Polysilicon consumption to decline below 4g/W in Q3 2018

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Abstract

The in-house market research team at PV Tech, this journal's sister website, has developed a new model for forecasting trends in polysilicon consumption by the solar industry. This article analyzes how, based on this new model, the industry's use of polysilicon will dip below 4 grams per watt by the end of this year.

Consumption of polysilicon used by the solar industry will decline to below 4g/W during 2018, hitting 3.92g/W at the end of Q4'18, according to a new value-chain model developed by the in-house market research team at PV Tech, P*hotovoltaics International*'s sister website.

Just a few years ago, the industry was accustomed to levels of 5-6g/W, but all this has changed recently, driven by several factors running concurrently.

This article explains a new model developed by our research team which factors in every key aspect of material efficiency, and allows for highly accurate forecasting going forward.

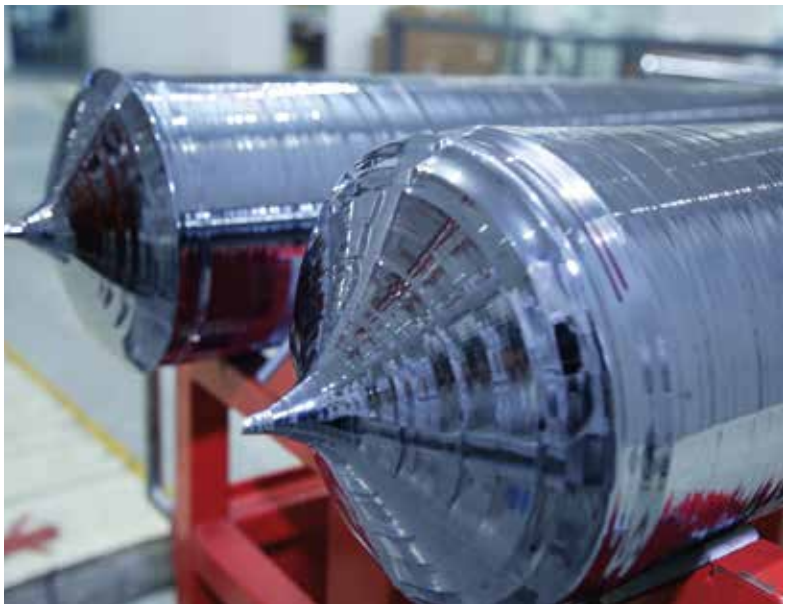
Introducing PV Tech's new poly model

At the heart of the new analysis is our bottom-up tracking of manufacturers throughout the entire c-Si value-chain, and allocation of cell technologies across all variants that affect module efficiency and wafer thickness. This unprecedented detail is then backed up through wafering, ingot production and finally arriving at polysilicon grams-per-watt levels that can be compared to legacy top-down, back-of-envelope estimates undertaken in the industry.

The analysis pulls out actual cell production, cell-to-module interconnection losses by technology, mono/multi usage (including n-type and p-type cell variants), diamond-wire saw adoption, kerf losses and many other factors that influence the ongoing reduction in polysilicon (g/W) used by the industry as a whole.

While the output from the analysis is fascinating in demonstrating how things have evolved – to end up with the current (blended) level today of 4.16g/W – the key advantage of the multi-variable input model is in forecasting, and assessing where the industry goes after 2018, when it is expected that polysilicon production (including the small allocation used by semiconductor applications) will reach 512kMT.

Consumption of polysilicon by the solar industry will decline to below 4g/W during 2018, hitting 3.92g/W at the end of Q4'18, PV Tech analysis suggests.



Credit: LONGi Green Energy

Diamond wires, mono and PERC drive down poly g/W

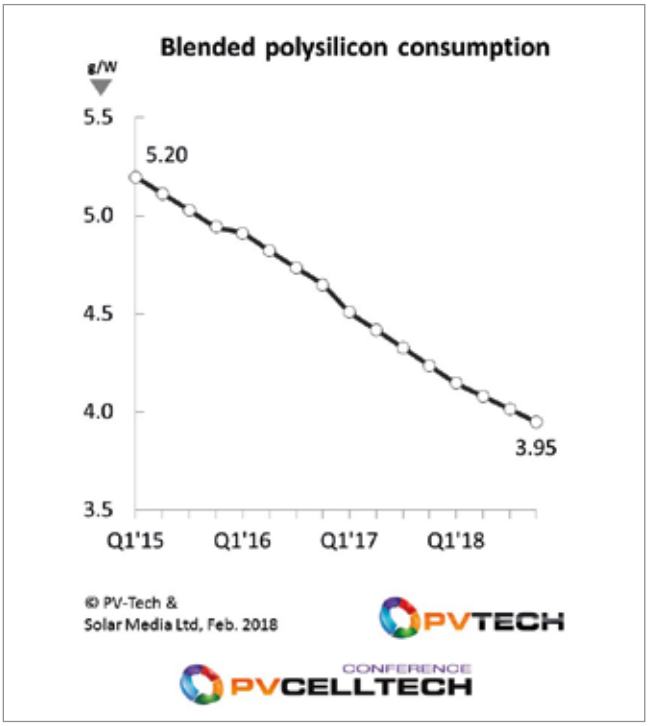
The major downward push on polysilicon g/W consumption is coming from two factors: diamond wire saws and cell efficiency improvements (more mono, and PERC in particular). By the end of 2018, almost all wafer manufacturing (mono and multi) will be using diamond wires, almost all mono will be PERC and multi will be well through its own PERC upgrade phase. The changes here dwarf incremental improvements seen at other stages (ingot casting/pulling, cell-to-module losses, and wafer thickness reductions).

The graphic in Figure 2, overleaf, looks at the percentage contributions coming from the various stages through the value chain, where the conclusions from the above come over clearly.

The rate of decline in g/W levels should slow down somewhat after 2018, with the industry largely having upgraded to diamond wires; the ongoing declines here coming now from annual kerf loss reductions that are much less pronounced.

Without any cell efficiency increases being factored in, increased share of p-mono alone will keep downward pressure on g/W levels. Cell efficiency increases will be less impactful also, with the move to glass/glass modules and bifaciality being factors more interesting to site owners when considering energy yields.

The upside will however come from higher penetration of n-type variants, although it is not



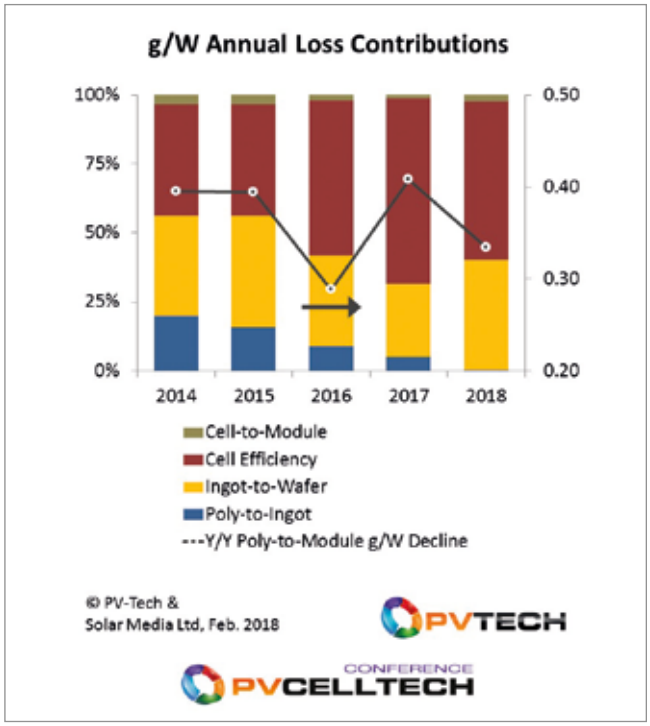


Figure 1 (top left). Polysilicon consumption is forecast to decline by 25% between Q1'15 and Q4'18, with blended levels down to 3.9g/W exiting 2018.

Figure 2 (top right). Increased mono wafer use, cell efficiency improvements, and the migration to diamond wire saws for mono and multi wafering, are key to polysilicon consumption declines today.

clear if the efficiency benefits (on circa. 180 micron wafers) will be significantly higher than leading p-mono offerings.

Wafer thickness reductions could re-emerge as key priority

This then takes us firmly back to wafer thickness reductions being the wildcard to any long-term polysilicon consumption analysis. Just how much longer can the industry go, without the inevitable shift to 140 microns as the likely first wafer reduction upgrade path?

Being in the diamond wire cut sector going into 2019, the prospects for thinner wafers are much more encouraging than at any other point in the past. For anyone looking at technology disruption over the next few years, this must be high up on the list. It is also worth noting that cell lines are more automated now, and this is one of the other key factors needed to move to thinner wafer use.

If the industry does embark on a wafer reduction path from 2019, it would basically halt all new polysilicon capacity expansion plans, over and above what is under construction and due to come online over the next 18 months.

Consider this as an example. If the solar industry goes through a 2x annual growth factor in the five-year period now (going from 100GW in 2017 to 200GW in 2022), then polysilicon required by the solar industry in 2022 would decline from approximately 670kMT (under a conservative g/W forecast using 180 micron wafers) to about 550kMT (if wafer reduction has largely moved to using 140 micron substrates).

This clearly highlights the frailty of polysilicon expansions beyond 2018-2019, with the industry comfortably on track to ship approximately 475kMT this year.

The caveat here of course is how much demand elasticity has set in, driven by the consequential material cost declines and solar as a whole being more competitive globally.

Polysilicon producers need to be cell experts to survive

However the next few years pan out for polysilicon consumption, it is bindingly clear that polysilicon producers need to be experts in what is happening with cell technology (from the basics of mono cell share, through to the plans for wafer thickness reduction), as cell line improvements will remain the dominant driver for g/W levels in the short to mid-term.

This was set to be a key theme at the PV CellTech 2018 conference in Malaysia, due to get underway as this edition of *Photovoltaics International* went to print. The conference was also due to include a panel session on kerfless wafering alternatives, which – while not discussed above – remain game-changers sitting in the wings.

About the author

Finlay Colville joined Solar Media in 2015 as head of the new market intelligence activities. Until October 2014, he was vice president and head of solar at NPD Solarbuzz. Widely recognized as a leading authority on the PV industry, he has presented at almost every solar conference and event worldwide, and has authored hundreds of technical blogs and articles in the past few years. He holds a BSc in Physics and a Ph.D. in nonlinear photonics.