PV manufacturing capacity expansion announcement plans and analysis for 1H 2016

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ABSTRACT

In this quarterly report of global PV manufacturing capacity expansion announcements in the first half of 2016, key analysis is given on the continued high level of activity through the second quarter of the year. This report also includes a new bottom-up analysis of 'effective' capacity expansions since the beginning of 2014 to provide a better and more accurate assessment of the current manufacturing environment.

April 2016

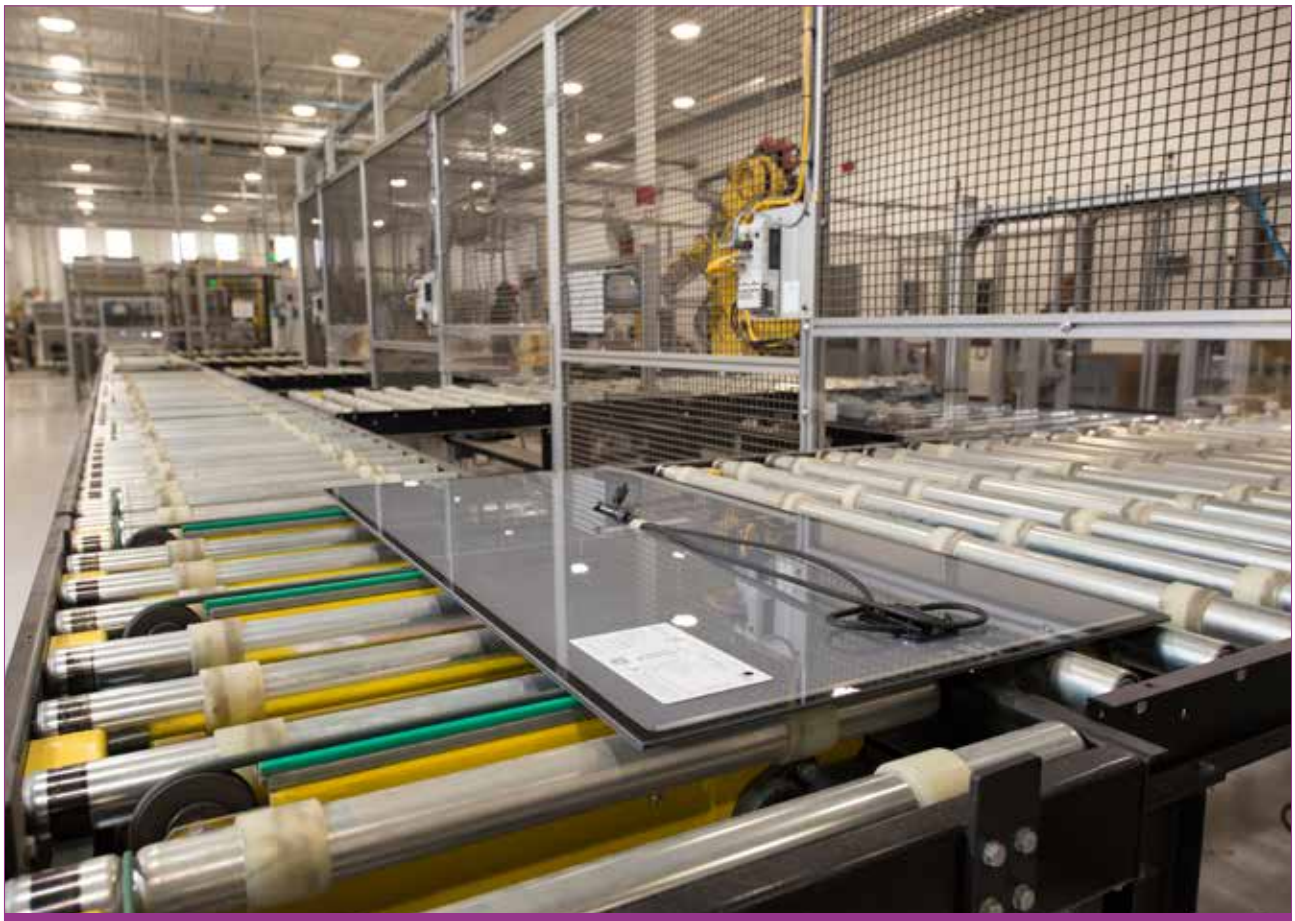
The scale and intensity of global PV manufacturing capacity expansion announcements since November 2015 led to numerous enquiries and subsequent updates to previous preliminary monthly reports, first posted on Photovoltaics International's sister website, PV-Tech.org.

Unlike past checks, whereby only small updates to monthly and subsequent quarterly and half-yearly analysis were required, preliminary monthly reports since February 2016 have undergone major revisions.

PV Tech's preliminary analysis of expansion announcements for April 2016 indicated nearly 9GW of planned future expansions of thin-film modules, solar cells and module assembly production, up from over 7.3GW in the previous month and the third consecutive monthly increase. Preliminary, total planned expansions reached 8,935MW. However, revised figures show that a further 1GW of announcements were made in April, bringing the combined total to 9,935MW.

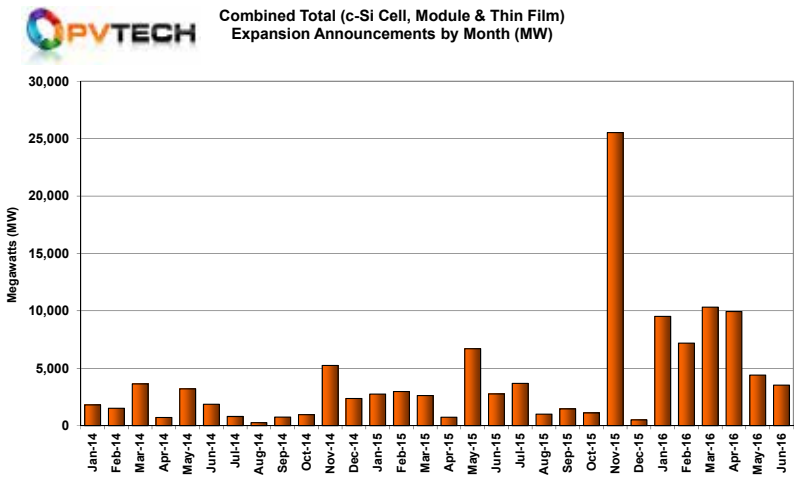
Revised dedicated solar cell capacity expansions announcements reached 4.25GW in April, up from 3.75GW in preliminary findings. This was down compared to revised March figures, which reached 6.55GW, up significantly from preliminary figures of 3.1GW in March 2016.

The increase in March figures was primarily due to updated information

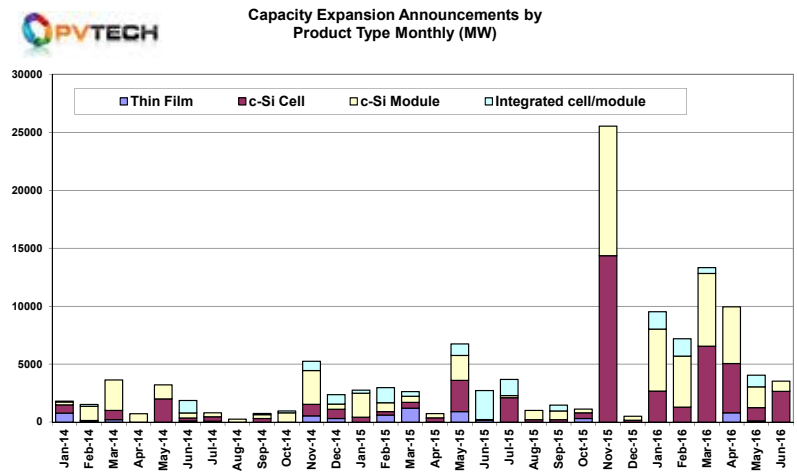


Credit: First Solar

Plans for new thin-film manufacturing capacity have featured in the most recent round of capacity expansion announcements



Combined total expansion announcements (c-Si cell, module & thin film) by month (MW)



Capacity expansion announcements by product type, monthly (MW)

on expansions plans by provided by Risen Energy and Vina Solar in Vietnam. The increase in April's figures, meanwhile, was primarily driven by confirmations to PV Tech by new entrant, Mundra Solar PV Ltd, a new subsidiary of India-based Adani Enterprises.

Having initially sought manufacturing partnerships, including an integrated multi-gigawatt operation with SunEdison that included polysilicon, modules and downstream PV power plant development, Adani is currently establishing its own operations.

First-phase plans include 1.2GW of multicrystalline and monocrystalline solar cell and module assembly, including 900MW multi-c-Si cell, 200MW of mono-c-Si PERC production and 100MW of bifacial production. Mundra Solar plans to start initial production in October 2016. Plans also include a further 1.8GW of cell and module production at facilities being built in Mundra, Gujarat, India.

Revised dedicated module assembly capacity expansions announced in April reached 4.85GW, up from preliminary figures of 4.38GW. However, revised March figures of 4.88GW, up from preliminary figures of 3.7GW, again indicated the intensity of planned expansions but were actually lower month on month.

Aside from Mundra Solar's ambitious plans, April generated announcements from module manufacturers in Taiwan, China and India. However, the second largest module assembly announcement in April was by German distributor CS Wismar, which revealed plans to restart module assembly operations at the former Sonnenstromfabrik facility in Wismar, Germany. This was previously owned by Centrosolar, whose bankruptcy in 2014 rival module manufacturer, Solar-Fabrik acquiring the facility in July, 2014. However, Solar-Fabrik itself went bankrupt in February 2015.

CS Wismar said the manufacturing facility had a capacity of around 525MWp and would primarily offer OEM services for companies focused on the fast-growing US market.

Breaking a sixth consecutive month of zero thin-film module production expansions, laser systems specialist LPKF Laser & Electronics said it had secured a major systems order from an unnamed customer within the PV thin-film manufacturing sector. With limited thin-film activity, only two customers are likely, First Solar and Avancis. However, the size of the LPKF order indicates it relates to First Solar and the upgrade of 800MW of mothballed capacity from the closure of its two production plants in Germany a few years ago.

Geographical split

With the absence of 'Silicon Module Super League' members and the confirmed plans of Mundra Solar, India accounted for 6.1GW of total new capacity expansion announcements in April.

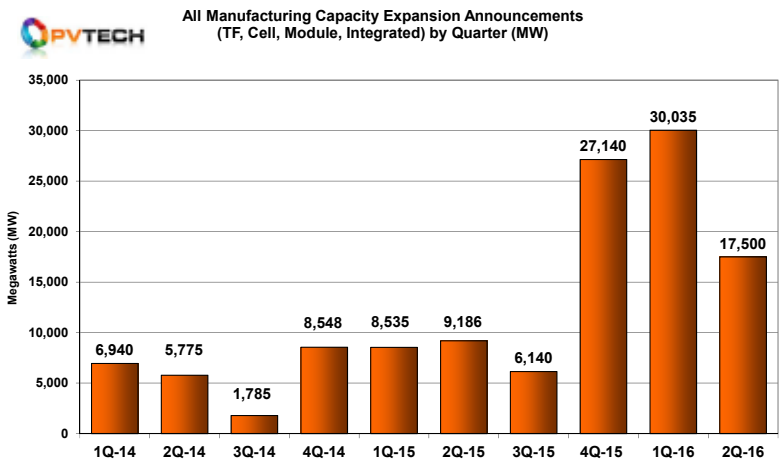
Purely from a capacity expansion announcement perspective, India became the second largest to China in 2015 with over 7.8GW of manufacturing plans, and with the Mundra Solar plans India remains a key potential emerging manufacturing market.

With a planned 200MW of solar cell expansions at TS Solartech, Malaysia accounted for 1GW of the total announced in April, should the First Solar equipment mothballed in Germany, head for Malaysia.

In the last two years to April 2016, Malaysia saw over 3.6GW of new capacity announcements and Thailand 2.3GW, confirming Southeast Asia's growing importance as a PV manufacturing hub.

A lull in China announcements led to only two companies planning capacity expansions, which totalled only 600MW.

Overall, April followed the



All manufacturing capacity expansion announcements (thin-film, cell, module, integrated) by quarter (MW)

previous months of 2016 with a relatively balanced number of solar cell and module assembly expansions, while total MW capacity announcements have remained at higher intensities than in 2015, excluding the month of November in 2015.

May 2016

The month of May 2016 was a key point in time for global PV manufacturing capacity expansion announcements as not only were revisions very small, but the month also revealed only 4.04GW of total new plans and a significant slowdown of over 58%, compared to the previous month.

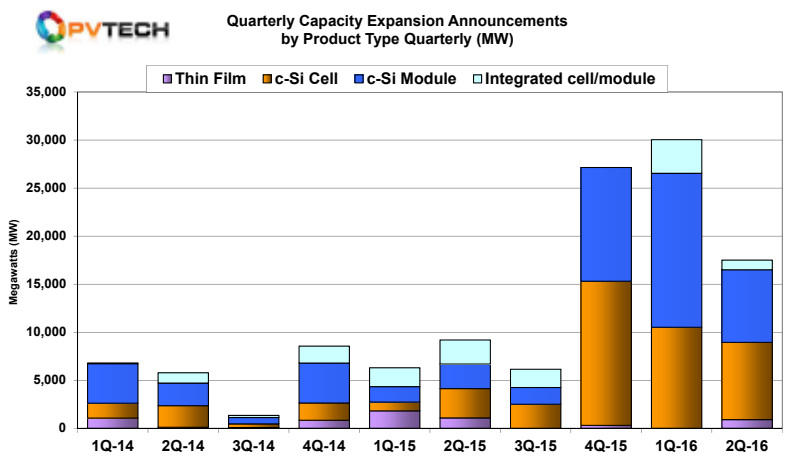
The absence of major expansions from the SMSL members and some China-based manufacturers cautiously extending their footprints outside China kept overall planned capacity expansions low, relative to the previous months of 2016.

This also resulted in the absence of any silicon-based capacity expansions being announced in China, although Canadian Solar and Hareon Solar were responsible for small capacity expansion plans in Southeast Asia and Morocco, respectively.

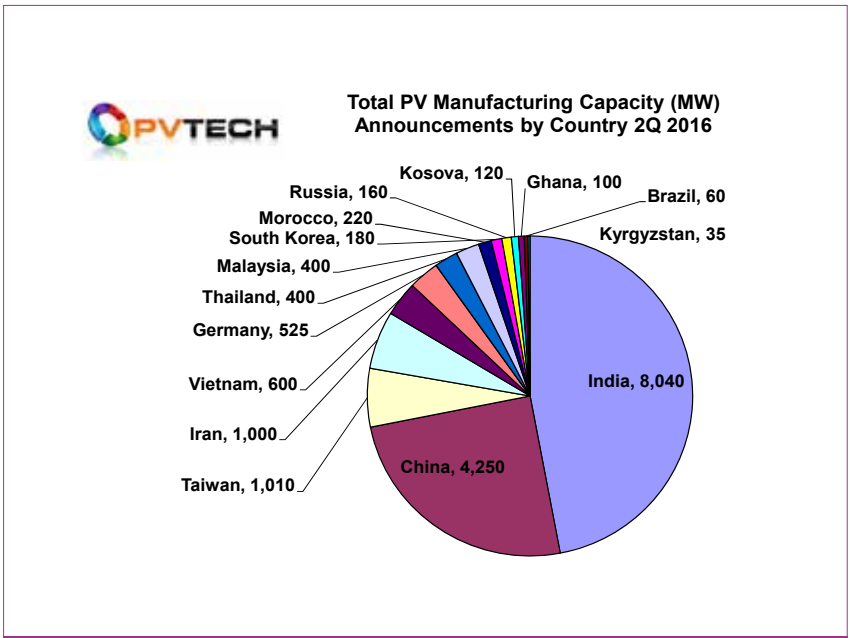
Several speculative announcements were also made in May, including big ambitions in Iran and India, though initial expansion phases were small and did not carry timelines to execution. Discounting these plans, announcements slumped by around a further 2GW in May.

Dedicated solar cell capacity expansions totalled 1.14GW in May, which included a 160MW expansion of monocrystalline capacity in South Korea by Shinsung Solar Energy. Dedicated PV module capacity expansion announcements reached 1.8GW.

The most meaningful capacity



Quarterly capacity expansion announcements by product type, quarterly (MW)



Total PV manufacturing capacity (MW) announcements by country, Q2 2016

announcement made in May was that of Taiwan-based PV manufacturer Neo Solar Power (NSP), which announced the closure of an existing 60MW assembly plant in Taiwan but a 500-600MW new expansion in Vietnam.

Vietnam has rapidly emerged to become an alternative destination for module assembly by China and Taiwan-based PV manufacturers with meaningful solar cell production expected to follow in due course.

The fully integrated (200MW to 1GW) planned new build in Iran was announced by the Industrial Development & Renovation Organization of Iran (IDRO) and turnkey equipment supplier, SCHMID Group.

An announcement made at SNEC 2016 marked the second consecutive month of CdTe thin-film expansions (100MW), led by a consortium of China-based firms and Western equipment suppliers. This was the only announcement of capacity expansions in China in May.

Geographical split

With China only contributing one 100MW expansion plan in May, the majority of announcements were centred on Southeast Asia. Three companies planned expansions in the region totalling almost 1,200MW.

This was followed by India and one company planning an initial 120MW of module capacity plans over the next five years to add 500MW of wafer production, 600MW of solar cell and reach 840MW of module assembly by 2021.

However, the Middle East and North Africa region emerged from a long lull in planned expansions, with Morocco and Iran contributing a total of nearly 1,200MW. Europe, North America and Latin America were not represented with new expansions planned in May.

June 2016

The month of June confirmed a second consecutive month of announcement declines. The month had a total of 3.52GW of planned capacity expansions, compared to 4.04GW in May, around a 12% decline, following a 58% decline in May.

Unlike the previous month, when a speculative announcement in May was made for 1GW of integrated c-Si capacity in Iran, June proved to better represent the slowdown underway.

Preliminary dedicated solar cell capacity expansions in June totalled only 960MW. However, updated information primarily from GCL Systems pushed the figure much higher to 2.65GW. Other notable solar cell expansions in June were made by Taiwan producers, Gintech and Motech, following announcements from several other cell producers in Taiwan in both May (Solartech & NSP) and April (TSEC).

Dedicated PV module capacity expansion announcements in June were significantly below dedicated solar cell plans at 875MW, compared to 1.8GW in May. There were no thin-film or integrated PV manufacturing capacity expansion announcements made in the month.

Geographical split

Without the 1.85GW of solar cell expansions by GCL Systems, which included a planned 250MW n-type monocrystalline heterojunction solar cell line, China-based expansions would have been negligible.

Once again, Southeast Asia (Taiwan, Thailand and Malaysia) attracted more plans: a combined total 800MW of planned expansions, compared to 1.2GW in May 2016. The small balance was made up from Russia, Kosovo, Brazil and Kyrgyzstan.

Q2 2016 analysis

With revised figures included for both the first quarter and second quarter of 2016, it is clear that total capacity expansions since the fourth quarter

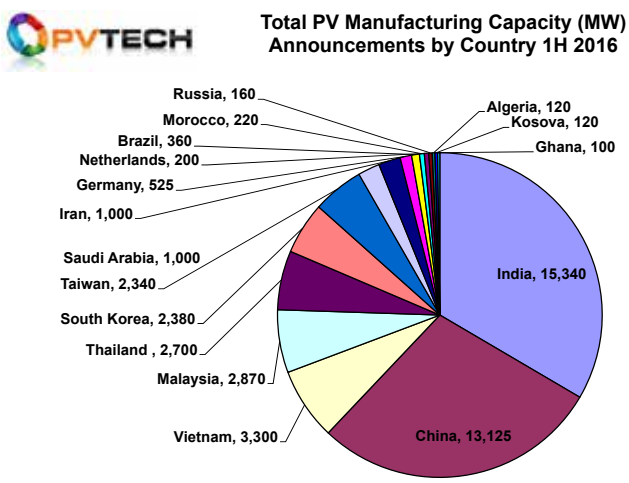
of 2015 have been significantly higher than at any period since the first quarter of 2014.

Total combined expansions in this nine-month period have exceeded 74.5GW. In comparison, total expansions from the first quarter of 2014 through the third quarter of 2015 (21 months) only reached around 47GW.

The first quarter of 2016 has proved to be a new record high in total announcements, just topping 30GW, compared to just over 27GW in the fourth quarter of 2015.

The slowdown from these elevated heights is clearly seen in the total number of announcements made in the second quarter of 2016, which represented around a 40% decline quarter on quarter at 17.5GW.

The second quarter of 2016 included 900MW of thin-film planned expansions, 8.04GW of dedicated solar cell and 7.56GW of dedicated module assembly plans. Integrated PV manufacturing plans totalled 1GW in the quarter.

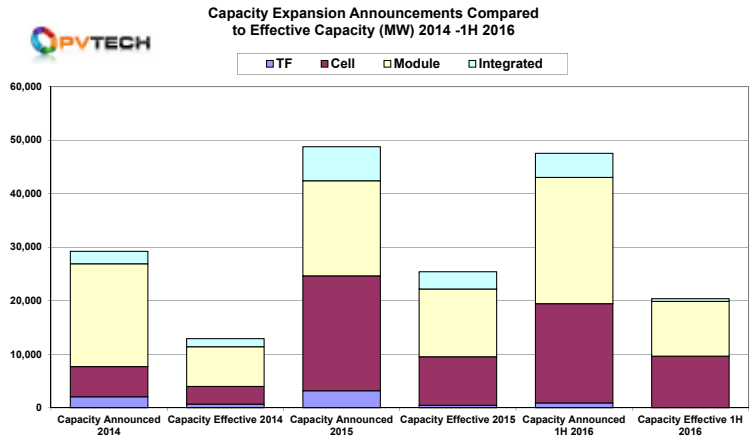


Total PV manufacturing capacity (MW) announcements by country, 1H 2016

Geographical split Q2 2016

In the first quarter of 2016, in which revised figures highlight that China continued to lead new capacity announcements with a total of 8.87GW, in contrast the second quarter was led by India with 8.04GW of plans, while China attracted less than half the amount from the first quarter at 4.25GW.

Indeed, India was the destination for a total of 7.3GW of announcements in the first quarter of 2016, second only to China and totalling almost the same amount (7.85GW) announced for the whole of 2015.



Capacity expansion announcements compared to effective capacity (MW) 2014 to 1H 2016

As already highlighted on a monthly basis, Southeast Asia proved to be a continued strong focal point for expansions, while specifically Taiwan was the third largest single destination (1.01GW) in the quarter, though down from 1.34GW in the previous quarter.

1H 2016 analysis

Total global PV manufacturing capacity expansion announcements in the first half of 2016 exceeded 47.53GW, almost as much as the total for 2015 of 48.76GW.

This included 18.55GW of dedicated solar cell expansion plans and 23.58GW of module assembly expansion plans. A total of 4.5GW of integrated cell and module expansion plans were announced in the period, while 900MW of thin-film expansions were also planned.

Geographical split 1H 2016

Perhaps the most surprising aspect of this period was that India surpassed China for announcements. India had 15.34GW of announcements in the first half of 2016, while China had a total of 13.12GW.

However, the period also reveals the attraction of Vietnam, primarily for China-based PV manufacturers in establishing OEM operations via two companies, Boviet Solar and Vina Solar.

Combined with Malaysia and Thailand, these three countries attracted 8.87GW of new capacity expansion plans in the first half of 2016.

Capacity expansion announcements versus effective capacity analysis, 2014-2016

The hardest and most controversial aspect of analysing capacity expansion announcements is converting them to actual or 'effective' new nameplate capacity.

In an ideal world the tracked announcements should all convert to effective nameplate capacity over a given period of time, providing a clear understanding of the global PV manufacturing landscape.

In the period 2014 through to mid-2016, total capacity expansion announcements have reached over 120GW, which includes over 6GW of thin-film, almost 48GW of dedicated solar cell and over 52GW of module assembly expansions. Integrated manufacturing plans almost reached 14GW.

A new bottom-up analysis was undertaken line by line to establish which of these announcements actually went ahead and whether the nameplate capacity could be categorised as effective capacity by the end of 2016.

Extensive checks were made on all listed announcements in our database from January 2015 to December 2015 to establish if the plans were actioned, completed and ramped. In regards to announcements in the first half of 2016, checks along the same lines were made, although these comprise a higher degree of theoretical production ramp modelling due to being more recently announced. Therefore a higher degree of certainty was given to major PV manufacturers than for example small or start-up phase producers, based on historical evidence of significantly longer lead-times required to migrate to effective capacity status.

2014

In 2014 a total of 26.8GW of capacity expansion announcements were made. By the end of 2016 the effective capacity from these announcements is expected to have reached 12.9GW. This equates to a total conversion rate of about 52%.

In 2014 a total of just over 2GW of thin-film expansion announcements were made, however only 678MW was converted to effective capacity. This equates to a conversion rate of only around 33%.

Dedicated solar cell announcements in 2014 reached 5.6GW, while effective capacity at the end of 2016 is expected to have reached 3.3GW, a conversion rate of nearly 59%.

Total module assembly announcements reached 19.2GW in 2014, while the effective capacity from these plans topped 7.4GW. This equates to a conversion rate of around 38%

In 2014 a total of just over 2.3GW of integrated cell and module plans were announced, of which 1.5GW has turned into effective capacity by the end of 2016. This equates to a conversion rate of around 65%.

2015

In 2015 a total of over 48.7GW of capacity expansion announcements were made. By the end of 2016 the effective capacity from these announcements is expected to have reached 25.3GW. This equates to a total conversion rate of around 48%.

Thin-film announced expansions in 2015 reached nearly 3.2GW but effective capacity by the end of 2016 is expected to have only reached less than 470MW. This would equate to a total conversion rate of only around 14%.

Dedicated solar cell expansions plans reached over 21.4GW in 2015. Effective capacity from these announcements is expected to reach just over 9GW by the end of 2016. This would equate to a total conversion rate of around 42%.

In 2015 a total of over 17.7GW of module assembly expansion plans were announced, while effective capacity of around 12.6GW would have been achieved by the end of 2016. This would equate to a total conversion rate of around 71%.

Integrated capacity plans reached over 6.3GW in 2015. A total of over 3.2GW is expected to have been converted to effective capacity by the end of 2016, a conversion rate of nearly 51%.

2016

As previously noted, capacity expansion announcements in the first half of 2016 reached around 47.53GW. Not surprisingly, a lower conversion rate to effective capacity would be expected by the end of the year, compared to the previous two years, due to capacity expansion start dates and ramp rates.

However, we expect around 20GW of these announcements to convert to effective capacity by the end of the 2016, giving a conversion rate of around 43%.

None of the 900MW of thin-film expansions announced in the first half of 2016 are expected to convert to effective capacity by the end of the year. These plans are 2017 and beyond.

Dedicated solar cell expansion plans expected to convert to effective nameplate capacity could reach 9.6GW by year-end, nearly a 52% conversion rate from the 18.5GW of announcements.

The module assembly conversion rate is expected to reach around 42%, from over 23.4GW of announcements, providing an effective module capacity figure of around 10.2GW by the end of 2016.

As a result of this analysis, effective capacity of thin-film modules through the end of 2016 is expected to have reached just over 1GW. Effective dedicated solar cell capacity would reach around 22GW and effective module assembly capacity would reach around 30GW. Integrated cell and module expansion plans that are expected to convert to effective nameplate capacity by the end of 2016 stand at around 5GW.

This equates to around 58.6GW of effective capacity from around 120GW of announcements since the beginning of 2014, through to the end of 2016, a conversion rate of nearly 49%.

Cumulative global effective module capacity

Looking at just effective PV module capacity (thin-film module capacity, c-Si module assembly capacity and integrated capacity), the total is expected to stand at around a combined 36.7GW at the end of 2016.

Although figures for effective capacity at the end of 2013 vary significantly, due primarily to the number of bankruptcies, exits and zombie companies as a result of the chronic overcapacity then in existence, between 43GW and 53GW of nameplate module capacity was thought to be available.

With around a combined 36.7GW of new module capacity on stream since 2014, effective module capacity is estimated to be in the range of 79.7GW to 89.7GW at the end of 2016.

Conclusion

We have demonstrated that there has been a significant increase in capacity expansion announcements in the fourth quarter of 2015 through the first half of 2016. However, conversion rates to effective capacity since the beginning of 2014 are just below 50%.

On a geographical basis, China and India stand out for accounting for the vast majority of announcements in the first half of 2016, yet both countries experience relatively low effective capacity conversion rates compared to other countries and are primarily responsible for the mismatch, with India notably so.