PV Industry Trends from Trends Report 2020 and some update

Izumi KAIZUKA, Deputy Operating Agent Task 1 IEA PVPS/ Principal Analyst, RTS Corporation, Tokyo

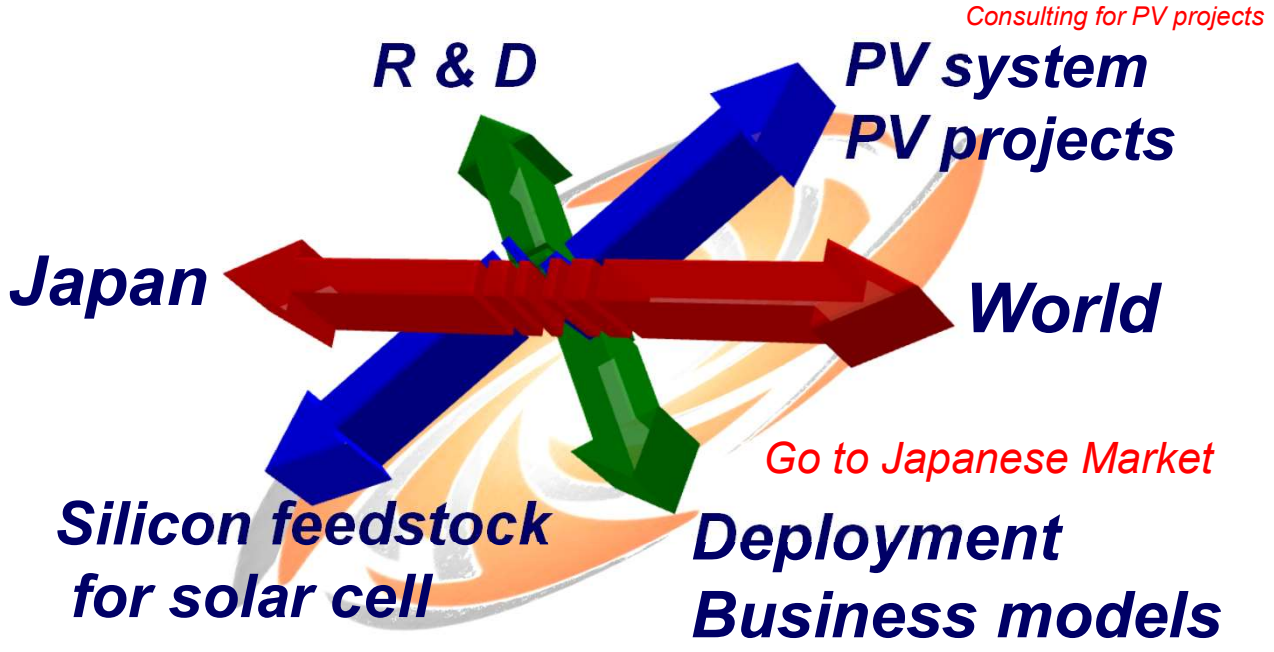
Septe10th November 2020, PVPS Workshop@PVSEC-30

RTS Corporation – founded in 1983, 36 year experience

Comprehensive Consulting company on Photovoltaics (PV)

Business: Helping establish PV business strategy, "Go to Japanese market "

Clients: Government agencies, utilities, manufacturers (entire value chain of PV) project developers, financial institutes, industry associations, etc.
in JP, US, DE, IT, FR, AT, NR, CHE, AUS, CHN, IND, KOR, Taiwan, Thailand, Norway, etc.



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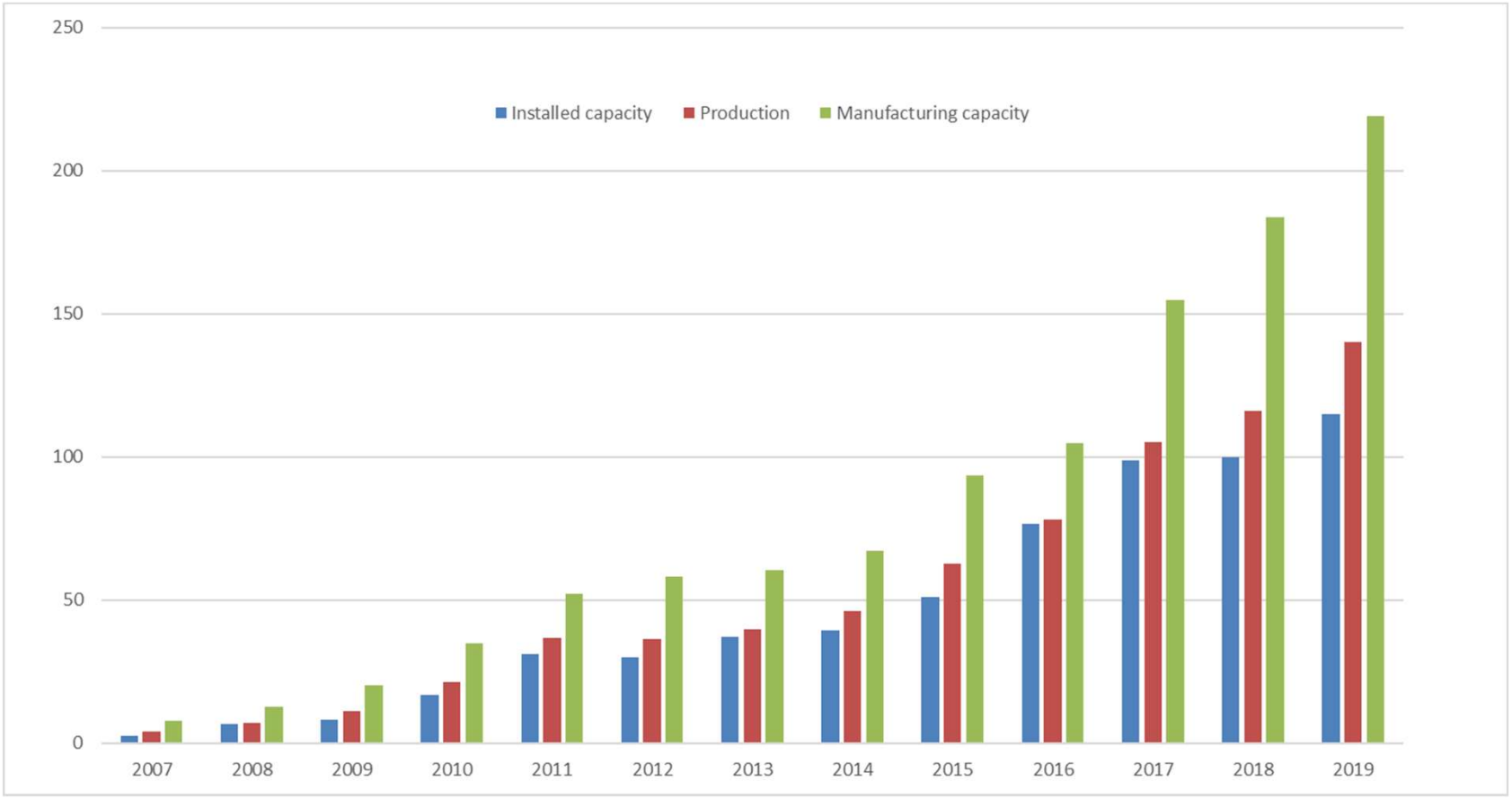
- Highlights from PV industry from Trends Report 2020
- Update of 2020 trends
- Conclusion

Trends with more focus on downstream sectors will be presented on Thursday, Date: 14:50-18:00, Nov. 12 (Thu), 2020

PVSEC SPECIAL FORUM- PV INDUSTRY IN THE POST-PANDEMIC ERA - CHALLENGES AND SOLUTIONS

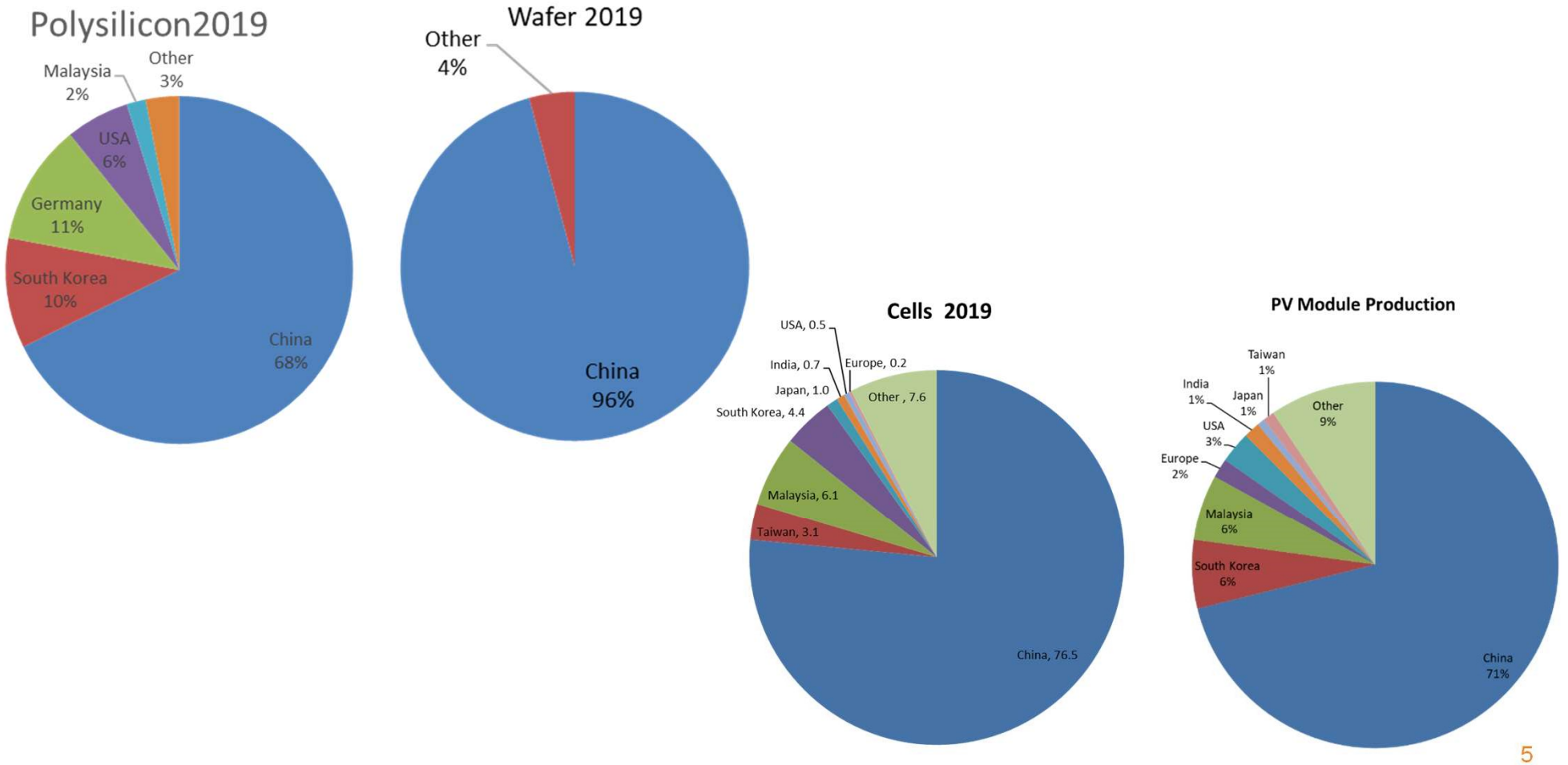
Yearly PV Installation, PV Module Production & Production capacity



Preliminary
(Trends 2020)

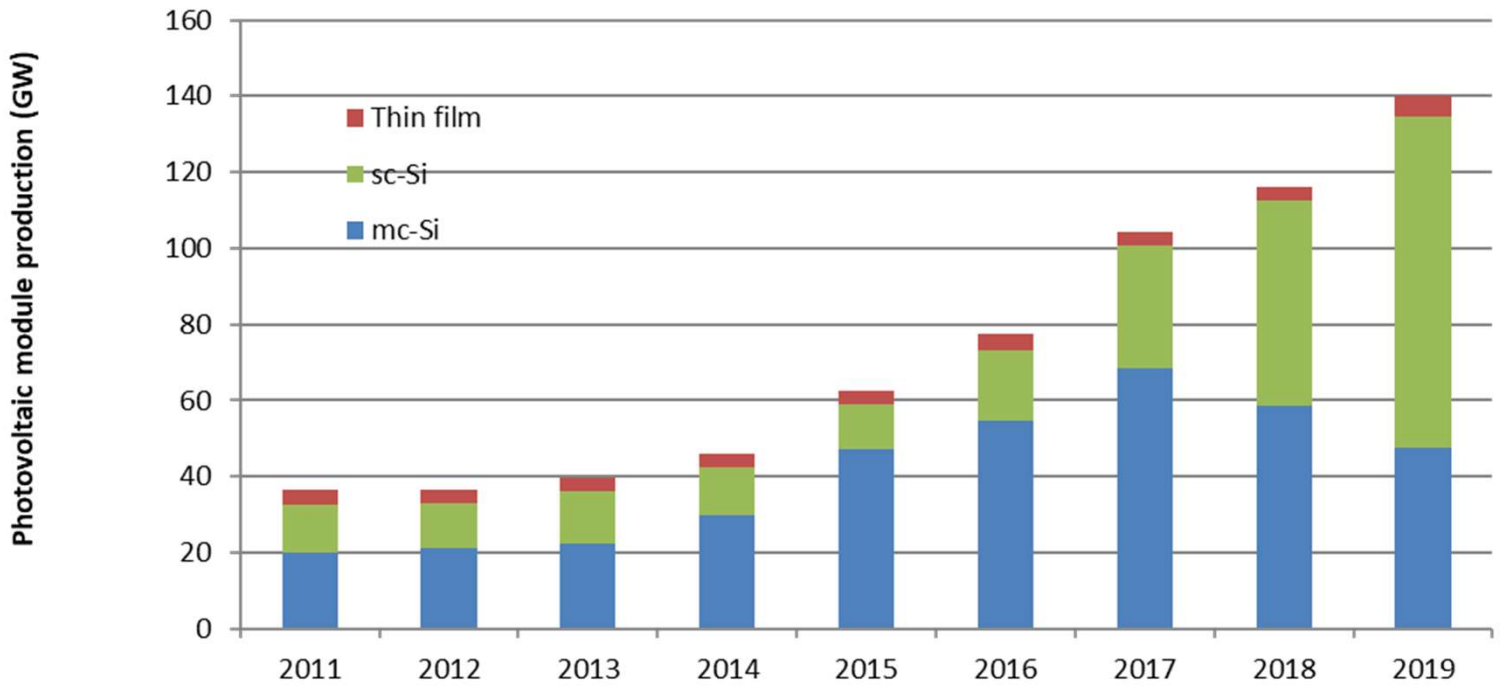
PVPS

Share of manufacturing countries along the value chain (2019)



Source: IEA PVPS and Trends Report 2020, to be published

PV Module production by technology



- sc-Si share increased to 62%, mc-Si share decreased from 50.4% to 34%
- Thinfilm share: 4.1%, majority from First Solar, then, Solar Frontier, etc.

Some update trends

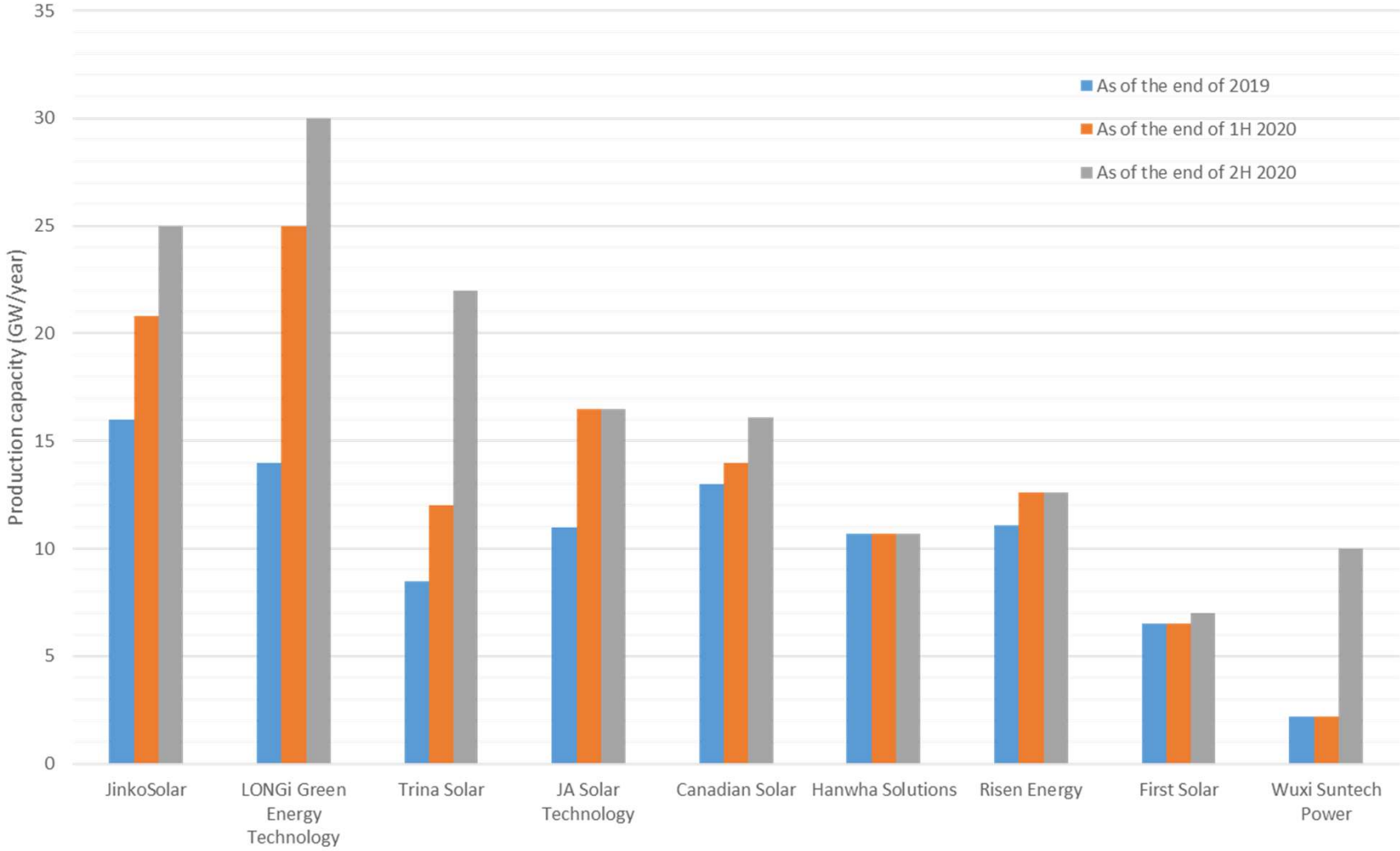
- 1H 2020 Module shipment rankings
- Further enhancement of manufacturing capacity
- PV module prices
- Higher output & efficiency technologies

PV module top 10 suppliers in 1H 2020 and major manufacturing sites

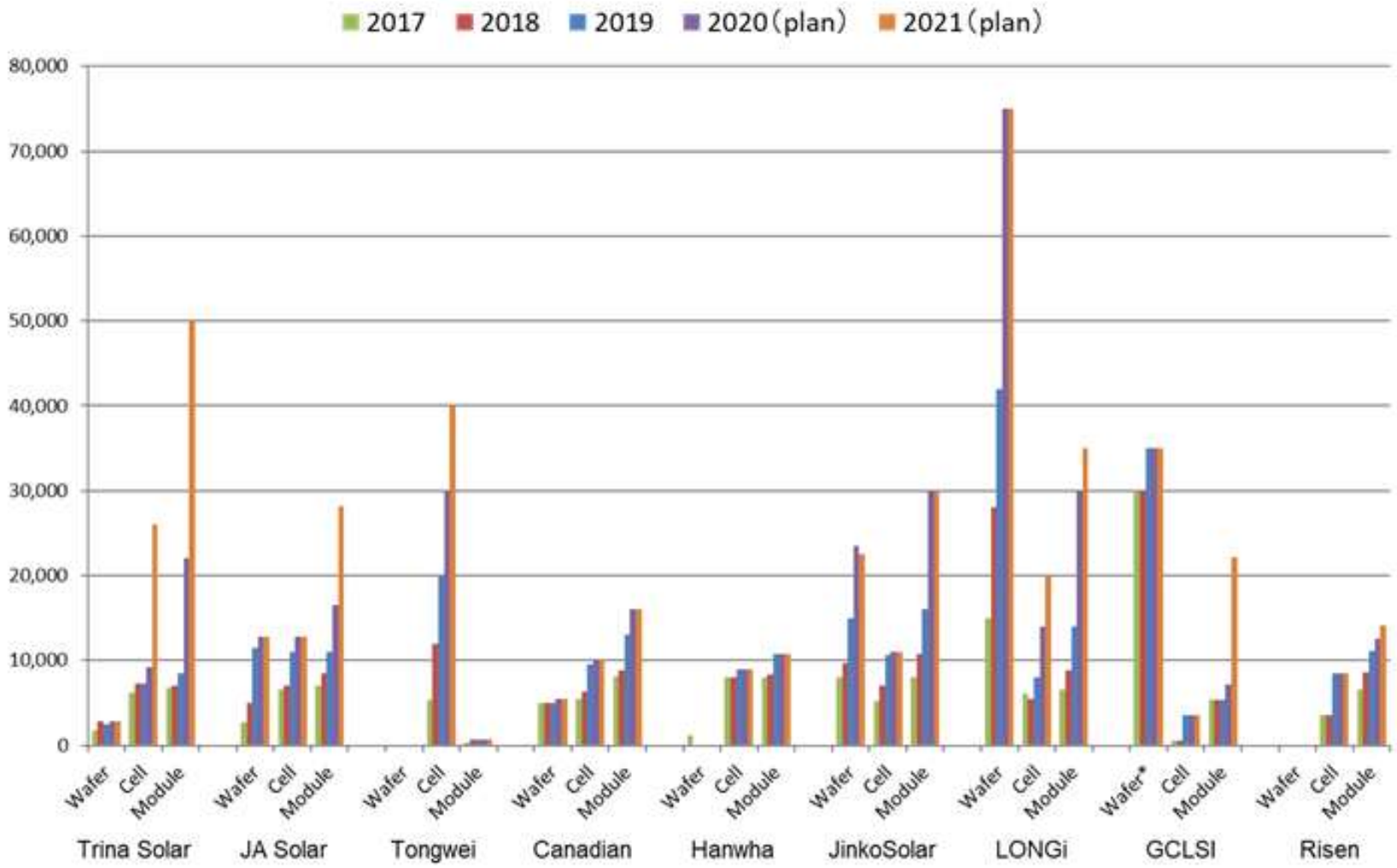
Rank	1H 2020 Shipment preliminary（GW）		2019 Shipment pleriminary（GW）		2018 Shipment（GW）	
1	**JinkoSolar (China/ Malaysia/ USA)**	8	JinkoSolar (China/ Malaysia/ USA)	**14.3**	JinkoSolar（China/Malaysia）	**11.17**
2	**LONGi Green Energy Technology (China/ Malaysia)**	6.8	JA Solar Technology (China/ Malaysia/ Vietnam)	**10.3**	JA Solar（China/Malaysia）	**8.5**
3	**Trina Solar (China/ Thailand)**	5.84	Trina Solar (China/ Thailand)	**10**	Trina Solar（China/Thailand）	**7.54**
4	**JA Solar Technology (China/ Malaysia/ Vietnam)**	5.46	Canadian Solar (Canada/ China/ Brazil/ Vietnam/ Taiwan)	**8.6**	Canadian Solar （Canada/China/Brazil/Vietnam ）	**6.82**
5	**Canadian Solar (Canada/ China/ Brazil/ Vietnam/ Taiwan)**	5.12	LONGi Green Energy Technology (China/ Malaysia)	**8.4**	LONGi Green Energy Technology （China/Malaysia）	**6.58**
6	**Hanwha Solutions (S. Korea/ China/ Malaysia/ USA)**	4	Hanwha Solutions (S. Korea/ China/ Malaysia/ USA)	**7.3**	Hanwha Q CELLS （S. Korea/China/Malaysia）	**5.60**
6	**Risen Energy (China/ Mexico)**	3.37	Risen Energy (China/ Mexico)	**6.3**	GCL System Integration Technology （GCLSI） （China）	**4.57**
8	**First Solar (USA/ Malaysia/ Vietnam）**	2.5	First Solar (USA/ Malaysia/ Vietnam）	**5.4**	Risen Energy（China）	**3.35**
8	**Zhejiang Chint Electrics （Astronergy） （China）**	2.22	Zhejiang Chint Electrics （Astronergy ） （China）	**3.7**	Shunfeng International Clean Energy/Suntech Power（China）	**3.30**
10	**GCL System Integration Technology （GCLSI） （China/ Vietnam）**	2	GCL System Integration Technology （GCLSI） （China/ Vietnam）	**3.6**	Chint Electrics（China）	**3.15**

Source：RTS Corporation based on annual report, etc.,including estimates, as of August 2020

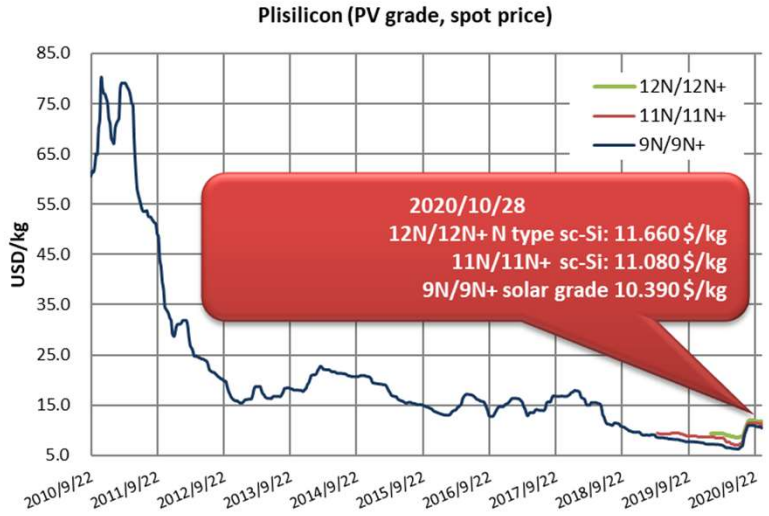
Capacity expansion of PV modules by major companies

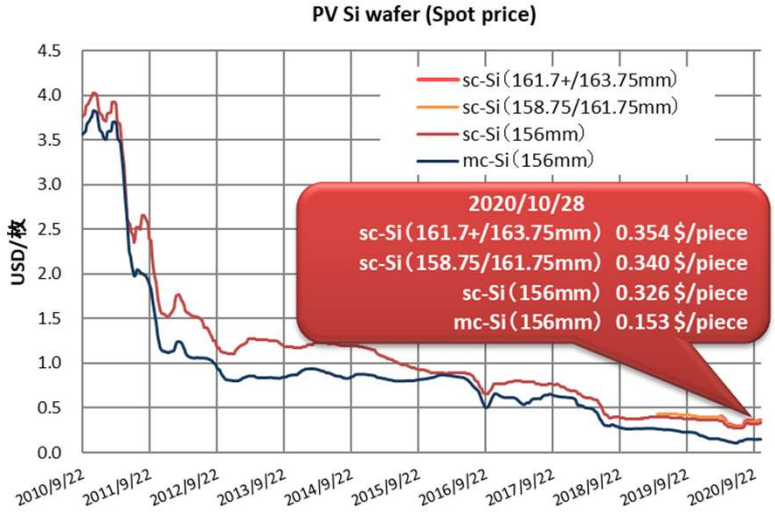


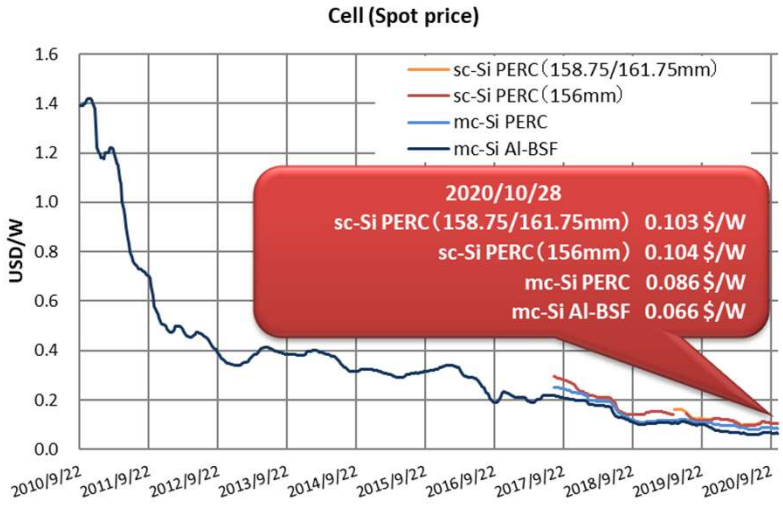
Manufacturing capacity along the value chain, as of 22nd October

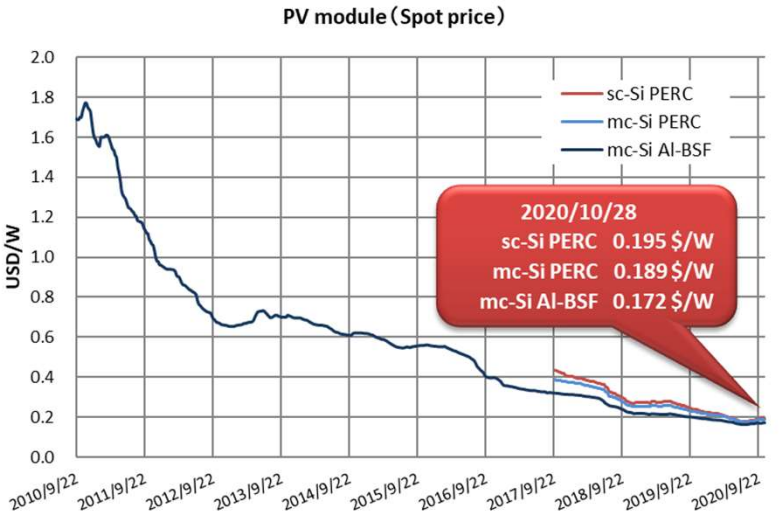


Recent PV module trends









Source: PV Insight

Glass for PV modules

Bloomberg Green

Green

Glass Shortage Threatens Solar Panels Needed for Climate Fix

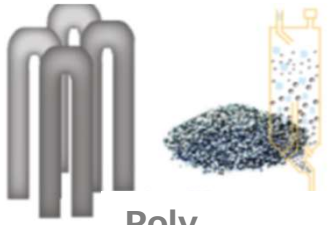
Bloomberg News
2020年11月5日 13:46 JST *Updated on 2020年11月6日 11:00 JST*

- PV glass output seen 20%-30% short of demand next year
- Price have risen 71% since July, hurting solar power economics

LISTEN TO ARTICLE
▶ 3:13

The world's biggest solar power company says a shortage of glass is raising costs and delaying production of new panels, throwing a wrench into

Technology trends along the value chain : Crystalline Silicon



Poly Silicon

- FBR
- Debottlenecking
- Higher purity for N-type solar cell, and semiconductor

Ingot

<u>mc-Si</u>

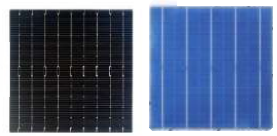
· Cast-mono

<u>sc-Si</u>

· Recharging
· Multiple use of
· Crucibles
· Longer pulling
· Ga doping

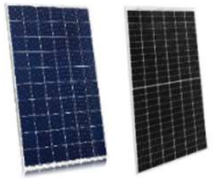
Wafer

- Larger sizes 156 →158 → 161/166 →180/182 →210mm
- Standazation



Solar Cell

- Higher efficiency: n-PERT, TOPCon (Passivated Contact),SHJ, IBC, Tandem)
- Bifacial
- Contacts (finer, multiple, MBBs)



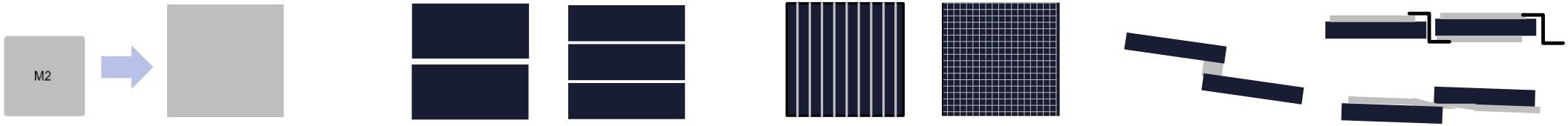
Module

- Higher power ½ Cut, 1/3 Cut or more
- Bifacial (Glass-Glass, Glass-Polymer) Interconnection (Shingled, Paving/Tiling, etc.)
- Light weight, bendable
- Colored/Printed glass
- BIPV/BAPV

PVPS

Location of manufacturing sites, Low-cost equipment, Smart manufacturing (Automation plus highly efficient process management with IoT, Bigdata, AI and machine learning), Sustainable manufacturing/lower carbon footprint

Trends for higher output for crystalline silicon PV modules



Larger wafers
（182/210mm）

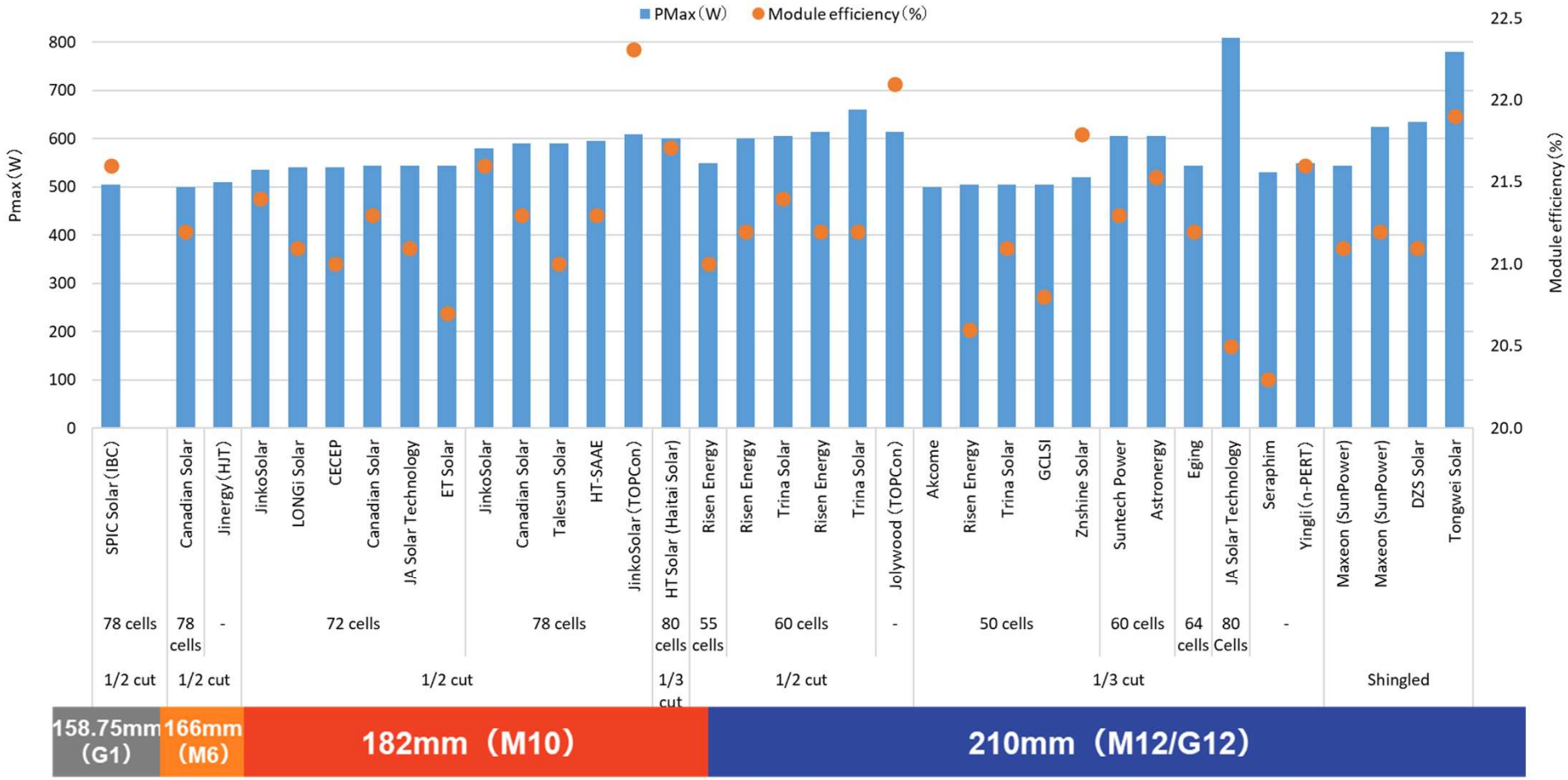
Cut cells
（1/2、1/3…, Demageless cutting）

MBBs/
Multiwire, Smart wire

Interconnections
Shingled/ Paving/ Tiling…）

Bifacial (PERC, HJT), Glass-Glass, Glass-polimer

Recently announced high efficiency PV modules



※If not noted, cell type is p-mono silicon PERC

※Cell number based on fullsize wafer

Technology trends along the value chain : Thinfilms

CdTe, CIGS, etc.

- Higher efficiency (tandem)
- Larger size module
- Light weight
- Flexible/ bendable
- Couloured/ Printed surface
- BIPV/BAPV

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Photo: RTS

Conclusion

- Still gap exists between demand and production capacities
- Price affected by supply issues of polysilicon and glass but eventually stabilized
- Cost competition → Higher output and efficiency to reduce LCOE
- COVID-19 may diversify of manufacturing location
- But lower margins cast some questions for future investment for TW era
- Reliability and sustainability are essential

Thank you for your kind attention !

感谢您的关注

끝까지 경청해 주셔서 감사합니다

ご清聴ありがとうございました

Acknowledgement for the support of PVPS activities

NEDO New Energy and Industrial Technology Development Organization

Contact : Izumi KAIZUKA, RTS Corporation, kaizuka@rts-pv.com