PV manufacturing capacity expansion announcement plans and analysis for Q3 2017

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Abstract

After the significant upwards revisions made to global solar PV manufacturing capacity expansion announcements in the first half of 2017, which we reviewed in the previous edition of *Photovoltaics International*, the third quarter was characterized by much more tempered plans. The 'Silicon Module Super League' (SMSL) continued to execute on previously announced plans with some adjustments, while others in emerging markets such as Turkey and India retained grandiose nameplate targets though initial ramps remained small.

July review

The month of July proved to be the most active for new capacity expansion announcements in the third quarter of 2017. Total plans reached 3,001MW, which included 1,000MW of new solar cell capacity, a total of 2,000MW of dedicated module assembly and a nominal 1MW advanced integrated manufacturing 4.0 R&D facility in California, opened by SunPower.

Turkish solar company Smart Energy Group was reported to have established a Joint venture with China-based Phono Solar (part of SUMEC) to build and operate an initial 400MW module assembly plant with future plans said to take capacity to 1,200MW. The assembly plant is set to be established in the Gebze Organized Industrial Zone.

Also of note in July was plans by India-based Premier Solar Systems to build a 1,000MW solar cell plant with an overseas business partner. The company had also announced that it had opened a 200MW fully automated solar module manufacturing facility in Sangareddy, Telangana, India. The module assembly expansion takes nameplate module capacity to 375MW. The company has 50MW of solar cell capacity.

August review

The weakest month for capacity announcements in the quarter was August with only one announcement. India-based Heavy Engineering Corporation announced plans to build a 150MW integrated cell and module assembly plant using both monocrystalline and multicrystalline wafers. Initially, the plant will have a nameplate capacity of 150MW. Modules will be used initially for its in-house downstream PV power plant projects.

There were no dedicated cell or module assembly plant announcements in August and none for thin film.

September review

New announcements rebounded slightly in September. Total new capacity plans totalled around 900MW and were dominated by China-based PV module manufacturer Sunport Power, which officially started production at a 1GW module assembly plant using Eurotron's MWT equipment for

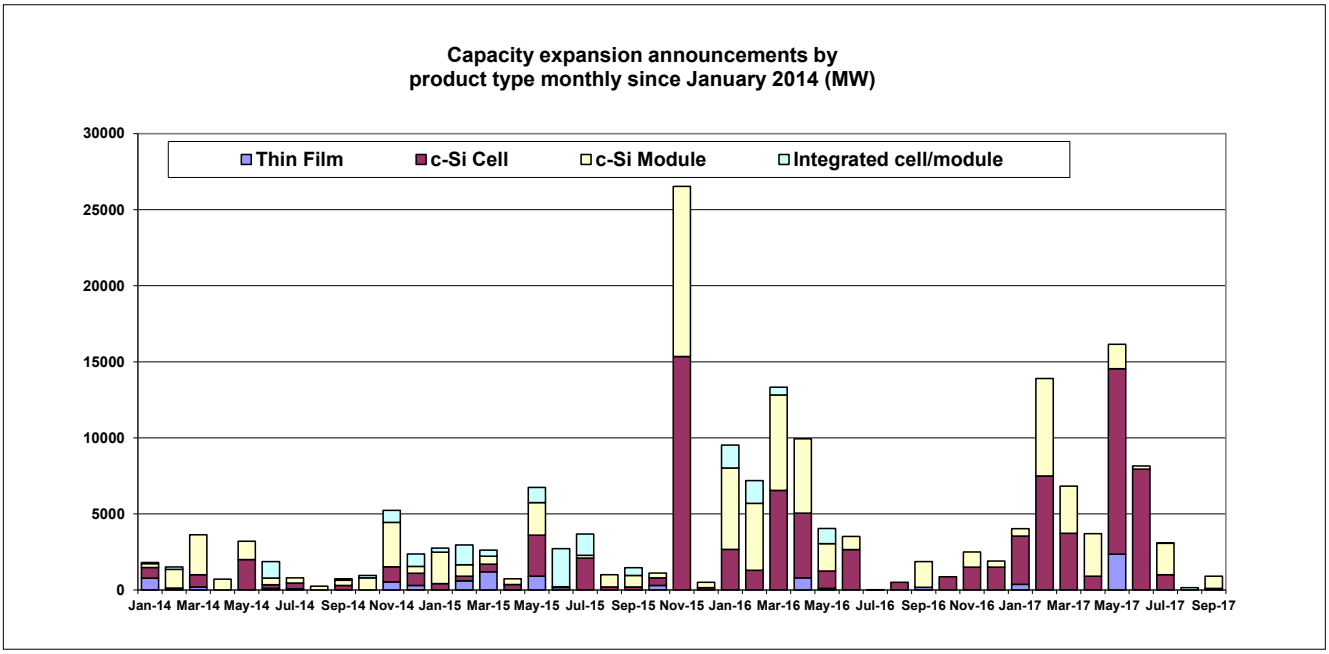


Figure 1. Capacity expansion announcements by product type monthly since January 2014 (MW).

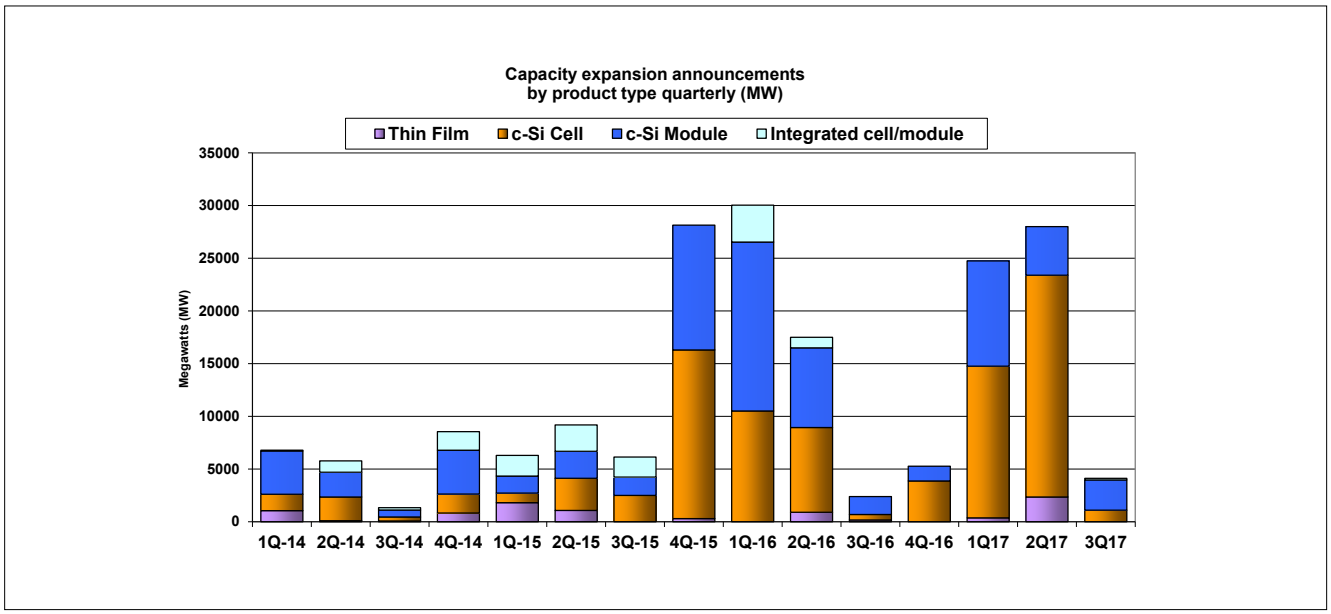


Figure 2. Capacity expansion announcements by product type quarterly (MW).

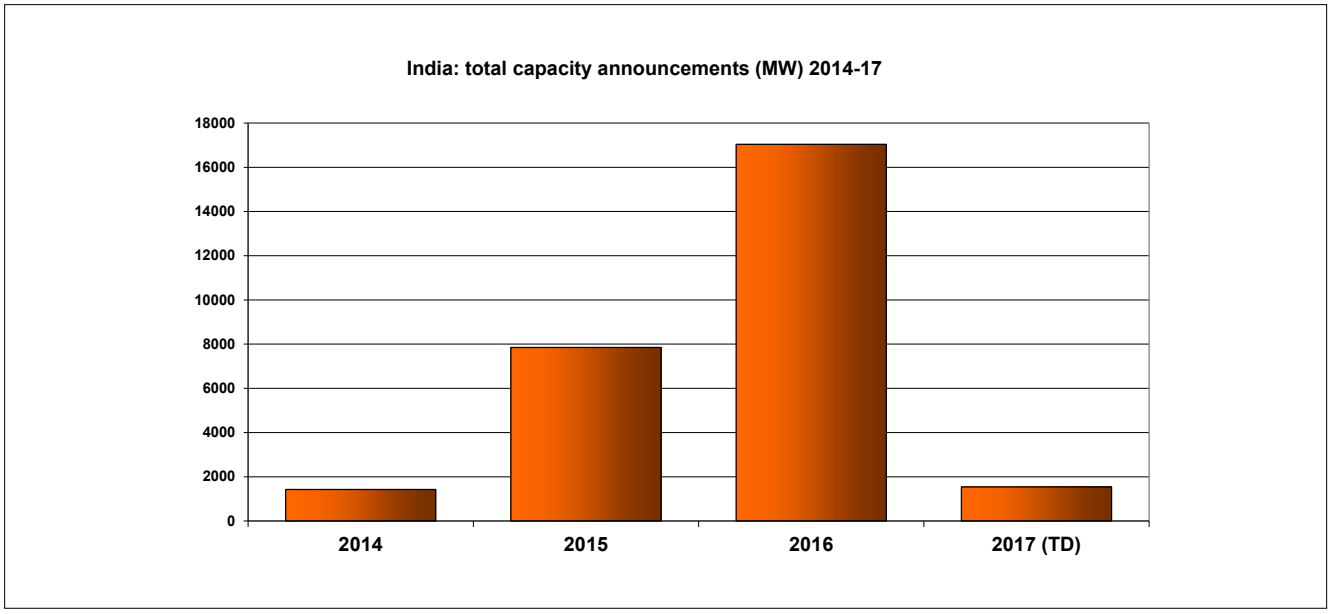


Figure 3. India: total capacity announcements (MW) 2014-17.

back-contact PV modules. The company had initially deployed a 200MW line so the new expansion accounted for 800MW of the total in September.

Also included in September was the first fully automated and unmanned 100MW monocrystalline solar cell line officially opened by Tongwei Group in Hefei, China as part of its most recent 2,000MW new solar cell plant.

Quarterly review

Total third quarter 2017 capacity expansion announcements reached only around 4,122MW, compared to 28,000MW in the previous quarter.

The subdued environment was driven by dedicated module assembly plans, which totalled 2,870MW, while integrated cell and module plans, absent so far in 2017, totalled 151MW. No new thin-film expansion plans were announced in the third quarter.

India review

With a history of solar manufacturing, albeit on a small scale, India has held the promise of becoming a major powerhouse for solar manufacturing, second only to China.

With a downstream PV market in the 6GW range in 2017 and the promise of much higher installation rates through 2022, the gap between capacity expansion announcements and effective nameplate capacity continues to be one of the widest.

Indian government data released in the second quarter of 2017 put solar cell capacity in India at just 3,164MW, yet only 1,667MW as deemed to be operational. A similar situation existed with module assembly capacity: a total of around 8,400MW of capacity was reported to exist in the country, while only around 5,500MW was deemed to be operational.

As seen in the Figure 3 2017 has seen a significant reduction in new announcements compared to the last two years with 2016 peaking at over 17,000MW. In total we have tracked over 27,800MW of announcements in India since 2014.

Building a manufacturing supply-chain base in India that comes even close to meeting domestic demand has proved elusive. A key perennial challenge has been the capital markets but a large proportion of the projects tracked were JVs with China-based companies as well as plans from US and Japan, which have also stalled despite the ability to tap low-cost finance in those countries.

A key emerging challenge that has been cited for manufacturing plans being stalled is related to the low prices tendered on multiple gigawatts of downstream power plant projects. Simply put, the winning bids are lower than potential manufacturing costs in India, not least due to the lack of a highly efficient low-cost manufacturing supply chain in the country that could match that of China.

Having depended on low-cost modules produced in China, India is challenged to compete and JVs with major Chinese producers such as Trina Solar and LONGi Group remain suspended.

However, new efforts by the Indian government to support domestic content requirements through a new wave of government-led downstream projects could become the catalyst required to kick start more effective capacity in India. Uncertainties in trade cases in the US could also make India attractive to supply modules to the US market in 2018 onwards. However, further reforms and a complete and low-cost manufacturing supply chain, coupled to rational tendering, all need to be in alignment before the imbalance between capacity expansion announcements and effective capacity is closed.

Solar 'manufacturing 4.0'

Although the third quarter of 2017 was subdued for capacity expansion plans, it has signalled an important milestone in PV manufacturing. Several facilities were opened in the quarter that relate to the concept of 'manufacturing 4.0', which includes fully automated manufacturing lines and remote operation.

In July, SMSL member GCL System Integration Technology (GCL-SI) announced the establishment and operation of an entirely unmanned module assembly workshop to test intelligent fully automated manufacturing tools and software systems. The workshop is expected to undertake tests for around two years.

The company noted that it was cooperating closely with Chinese domestic equipment manufacturers, and has independently researched and developed a series of intelligent systems, which include a high-speed automated tabbing machine, a high-precision layout machine and a robotic palletizing system. In all, GCL-SI said that 26 separate systems so far developed were industry firsts.

GCL's manufacturing 4.0 workshop.

A key aim of the tests is to achieve a 50% improvement in efficiency, a 60% reduction in online manpower and a 30% reduction in processing costs. Product quality improvement targets were being set at a 21% overall improvement. GCL-SI says its intention is to implement the improvements across its volume manufacturing operations.

In August, SunPower said it had invested around US$25 million in the last 12 months on a new US R&D and pilot line facility located at its headquarters in San Jose, California.

SunPower said the new facility included several high-volume production-sized manufacturing tools, high levels of automation and specialised testing equipment, designed to support its next generation of high-efficiency n-type monocrystalline interdigitated back contact (IBC) solar cells and modules, which are being designed with greater emphasis on lower cost manufacturing.

According to SunPower, over 30 parts suppliers and equipment manufacturers located in the US supplied the facility, which is housing over 100 SunPower engineers and support staff.

In September, as already noted, Tongwei Group opened its completed high-efficiency solar cell plant (S2), which included the world's first technically unmanned 100MW monocrystalline solar cell production line.

The S2 plant in Chengdu, China has an initial nameplate capacity of 2GW, which brings Tongwei's monocrystalline cell capacity to around 3.4GW. The company also has around 2GW of multicrystalline solar cell capacity. The company also has around 2GW of multicrystalline solar cell capacity and recently completed a 5,000MT polysilicon plant expansion, bringing nameplate production capacity to 20,000MT.

Tongwei is investing around RMB12 billion (US$1.8 billion) in total to construct new cell manufacturing facilities at in the Hefei High-tech Industrial Development Zone in Chengdu City to provide nameplate capacity of 10GW, while a further 10GW

Tongwei opened its first 100MW 'manufacturing 4.0' line at its 2GW S2 plant.

of capacity will be housed in the Southwest Airport Economic Development Zone of Shuangliu District, Chengdu City. Construction on the new projects is expected to start in November 2017 and production ramped in phases over the next three to five years.

Tongwei has taken the early lead in China in investing in manufacturing 4.0 capabilities, however much is being done behind the scenes at other major manufacturers and the learning curve is expected to take several years.

SMSL Q3 manufacturing update

JinkoSolar

Leading SMSL member JinkoSolar reported that its in-house annual silicon wafer capacity stood at 7GW at the end of the third quarter, up 1GW from the prior quarter.

Solar cell capacity as expected was 4.5GW, while module capacity did increase by a further 500MW in the third quarter, reaching 8GW. These are the expected nameplate capacities exiting 2017. Although the company claimed its next wave of expansions had yet to be determined and would be based on market demand dynamics it is highly likely new plans will be announced in the next two quarters.

JinkoSolar is expecting to hit record shipments in 2017, having guided just short of 10GW, indicate almost a 10% global market share of module shipments and is sold out through the first half of 2018.

Canadian Solar

Canadian Solar has made four revisions to capacity expansion plans in 2017 and has also provided initial new expansion plans for 2018.

The SMSL member said it had completed the ramp-up of a new multicrystalline silicon ingot casting workshop at Baotou, China at the end of the third quarter of 2017, with a total annual capacity of 1,100MW, which included capacity relocated from its plant in Luoyang, China.

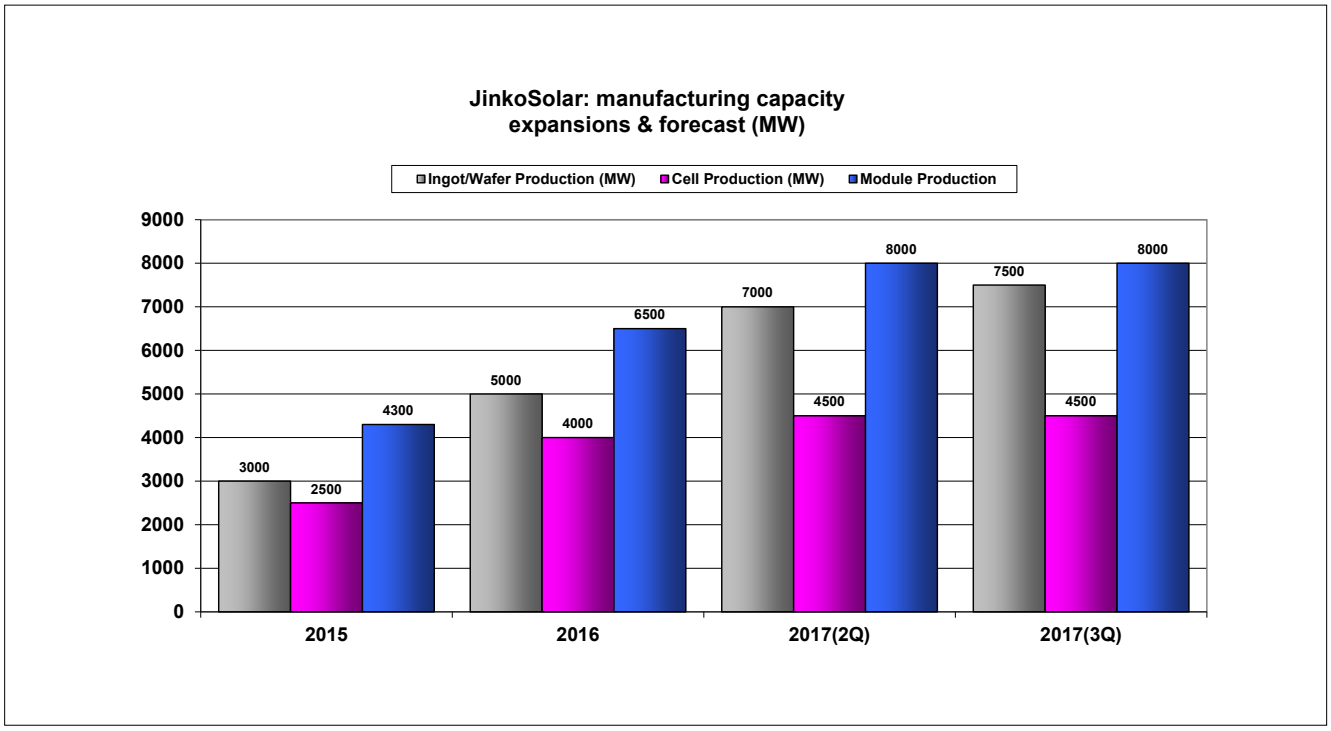
It also said it expected debottlenecking to push capacity to 1,200MW by the end of 2017, which is in line with the last two updated plans.

Canadian Solar said that it had plans further increase its ingot capacity to 1,720 MW by 30 June 2018, and may expand to 2,500MW if market conditions justify.

Wafer manufacturing capacity had reached 3GW in the third quarter of 2017. The company had previously guided that it expected wafer capacity to reach 4GW at the end the year.

However, Canadian Solar noted that its shift to diamond-wire saw technology, which

Figure 4. JinkoSolar: manufacturing capacity expansions & forecast 2017 (MW).



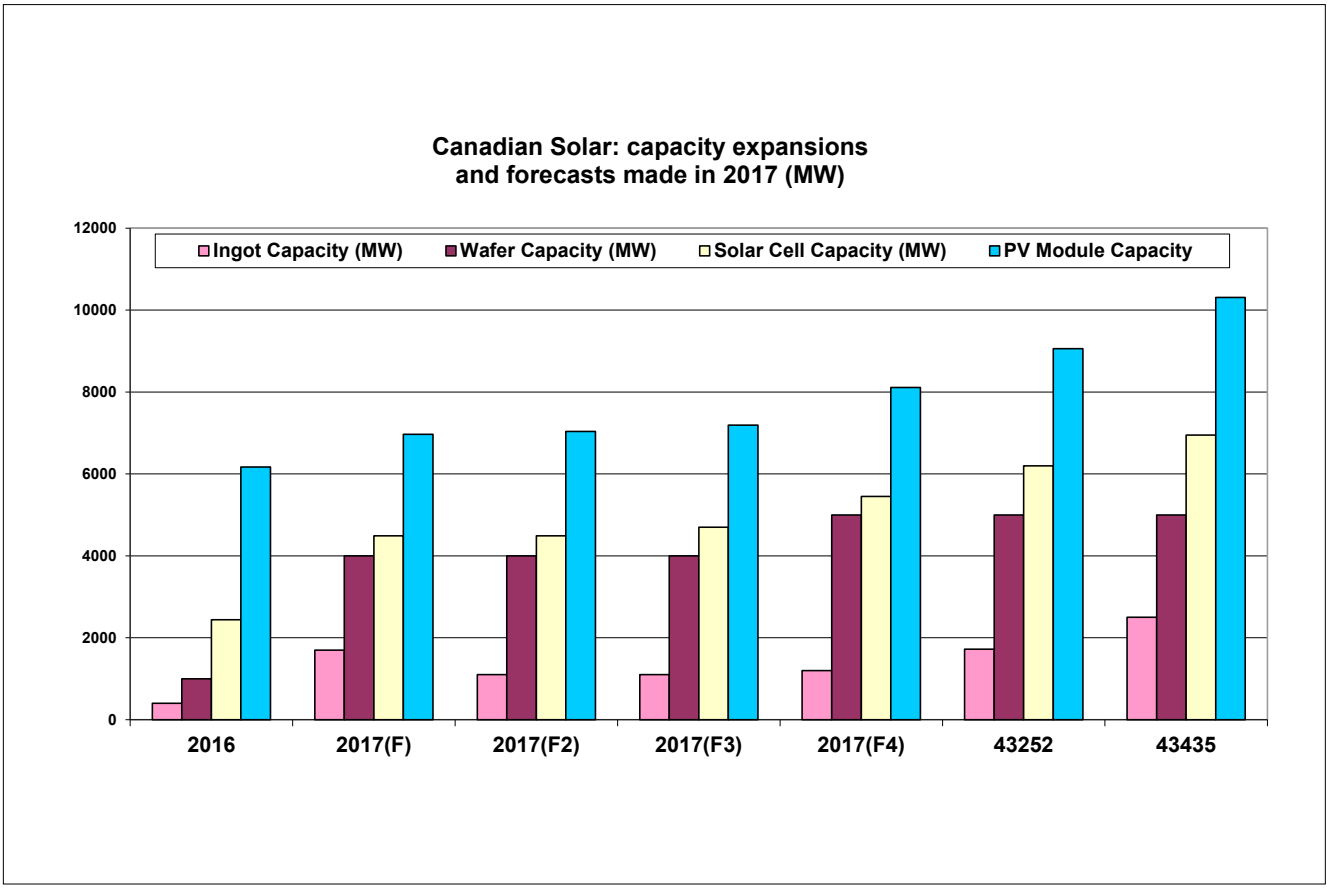


Figure 5. Canadian Solar: capacity expansions and forecasts made in 2017 (MW).

is compatible with its proprietary and highly efficient 'Onyx' black silicon multi-crystalline solar cell technology, helped to significantly offset the recent impact of polysilicon price increases that impact margins and so was planning to add a further 1GW of wafer production to end the year at 5GW.

The company said that its solar cell manufacturing capacity reached 4.7GW at the end of the third quarter of 2017, which was the target in its third revision to its capacity expansion plans.

However, Canadian Solar said that it planned to add additional cell manufacturing capacity at its Funing and Southeast Asia plants by year end, bringing 2017 cell nameplate capacity to 5,450MW, a 750MW increase.

Subject to market conditions Canadian Solar said it planned to add another 1.5GW of cell capacity in 2018 to reach approximately 7GW by the end of 2018.

With respect to PV module manufacturing capacity, Canadian Solar expects that its total worldwide module capacity would exceed 8,110MW by the end of 2017.

Subject to market conditions again, the SMSL member said it planned to add another 1,250MW of module capacity by the end of 2018, bringing nameplate capacity to 10.3GW. Canadian Solar is the first manufacturer to guide nameplate module capacity to reach over 10GW.

JA Solar

JA Solar confirmed that it expected to achieve both cell and module nameplate capacities of around 7,000MW by the end of 2017. JA Solar is on track to achieve full-year module shipments in the region of 6.8GW in 2017, but did not provide an update on 2018 capacity expansion plans.

Hanwha Q CELLS

Hanwha Q CELLS said that it was starting to migrate solar cell capacity at its China-based facilities to passivated emitter rear cell (PERC) technology, highlighting the shift away from standard back side field (BSF) technology for higher conversion efficiencies.

Hanwha Q CELLS noted in its third quarter earnings call that capital expenditure was being focused on its manufacturing facilities in China to enable the company to have PERC cell production capacity of 1.4GW, while retaining around 1.2GW of BSF production. Hanwha's lead manufacturing facilities are in Malaysia and are already 100% PERC.

Its affiliate, Hanwha Q CELLS Korea, is currently adding 1.6GW of cell and module production, which is expected to provide a nameplate capacity of 3.7GW by the end of this year.

"Although the third quarter of 2017 was subdued for capacity expansion plans, it signalled an important milestone in PV 'manufacturing 4.0'"

Hanwha Q CELLS' in-house cell and module capacity has not increased in 2017 as the company keeps tight control on spending to return to sustainable profitability. However, with Hanwha Q CELLS Korea expansions in 2017, the group will have access to 8GW of cell and module capacity starting in 2018, up from 6.4GW at the end of the third quarter of 2017.

Hanwha Q CELLS recently reiterated that it expected module shipments in 2017 to be in the range of 5.5GW to 5.7GW.

GCL System Integration Technology

GCL-SI reported it had ramped its solar cell and module assembly JV plant in Vietnam to around 800MW in the third quarter of 2017.

Critical to the market, the solar cell capacity ramp has been PERC technology with the flexibility to produce p-type multi and p-type mono cells for the residential, commercial and utility-scale markets.

The company said that its total solar cell capacity would reach 2GW by the end of 2017, which would be completely PERC-based technology. Currently, around one-third of production is p-type multi using 'Black Silicon' texturing after wafers (S2 size) are cut with diamond wire. Around a third of production is p-type mono PERC, while a further third of production is flexible to customer demand.

LONGi Group

LONGi Group, which is leading the industry transition to high-efficiency monocrystalline wafers, cells and modules, has actually increased the pace of some of its previously announced plans for 2017.

At the beginning of the year its capacity for wafers had reached 7.5GW and is was expected to reach 12GW by the end of 2017. In the third quarter of 2017, LONGi surpassed the 12GW mark and said it was planning to add further capacity to meet continued strong demand.

LONGi still expects to meet expansion goals of 5GW for solar cells and 6.5GW for modules by the end of the year. However, it does not plan to provide updated plans until issuing its 2017 annual report.

Conclusion

Despite the slowdown in new plans in the quarter, executing on existing plans has been a key theme throughout the year, notably for China-based firms and the majority of SMSL members. Having continued to gain market share in 2017, SMSL members are all expected to announce record annual module shipments in 2017.