Full-year 2015 PV manufacturing capacity expansion plans and analysis

Mark Osborne, Senior News Editor, Solar Media

ABSTRACT
In this quarterly report a full analysis is given for the first time of two years' worth (2014-15) of PV manufacturers' capacity expansion announcements and assessment of announcements that have or are planned to convert to effective new nameplate capacity through to the end of 2016. The analysis provide the first insight into new capacity ramp profiles of effective capacity expansions over the last two-year period and highlights future ramp profiles so far expected through to the end of 2016.

Record expansion plans in 2015

According to our analysis, which includes thin film, solar cell, dedicated module assembly and integrated cell and module categories, PV manufacturing capacity expansion announcements in 2015 more than doubled (21GW in 2014) year-on-year to reach 55.19GW.

However, no one should panic that a new cycle of overcapacity is about to hit the industry in 2016, as it is important to reiterate that this figure is all inclusive. By that we mean that it accounts for actual plans that are expected to become 'effective capacity' over a 12-month period or extended period over several years of phased expansions, as well as memoranda of understanding (MOU) and letters of intent (LOI) that may never happen.

Indeed, in certain cases announcements made in 2015 have already been cancelled (see below analysis of Hanergy Thin Film), companies have gone bankrupt and previously announced plans (SunPower) re-announced.

As plotted in 2014, announcements by new entrants and start-ups have much longer lead times, primarily due to difficulty in raising finance for production plants, or have simply been dropped.

Specific to 2015 was a ridiculous number of MOUs and LOIs across all

Credit: Hanwha Q CELLS

Announced PV manufacturing expansions doubled in 2015, topping a theoretical 55GW.

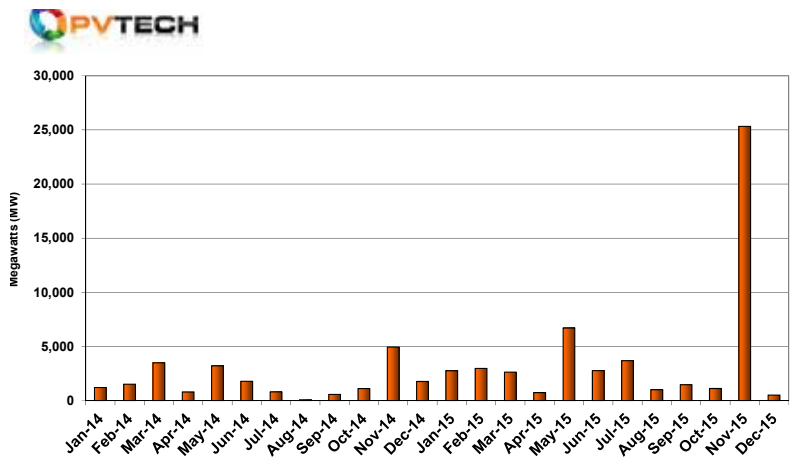

Figure 1. Combined total (c-Si cell/module & thin film) expansion announcements by month (MW)

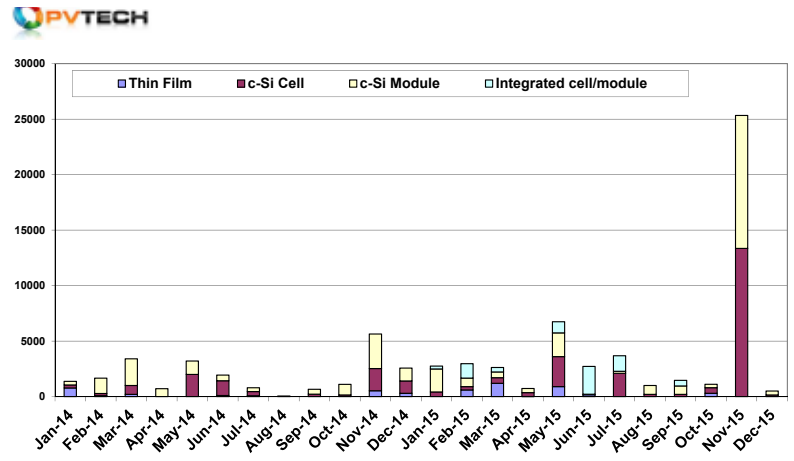

Figure 2. Capacity expansion announcements by product type, monthly (MW)

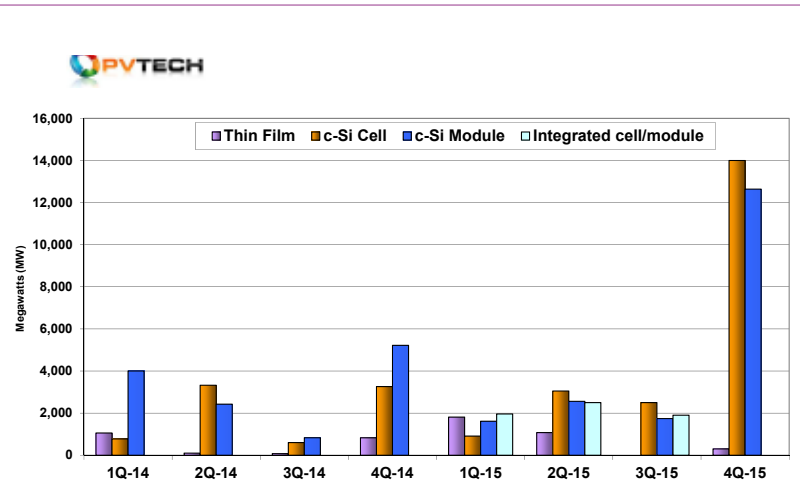

Figure 3. Capacity expansion announcements by product type, quarterly (MW)

segments, including polysilicon, that related to India. The vast majority of these announcements have not been counted, however there are around 6GW of announcements that we have recorded. This is due to the specific companies involved that have a history of good execution as well as those that have finance in place and some plans that have already started to be implemented. However, that still leaves several gigawatts of announcements in India that have yet to progress from paper plans.

Also more specific to 2015 was the scale of many announcements in the 1GW-plus range. However, many of these have more humble initial production capacity ramps than the headline figures. Therefore a complete refresh and reappraisal of all announcements on a monthly basis was undertaken with the intention of providing a more measured headline figure for 2015.

Effective capacity announcements in 2015

This allowed us to eliminate over 15GW of announcements in 2015 that failed the validity tests, at this time. As a result, a more measured figure for capacity expansion announcements in 2015 is 39.87GW.

Going further and only counting initial-phase capacity expansions as being valid at this time, we can eliminate a further 10.7GW, bringing the most realistic figure of announcements in 2015 that could potentially migrate to effective capacity over the next 12 to 24 months to around 29GW.

We also undertook a specific reappraisal of the record announcements made in November 2015. We had reported preliminary figures for November of over 17GW of new planned capacity expansions, but the reappraisal after the dust had settled revealed an extra 7.7GW of capacity planned, bringing the total to over 25GW.

However, including the validity tests and checks, November stood out for including previously announced capacity expansion plans that would have led to duplication, as well as phantom capacity due to outsourcing and the inclusion of small-scale initial-phase capacity attached to multiple gigawatt future phased expansions with uncertain timescales. As a result November's figures were cut by 11GW, bringing the realistic figure down to 14GW.

Nevertheless, November set several individual benchmarks such as a new

record monthly and subsequently quarterly figure. A key reason for this change was the massive involvement of 'Silicon Module Super League' (SMSL) members (Trina Solar, Canadian Solar, JinkoSolar, JA Solar and Hanwha Q CELLS) announcing significant expansions at existing facilities in China, which remain non-integrated classification, as well as new and further expansions of facilities outside China, namely Malaysia, Thailand and South Korea.

Thin film

All thin-film type capacity expansions announced totalled around 4.4GW in 2015.

All but 1MW of a-Si thin-film announcements came from Hanergy Thin Film, a total of 2.7GW.

However, all the customers have since cancelled contracts, negating completely these capacity plans, while its 600MW CIGS thin-film plant using acquired company technology from the US and Germany remains a question mark, unless Hanergy TF provides updates that have been absent for almost a year.

More validity exists with other CIGS thin-film plans, which totalled over 1.6GW in 2015. Initial production ramps and expansion phases are only expected to be around 500MW, which includes the odd R&D pilot line. The bulk of the planned CIGS expansion relates to an eventual 1.5GW ramp over multiple years of the Avancis/CNBM plant in China.

Also excluding Hanergy TF from 2014 announcements means thin-film expansions totalled just over 650MW that year, primarily due to First Solar and a lesser extent, Solar Frontier, both notable for executing on those plans and becoming effective capacity additions through 2015.

The relative inactivity in the thin-film segment (excluding First Solar and Solar Frontier) caps several years of thin-film underachievement and underlines the growing dominance of crystalline silicon technologies.

C-Si solar cells

In that respect, dedicated c-Si solar cell expansion plans topped 20.4GW in 2015, compared to 8GW in 2014. Interestingly, dedicated module assembly announcements failed to exceed those for solar cells, reaching over 18.5GW in 2015, compared to 12.4GW in 2014.

We had highlighted in monthly analysis reports last year that the lack of new cell capacity plans in 2014 compared to module assembly would need to be rebalanced; this is indeed what has happened in 2015.

Another strong trend through the first nine months of 2015 had been the plans for integrated cell and module expansions, a trend not seen in 2014, when dedicated module assembly expansion announcements dominated.

However, the integrated cell and module category gained no further traction in the fourth quarter of 2015, replaced as it was by a much stronger trend of dedicated solar cell capacity and dedicated module assembly capacity expansion announcements.

A full-year breakout highlights that integrated cell and module plans peaked at just over 6.3GW.

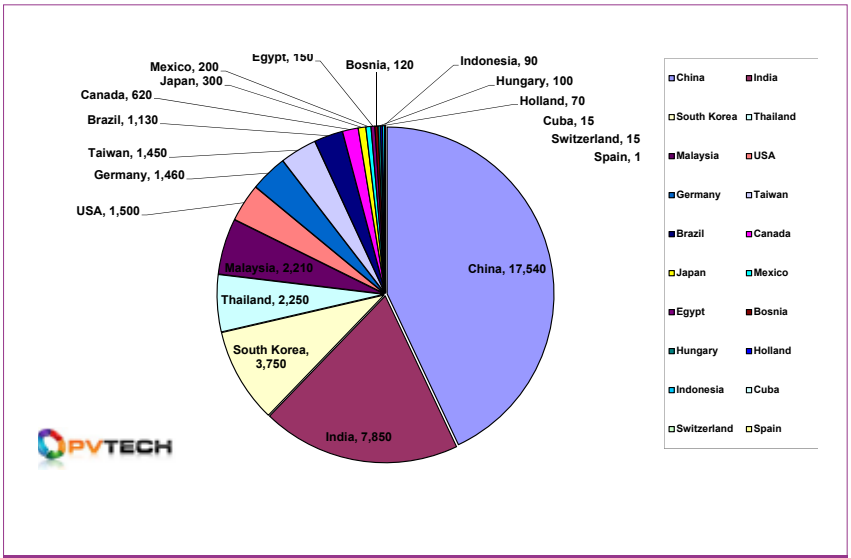

Figure 4. PV manufacturing capacity announcements (cell/module/thin film) by country (MW) in 2015.

Multi versus mono

The year was also marked by the number and scale of announcements related to n- and p-type monocrystalline cell and module assembly capacity expansion plans, which reached a combined total of nearly 9.4GW, compared to 4.38GW in 2014.

N-type mono cell and module assembly (including heterojunction) announcements topped 2.23GW in 2015, compared to 2.38GW in 2014. However, applying the validity tests we can eliminate 500MW from the 2014 figures and 1.4GW from the 2015 figures at this time, resulting in realistic figures of 1.88GW in 2014 and 830MW in 2015. Clearly, the momentum for mono has built over the last two years but n-type has been in moving at a much slower pace.

That is not the case with multicrystalline solar cell and module assembly capacity expansion announcements (including integrated cell/module), which topped a combined total of over 41.5GW in 2015. In 2014, multicrystalline announcements stood at over 14GW, and it therefore remains the dominant technology, outstripping monocrystalline technologies' momentum.

C-Si module assembly

The capacity expansion figures that mean the most relate to c-Si module assembly, which includes integrated and dedicated segments. In 2015 total c-Si module assembly capacity expansion announcements were around 27.5GW.

However, validity tests indicate almost 9GW of announcements are highly suspect, based on duplication, financing and past history of companies' execution. This would bring the total down to around 18.6GW, still a sizeable number. Applying analysis undertaken on 2014 announcements to actual effective capacity metrics (see below analysis) suggests it would be prudent at this time to discount a further 30%, simply from an overall execution perspective.

Therefore, around a further 5.58GW could be expected not to materialise from 2015 announcements in the next 24 months. Potential effective expansions of c-Si module assembly capacity from 2015 could be around 13GW.

Regional shifts

The geographical chart (Fig 4) showing where capacity expansion announcements were targeted in 2015 disguises the fact that the number

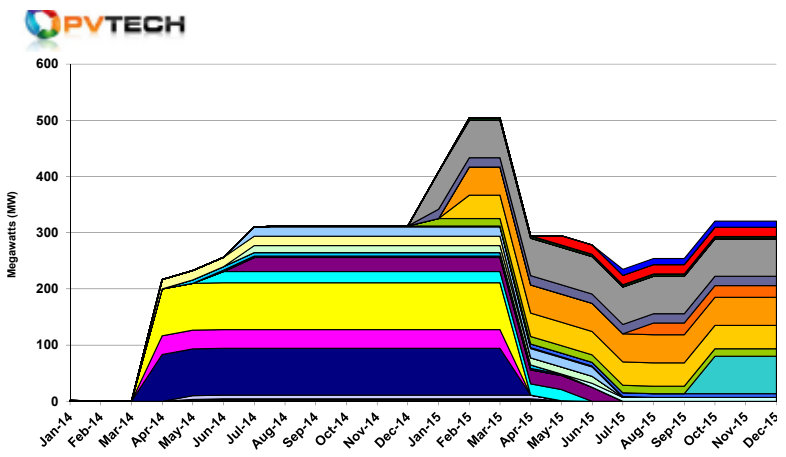

Figure 5. Cumulative c-Si module assembly effective capacity expansions (MW) from 2014 announcements.

and scale of expansions announced in China in the first half of the year only reached 4.7GW and more than half were related to Hanergy TF.

No major China-based module manufacturer announced expansion plans in China in the first half of the year. Instead, they announced more than 6.7GW of planned capacity expansions in a number of overseas countries, including India, Malaysia, Thailand, South Korea, Brazil and the US.

The lack of new capacity expansions in China contrasts with over 12GW of new announcements in 2015 for other regions across Asia, with Chinese producers accounting for just over half of the capacity announcement figures. The second half of 2015 went a long way to restoring the balance but Southeast Asia remains a hot destination.

New capacity announcements in China increased by over 10GW in the fourth quarter of 2015 alone, resulting in the total reaching over 17.5GW in 2015; as such it remains the destination leader globally, but the figure is below the 19GW announced in the previous year.

Although India is clearly the second largest destination with over 7.8GW of announced plans in 2015, and only 1.4GW in 2014, less than 1GW has moved from the MOU/LOI category. But it is certainly the emerging destination to watch in 2016.

A similar situation exists in relation to Brazil, which has exceeded 1GW of announced capacity plans but again the effective capacity by the end of the year was almost non-existent. Yet, with gigawatts of PV power plant projects planned, effective capacity activity could move forward in 2016.

One of the surprises for 2015 was South Korea, which generated just over 3GW of capacity expansion announcements. Already in 2016, LG Electronics has built on that momentum with plans to expand n-type monocrystalline cell production from the current 1GW nameplate capacity to 3GW by 2020.

Both Germany and the US did not disappoint with both countries nudging announcements around the 1.5GW mark, and the US beating Taiwan for the second consecutive year.

Interestingly, the figures for Malaysia (2.21GW) and Thailand (2.25GW) may not accurately represent final figures as a number of companies such as Trina Solar, JinkoSolar and SunPower have stated some of their capacity expansion by location but not yet confirmed several gigawatts of planned expansions, all potentially in either Southeast Asia country.

The overriding trend from a location perspective is that manufacturing outside China has seen significant growth and the emergence of a larger global footprint for manufacturing is taking shape.

C-Si module assembly effective capacity expansion ramp analysis for 2014

As already highlighted, equating capacity expansion announcements with 'effective' capacity is misleading. Understandably, there is a time lag between many announcements and the time when that capacity comes on stream and potentially meets its annual nameplate figure within the 12-month period from the start of the ramp.

A recent reappraisal of all 2014 c-Si module assembly capacity expansion announcements was made. This was to determine whether plans were realised and to plot the effective ramp rate timelines and the overall effective capacity additions made to the global PV industry from 2014 announcements through to when the final phase of those expansions can be treated as completed effective capacity.

It should be noted that the analysis also includes and adjusts for effective capacity added but for other reasons, such as bankruptcies or sector exits was later shutdown.

Not surprisingly, there was a short period of inactivity from announcements made early in 2014, but an initial momentum phase started in March 2014 and peaked in July. A plateau appeared through the remaining nine months of 2014, due to a stall in further new planned expansions beginning to ramp.

At the end of 2014, a total of around 2.57GW of effective capacity had been added to global c-Si module assembly capacity from 2014 announcements that had totalled 10.7GW. This equated to only a 24% conversion rate. However, significant ramps kicked off again in January 2015 from announcements made in late 2014, with just over 1.4GW added during the first quarter.

However, Q1 2015 announcements picked up momentum faster than those in the same period of 2014, with a further 1GW of cumulative effective capacity added in quarter.

As can be seen in Figure 6, a significant steep ramp developed and by mid-year cumulative effective c-Si module assembly capacity from 2014 and 2015 announcements had reached just over 5.22GW, which had taken 15 months to achieve.

By the end of 2015, the total cumulative effective c-Si module assembly capacity added from 10.7GW of 2014 announcements had reached nearly 6.4GW. Cumulative capacity reached 8.76GW.

Importantly, by mid-2016 all effective c-Si module assembly capacity from 2014 announcements that we know have been ramping will be accounted for, bringing the total effective nameplate capacity to around 7.33GW from the 10.7GW of 2014 announcements. Therefore, around 68.5% of c-Si module assembly capacity expansion announcements from 2014 would have converted to effective nameplate capacity by mid-2016,

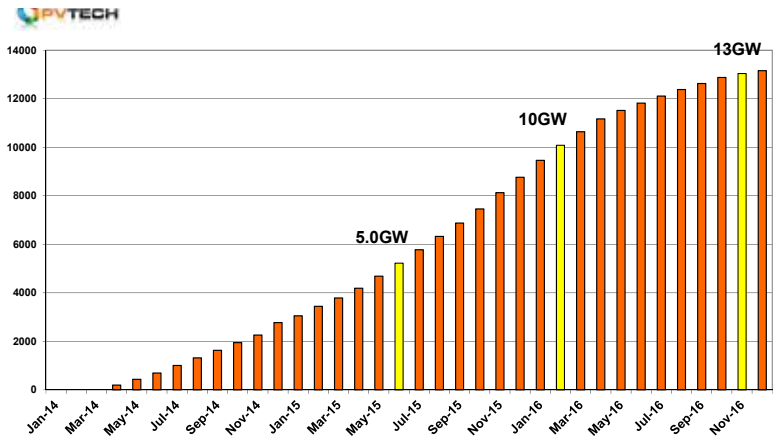

Figure 6. Cumulative C-Si module assembly monthly effective capacity expansions ramps from 2014 & 2015 announcements (MW).

ending incremental nameplate capacity for that year.

The analysis reaffirms that the headline figures from 2014 get diluted over time (31.5% in that year) while effective nameplate timescales can stretch much longer than many may have expected. However, it should also be noted that several expansion plans from 2014 that have yet to materialise could resurface at any moment so the final conversion figure should not yet be assumed.

Of course effective c-Si module assembly capacity from 2015 announcements has to be included to get the closest realistic picture of completed effective new nameplate capacity for that year.

2015 effective capacity expansions

The profile of the capacity additions in 2015 differed considerably from the 2014 ramp profile. More companies added more capacity and kick-started expansions more quickly. Some companies had already started to add capacity before officially announcing plans, which all contributed to the expansion ramp profile divergence.

With the last of 2014 expansions completed in the early part of the fourth quarter of 2015, coupled to the peak in activity from 2015 expansions, a significant drop in expansions happened in the following three months. From a cumulative-capacity-added perspective it is expected to only take eight months (by March 2016) to reach the next 5GW.

From expansions underway from 2015 announcements to date, a total of just over 13GW of cumulative c-Si module assembly nameplate capacity would have been added since the beginning of 2014.

As Figure 6 shows, effective new capacity, coming on stream in the second half of 2016 looks to be slowing. However, a number of announcements from 2015 have yet to get off the ground for a number of reasons, but meaningful gigawatts could subsequently be added to the ramp profile over the coming months. Therefore, the 13GW figure and slowing ramp curve should be treated as conservative at the current time.

We have also tentatively plotted estimates of global effective nameplate capacity figures from pre-2014 as well as making adjustments for nameplate capacity going offline due to bankruptcies or exits from the sector. As a result, cumulative effective capacity coming on stream from 2014 and 2015 announcements closely match end-market demand growth over the period.

Though further announced capacity from both 2014 and 2015 are expected to become effective capacity at some stage, the nameplate figures do not suggest a swing to any meaningful overcapacity scenario in 2016.

Tight wafer and polysilicon supply

Looking past 2016 a potential looming shortage of polysilicon and multicrystalline wafers could constrain c-Si cell and module expansions, despite expectations that global end-market demand growth will increase strongly.

Little new ingot/wafer capacity was announced in 2014, as major suppliers continued to suffer from weak ASPs that were stubbornly below manufacturing costs, providing few commercial reasons to add capacity. Like the polysilicon sector, aggressive expansions before 2014 had come on stream, causing severe overcapacity in both sectors.

However, the key message coming out of REC Silicon's recent fourth quarter financial conference call was the tight supply of both polysilicon and wafers with shortages of polysilicon in China in 2017.

Taking GTM Research's global PV demand forecast data as a 'middle ground' view, REC Silicon highlighted that the global end market demand could reach 64GW in 2016 and climb to 78GW in 2017.

However, with the polysilicon trade war with China yet to be resolved, access to the world's biggest consumer of polysilicon for US-based producers, primarily Hemlock Semiconductor and REC Silicon, is effectively closed.

As PV manufacturing rises to meet end-market demand, excess inventory levels are expected to be depleted but only limited new polysilicon capacity is expected to come on stream. But moving to demand forecasts in 2017, the situation becomes increasingly disconnected, with polysilicon supply markedly below end-market demand to the tune of an estimated 28,000MT.

With Siemens-based polysilicon plants taking an average of four years to build (fluidized bed reactor around 2.5 years), polysilicon supply shortages could be nearly 60,000MT in 2018, based on global PV end-market demand topping 95GW.

Should such conditions develop then this would indeed impact effective capacity expansion plans for c-Si solar cell and module assembly.

Conclusion

Clearly, the conversion of capacity expansion announcements in 2014 into effective capacity was not as rapid or as high as many would have expected. Momentum clearly built in 2015 and how the tail of those announcements turned into effective capacity could impact on the effective ramp profile for the second half of 2016 and into 2017 remains unclear.

The global manufacturing footprint of the PV industry is set to continue to expand with India and Brazil notable emerging markets. Supply constraints with polysilicon and wafers could impact expansion plans in 2017, yet the impact on the ramp profile also remains uncertain.