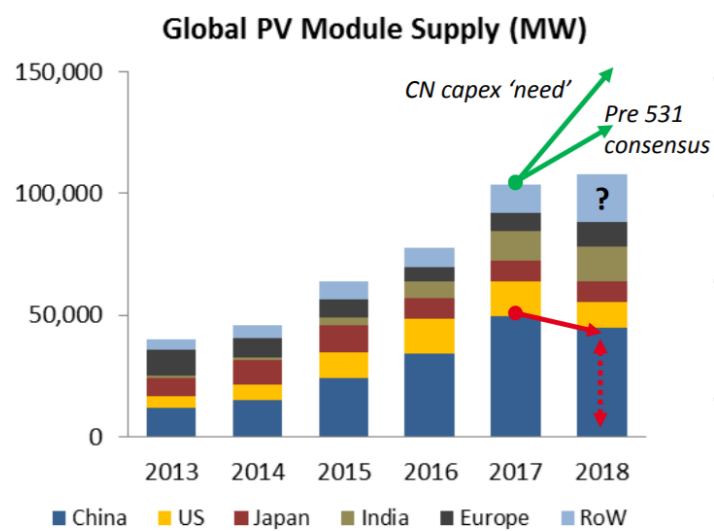




## Market Trend

PVTech 2018



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## Market Trend

PVTech 2018

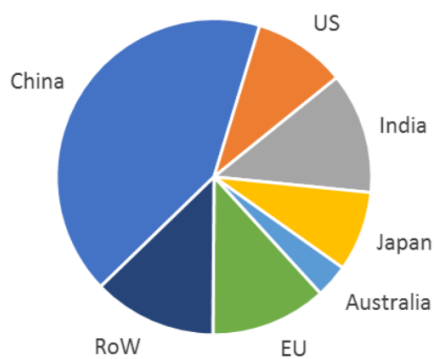
End-Market	Policy climate	Ease of doing business (importing)	Where is the supply coming from	Current market-share 'leaders'
China	Confused, adjusting	N/A. Made-in-CN only	All China module makers	LONGi, TSE, JKS, JASO, Talesun, GCL-Si, Wuxi-Suntech, Risen, CSI
US	Overall net positive	Specific hurdles, still 'closed' to Made-in-CN	SEA dominant, 2019 uptick domestic	First Solar, HQC, JKS, TSE, CSI, JASO, SunPower, REC, LGE
India	Robust LT plans	Reluctantly accepting from CN, SEA today	China, SEA, India	<i>Next talks/discussions to reveal more</i>
Japan	Stable 2030 additions	Very good (legacy JP brand m/share small)	China, JP, various other RoW	CSI, JKS, HQC, JASO, YGE, TSE, SunPower, JP (Kyocera, Sharp, Solar Frontier, Panasonic...)
Australia	Good while it lasts	Fully open	China & RoW	<i>Next talks/discussions to reveal more</i>
EU	Overall net positive	Post-MIP open again (few transient glitches)	SEA & China (new)	JKS, TSE, HQC, JASO, CSI, REC
RoW	Lumpy but massive growth potential	Open with few exceptions (TW, SK,...)	China, SEA, RoW	JKS, JASO, HQC, Risen, BYD, LGE, TSE, CSI, GCL-Si, First Solar, LONGi

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## Global Demand

PVTech 2018

2017-2018 Geographic Mix

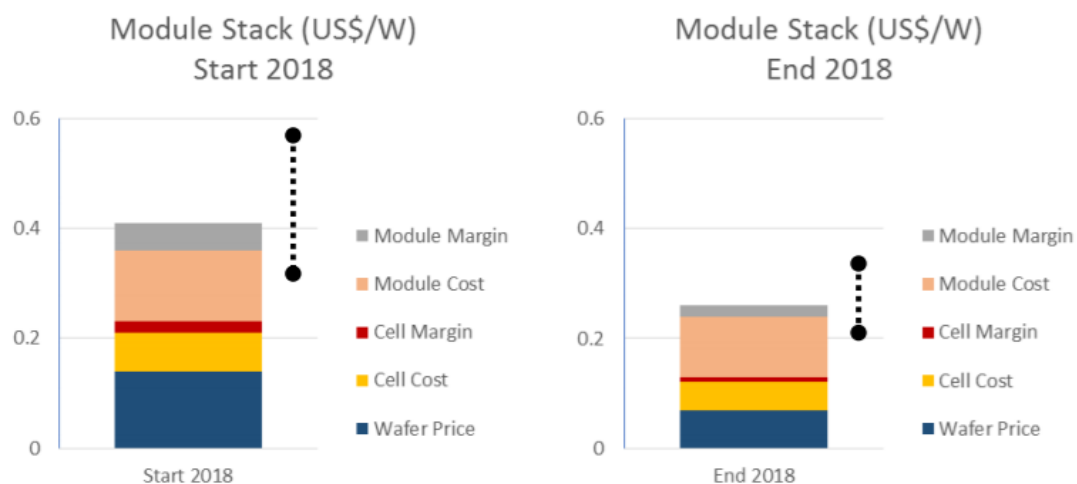


- Outside China, most supply is now going to the Rest-of-the-World (RoW) grouping shown here.
- This is mostly coming from SEA, MEA, LATAM regions.
- While a global demand pictures often show these type of end-market segmentations, each country has different module supply dynamics.

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## FINAL ASP Trend

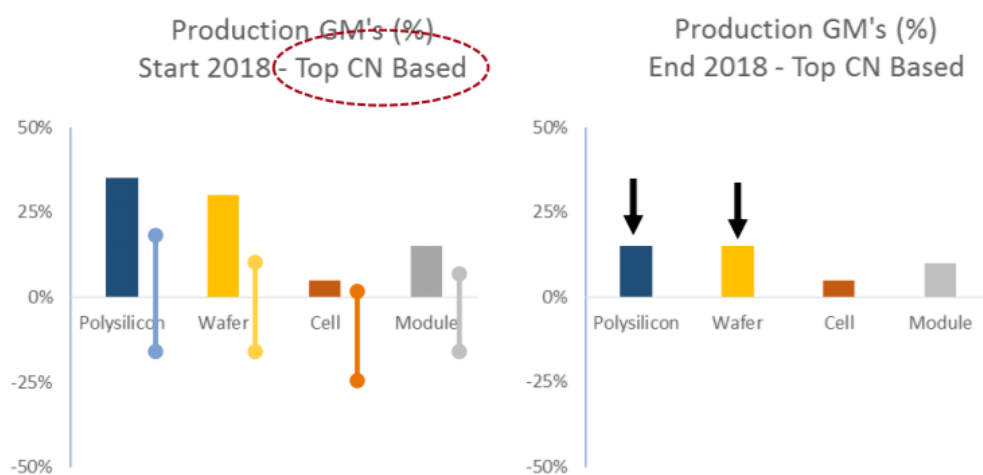
PVTech 2018



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## Declining ASP

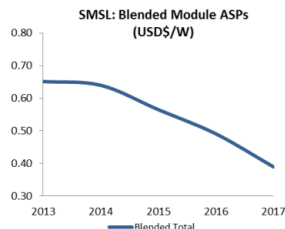
PVTech 2018



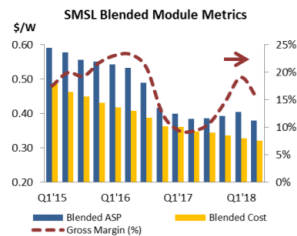
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## Declining ASP

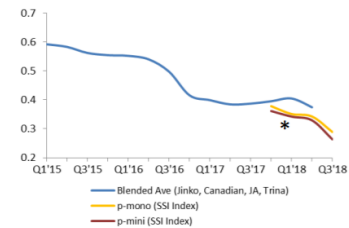
PVTech 2018



- SMSL: Jinko, Trina, JA Solar, Canadian Solar, LONGi, GCL-SI, Hanwha Q-CELLS
- Annual blended is simply Y/Y declines.
- Blended from the SMSL is the most accurate, as factors in contract pricing more than spot trading.



- Module margins for the SMSL have generally fluctuated in the 15 ±5% band, despite strong ASP decline.
- Cost reductions have been coming mainly from wafer price variations (also cell & module processing cost declines).

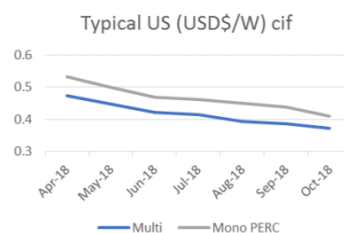
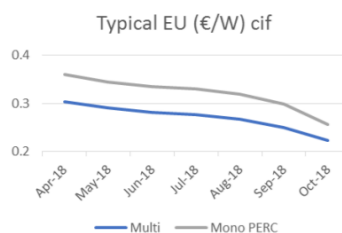
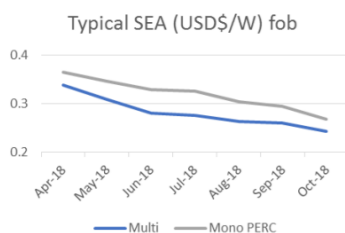


- Above graphic – blue line – shows blended ASP average of Jinko, Canadian, JA Solar, Trina) – key global module grouping today.
- \* TTM data from Singapore Solar Exchange: *Singapore Solar Index* - courtesy Basma Amezian.

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## ASP by Region

PVTech 2018



- PV industry always had ASP premiums based on **Performance** (n-type, p-type HE variants), by **Segment** (Ground-Mount vs Rooftop), by **Region/Country** (buying preferences, downstream margin expectations, importing factors), **Terms** (Spot/Contract), **Volumes** (e.g. 5kW vs. 500MW), & **Supplier-Brand-Premium**.
- p-type like-for-like delta (previously multi vs mono, now PERC variants) has typically trended at 10%.
- Graphic top-left is the most interesting as SEA pricing most representative of global utility module sales business, extending to MEA, LATAM, India (extreme example), etc.
- Data from Singapore Solar Exchange: *Singapore Solar Index* - courtesy Basma Amezian.

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## ASP Bottom out

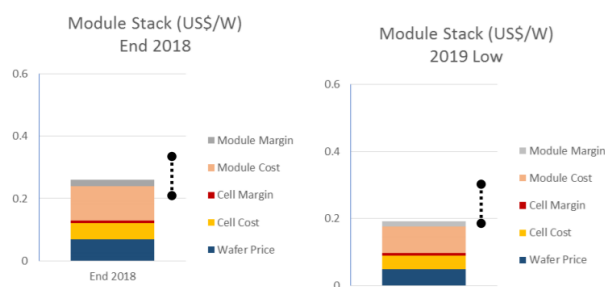
PVTech 2018

- Assumptions...
  - Global demand remains in the 100-120GW (annualized) band for the next 12-18 months.
  - China is determined to own the entire Poly and Wafer supply market (>97% say). All poly & wafer outside China is ultimately stranded, or so small volumes as not to impact module ASP trends.
  - Poly & wafer margins compressed to match China-accepted high-volume (reported/audited) norms (15% say).
  - Poly & wafer costs see strong 'assistance' virtue of low-cost CN manufacturing locations.
  - Mono wafer availability continues to grow; multi oversupply with increased capacity coming offline.

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## Mono vs Poly Trend

PVTech 2018



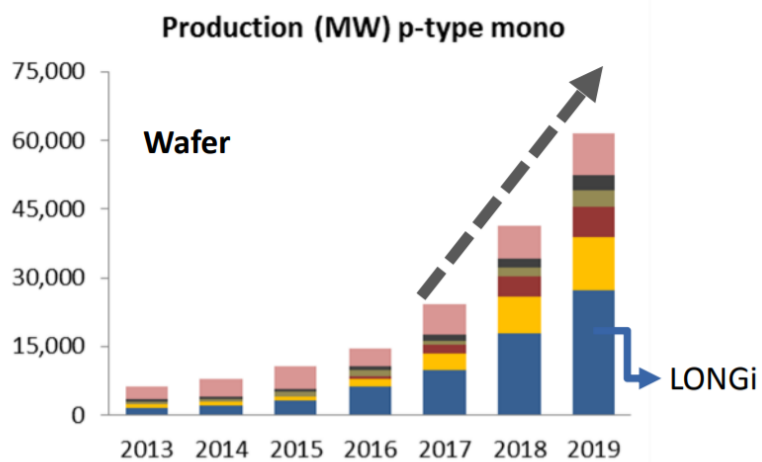
..... Final ASP variation (incl. different contributions from CIF, duties, tariffs, etc.)

- Polysilicon & wafer production margins hardest hit.
- Module production costs still dominant but on fast cost-decline curve.
- Efficiency and reduced g/W usage still helping downward trajectory.
- Essentially low margins across all production (poly/ingot/wafer in China, cell no-change, module minor contraction).
- Delta still for n-type and rooftop applications.
- Impact of bifacial still unknown on ASPs during 2019.

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## Mono vs Poly Trend

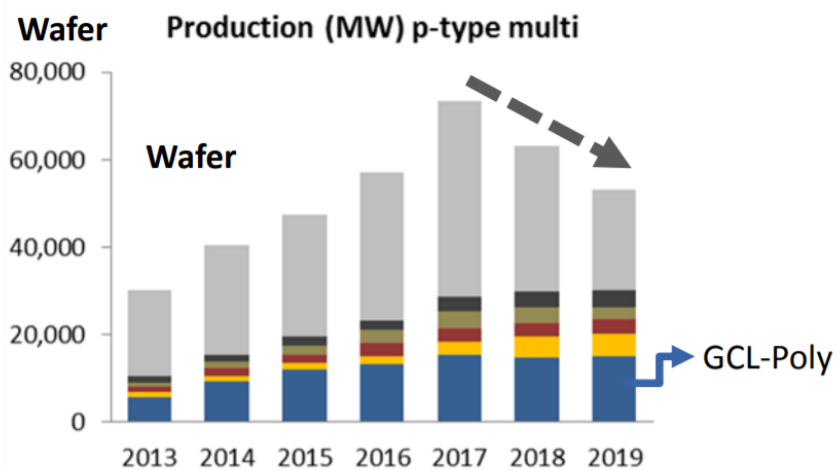
PVTech 2018



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## Mono vs Poly Trend

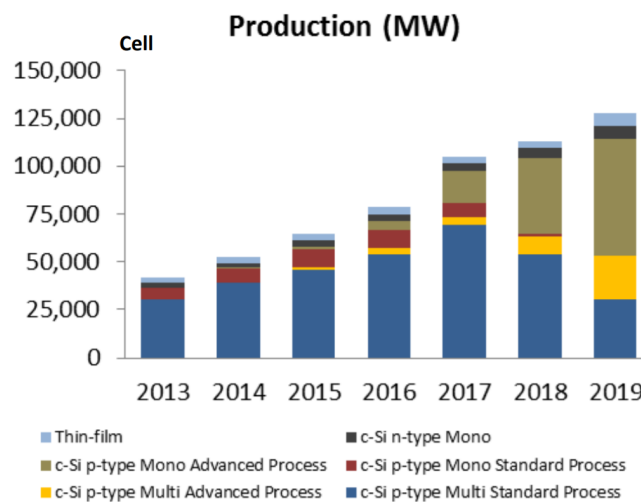
PVTech 2018



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## Mono vs Poly Trend

PVTech 2018



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## Mono vs Poly Trend

- 2018-2022 likely to represent the full mono-to-multi transition phase.
- Mono enables PERC.
- PERC enables bifaciality.
- Mono allows more efficiency enablers on cells/modules.
- Mono wafers allow n-type variants to grow faster.

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**Mono vs Poly Trend**

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- The PV industry went through a long phase of almost no technology upgrades that made downstream channels have to rethink.
- This all changed with mono wafer supply & related cell enhancements that have led to the wide range of HE options today, across both p-type and n-type.
- Potentially, we are at the start of a high-pace technology upgrading cycle, not waiting for it to 'settle-down'.

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**Why China**

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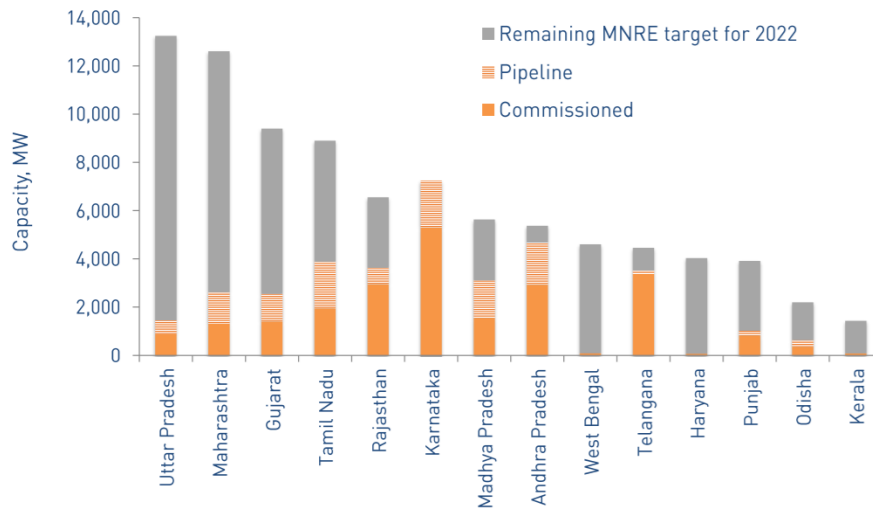
**CHINA DOES IT BETTER**HIGHER  
AUTOMATIONMORE TESTS  
(MATERIAL,  
PRODUCTION)SHARED  
KNOWLEDGE

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## India a market on its own

PVTech 2018



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## Markets driving demand

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- China Targets upgraded targets 250 ~ 270Gw
- 40~50Gw p/a 2019 to 2020
- Massive shift to Mono High tech (70Gw end of 2019)
- Indian market will continue to cause disruptions in mainstream supply

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