectively. Polysilicon production capacity will increase with REC bringing its Moses Lake facility online in 2024.

# European Solar Manufacturing (GW)



Europe actively supports capacity developments, with sizeable expansions ranging from ingot to module production being planned. Europe has a strategic interest in rehoming PV manufacturing capacity, expedited by Russia's ongoing war in Ukraine. This crisis has galvanized Europe's aims for energy security and reduced reliance on Russian fossil fuels. Factors such as high logistics costs, and volatile energy commodity prices, are among the compounding drivers for developing domestic European manufacturing capabilities. Europe remains an increasingly sought-after market for solar exports from China. Although Europe's political interest in decoupling from China's PV supply chain may impede future trade, this is unlikely to occur in the near term, given Europe's current lack of PV manufacturing capacities and the urgency for a transition to replace Russian fossil fuels.

# Indian Solar Manufacturing (GW)



India's Basic Customs Duty of 40% on imported solar panels and 25% on imported solar cells and a USD 3.21 billion allocation for a Production Linked Incentive (PLI) plan to boost domestic solar manufacturing has spurred strategies for integrated PV manufacturing facilities. Cell manufacturing capacities in India are expected to reach around 10 GW by the end of this year, while module manufacturing is expected at approximately three times that of cell capacities. Significant cell manufacturing capacities are expected to be online in 2024 as emerging suppliers complete construction and ramp up their facilities. Once there is module production capacity beyond projected domestic demand around 2024, more module producers in India will have the scale and expertise to start exporting in significant volume to the US and EU markets.

# MCT Quarterly Ratings

# MCT Ratings

## (Manufacturing Readiness Level, Capacity Scale, And Track Record)

CEA introduced new supplier ratings in the Q4 2019 issue of the PV SMIP report to facilitate a quick overview and comparison of suppliers regarding three critical areas covered by the PV SMIP: Technology, capacity, and track record. The PV SMIP development team uses three ratings for each supplier for its scoring system. The grading methodology since Q1 2022 has been updated and will differ from previous methods.

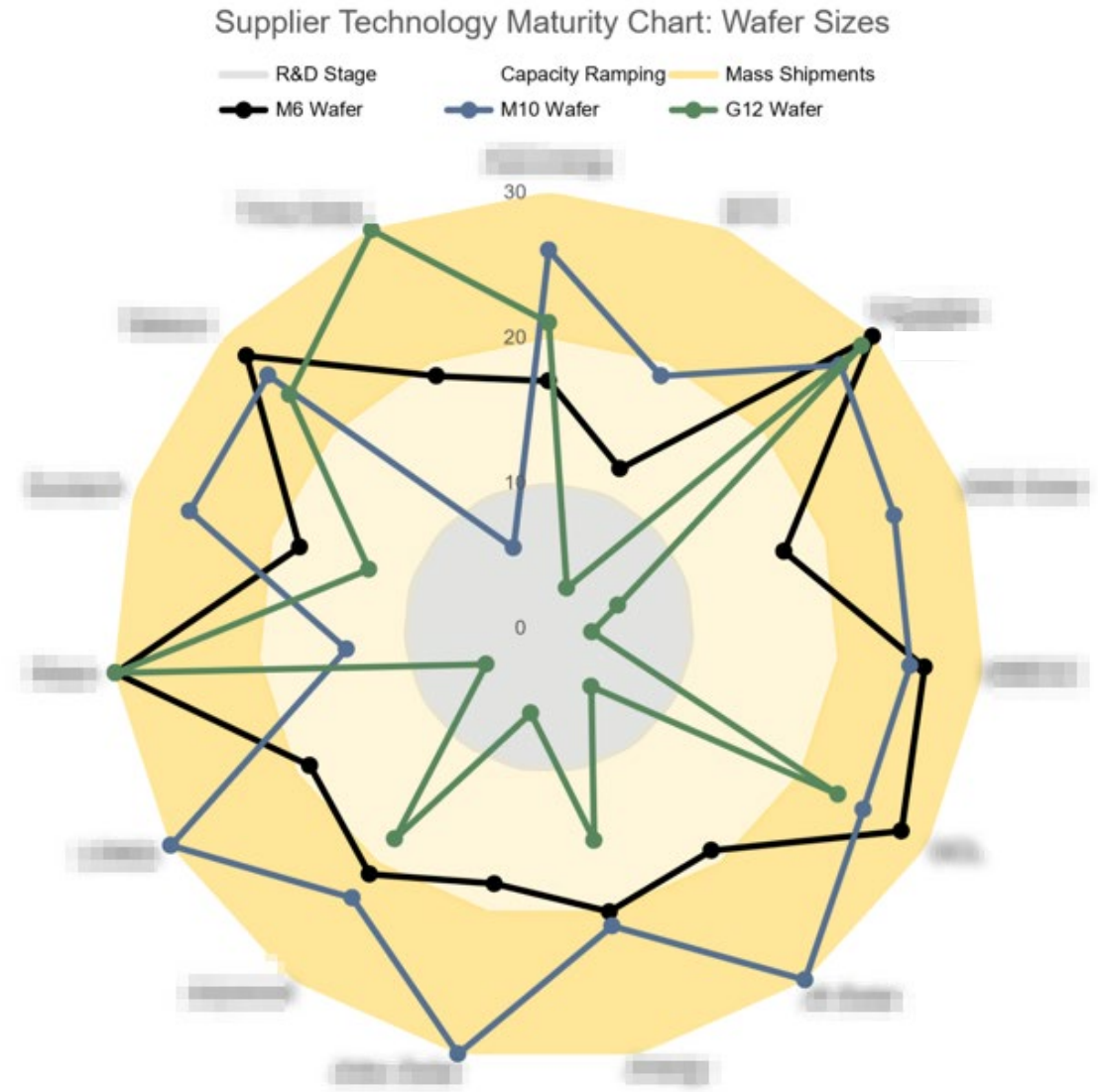
- 1. Manufacturing Readiness Level (MRL):** A measure developed by the US Department of Defense to specify the rate of maturity of technologies.
- 2. Capacity Scale:** A measure used to specify the production capacity levels for specific technologies of each supplier.
- 3. Track Record:** A measure used to specify the volume of shipments of specific technologies for each supplier. The grading criteria and methodology for each of these ratings are described in more detail in Section 10. All suppliers except for First Solar and Qcells are given ratings.

# Technology Maturity (Wafers)

In this comparison, the most relevant M6 (166 mm), M10 (182 mm), and G12 (210 mm) wafers are considered.

166 mm remains a mature technology for most suppliers. However, several suppliers phased out this wafer size, downgrading their technology maturity rating for 166 mm wafers this quarter.

There is a consistent increase in technology maturity ratings for M10 and G12, with improvement of MRL, shipments, and capacity expansions.



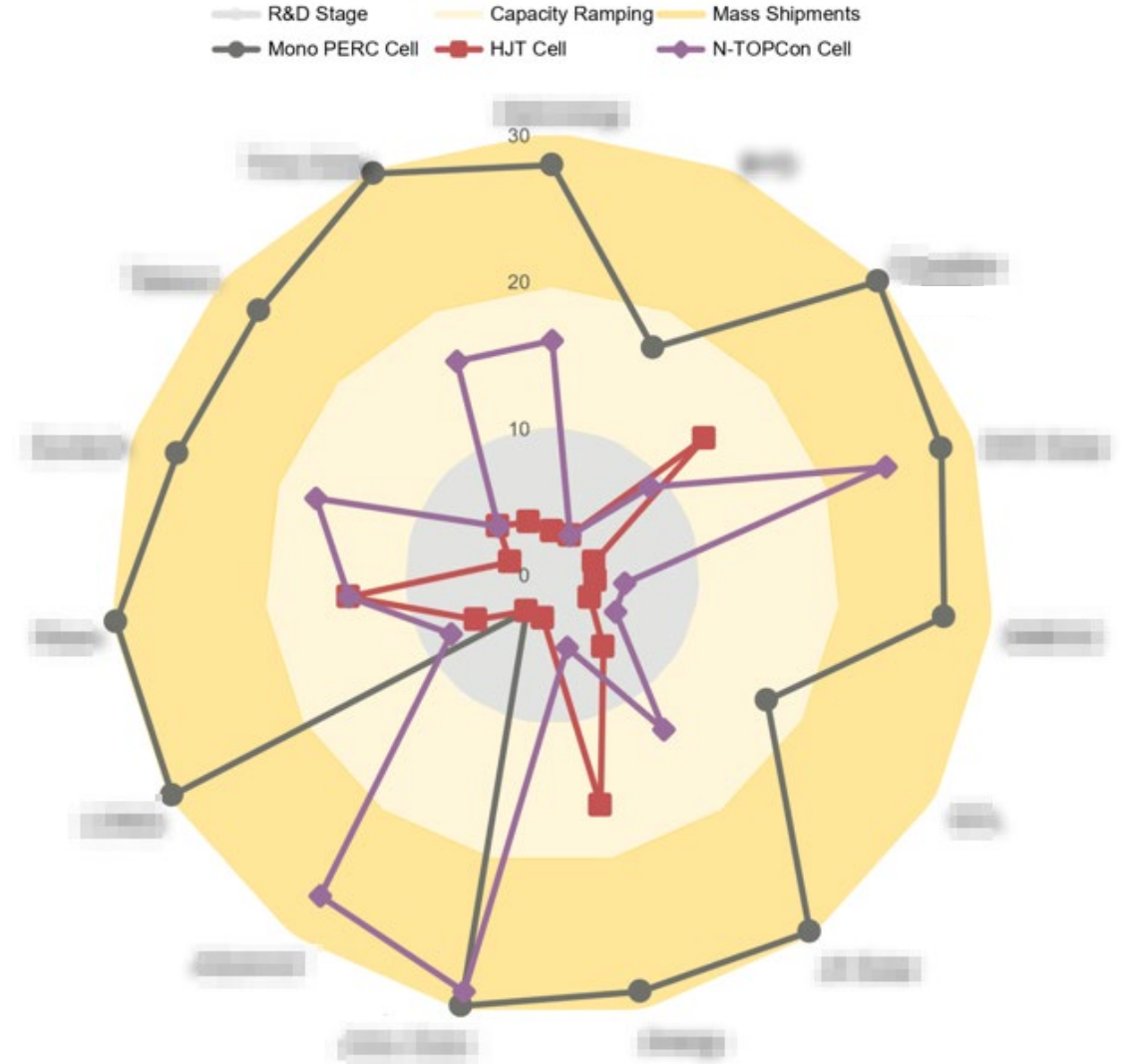
# Technology Maturity (Cells)

PERC, the industry's incumbent technology and technology of choice for most suppliers, is now facing increasing competition with n-type TOPCon and HJT technologies.

This quarter, the TOPCon rating for *two suppliers* increased with an increase in the cell capacity at their facilities.

For *one supplier*, both TOPCon and HJT showed an increase in overall ratings with the availability of pilot and mass production of these technologies, respectively.

Supplier Technology Maturity Chart: Cell Technologies



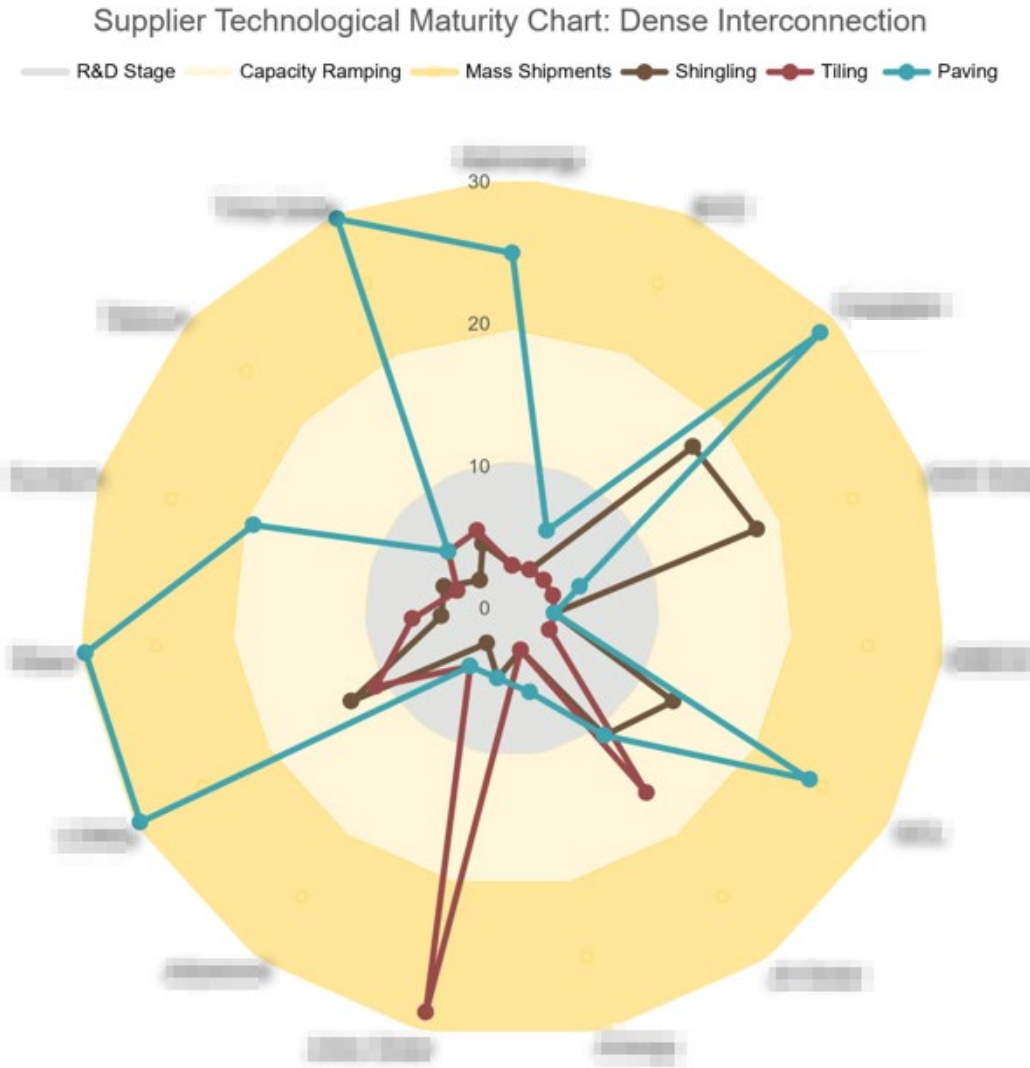
# Technology Maturity (Dense Interconnection Technologies)

Paving continues to be the preferred dense interconnection technology among most suppliers.

The ratings for *three suppliers* increased this quarter with an increase in MRL ratings for these three suppliers.

With the implementation of a new wafer variant, 182P, *one supplier* has brought back tiling and is ramping up capacity for this technology.

This quarter, there has been no significant change concerning the ratings of dense interconnection for other suppliers.





# MCT Ratings

## (Manufacturing Readiness Level Comparisons)

The Manufacturing Readiness Level “heatmap” view highlights the maturity of several technologies across wafer, cell, and module segments. Many suppliers have exhibited increased maturity in 210 mm manufacturing, while many others have downgraded 166 mm capacities, with many suppliers returning to a score of 8 in this category. At the cell level, TOPCon and HJT are gaining traction: this quarter *four suppliers’* MRL ratings for these technologies increased with their capability to manufacture these products. At the module level, paving remains the leading technology option for almost all suppliers.

Supplier	Rating	Wafer			Cell					Module							
		166 mm	182 mm	210 mm	Mono PERC	Multi PERC	Cast Mono PERC	TOPCon	HJT	Double glass	Bifacial DG	Bifacial Transp. Backsheet	Half-cut	MB B	Shingling	Tiling	Paving
	MRL	8 ↓	10	10 ↑	10	10	3	8 ↑	3	10	10	5	10	10	3	3	10
	MRL	8 ↓	10	3	9	3	3	3	3	9	9	3	10	10 ↑	3	3	6 ↑
	MRL	10	9	10	10	10	8 ↓	7	9 ↑	10	10	6	10	10	9	3	10
	MRL	10	10	10	8 ↓	8 ↓	9	5 ↑	3	10	10	8 ↓	10	10	8 ↓	3	9
	MRL	8 ↓	10	5 ↑	10	8	7	8	6	10	10	8	10	10	8	9	8
	MRL	10 ↑	10	9	10	3	3	5 ↑	8	10	10	6	10	10	3	3	6 ↑
	MRL	10	10	6 ↑	10	7	7	10	3	10	10	10	10	10	5	10	5
	MRL	10	10	9	3	3	3	10	3	10	10	10	10	10 ↑	3 ↓	5 ↑	5 ↑
	MRL	8 ↓	10	5	10	3	3	6	6 ↑	10	10	8	10	10	8 ↓	8	10
	MRL	10	9	10	10	3	3	8	8	10	10	5	10	10	5	7	10
	MRL	8 ↓	10	9 ↑	10	8 ↓	6	9	3	10	10	6	10	10	5	4	9
	MRL	10	10	10	10	3	5	5	5 ↑	10	10	10	10	10	3	6	6
	MRL	8 ↓	6 ↑	10	10	8	7	8	4	10	10	6	10	10	5	6	10
	MRL	8 ↓	10	5 ↑	10	3	3	10 ↑	3	10	10	8	10	10	10	3	5
	MRL	10	10	3	10	3	3	5 ↑	3	10	10	3	10	10	3	3	3

# MCT Ratings

## (Capacity Scale Comparisons)

Capacity ratings lag Manufacturing Readiness Level ratings, which is to be expected when many new technologies are still developing. The Capacity Scale ratings for TOPCon and HJT technologies have increased for *three suppliers*. At the module level, *one supplier's* increase in capacity for tiling technology has increased its rating this quarter. Many suppliers are phasing out 166 mm capacity, which has reduced scores for many suppliers.

Supplier	Rating	Wafer			Cell					Module							
		166 mm	182 mm	210 mm	Mono PERC	Multi PERC	Cast Mono PERC	TOPCon	HJT	Double glass	Bifacial DG	Bifacial Transp. Backsheet	Half-cut	MBB	Shingling	Tiling	Paving
	Capacity Scale	1 ↓	10	7 ↑	8 ↑	1	0	6 ↑	0	10	10	0	10	10	0	0	10
	Capacity Scale	1 ↓	5	0	5	0	0	0	0	5 ↑	5 ↑	0	5 ↑	5 ↑	0	0	0
	Capacity Scale	10	10	10	10	3	1	2 ↑	3 ↑	10	10	0	10	10	4	0	10
	Capacity Scale	10	10	10	1	1	1	0	0	10	10	1	10	10	1	0	10
	Capacity Scale	1 ↓	10	0	10	1	0	3 ↑	0	10	10	1	10	10	1	4 ↑	1
	Capacity Scale	4 ↓	7	4	10	0	0	0	4	8	8	0	8	8	0	0	0
	Capacity Scale	4	10	0	10	0	0	10	0	10	10	10	10	10	0	10	0
	Capacity Scale	5	7	7	0	0	0	8	0	6	6	6	6	6 ↑	0	0	0
	Capacity Scale	1 ↓	10	0	10	0	0	0	0	10	10	2	10	10	1	1	10
	Capacity Scale	10	3	10	10	0	0	3	3	10	10	0	10	10	0	0	10
	Capacity Scale	1	10	2 ↑	8	1	0	5	0	10	10	0	10	10	0	0	7
	Capacity Scale	10	10	10	8	0	0	0	0	10	10	4	10	10	0	0	0
	Capacity Scale	1 ↓	0	10	10	1	0	4	0	10	10	0	10	10	0	0	10
	Capacity Scale	1 ↓	10 ↑	0	10	0	0	10	0	8	8	4	8	8	4	0	0
	Capacity Scale	10 ↑	10 ↑	0	8	0	0	0	0	10 ↑	10 ↑	0	10 ↑	10 ↑	0	0	0

# MCT Ratings

## (Track Record Comparisons)

Track Record ratings usually match Capacity Scale ratings. Shipments for 182 mm and 210 mm wafers continue to increase each quarter. A significant increase is observed in the case of *three suppliers* this quarter for 210 mm and/or 182 mm products. At the cell level, *one supplier's* cumulative shipments have increased its TOPCon rating this quarter. *Three suppliers* also recorded shipments this quarter. With *one supplier's* significant shipment record for modules with paving technology and *another supplier* using tiling technology, their ratings have increased since last quarter.

Supplier	Rating	Wafer			Cell					Module							
		166 mm	182 mm	210 mm	Mono PERC	Multi PERC	Cast Mono PERC	TOPCon	HJT	Double glass	Bifacial DG	Bifacial Transp. Backsheet	Half-cut	MBB	Shingling	Tiling	Paving
	Track Record	8	6	4	10	8	0	2 ↑	0	9	9	0	10	10	0	0	5
	Track Record	3	4 ↑	0	3	0	0	0	0	3	3 ↑	0	8	3 ↑	0	0	0
	Track Record	10	8 ↑	9 ↑	10	9	8	0	2	10	10	0	10	10	4	0	9 ↑
	Track Record	8 ↑	5	3	8	8	4	0	0	5	5	4	9	9	4	0	5
	Track Record	10	10	0	10	2	0	2 ↑	0	10	10	2	10	10	2	3 ↑	2
	Track Record	6	4	2	9	0	0	0	4	4	4	0	6	6	0	0	0
	Track Record	4	10	0	10	0	0	9 ↑	0	9	9	9	10	10	0	9	0
	Track Record	6	6 ↑	2	0	0	0	9	0	9	9 ↑	8 ↓	9	9 ↑	0	0	0
	Track Record	10	10	0	10	0	0	2	0	10	10	2	10	10	4	2	10
	Track Record	10	2	10	10	0	0	3 ↑	3	10	10	0	10	10	0	0	10
	Track Record	9	6	2 ↑	9	8	0	3	0	8	8	0	10	9	0	0	3
	Track Record	8 ↑	6 ↑	4 ↑	9	0	0	0	0	8	8	2	9	9	0	0	0
	Track Record	10	0	10	10	4	0	4	0	10	10	0	10	10	0	0	10
	Track Record	8	5	0	8	0	0	4	0	5	5	2	8	8	4	0	0
	Track Record	6	5	0	9	0	0	0	0	8	8	0	8	8	0	0	0

# Report Contents: 219 Pages of In-Depth Reporting

CEA's **Supplier Market Intelligence Program** is the leading source of data and analysis in the solar and storage industries. We report on current trends and have a pulse on the latest PV solar and energy storage technologies set to disrupt the renewable energy landscape.

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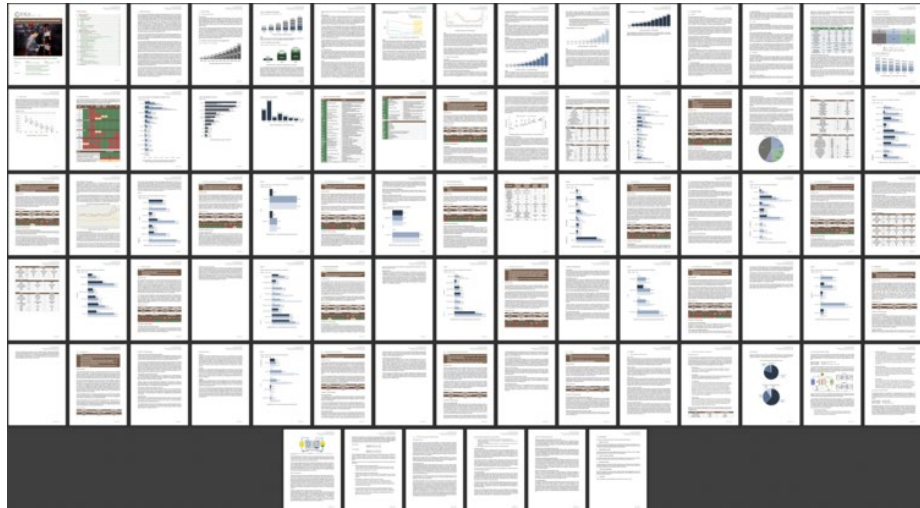
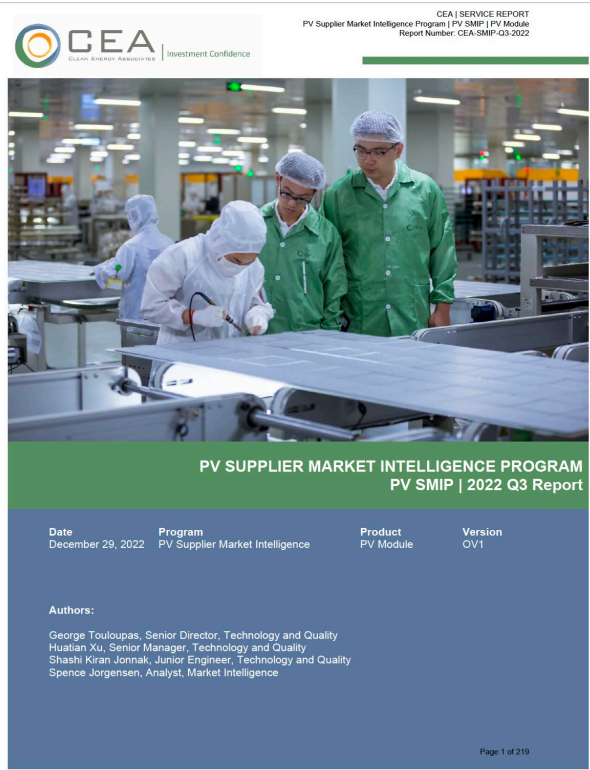


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# Thank You

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