Quarterly analysis of PV manufacturing capacity expansion plans

Mark Osborne, Senior News Editor, *Photovoltaics International*

ABSTRACT
This quarterly report will focus on the third quarter of 2015, which was expected to be the low point in new capacity expansion announcements during the year. Momentum seen during the first half of the year, however, carried through, and so a full nine-month analysis is also provided, to further characterize developments in 2015. Finally, developments in October and the record-setting month of November will also be covered, ahead of a full-year analysis of all expansion announcements over the last 24 months that were converted into 'effective' capacity in the next quarterly report.

July the joker

Global PV manufacturing expansion plans for the month of July 2015 could have provided a longer-term picture of future expansions, rather than more-immediate decisions that might have resulted in newly added capacity within the next 12 months. In July global PV manufacturing expansion plan announcements totalled 3.68GW, up by over 30% from June, which amounted to 2.75GW.

In the first half of the year, May was the high point of announcements, which totalled 6.7GW, as well the most active month in terms of the number of companies announcing new plans for capacity expansions. Despite the 3.68GW of announcements for the month of July, that figure proved to be the second largest to May's record

The challenge with the majority of planned expansions announced in July was that most lacked either a definitive timeline or a definitive location, while some lacked both. In one particular case, an initial plan was for 160MW of integrated PERC cell/module production in India as part of a more ambitious target of 1GW of production that was also announced for future years without any specific timelines being given for execution. Adding to the challenge of qualifying the majority of the announcements in July is the lack of details regarding financing. Consequently, announcements in July fell significantly below the meaningful

Credit: JA Solar

Figure 1. November this year saw a record surge in cell and module production capacity expansion announcements.

capacity qualification criteria, compared with the many that met the mark in February, March and May.

Even in May's record level of announcements, however, close to 1GW of announced expansions can already be eliminated from the total. This is because a 900MW a-Si thin-film plant by Hanergy Thin Film was cancelled after the Hong Kong stock market commission began investigating the company. Its shares remain frozen through the end of November 2015. Several other small module assembly expansions from start-ups bring the total close to the 1GW level, as obtaining financing for such projects can often take more than a year to arrange, if this done at all.

> "July stands out because of the 1GW of planned monocrystalline solar cell capacity in China, from a single company."

The month of July also stands out because of the 1GW of planned monocrystalline solar cell capacity in China, from a single company. The expansion schedule is understandably phased over an unspecified number of years, but does have substance for several reasons. First, there is a renaissance under way in high-efficiency monocrystalline wafer/cell production. Second, the announcement was made by a leading Chinese monocrystalline wafer producer as part of its strategy to support growth of monocrystalline production overall to enable low-cost competitive modules. Third, overall solar cell capacity expansions have trailed module assembly expansion plans in 2014, yet the first half of 2015 has been notable for the resurgence in cell expansion plans as companies start to rebalance production.

Another project that materialized in July comes from a Tier-1 integrated PV manufacturer in Asia, with an expected 400MW expansion of multicrystalline PERC production. The company has been capacity constrained and running at 100% utilization rates.

Dedicated solar cell capacity expansions announced in July topped 2.1GW, while integrated cell/module expansions totalled 1.4GW. Dedicated module assembly expansions were only 180MW.

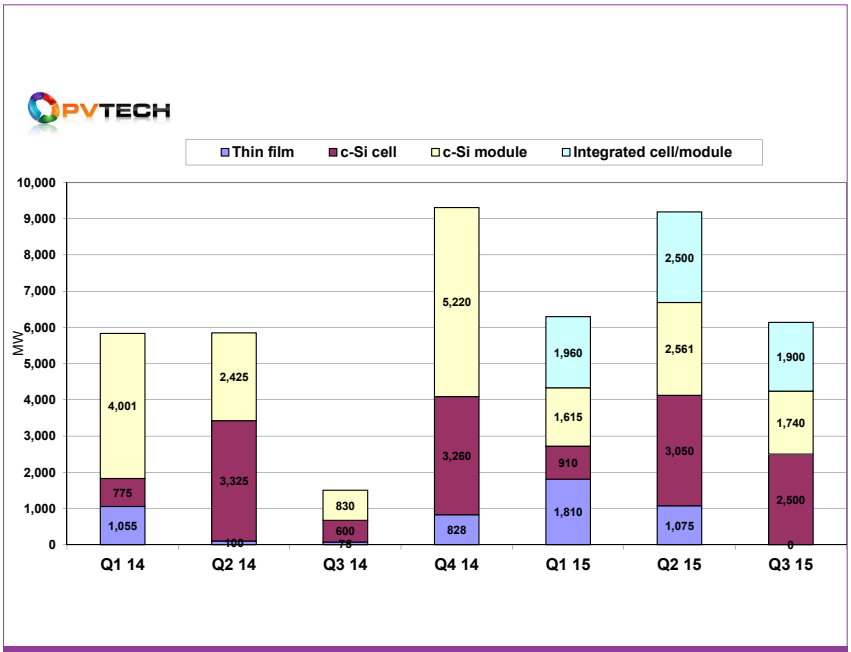

Figure 2. Capacity expansion announcements by product type and by quarter.

USA dominates August

Global PV manufacturing expansion plans announced for the month of August 2015 neatly totalled 1GW, down by over 72% from 3.68GW in the previous month, but significantly higher than announcements made in August a year ago, which only totalled 50MW. The majority (800MW) of capacity expansions were for PV module facilities, which included 320MW of capacity additions at existing facilities and 480MW for new module assembly plants.

Only four companies announced plans in August; these included Suniva on its acquisition by Shunfeng/Suntech, Silfab Solar, Amerisolar and Globo Brazil, which was a new facility that officially opened in the month. Significantly for the month of August, virtually all the announcements (820MW) related to North America, with 700MW concerning the USA.

Despite the booming US market and stiffened anti-dumping duties against China and Taiwan, only 1GW of new capacity plans had been announced for the USA by the end of August.

September slumber

The expectation for September was that after the record capacity expansion level set in May (6.7GW), new announcements would decline through to the fourth quarter, when major new announcements from some of the major PV manufacturers could be expected during third-quarter financial conference calls. Though the trend has been downward as expected, a total of almost 1.5GW of new capacity plans were announced from five companies – a much higher figure than the 1GW announced from five companies in August.

Similarly to August, the announced September capacity plans were dominated by dedicated solar cell (200MW) and integrated cell and module (500MW) expansions, while dedicated module assembly plans totalled 760MW. There were zero capacity expansions announced for thin-film production, and zero for the third quarter of 2015.

The main expansion announced (700MW) was that of China-based Seraphim Solar System; this was an expansion of previously revealed plans in May (300MW) of module assembly in Jackson, Mississippi. The company has since said that it would be using solar cells procured from merchant cell producers in South Korea, which would include multi and mono products.

The surprise news of the month was the planned introduction of 200MW of solar cell capacity at aleo solar's module assembly plant in Germany. Despite the European end-market being in decline, European producers are mostly running at full capacity.

Once again, a level of caution should be applied to more than 500MW of plans for India announced by LONGi Silicon Materials (for a 500MW integrated facility) and by GCL Integrated Technology Co/Adani Group joint venture (unspecified). The recent GCL/Adani announcement simply lacks any details at all, especially with regard to financing,

suggesting that both companies have issues with raising new capital.

Impressively, around 2GW of planned expansions by cell/module subsidiary Lerri Photovoltaic have recently received financing through a private placement of shares in the parent company, while the remaining capacity plans have yet to be finalized.

Third-quarter analysis

As expected, total capacity announcements declined from the highs of 9.2GW in the second quarter of 2015 to just over 6GW in the third quarter (Fig. 2). The drop-off was not as significant as expected, however, especially when only 1.4GW was announced in the same period in 2014. The strength of announcements for Q3 mirrors that for Q1, and is similar in size to that for the first two quarters of 2014.

> "Total capacity announcements declined from the highs of 9.8GW in the second quarter of 2015 to just over 6GW in the third quarter."

The third quarter also confirmed that emphasis at a MW level has most definitely switched to capacity plans for both dedicated solar cell expansions and integrated cell/module expansions. A total of 2.5GW of dedicated solar cell expansion announcements were made in the third quarter, while at least 1.9GW of integrated production plans were announced. Dedicated module assembly plans totalled around 1.7GW, slightly ahead of first quarter plans, but down significantly from the second quarter's 2.5GW.

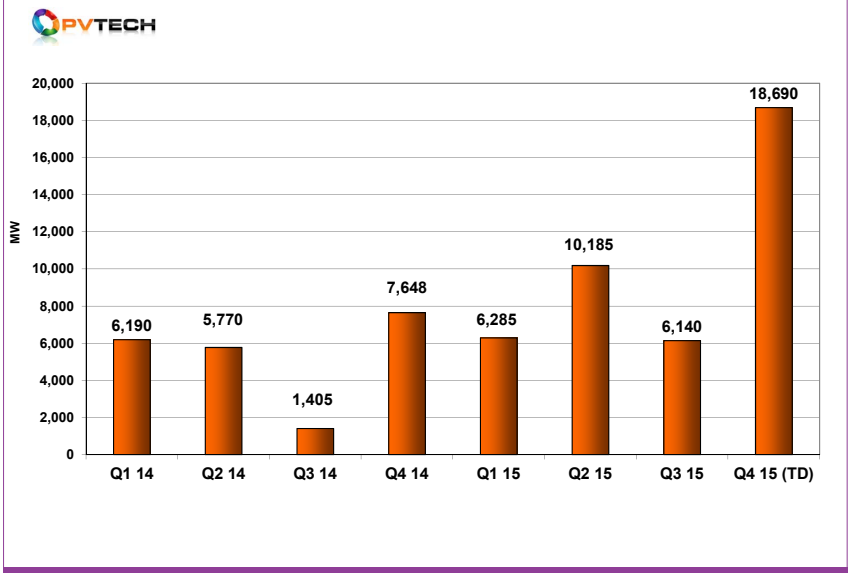

Figure 3. All manufacturing capacity expansion announcements by quarter.

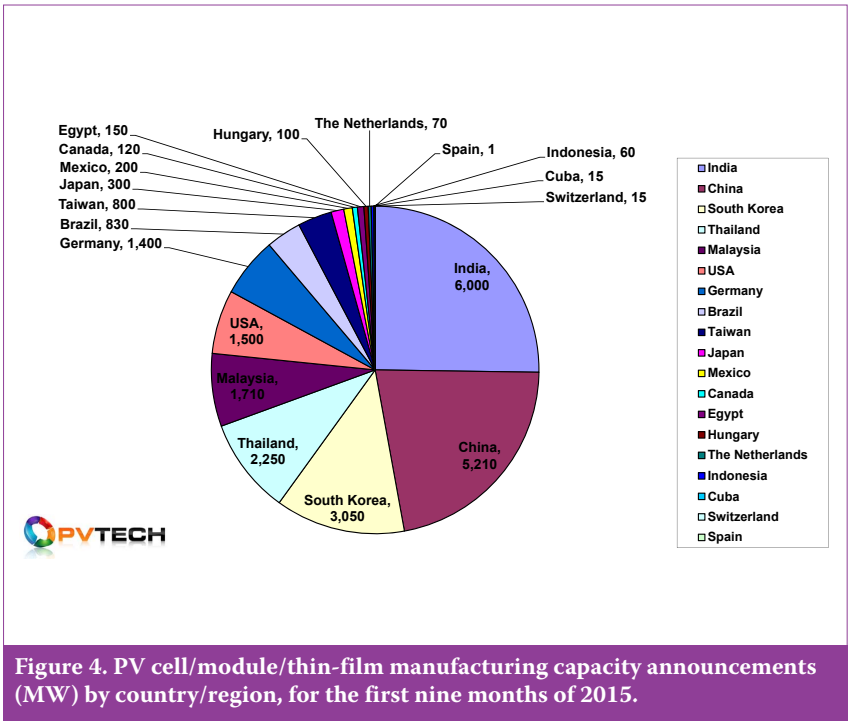

Figure 4. PV cell/module/thin-film manufacturing capacity announcements (MW) by country/region, for the first nine months of 2015.

Nine-month analysis

The most important trend in the first half of 2015 was arguably the geographical shift in planned expansions. With the wise precaution of excluding announcements made by Hanergy Thin Film, no new capacity announcements were made in China in the first six months of the year. That dry spell ended abruptly in July, however, when LONGi began announcing 5.5GW of expansions in China. Nevertheless, LONGi was the only Chinese producer to announce major plans in China in the third quarter of the year, clearly indicating that a significant hold on capacity expansions remains in place.

In the first nine months of 2015, a total of over 22GW of new capacity expansions were announced, compared with over 13GW during the same period in 2014 (Fig. 3). Clearly, strong momentum has been building.

Geographical trends

A total of 1,843MW of capacity expansion announcements were made for the USA in 2014, with 1,000MW being attributed to SolarCity. Interestingly, around 530MW of the 2014 announcements for the USA have become operational, and are classified as effective capacity increases to date. Around 8.5GW of capacity expansion announcements in Asia since the start of 2014 have primarily been made to circumvent or capitalize on the anti-dumping duties in the USA.

PV Tech recently highlighted the seismic shift that occurred in the first half of 2015, which saw few, if any, new capacity plans by Chinese producers for manufacturing in China. Instead, Chinese silicon-based PV manufacturers announced more than 6.7GW of planned capacity expansions

in a number of overseas countries that included India, Malaysia, Thailand, South Korea, Brazil and the USA.

The announcements in 2015 for capacity expansions in the USA have included three Chinese firms, Seraphim, Shunfeng and Amerisolar, totalling 800MW so far this year.

The promise of India

The Indian government's plans to install 100GW of PV by 2022 has sparked a significant wave of pledges and MOUs to build PV manufacturing facilities in the country, covering polysilicon, ingot/wafers, solar cells and PV modules. Much of this promise has yet to convert from hype and hope to any actual meaningful new effective capacity.

The assessment of significant double-digit gigawatts of pledges boils down to around 6GW (at the end of September 2015) of potential expansions of cell and module production at some point in the future. Though much remains speculation, the 6GW figure is based on such projects having a much higher probability of happening, which catapults India to the top of the list of locations for planned capacity expansion announcements in the first nine months of 2015 (Fig. 4).

Changing China

Another major change, as already reported in the previous quarterly report, was the seismic shift away from new capacity announcements in China. Discounting (because of Hanergy's financial and stock market issues) a-Si and CIGS thin-film announcements by Hanergy of over 2.1GW, there were no expansions announced in China in the first half of 2015. That trend was broken in July, however, with LONGi announcing ingot/wafer and module production expansions in China. Several months then went by before further announcements were made. Chinese PV manufacturers instead announced many plans to start production outside China, a trend that continued through the end of November.

If Hanergy's plans with others for expansions in China in the first nine months of the year are included, a total of around 5.2GW of announcements were made, still making China the second largest to India with regard to capacity expansion plans.

Perhaps the most significant trend of where meaningful capacity expansions were occurring was the rise of South East Asia, notably Malaysia (1.7GW) and Thailand (2.2GW), with South Korea (3GW) being the surprise draw in Asia, after Hanwha and several other companies selected that country in 2015 (Fig. 4).

Less dependence on expansions in China in 2015 led to an overall broader potential global manufacturing footprint, a trend further supported by announcements made in October and November, covered next.

October calm

New capacity expansion announcements reached 1.1GW in October, covering a sprinkling of thin film, c-Si solar cell and module assembly. Overall expansion plans were in line with expected rates, as the lull seen during August to October 2014 was repeated in the same months in 2015, but the 2015 figures were slightly higher, despite October 2014 and October 2015 producing identical announcements (1.1GW).

Although the announcements in October of both years were the same, the product mix was very different. In October 2014, c-Si module assembly expansions dominated (950MW), while 150MW was provided by dedicated solar cell expansions. By contrast, in October 2015, thin film contributed 300MW, dedicated solar cell expansions totalled 500MW, and 310MW was attributed to c-Si module assembly. No integrated solar cell/module assembly expansions were announced in October 2015.

The relatively few capacity expansion announcements reflected once again the small number of companies (six) that declared plans. Nevertheless, some of the plans demonstrated bigger ambitions over the next few years, as seen in July 2015.

The CIGS thin-film plans of ADVANCIS are worth noting because, although the initial first-phase capacity expansion is 300MW at a new facility in China, ambitious plans were announced for subsequent build-out totalling 1.5GW of capacity at a single facility. The other big ambition relates to 1366 Technologies' initial 250MW 'Direct Wafer' production plant in the USA, with future plans to expand capacity to 3GW in coming years.

Staying with upstream manufacturing, Elkem Solar announced plans to restart multicrystalline ingot production at the former REC plant in Herøya, Norway. Although planned production levels were not disclosed, the plant had a capacity of 650MW and several hundred employees. Elkem Solar is expecting to initially create around 70 to 80 jobs, indicating that initial production would be low.

There have been few new multicrystalline wafer capacity expansions announced in more than two years, apart from an additional meaningful 1GW of capacity at GCL-Poly, taking nameplate capacity to 14GW. Overcapacity and weak ASPs have limited expansions in this upstream sector.

In mid-October China Sunergy (CSUN) announced that it had officially started the volume production ramp-up at a new 200MW solar cell plant in Incheon, South Korea, after having had trial production successfully undertaken in May. The NASDAQ-listed PV manufacturer had not previously disclosed any specific plans for production in South Korea. The cash-strapped company is believed to have transferred tools from its facilities in China, and said it was considering expanding production to 500MW with additional production lines, once the facility has reached around 50% utilization rates; this is against the backdrop of a restructuring of its manufacturing footprint to circumvent US and EU anti-dumping duties.

Technically, CSUN's announcement would not be classified as a capacity expansion announcement, but as simply a relocation of nameplate capacity. In recent years, however, the company has experienced low utilization rates, and the shift of tools to South Korea would bring idled capacity back into being 'effective' capacity.

November storm

Global PV capacity expansion announcements in November 2015 set several new major benchmarks: of the big six Silicon Module Super League (SMSL) members, five (Trina Solar, Canadian Solar, JinkoSolar, JA Solar and Hanwha Q CELLS), as expected, announced further expansions to meet growing demand in 2016.

A total of 17.5GW of new capacity expansions were announced in November, across dedicated solar cell and dedicated module assembly. Notably, no integrated cell/module capacity expansions were announced that month, primarily because of the dominance of announcements by SMSL members. This is by far the highest figure set during the two years 2014–15, and is almost triple the benchmark capacity announcements of 6.7GW set earlier in the year in May.

The number of companies announcing expansions totalled 14 in November 2015, beating the previous benchmark of 11, set in May. Interestingly, three SMSL members – Trina Solar, JinkoSolar and Hanwha Q CELLS – participated in setting the May and the November benchmark figures.

"The number of companies announcing expansions totalled 14 in November 2015, beating the previous benchmark of 11, set in May."

SMSL dominance

Overall, five of the six SMSL members dominated capacity expansion announcements in November. Canadian Solar announced a total of over 4GW of expansions across ingot/wafer, dedicated solar cell and dedicated PV module assembly. Expansions or new plants in various regions were announced, including Canada, China, Brazil, Indonesia and Vietnam, as well as plans for a 400MW solar cell plant somewhere in South East Asia.

JA Solar kept things simpler on the geographical front, announcing that a total of 1.4GW of new solar cell capacity would be added in China and Malaysia, while a similar figure of dedicated module assembly would be added in China. Including 500MW of new ingot/wafer capacity in China, a total of 3.3GW of new expansions was announced by the company in November.

JinkoSolar also announced in this month a total of 1.8GW of expansions, across ingot/wafer, dedicated solar cell and module assembly. The company has not yet decided the split of manufacturing between China and Malaysia. The situation was also similar with Hanwha Q CELLS, who announced module assembly expansions of 1GW, while not disclosing the location and capacity levels between China, South Korea and Malaysia. Leading global PV manufacturer Trina Solar announced a total of 2.8GW of new capacity. Once again, geographical locations were not forthcoming.

The SMSL members' capacity expansion announcements totalled around 13GW in November 2015 alone.

Dedicated solar cell capacity announcements in November reached 6.2GW, significantly higher than the previous benchmark of 2.7GW set in May 2015. Including SunPower's re-announced IBC cell plant and further planned phases of solar cell capacity expansions over the next five years that were announced in November, the total for the month reaches an astonishing 13.1GW.

Similar significant figures were announced for dedicated PV module assembly expansions, which totalled 11.38GW in November 2015. The previous monthly benchmark for dedicated module assembly expansions was set at 3.11GW in November 2014, while the integrated cell/module benchmark of 2.96GW was set in February 2015.

Another interesting development was further announcements surrounding expansions of multi c-Si ingot and wafer production by several integrated PV manufacturers, such as JA Solar, JinkoSolar, Canadian Solar and Trina Solar, from the big six SMSL. In total, 1.6GW of multi c-Si ingot/wafer expansions and upgrades were announced in November. Although a sign that outsourced wafer capacity may be finally tightening, it does not yet indicate that wafer supply is heading for major constraints.

Leading multi c-Si ingot/wafer producer GCL-Poly, however, has yet to announce capacity expansion plans in 2015, after increasing capacity in 2014 by 1GW, to 14GW. The company is currently attempting to close on a major deal to sell its coal-fired power station and steam-generation businesses in order to raise major new funding for expansions in solar cell (joint venture with Canadian Solar) and ingot/wafer production.

Seismic shift rebalance

As a result of the unspecified locations for much of the planned expansions in November, excluding Canadian Solar, it is difficult at this time to put an accurate figure on the latest expansions planned in China. Nevertheless, the announcements made in November indicate that at least 6.1GW is clearly earmarked in China, which brings the total for the first 11 months of 2015 (including Hanergy) to 11.31GW.

Malaysia is also expected to be a key location for further expansions, but once again the lack of details at this time precludes specifying an accurate figure past the figures that have been provided for the first nine months of 2015.

Meaningful capacity additions

In tracking capacity expansion announcements, one of the perennial topics for discussion is the conversion rate to actual production; to address this point, several levels of assessment are made.

First, the term 'meaningful capacity additions' is used when assessing announcements from the likes of Tier-1 manufacturers, for whom the likelihood of conversion is typically greater. This is no guarantee of this happening, however, and several major announcements made by such manufacturers in 2014 have been cancelled or are currently still pending.

Second, assessments are made on key metrics surrounding the details provided in initial announcements. The lack of information about expansion schedules and locations, as well as about the ability to finance such expansions, are all taken into account.

An assessment of 2014 capacity expansion announcements categorized as 'meaningful' indicates that around 85% of the plans have progressed to the under-construction, tool-installation or ramping-up phase. The high rate of conversion of meaningful capacity additions from announcements in 2014 was simply due to a key number of larger or long-standing manufacturers executing plans; those executed capacity expansions then pass from being 'meaningful' additions to 'effective' additions. Effective capacity relates to not only capacity that exists, but also in the real world to the manufactured products that will be sold on the market.

At the beginning of 2014, effective global PV module capacity stood at around 45GW, compared with a nameplate capacity of more than 60GW. A disconnect also exists between capacity announcements, meaningful additions and effective capacities from the massive expansions made through 2011. With the new wave of expansions that started again in 2014, the same disconnects are occurring.

Tracking manufacturing-equipment orders, backlogs and delivery schedules from leading suppliers is also used to assess meaningful capacity additions. Again, it is clear that order intake at equipment suppliers tracks meaningful capacity additions. In 2014,

however, it was not as straightforward as one might have expected, looking at the period through 2011.

A sizeable disconnect existed between meaningful capacity additions and order intake in 2014. One of the key reasons for this was the emphasis on PV module assembly expansions and the regional dominance of China in those announcements. Lower capital expenditure requirements for back-end assembly equipment, coupled with a shift to using domestic equipment suppliers for expansions compared with the last expansion phase when western suppliers were dominant, were behind the disconnect.

Lead times for solar cell equipment, from ordering to tool installation to qualification, for example, have been taking between six and nine months since 2014, and have remained relatively unchanged since the prior expansion phase. This has again led to a typical lapse in revenue generated by suppliers before customers announce meaningful capacity additions, as the next phase of capacity expansions gets under way.

A detailed appraisal of meaningful capacity additions announced over the first seven months of 2015 indicates that a total of 9.3GW could come on stream in the next four to eighteen months, on the basis of a grand total of capacity announcements in this period of around 19GW. Although around 10GW fail the meaningful capacity test, this does not mean that many of the plans would not meet the test in the future.

Eliminating the possibility of Hanergy's plans ever happening, however, is treated as being prudent in the current circumstances the company finds itself in; this elimination accounts for 3.6GW since 2014. Yet it should be noted that Hanergy's plans to build 600MW of CIGS capacity, using technology from its acquisitions of Solibro and MiaSolé, recently met our meaningful capacity addition test, as some equipment suppliers, one in particular, publicly confirmed advanced payment.

Several potential gigawatts of capacity expansions announced in the first half of 2015 include joint ventures with major PV manufacturers, notably in the form of plans to establish production in India. Many of these could indeed progress to meet meaningful capacity criteria metrics in the next 12 to 18 months, with the potential for some to happen sooner than that. July, however, still stands out as the weakest month in 2015 for meeting meaningful capacity criteria metrics, despite its top-line 3.68GW figure. When that aspect is taken into account, the month of July in 2014 had less than 800MW of announcements (with around 200MW since then) converted to actual production.

> "A new meaningful capacity expansion phase is clearly under way and gaining momentum."

Conclusion

Despite the highlighted disconnects, a new meaningful capacity expansion phase is clearly under way and gaining momentum. Capacity announcements have increased in 'intensity', as seen by the announcements made in November, representing larger nameplate figures than those announced in 2014.

In the first 11 months of 2015, a total of over 41GW of capacity expansions was announced (Table1, on next page), compared with a total of just over 21GW for the full-year 2014.

Company	Announcement date	Manufacturing location	New nameplate capacity	Production product type
Jetion Solar	Jan-15	Thailand	200MW	Integrated c-Si cell/module
Renovasol	Jan-15	Brazil	70MW	Multi c-Si module assembly
Hanwha Q CELLS	Jan-15	Cyberjaya, Malaysia	230MW	(Relocated) PERC multi c-Si solar cell
Hanwha Q CELLS	Jan-15	Cyberjaya, Malaysia	130MW	(Relocated) multi c-Si module assembly
PT Len	Jan-15	Indonesia	60MW	Integrated c-Si cell/module
E-Ton Solar Tech	Jan-15	Tainan, Taiwan	60MW	PERC cell upgrade
Surana Solar	Jan-15	Fab City, Hyderabad, India	110MW	Multi c-Si solar cell
SolarPark Korea	Feb-15	South Korea	600MW	Integrated c-Si cell/module
LG Electronics	Feb-15	South Korea	200MW	n-type bi-facial mono c-Si cells and modules
Zhongli Talesun	Feb-15	Rayong, Thailand	500MW	Integrated PERC c-Si cell/module
Silevo/SolarCity	Feb-15	California, USA	32MW	(Relocated) Pilot and R&D line
Waaree Energies	Feb-15	Surat, Gujarat, India	750MW	Multi c-Si module assembly
Empresa de Componentes Electrónicos	Feb-15	Cuba	15MW	Multi c-Si module assembly
Tainergy Tech	Feb-15	Taiwan	300MW	Multi c-Si solar cell
Hanergy Thin Film/ Shangdong Macrolink New Resources Technology	Feb-15	China	600MW	a-Si thin-film BIPV plant
SolarWorld	Mar-15	Arnstadt, Germany	500MW	Mono c-Si ingot production
SolarWorld	Mar-15	Arnstadt, Germany	700MW	Upgrade PERC cell production
Vietnam Government	Mar-15	Hanoi, Vietnam	20MW	Multi/mono c-Si module assembly
Ener Brazil	Mar-15	Brazil	50MW	Semi-automated c-Si PV module assembly plant
Woongjin Energy Co	Mar-15	South Korea	1GW	n-type and p-type ingot/wafer plant
SAS/ Sunrise Global	Mar-15	Taiwan	350MW	PERC, p-type mono cell expansion
JA Solar	Mar-15	Penang, Malaysia	400MW–1GW	Integrated c-Si cell/module
JinkoSolar	Mar-15	Malaysia	500MW	Multi c-Si PERC solar cell
JinkoSolar	Mar-15	Malaysia	450MW	Multi c-Si module assembly
Hanergy Thin Film/ Inner Mongolia Manshi Investment Group	Mar-15	China	600MW	a-Si thin-film BIPV plant
Hanergy Thin Film/ Baota Petrochemical Group	Mar-15	China	600MW	a-Si thin-film BIPV plant
Flextronics	Apr-15	Ciudad Juarez, Mexico	200MW	Multi/mono c-Si module assembly
Eclipse Brasil	Apr-15	Limoeiro do Norte, Ceará, Brazil	100MW	Multi c-Si module assembly
Orange Solar Power	Apr-15	The Netherlands	70MW	15MW 'monoflex' and 55MW multi c-Si module assembly
Hanergy Thin Film	Apr-15	Wuhan, China	10MW	Thin-film GaAs R&D/pilot line
Onyx Solar	Apr-15	Spain	1MW	c-Si BIPV
Sunrise Global Solar	Apr-15	Taiwan	350MW	Multi c-Si PERC solar cell
Hanergy Thin Film/ Hanergy Group	May-15	China	900MW	a-Si thin-film BIPV plant
Trina Solar	May-15	Rayong, Thailand	700MW	Multi c-Si solar cell (PERC)
Trina Solar	May-15	Rayong, Thailand	500MW	Multi c-Si module assembly
Gintech Energy	May-15	Thailand	350MW	Multi c-Si solar cell (incl. PERC)
Seraphim Solar System	May-15	Jackson, Mississippi, USA	300MW	Multi c-Si module assembly
Intéling soluções inteligentes	May-15	Bento Gonçalves, Brazil	Unknown	Multi c-Si module assembly

Panasonic Corp	May-15	Shimane, Japan	150MW	HJ mono c-Si cell
Panasonic Corp	May-15	Shiga, Japan	150MW	HJ mono c-Si module assembly
JA Solar/Essel Group JV	May-15	India	500MW	c-Si cell plant
JA Solar/Essel Group JV	May-15	India	500MW	c-Si module assembly
Trina Solar/Welspun JV	May-15	India	500MW	Integrated c-Si cell/module
Vikram Solar	May-15	India	250MW	c-Si mono/multi assembly
Vikram Solar	May-15	India	250MW	c-Si mono/multi assembly
BYD Company	May-15	São Paulo, Brazil	400MW	Multi c-Si module assembly
Hanwha Q CELLS	May-15	South Korea	250MW	Multi c-Si module assembly
Hanwha Q CELLS	May-15	Jincheon, South Korea	1.5GW	Multi c-Si PERC solar cell
Flisom	Jun-15	Niederhasli-Zurich, Switzerland	15MW	Flex-CIGS thin film
Central Electronics Limited	Jun-15	Sahibabad, Ghaziabad, India	40MW	Multi c-Si automated module assembly line
Sunprism Energy	Jun-15	Cairo, Egypt	50MW	Multi c-Si module assembly
CNPV Power	Jun-15	Saemangeum, South Korea	500MW(E)	Integrated c-Si cell/module
Trina Solar	Jun-15	India	2GW	Integrated PERC c-Si cell/module
Hulk Energy Technology	Jun-15	Taiwan	150MW	CIGS thin film
Central Electronics Limited	Jun-15	India	40MW	Multi c-Si module assembly
ARECO/Z-One	Jul-15	Alexandria, Egypt	52–100MW	Multi c-Si module assembly
Lerri Photovoltaic Science & Technology Co/Xi'an LONGi Silicon Materials	Jul-15	Taizhou City, Jiangsu, China	2GW	Mono-c-Si PERC PV cell plant
Xi'an LONGi Silicon Materials	Jul-15	Yinchuan City, China	3GW	Mono c-Si ingot/wafer production
Xi'an LONGi Silicon Materials	Jul-15	Yinchuan City, China	500MW	Mono c-Si module assembly plant
REC Solar	Jul-15	South East Asia (TBC)	400MW	Integrated PERC cell/multi c-Si module assembly
EcoSolifer AG	Jul-15	Brazil (TBC)	80MW	Mono-Si (HJ) module assembly
EcoSolifer AG	Jul-15	Csorna, Hungary	90–100MW	Mono-Si (HJ) cell plant
Hareon SolarTechnology/ Dalmia Group JV	Jul-15	India (TBC)	160MW–1GW	Integrated PERC cell/multi c-Si module assembly
Shunfeng/Suniva Inc.	Aug-15	Michigan, USA	200MW	n-type mono-c-Si Cell
Shunfeng/Suniva Inc.	Aug-15	Michigan, USA	200MW	n-type mono module assembly
Silfab Solar	Aug-15	Ontario, Canada	120MW	n-type BiSoN module assembly
Amerisolar	Aug-15	USA/ TBC	300MW	c-Si PV module plant
Globo Brasil	Aug-15	São Paulo, Brazil	180MW	c-Si PV module plant
Seraphim Solar System	Sep-15	Jackson, Mississippi, USA	700MW	Multi c-Si module assembly expansion
aleo solar/SAS/ aleo Sunrise GmbH	Sep-15	Prenzlau, Germany	200MW	Multi/mono c-Si solar cell production
Xi'an LONGi Silicon Materials	Sep-15	Sri City, Chittoor region, Andhra Pradesh, India	500MW	Integrated mono cell/module plant
GCL Integrated Technology Co/Adani Group	Sep-15	Mundra, India	TBC	c-Si integrated ingot/wafer/cell/module
HHV Solar Technologies	Sep-15	Bengaluru, India	60MW	c-Si/mono module expansion
1366 Technologies	Oct-15	Genesee County, New York, USA	250MW–3GW	Multi c-Si 'direct wafer' production
Elkem Solar	Oct-15	Herøya, Norway	650MW	Multi c-Si ingot production restart
Heckert Solar	Oct-15	Chemnitz, Germany	60MW	Multi c-Si module assembly expansion
AVANCIS/CNBM	Oct-15	Bengbu, Anhui Province, China	300MW–1.5GW	CIGS thin film

Sonali Solar	Oct-15	Gujarat, India	250MW	Multi c-Si module assembly expansion
China Sunergy (CSUN)	Oct-15	Incheon, South Korea	200–500MW	Multi c-Si solar cell production
Hyundai Heavy Industries (HHI)	Oct-15	Eumseong, South Korea	200MW	Mono c-Si PERL solar cell upgrade
Kaneka Corporation	Oct-15	Japan	Pilot line	n-type mono HJ solar cell line
Canadian Solar	Nov-15	Luoyang plant, Henan Province, China	600MW	Ingot/wafer expansion
Canadian Solar	Nov-15	Suzhou plant, Jiangsu Province, China	500MW	Multi-c-Si solar cell expansion
Canadian Solar	Nov-15	Funning plant, Jiangsu Province, China	600MW	Multi-c-Si solar cell expansion
Canadian Solar	Nov-15	South East Asia (TBC)	400MW	Multi-c-Si solar cell plant
Canadian Solar	Nov-15	Changshu, Jiangsu Province, China	200MW	c-Si module assembly
Canadian Solar	Nov-15	Luoyang, Henan Province, China	600MW	c-Si module assembly
Canadian Solar	Nov-15	Canada	500MW	c-Si module assembly
Canadian Solar	Nov-15	Brazil (TBC)	300MW	c-Si module assembly
Canadian Solar	Nov-15	Vietnam (TBC)	300MW	c-Si module assembly
Canadian Solar	Nov-15	Indonesia	30MW	c-Si module assembly
SunPower	Nov-15	South East Asia (TBC)	800MW	n-type mono IBC Cell production plant
SunPower	Nov-15	Multiple locations (TBC)	2GW	Multi/mono c-Si module assembly (P Series)
Motech/ Solargiga JV Jiansu Aide Solar Energy Technology	Nov-15	China	400–600MW	c-Si module assembly expansion
Sunew/CSEM Brasil	Nov-15	Belo Horizonte, Brazil	TBC	OPV thin-film module plant
JA Solar	Nov-15	China	500MW	Multi c-Si ingot/wafer expansion
JA Solar	Nov-15	China, Malaysia TBC	1.4GW	Multi c-Si cell expansion
JA Solar	Nov-15	China	1.4GW	Multi c-Si module assembly
Tongwei Group	Nov-15	Hefei, China	1–5GW	Multi c-Si cell plant (3–5 year plan)
JinkoSolar	Nov-15	China	300MW	Multi c-Si ingot/wafer upgraded
JinkoSolar	Nov-15	China/Malaysia TBC	500MW	Multi c-Si solar cell expansion
JinkoSolar	Nov-15	China/Malaysia TBC	1GW	Multi c-Si module assembly expansion
Hanwha Q CELLS	Nov-15	China/Malaysia/Korea TBC	1GW	Multi c-Si module assembly expansion
Trina Solar	Nov-15	China	100MW	Multi c-Si ingot production upgrade
Trina Solar	Nov-15	China	100MW	Multi c-Si wafer production upgrade
Trina Solar	Nov-15	TBC	1.3GW	Multi c-Si solar cell expansion
Trina Solar	Nov-15	TBC	1.3GW	Multi c-Si module assembly expansion
Lanco Infratech	Nov-15	Rajnandgaon, Chhattisgarh, India	100MW–2.2GW	Multi c-Si solar cell plant
Lanco Infratech	Nov-15	Rajnandgaon, Chhattisgarh, India	250MW	Multi c-Si module assembly plant
Jiangsu Aide Solar Energy Technology	Nov-15	China	500MW	Multi c-Si module assembly expansion
HHV Solar Technologies	Nov-15	India	900MW	c-Si/mono module expansion over 5 years
ZNshine Solar/Chongqing Silian Optoelectronic Technology JV	Nov-15	China	500MW	Mono/multi c-Si module assembly plant
Neo Solar Power (NSP)	Nov-15	South East Asia TBC	TBC	Relocating c-Si solar cell production
Inventec Solar Energy	Nov-15	Taiwan	400MW	Multi c-Si solar cell expansion

Table 1. PV manufacturing capacity expansion announcements in 2015.