PV manufacturing capacity expansion announcement plans and analysis for 2017

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Abstract

PV manufacturing capacity expansion announcements in 2017 far exceeded the three preceding years, despite the significant slowdown in new plans in the third quarter. The year was dominated by c-Si solar cell expansion plans and the return of CdTe and CIGS thin-film activity – the highest seen in many years. This quarterly report reviews the fourth quarter activity as well offering a full-year review and analysis of a record year across all segments of upstream manufacturing.

October review

The weakest month for capacity expansion announcements in the fourth quarter of 2017 was October, even though this represented an apparent major rebound from September, which had a combined total of only around 900MW of announcements.

A combined total of 3,250MW of new capacity was announced in October. The majority of this came from the c-Si module assembly segment, which reached 2,500MW. The remaining 750MW was accounted for by c-Si cell plans, the first significant activity in this segment for three months.

However, only one of the announcements in October had any meaningful substance. This related to leading Taiwanese solar cell and module manufacturer Motech Industries, which said it was entering into a joint venture (JV) called Taiwan Solar Module Manufacturing Corporation (TSMMC) with metallization paste supplier, Giga Solar Materials Corp, to establish a 1GW (estimated) solar module assembly plant in Taiwan to meet future domestic demand.

Motech is expected to reach around 3.6GW of annual solar cell capacity in 2017, which currently includes 1.6GW in China and 2GW in Taiwan. The expansions through 2017 are around 600MW.

In parallel with Motech's JV announcement, three of Taiwan's merchant solar cell and module producers, Gintech Energy Corp, Neo Solar Power (NSP) and Solartech Energy officially announced plans to merge and exit the 'foundry' business model and create a new entity, United Renewable Energy Co., Ltd. (UREC).

NSP is estimated to have around 2.2GW of total solar cell capacity of which around 700MW is primarily dedicated to monocrystalline cell production. The company had relocated around 100MW of mono cell production from its 500MW cell plant in Malaysia to Vietnam and planned to migrate around 500MW of capacity in Taiwan to mono-PERC and ultimately stop all multicrystalline cell production.

NSP had also announced in April 2016 that it would also establish a 50MW dedicated n-type monocrystalline heterojunction (HJ) line that offers higher potential cell and module conversion efficiencies than mono-PERC products.

Gintech is estimated to have around 2GW of cell capacity that includes at least 350MW in Thailand,

Credit: Manz AG

CIGS and CdTE thin-film manufacturing plans featured heavily in 2017's expansion announcements.

while Solartech has around 1GW of cell capacity in Taiwan and access to around 350MW of cell and module capacity via a JV in Malaysia, TS Solartech.

Finlay Colville, head of market research at *Photovoltaics International* publisher Solar Media noted in a blog post at the time of the announcement that the new venture would become the fourth largest solar cell producer in the industry during 2018, placing it in an exclusive grouping with JA Solar, Hanwha Q CELLS and JinkoSolar.

All three companies have small levels of module assembly capacity but told Taiwanese media that the JV would establish manufacturing operations estimated to be 1GW (cell: 500MW & module assembly: 500MW) in the US as part of a broader global footprint drive as its turned into a selective integrated upstream manufacturer and downstream PV project developer.

The other significant announcement in October came from India-based engineering firm, Jakson Group, which plans to increase its solar manufacturing capacity to 1.5GW by 2020. The company plans a 500MW first-phase module assembly expansion, followed by a further 500MW expansion that will include an initial 250MW c-Si cell plant.

November review

The month of November set a new benchmark when China-based integrated and merchant PV manufacturer Tongwei Group said it would go ahead with capacity expansion plans at its subsidiary Tongwei Solar (Hefei) Co at two locations (10GW per location) in China at a cost of US$1.8 billion over the next three to five years, adding a total of 20GW. This is the largest ever single capacity expansion announcement.

Tongwei has a strategic goal of building a world-class clean energy enterprise and recently opened its high-efficiency monocrystalline solar cell plant in Chengdu, China with an initial nameplate capacity of 2GW as well as hosting the world's first technically unmanned monocrystalline solar cell production line under the intelligent manufacturing term, Industry 4.0, which we covered in the last report.

Tongwei plans to invest around CNY12 billion (US$1.8 billion) in total, constructing new cell manufacturing facilities at Hefei Solar's facilities in the Hefei High-tech Industrial Development Zone in Chengdu City to provide nameplate capacity of 10GW, while a further 10GW of capacity will be housed in the Southwest Airport Economic Development Zone of Shuangliu District, Chengdu City.

Construction on the new projects was expected to start in November 2017 and production to be ramped in phases over the next three to five years.

With the recent opening of its new 2GW plant, Tongwei has monocrystalline cell capacity of around 3.4GW. 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. The company is also undertaking the construction of a new 50,000MT polysilicon plant.

In November, a combined total of 20.8GW of new expansion plans were announced, the second largest month since we started monthly tracking for reports at the beginning of 2014. The record month remains November 2015 at over 26.5GW.

Aside from Tongwei's 20GW, a total of 800MW of module assembly expansion plans were announced in China and Taiwan.

December review

Momentum was maintained in December with combined new announcements reaching 16.1GW. Importantly, a level of 'normality' was restored with a variety of cell, module, thin-film and integrated cell/module announcements from a broader group of PV manufacturers across a broader geographical footprint.

Included in the 16.1GW total for December was 1.2GW of CdTe thin-film expansions, 7.35GW of c-Si solar cell expansions and 6.55GW of module assembly plans. There was also an announcement for a 1GW integrated cell and module plant.

Of note was the announcement by First Solar to build its second (1.2GW) CdTe module plant in Vietnam. First Solar said at its 2017 Analyst Day event that it was already building its second CdTe module plant in Vietnam to support the transition to its Series 6 large format panel.

The second fab is adjacent to its existing plant, which is undergoing readiness for the initial ramp of Series 6 panels. Both facilities have an initial nameplate capacity of 1.2GW each.

'Vietnam S6 Factory 2' is expected to be built and ready for tool installation in the third quarter of 2018. The company also highlighted that first module production was expected in the first quarter of 2019.

As a result of the capacity expansion, First Solar is expecting to reach a total global manufacturing capacity of 5.4GW in 2020 with capex of US$1.4 billion through 2020.

The company has also just produced the first Series 6 panel at its 600MW Ohio plant and is expected to ramp to volume production in the second quarter of 2018. Potential Series 6 nameplate capacity at the Ohio facilities is 1,100MW.

Major China-based PV module manufacturer Risen Energy has recently signed a framework agreement to build and operate a 5GW monocrystalline cell plant and a 5GW module plant in Changzhou City, Jiangsu Province, China. The company entered PV Tech's global 'Top 10 Module Manufacturers' rankings for the first time in 2017 (see p.12).

Risen is partnering with Changzhou Xixi Modern Agricultural Development Co as designated by the local Jintan District government in a project expected to require approximately CNY2.5 billion (US$383 million) in capital expenditures.

The JV framework agreement calls for Risen to

provide CNY1.5 billion (60% stake) and its partner CNY1.0 billion (40% stake) towards establishing the new manufacturing facilities.

Risen also noted in a separate press release that total capital expenditures for the JV to reach the 5GW nameplate capacity of both cells and modules, as well as R&D activities would be approximately CNY8.0 billion (US$1.23 billion).

The new manufacturing base is expected to be Risen's most advanced, producing leading-edge high-efficiency products by 2020, and provide the development of both upstream manufacturing clustering and downstream industries including project development in the region.

December also included several speculative announcements via media outlets for c-Si cell and module assembly plant plans in Iran, Egypt and Morocco in the several gigawatt range but all lacked specific details.

Fourth quarter review

The fourth quarter of 2017 smashed all multi-gigawatt quarterly records previously set since the beginning of 2014. Total combined capacity expansion plans exceeded 40GW.

This included a total of 1.2GW of thin-film expansion plans, over 28GW of c-Si solar cell and almost 10GW of module assembly plans. It should be noted that speculative plans topped 5GW in the quarter. Nevertheless, even discarding these plans until more definitive information is available, the fourth quarter still exceeded any previous quarter, regardless of the inclusion of speculative plans in the other three quarters of 2017.

It should be noted that just two companies accounted for 30GW of planned expansions in the quarter, which had Tongwei with 20GW of mono c-Si cell plans outlined and Risen with 5GW of mono c-Si cell and 5GW of module assembly plans also at new facilities in China.

However, both companies have experience of gigawatt-plus expansions in recent years and are major manufacturers based in China. The fact that these are phased expansions over specified and not-so-specified timelines stretching over several years does indicate a higher level of credibility and more chance the plans achieve 'effective' capacity status in the future.

It should also be noted that Tongwei is a major merchant cell provider to several leading module manufacturers, such as Canadian Solar, which has a strategy of limiting in-house cell capacity to around 50% of its in-house module assembly capacity and sources complete modules to supplement in-house module nameplate capacity.

SMSL update

There were only a few updates in the fourth quarter of 2017 from the 'Silicon Module Super League' (SMSL) members.

Canadian Solar reported stronger third quarter 2017 financial results than expected and increased full-year shipment and capacity expansion guidance. It has now made four revisions to capacity expansion plans for 2017 and provided expansion plans for 2018 for the first time.

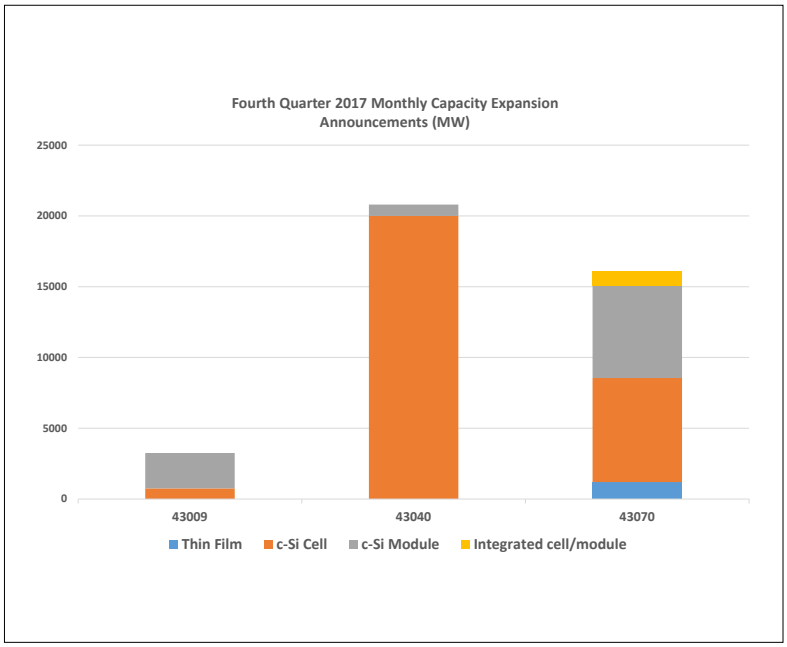


Figure 1. Fourth quarter 2017 monthly capacity expansion announcements (MW).

The SMSL member noted that 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.

The company noted that 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 1,720MW by June 30, 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 and was planning to add a further 1GW of wafer production to end 2018 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.

Canadian Solar also noted 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 the compan 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 is adding almost 1GW of nameplate capacity more than its third revision made

in the second quarter of 2017, which would have led to a 2017 capacity of 7,190MW.

The company 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.

The only other SMSL member, Hanwha Q CELLS, officially announced the start of construction of its wafer, cell and module facilities in Ankara, Turkey in December. Although the previously reported capacity of the new facilities was around 500MW each, local media that attended the launch event cited slightly higher capacity figures now that the construction had started, which is not unusual.

Per the local media reports, the SMSL is adding 150MW of initial solar cell capacity and a further 300MW of module assembly capacity to the initial plans announced in May 2017.

2017 review and analysis

Monthly review

On a monthly basis, 2017 produced some spectacular highs and lows, indicating once again that drawing any clear trends on a monthly basis should not be undertaken.

The year started relatively strong as total combined expansion plans topped 4GW, especially after muted activity through the second half of 2016, which managed a monthly high in November 2016 of 2.5GW, combined total.

Four out of the six first months of 2017 (February, March, May and June) exceeded total combined expansion plans above 5GW. May was notable for having the highest activity in the first half of the year (16.15GW), followed by February (13.9GW).

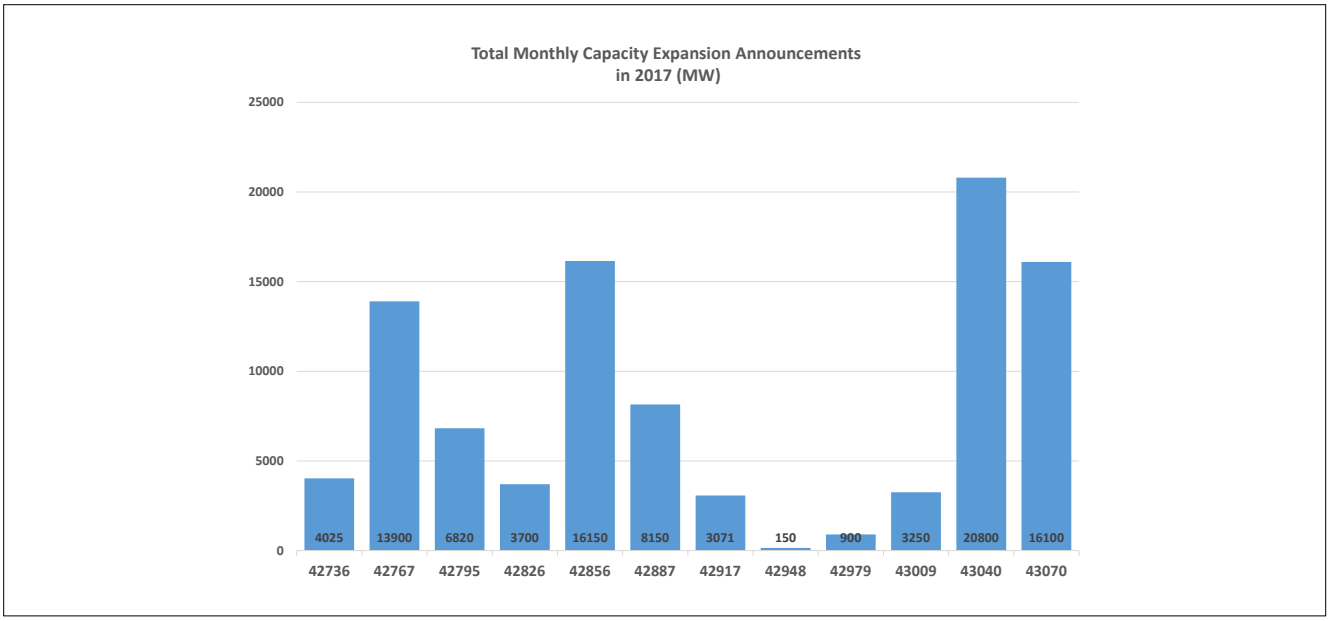
Activity levels declined again through August, which proved to be the low point in the year, although September struggled to reach 900MW of new capacity expansion announcements.

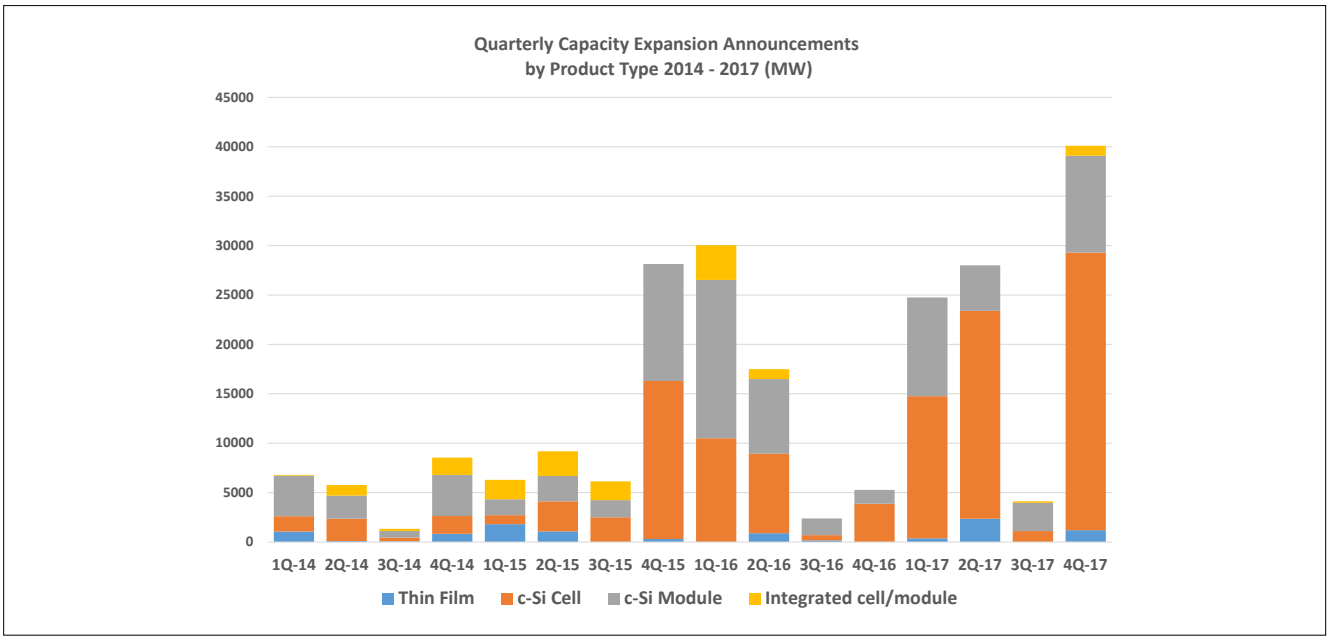
As already detailed in this report, November surprised with 20.8GW but with 20GW coming from one company, Tongwei. December was another strong month topping 16GW, led by 10GW of new plans from Risen Energy.

Quarterly review

Looking at the quarterly trends in 2017, clearly the first two quarters were strong and produced momentum from the first quarter (24.7GW) to the second quarter (28GW) but then collapsed considerably in the third quarter (4.1GW).

Such was the intensity of activity in the first half of the year with companies announcing multi-phase, multi-year and multi-gigawatt plans, a breather was





highly likely but the degree of the collapse in the third quarter was a still a surprise.

Indeed, with October lacklustre the magnitude of the rebound in November and December making the fourth quarter (40.1GW) a new quarterly record was also unexpected.

Segment review

Twenty-seventeen was notable for the revival in thin-film activity, with prominent pronouncements relating to CdTe via First Solar and CIGS via Avancis and Manz partners in China leading to 4GW of thin-film planned expansions announced in 2017. Importantly none of the announcements in this segment are seen as speculative.

But the major trend was the aggressive new wave of c-Si solar cell expansions, which topped 64.6GW, far outpacing c-Si module assembly plans that exceeded (27.2GW) in 2017. More than 80% of the c-Si plans related to high-efficiency monocrystalline PERC technology, accounting for around 52GW of the total.

New plans for n-type mono c-Si (IBC) and heterojunction (HJ) technology expansions almost reached 3GW in 2017 with the wild card HJ technology expansion plans being Tesla and its manufacturing partner Panasonic, which has kept a shroud over the actual ramp at its plant in Buffalo NY state.

Integrated cell and module plans just topped 1GW in 2017. However, several announcements through the year could actually be classified as integrated once construction and start of operations in 2018 happens and further information becomes available.

Geographical review

The key geographical trend in a record but volatile year was the major resurgence of China as the dominant destination for capacity expansion announcements in 2017.

Figure 3 (top). Quarterly capacity expansion announcements by product type 2014-2017 (MW).

Figure 2 (bottom). Total monthly capacity expansion announcements in 2017 (MW).

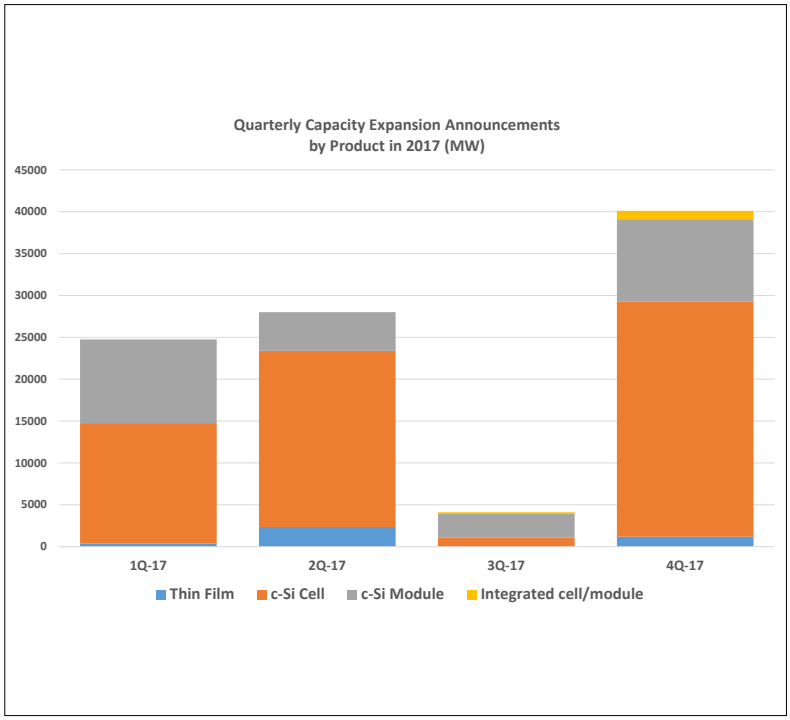


Figure 4. Quarterly capacity expansion announcements by product in 2017 (MW).

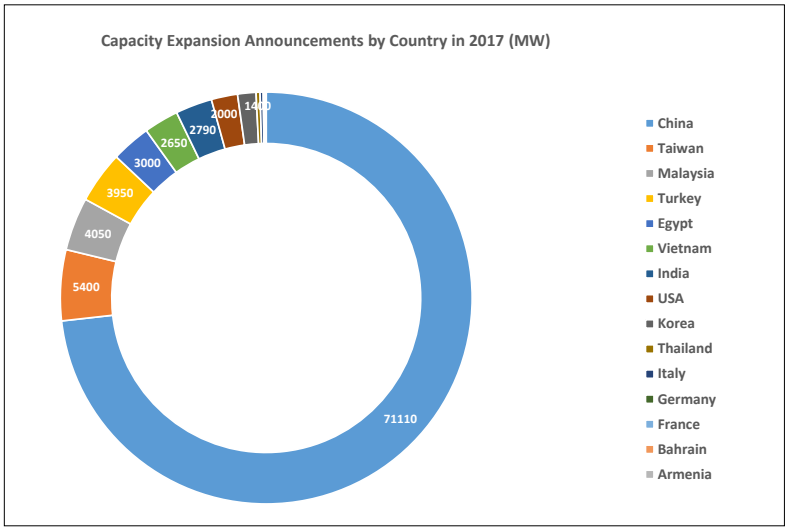


Figure 5. Capacity expansion announcements by country in 2017 (MW).

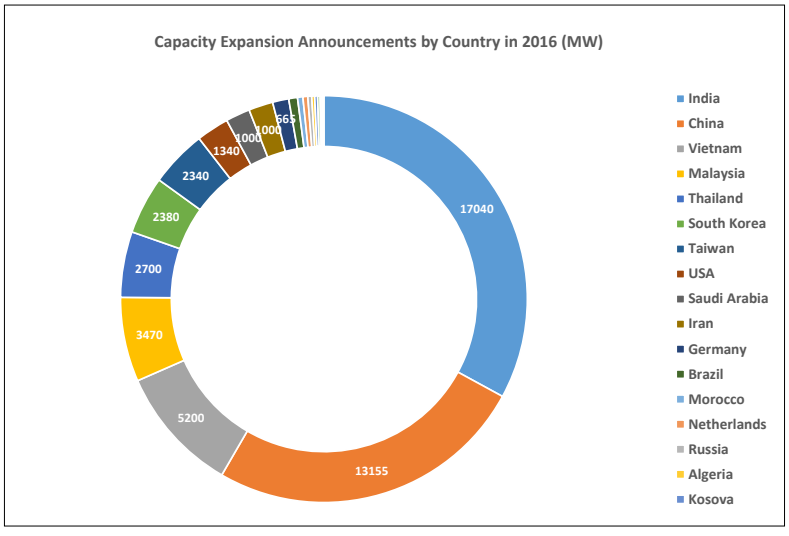


Figure 6. Capacity expansion announcements by country in 2016 (MW).

China accounted for over 71GW of total combined expansion plans in 2017, accounting for around 72% of the total, compared to 13GW or 25% of plans in 2016. It should also be noted that on a segment basis, high-efficiency mono c-Si PERC as well as n-type mono IBC cell expansion plans dominated after years of relatively balanced cell-to-module capacity expansion plans.

The dominance of China should also be looked at in the context of downstream solar module demand hitting a record 53GW in 2017, accounting for around 50% of total global demand.

India had surpassed China in 2016 with combined plans totalling over 17GW and accounting for 33% of the total. But with very few plans from 2016 actually turning into effective capacity in 2017, not surprisingly India mustered only around 2.8GW of plans in 2017, accounting for just 3% of the total and with much of this lower total in 2017 remaining speculative.

China's resurgence also impacted previously highly attractive destinations for Chinese manufacturers in 2017, such as Thailand, which accounted for only 300MW of new expansions, compared to 2.7GW of new expansion plans in 2016.

Vietnam also experienced a significant decline in 2017, despite First Solar's 1.2GW plans announced in December. Vietnam attracted a combined total of over 2.6GW of planned expansions, compared to 5.2GW in 2016.

However, Malaysia held its own with just over 4GW of new capacity plans, compared to around 3.5GW in 2016. However, no new announcements were made in the second half of the year related to Malaysia.

Emerging downstream markets such as Turkey and Egypt also attracted upstream manufacturing attention in 2017. Turkey attracted almost 4GW of new plans throughout the year, up from zero in 2016. Egypt attracted 3GW of manufacturing plans in 2017, up from zero in 2016.

As with many emerging downstream PV markets, speculative upstream manufacturing follows; Egypt outweighed Turkey in that respect in 2017.

The European region also suffered from fewer announcements and smaller expansions in 2017, compared to the previous year. Germany, the largest location for cell and module production in Europe only had 100MW of new expansion plans announced in 2017, compared to nearly 700MW in 2016.

Conclusion

The year set a number of new planned expansion announcement records with a global combined total of over 97GW, up from over 55GW in 2016, or nearly an 80% increase year-on-year.

With China's destination resurgence and domination of high-efficiency c-Si solar cell expansion plans, only Malaysia and potentially Taiwan held their own year-on-year.