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ITRPV | International Technology Roadmap for Photovoltaics

VDMA

Trends in c-Si PV

ITRPV 11th edition – Laser update & Status Hanwha QCells

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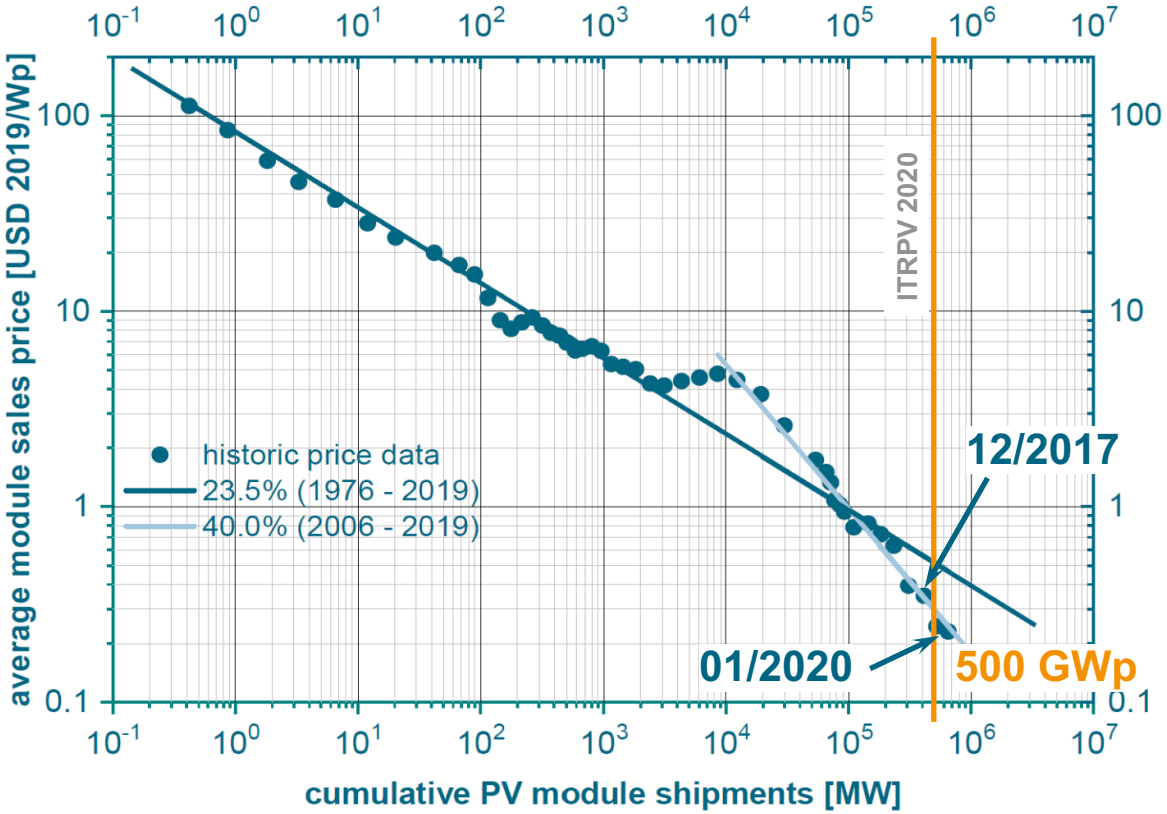
Hanwha Q Cells GmbH, Germany
EPIC Webinar, June 26

Outline

1. Status ITRPV PV Learning Curve / Laser applications
2. Hanwha Q Cells at a Glance
3. ITRPV Outlook

PV learning curve



Shipments /avg. module price at year end:

2018: 109 GWp / 0.24 US$/Wp
2019: 130 GWp / 0.23 US$/Wp

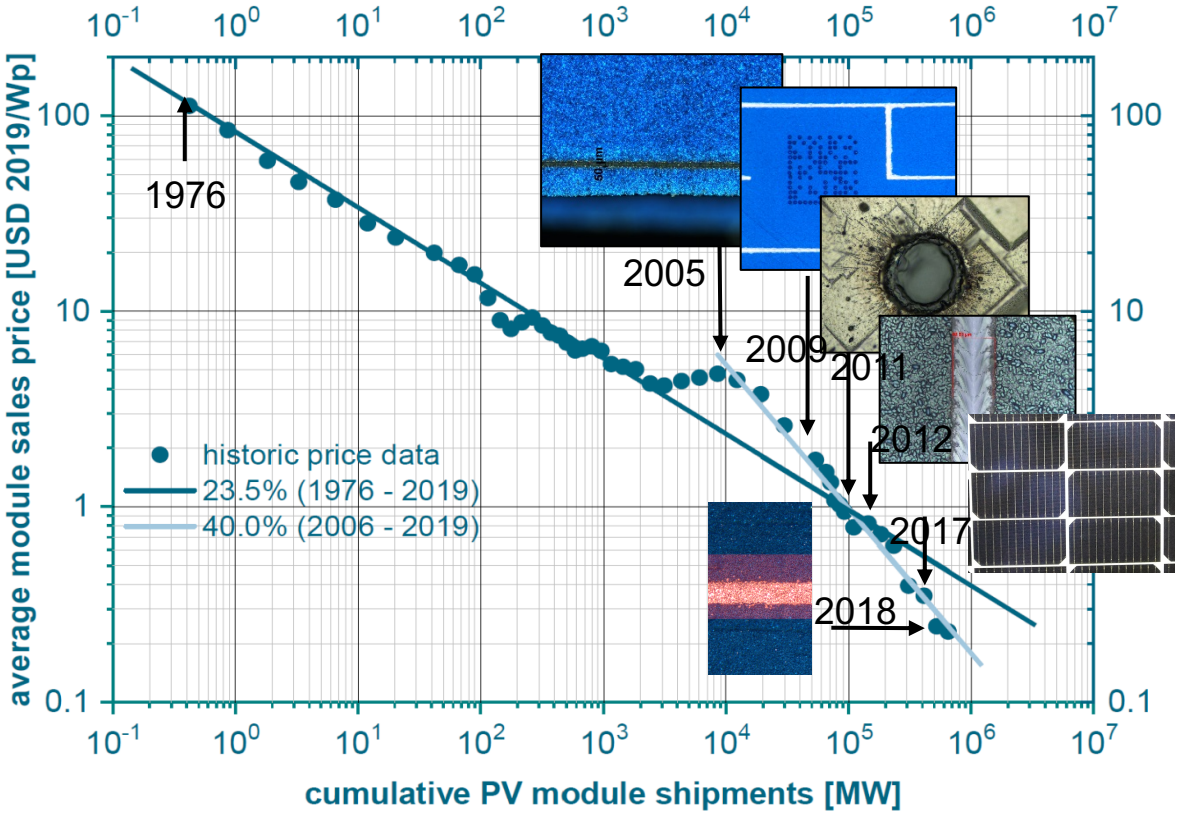
o/a shipment: ≈ 654 GWp
o/a installation: ≈ 628 GWp

LR ≈ 23.5 % (1976 …. 2019)
LR ≈ 40.0 % (2006 …. 2019)

→ high volume shipped w/ increased product diversity
→ Significant change in module concepts / size

→ **Price learning continues**

Laser Processes in c-Si Products – examples



2005: Laser edge isolation

2009: TRAQ = QC Laser marking

2011: LFC = Laser Fired Contact

2012: LCO = Laser Contact Opening

2017: Half Cell (Laser cutting)
new module challenges

2018: Selective Emitter

202X: what's next for Laser ?

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Global operation: R&D and production sites

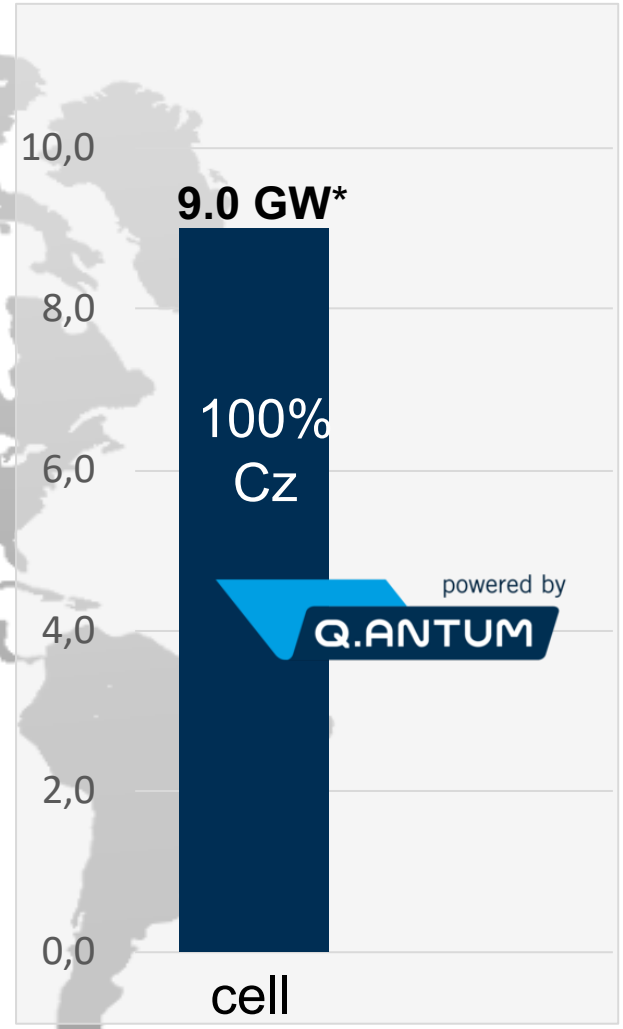
Germany
- Global R&D Center
- Global QM
- VDE Lab (in-house)

Korea (JC)
Cell & module production

USA (GA)
Module production

China (QD)
Cell & module production

Malaysia (CYB)
Cell & module production



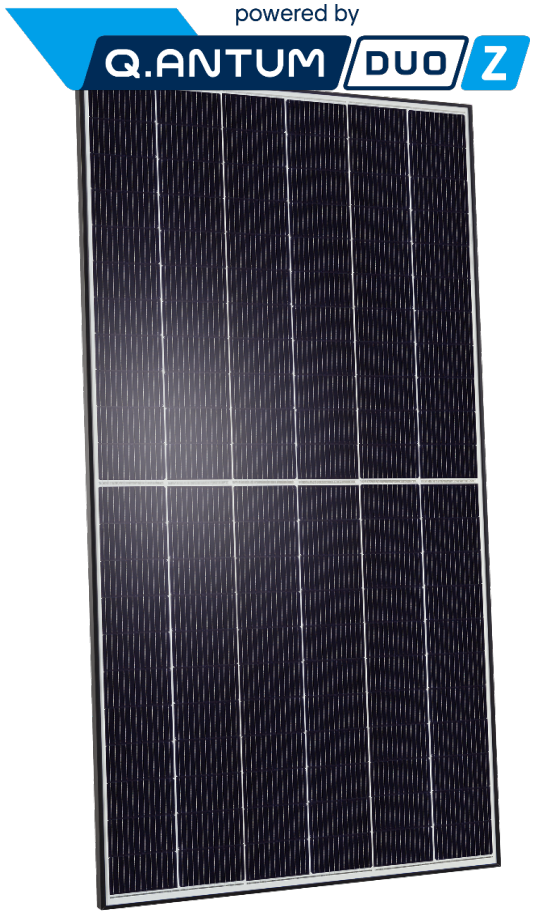
* As per end of Q2, 2020

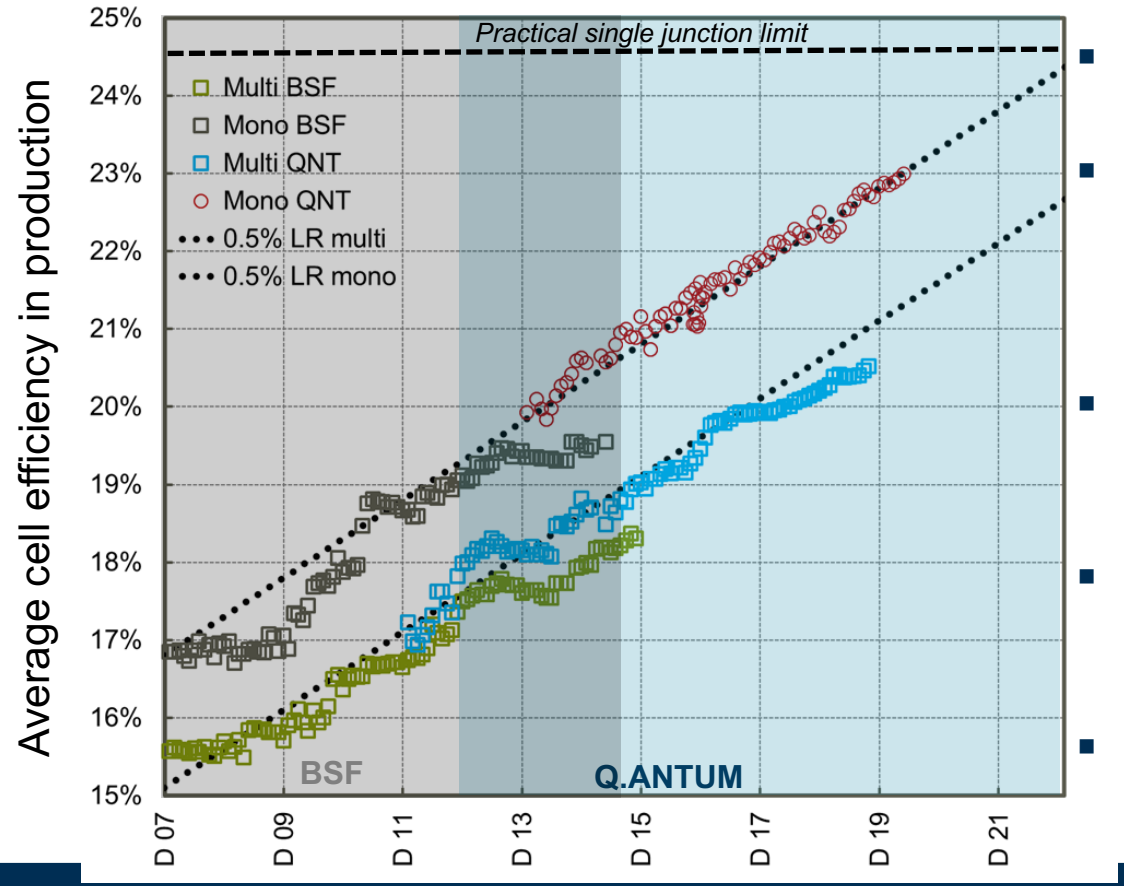
Global operation: Our Module Products

Q.ANTUM mass production of mono Si cells (mc-Si stopped)

Evolution of running products: no record efficiencies, but optimized LCOE

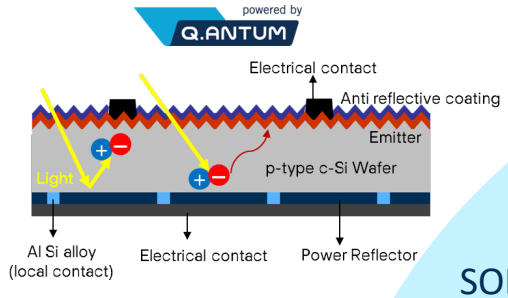
HQC module series:	Q.PEAK DUO G8/L-G8	(120/144 half-cell M4)	→ up to 360Wp/430Wp/ 20.0%
	Q.PEAK DUO L-G8.3/BFG	(144 half-cell M4 bifa)	→ up to 420 Wp /19.6%%
	Q.PEAK DUO ML/XL-G9	**(132/156 half-cell M4)**	**→ up to 390Wp/460Wp/20.6%**





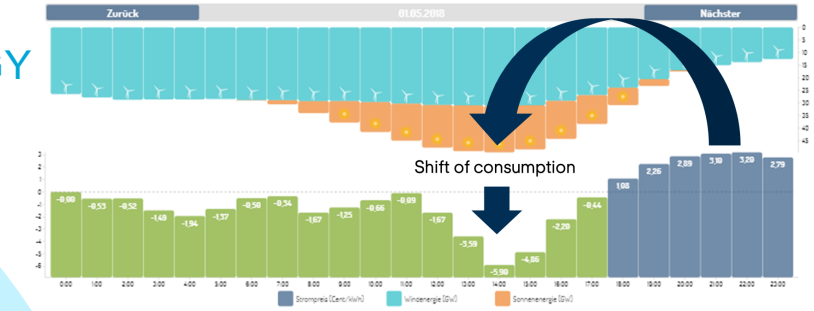
- Learning rate continues
- Current average cell efficiency ≈ 23.0% p-Cz pilot-production mc–Si stopped @ 20.5%
- Efficiency headroom of Q.ANTUM - p-Cz > 24 %
- Zero gap technology → higher module efficiency
- For efficiency > practical limit of Si → new concepts like tandem

Q Cells Product Portfolio 2020

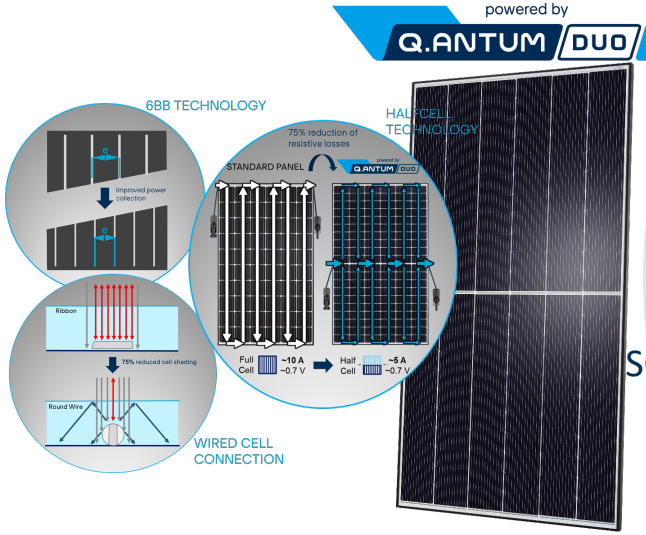


SOLAR CELLS

Q.ENERGY



ENERGY RETAIL SERVICES



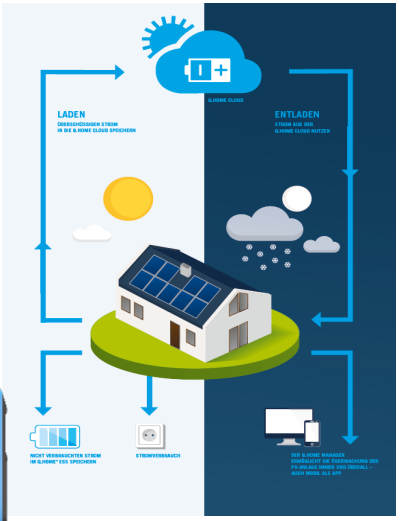
SOLAR PANELS

...for more information:

Q CELLS
Engineered in Germany
www.q-cells.com

CLOUD SOLUTIONS

Q.HOME CLOUD



Q.HOME+

STORAGE

SOLAR POWER PLANT

SYSTEMS

Q.FLAT

Q.MOUNT

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PV today and in future

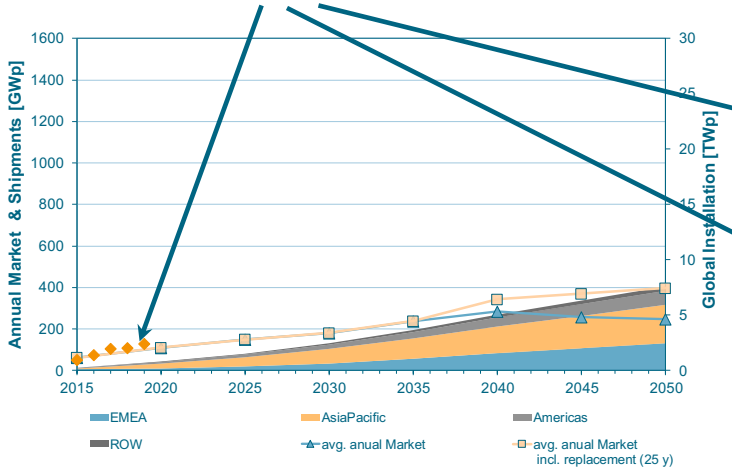
Different calculated scenarios in 11th edition:

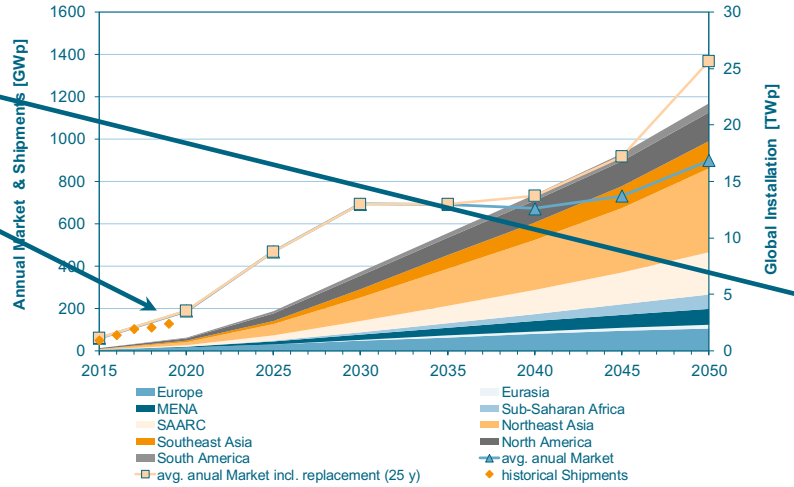
BNEF NEO 2019
low: 7.6 TWp/ 9.3 PWh (22% global electricity)
market peak:400+GWp / 2050

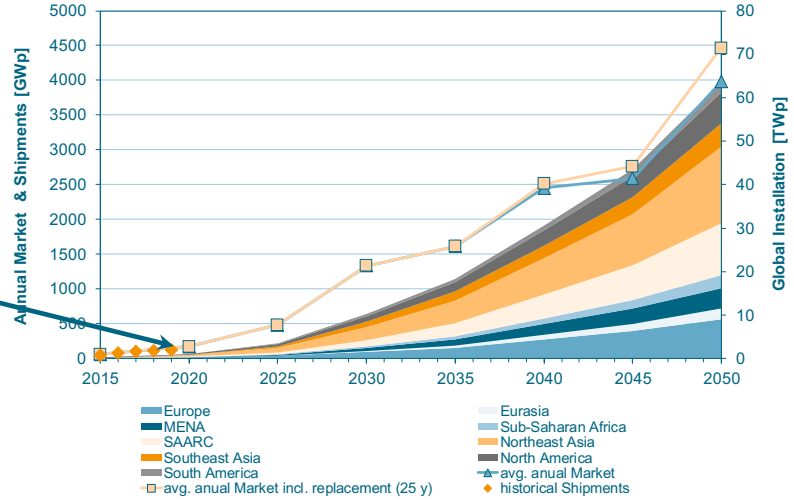
Breyer (“Electricity”)
high: 22 TWp/ 38 PWh (69% global electricity)
market peak: 1,400+GWp /2050

Breyer (“Broad electrification”)
mix: 63 TWp/ 104PWh (69% global energy)
market peak:4,500+ GW/ 2050

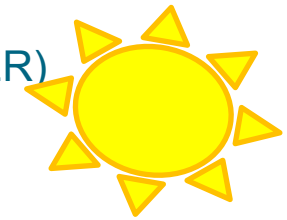
→ Shipments 2019 were close to approaches!







ITRPV finding:
- PV learning continues and progresses but market will remain volatile **esp. in Corona season**
→ Several 100GW markets are ahead, and can be served based on todays PV technologies (also for LASER)
→ Further effort is required to meet x TWp market requirements!



ITRPV will provide also in future guidance to handle the PV challenges

Q CELLS
Engineered in Germany

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VDMA
Photovoltaic Equipment

Thanks for your interest!

Free download of roadmap & ITRPV presentations at itrpv.org

More Information on Q Cells: www.q-cells.com