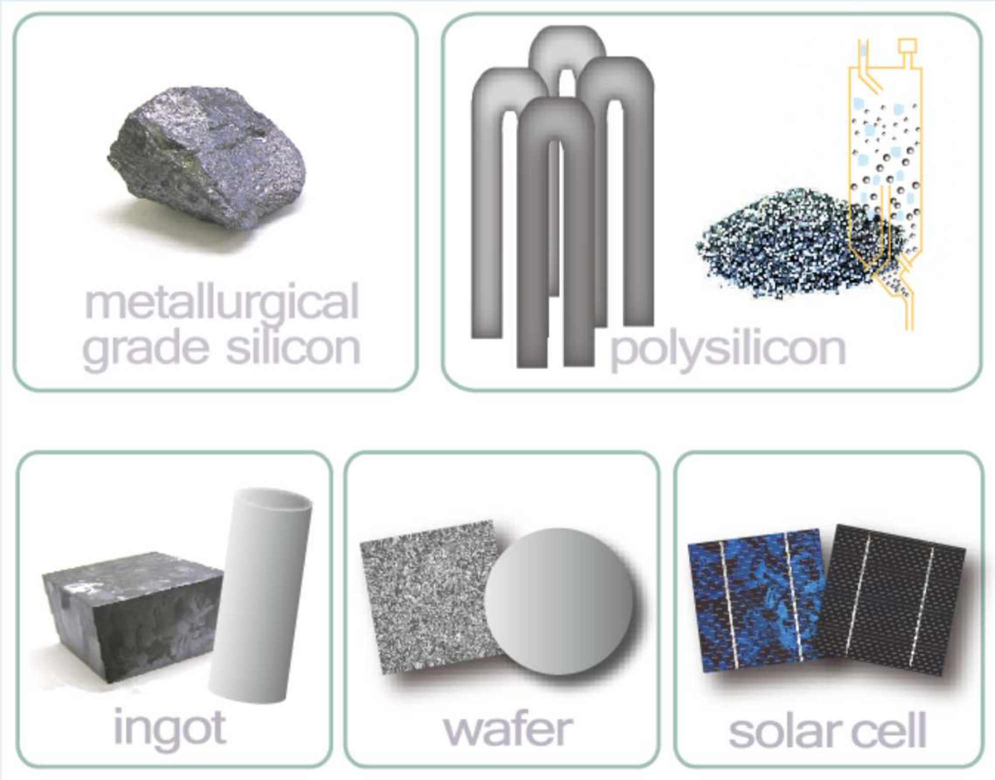
PV INDUSTRY TRENDS 2016



8th December 2016, **ISES Webinar**

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IEA PVPS Task 1 expert, Japan
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The Denver International Airport (DIA) features a 2 MW PV system at sunset. DIA is now host to a second 1.6 MW array system. © DIA

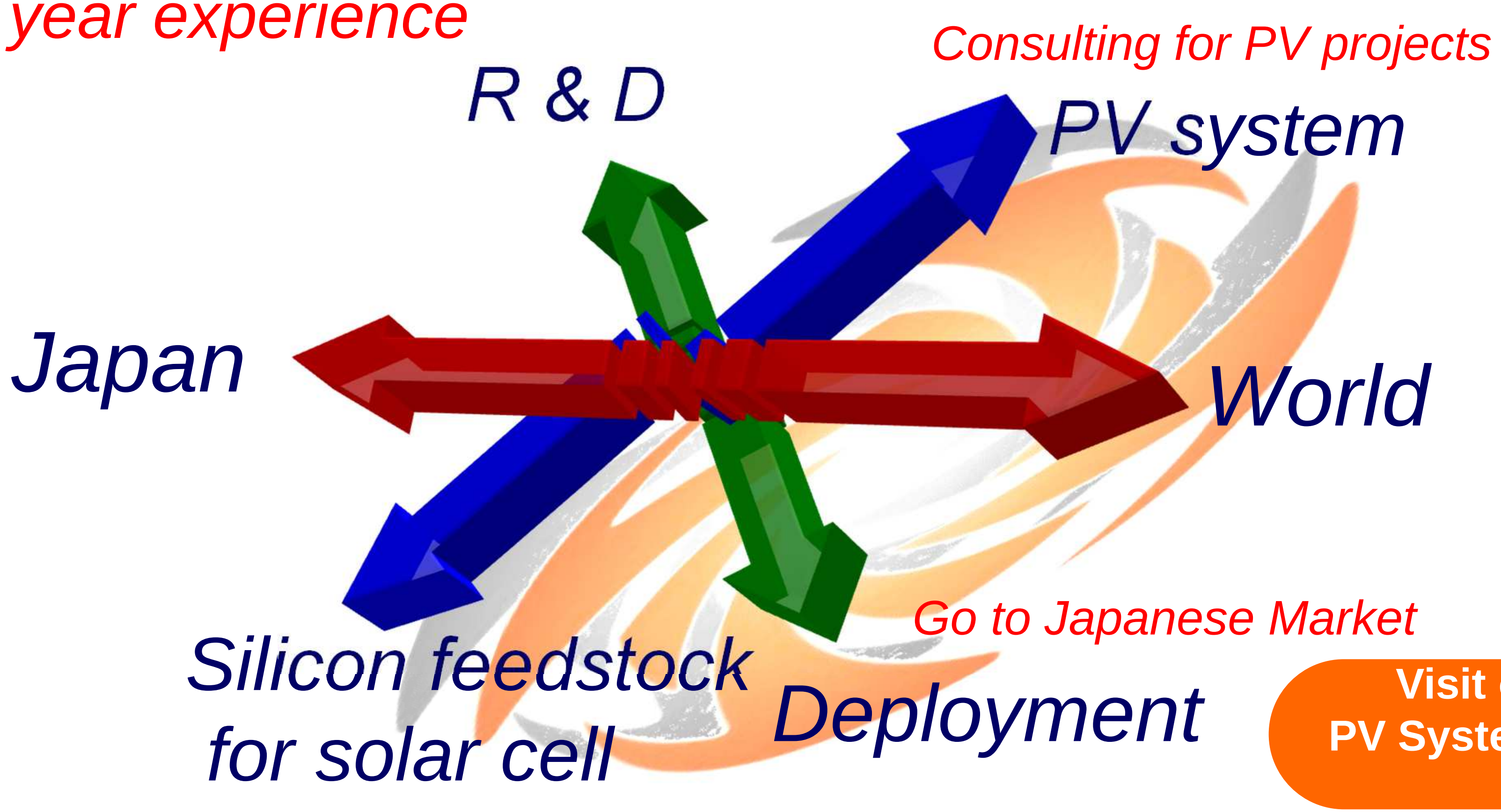
About RTS Corporation, founded in 1983

-- Comprehensive Consultancy on Photovoltaic Power Generation (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, etc.

30 year experience



Visit our booth at PV System EXPO：E42-57

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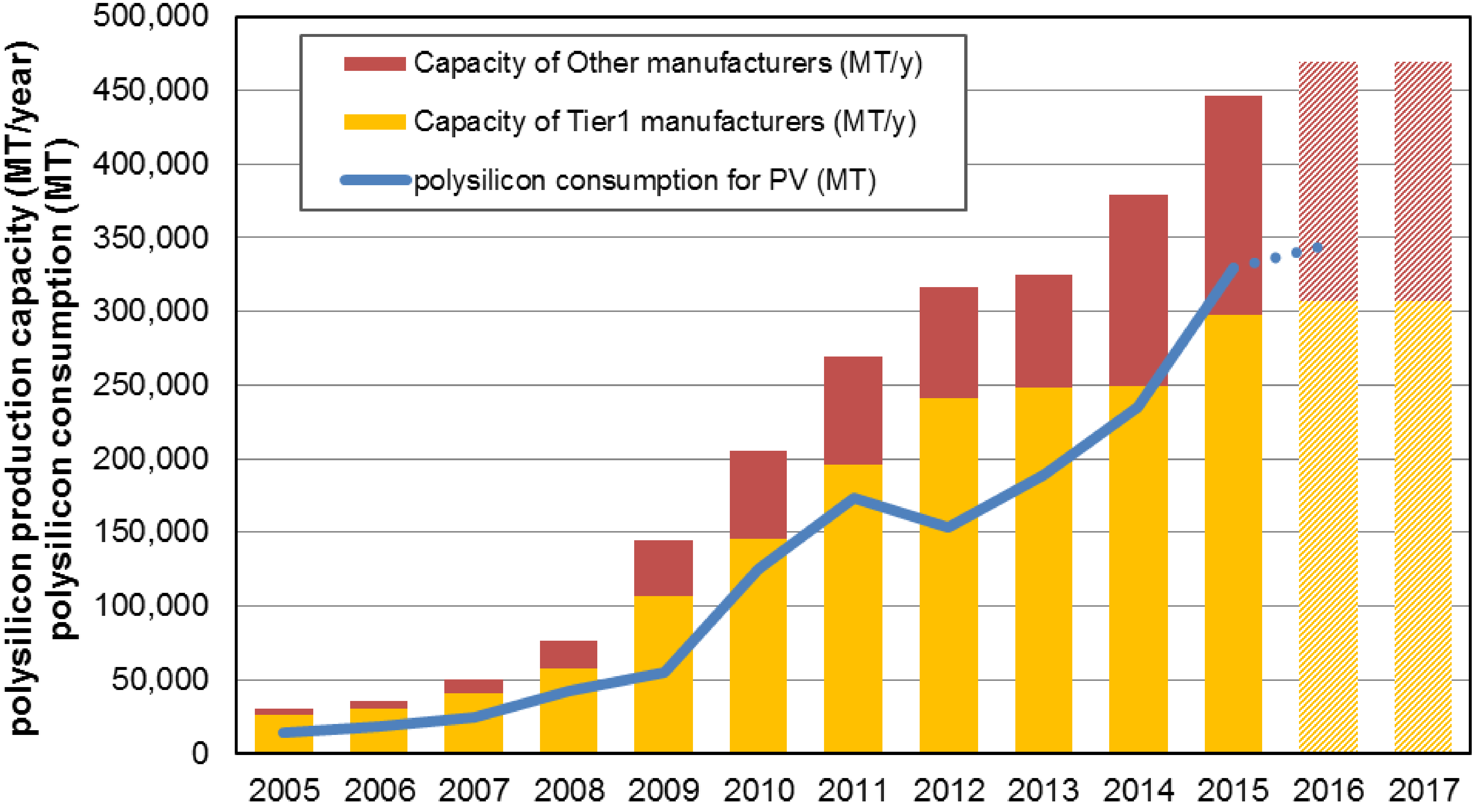
Chapter four
Trends in the PV industry

- Upstream PV sector
  - Polysilion, PV cell and modules
  - Crystalline Si PV and Thin-films
  - Impacts of trade conflicts
  - BOS (inverters, trackers, batteries.,)
- Downstream sector
  - Project developers, EPCs , financers, etc.

PolySi production

- 2015 Production for solar cell
  Production: >30 000 tons, (Consumption: 33 000 tons)
  Capacity: 446 000 t/year
- China：
  - largest producer (16 500 t, > 50% of global) & consumer (importing 9 5000 t)
- Other major producing countries
  - Germany, South Korea, USA, Japan, Malaysia and Norway
- Price decline
  - Jan. 2015: 20 USD/kg → Dec. 2015：13 USD/kg → 12 USD/kg → Dec. 2016：14.6 USD/kg
- Efforts for cost down
  - Higher quality
  - Lower manufacturing cost (2010: 80 kWh/kg → <55 kWh/kg）
  - Debottlenecking of Siemens process
  - FBR process
  - Meturagical process

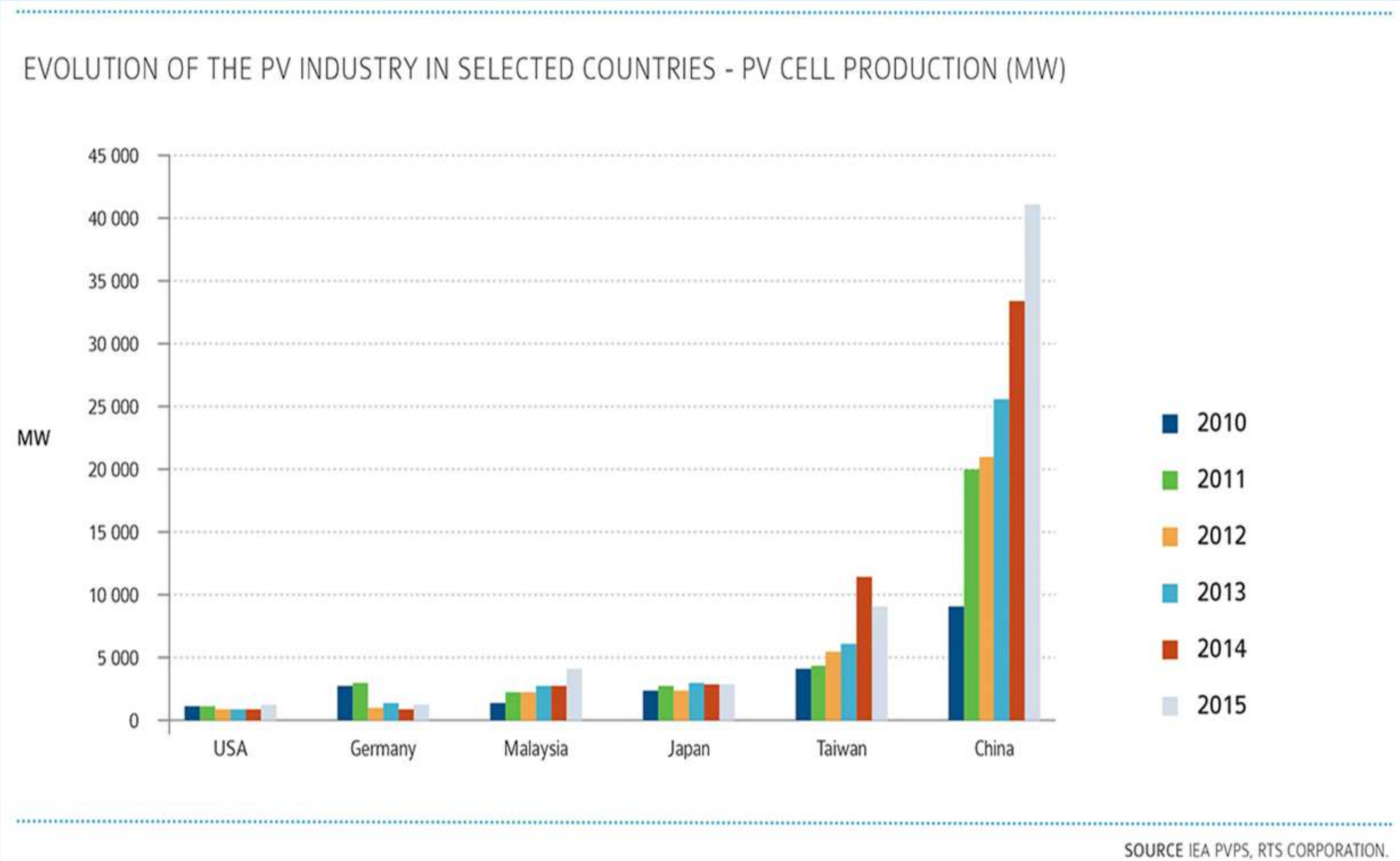
Trends of Polysilicon production capacity and consumption



Source: RTS Corporation, "Crystalline Si solar cell, Monthly Update"

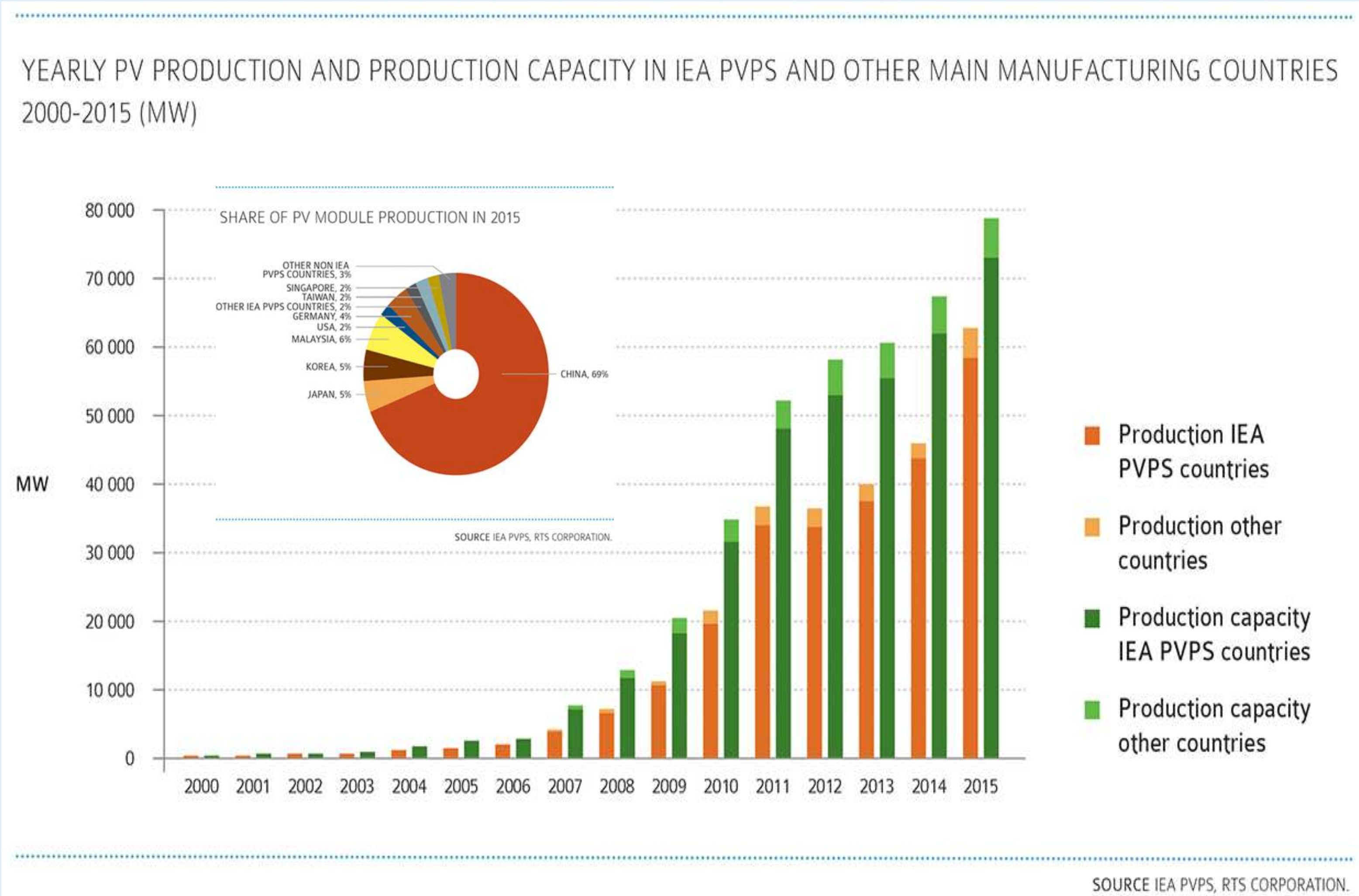
PV cell production (crystalline Si + Thin-film)

- Global production : ~ 63 GW in 2015
- Largest producer and consumer : China



PV module production (crystalline Si + Thin-film)

- Global production: ~ 63 GW in 2015
- Largest producer and consumer (installed capacity): China



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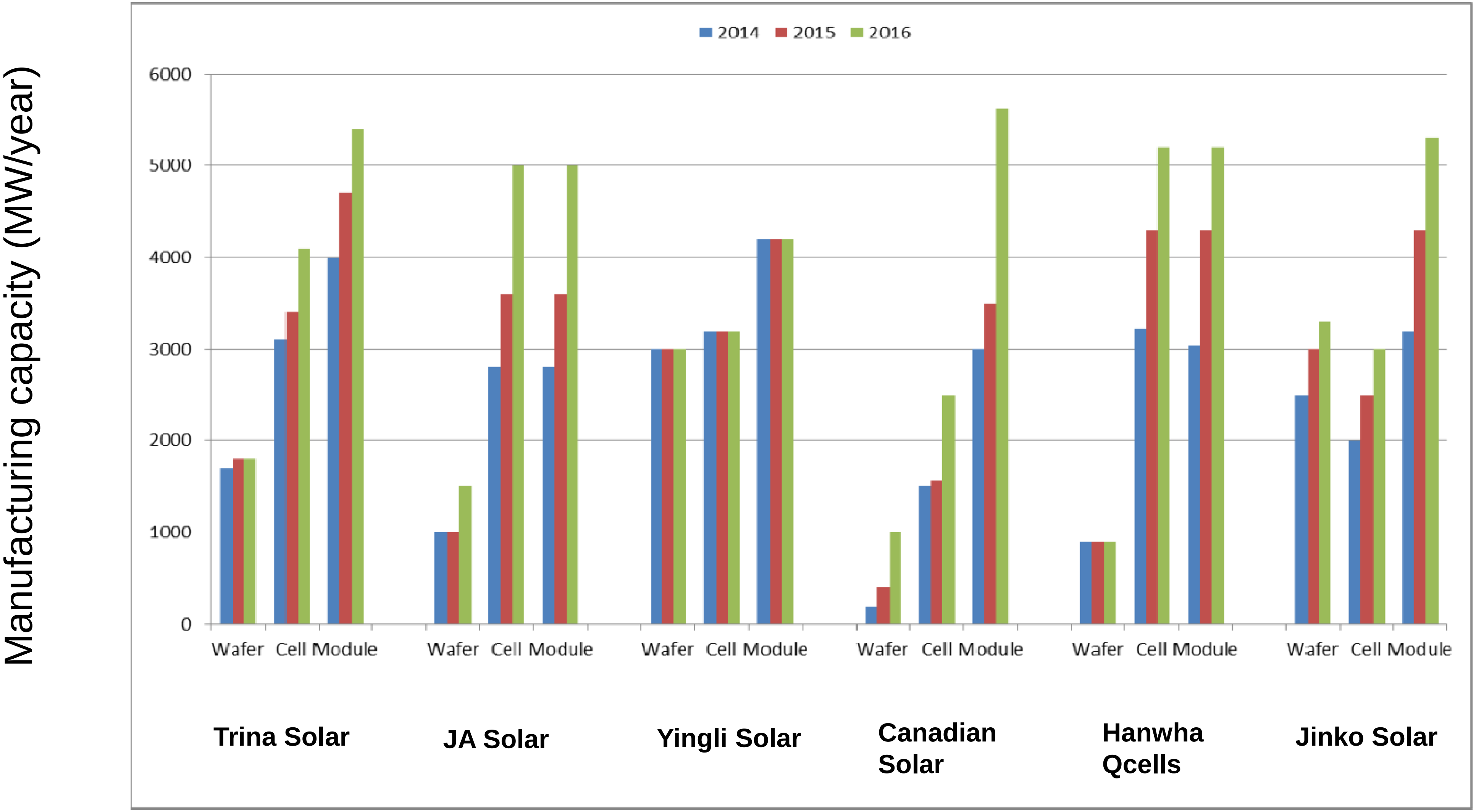
Top 10 cell suppliers and PV module suppliers

Rank	Production volume *1 (MW)				Shipment volume*1 (MW)	
	Solar cell		PV module		PV module	
1	Hanwha Q CELLS (Korea/ China/ Malaysia/ Germany)	3,935	Trina Solar (China)	5,873	Trina Solar (China)	5,740
2	Trina Solar (China)	3,884	JinkoSolar (China/ Portugal/ Malaysia/ South Africa)	4,400	Canadian Solar (China/ Canada)	4,706
3	JA Solar (China/ Malaysia)	3,600	Canadian Solar (China/ Canada)	4,316	JinkoSolar (China/ Portugal/ Malaysia/ South Africa)	4,308
4	First Solar (USA/ Malaysia)	2,618	Hanwha Q CELLS (Korea/ China/ Malaysia/ Germany)	4,200	JA Solar (China/ Malaysia)	3,673
5	JinkoSolar (China/ Portugal/ Malaysia/ South Africa)	2,500	JA Solar (China/ Malaysia)	3,510	Hanwha Q CELLS (Korea/ China/ Malaysia/ Germany)	3,300
6	Motech (Taiwan)	2,350	First Solar (USA/ Malaysia)	2,618	First Solar (USA/ Malaysia)	2,900
7	Yingli Green Energy (China)	1,942	GCL System Integration Technology (China)	2,219	Yingli Green Energy (China)	2,374
8	Canadian Solar (China/ Canada)	1,734	Yingli Green Energy (China)	1,942	GCL System Integration Technology (China)	2,100
9	Suntech Power/ Shunfeng (China)	1,696	SunPower Corporation (Philippines/ France)	1,376	ReneSola (China)	1,597
10	Neo Solar Power (Taiwan/ China)	1,650	Risen Energy (China)	1,359	SunPower Corporation (Philippines/ France)	1,350

Manufacturing capacity of major PV players



Source: RTS Corporation

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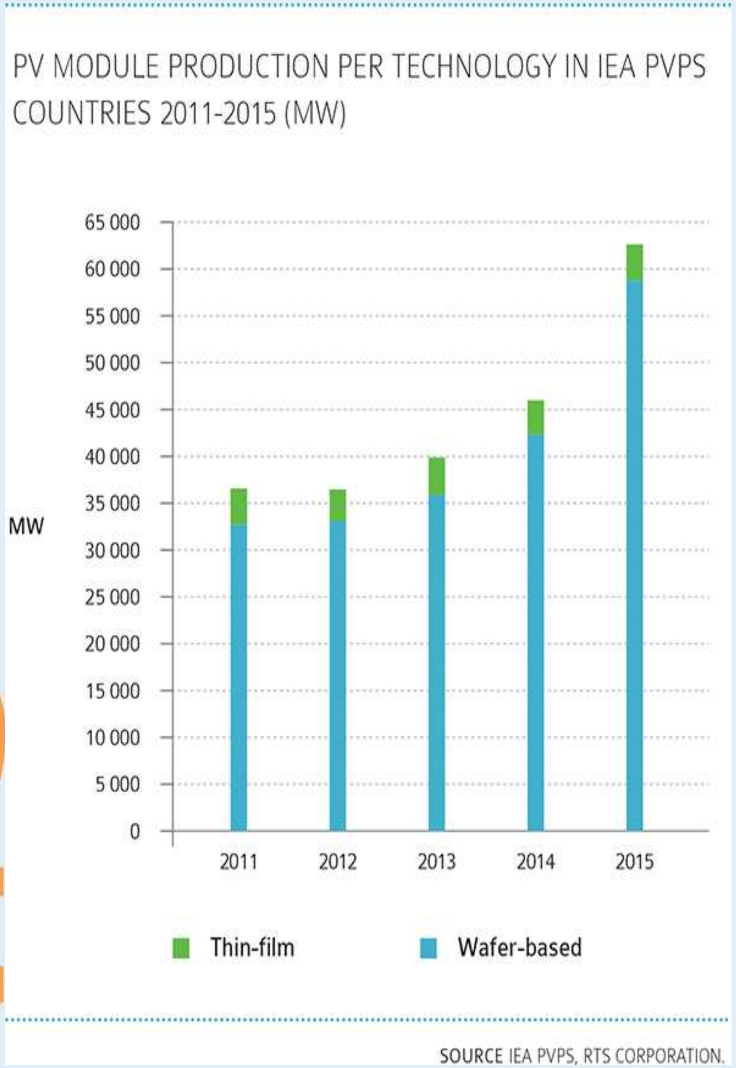
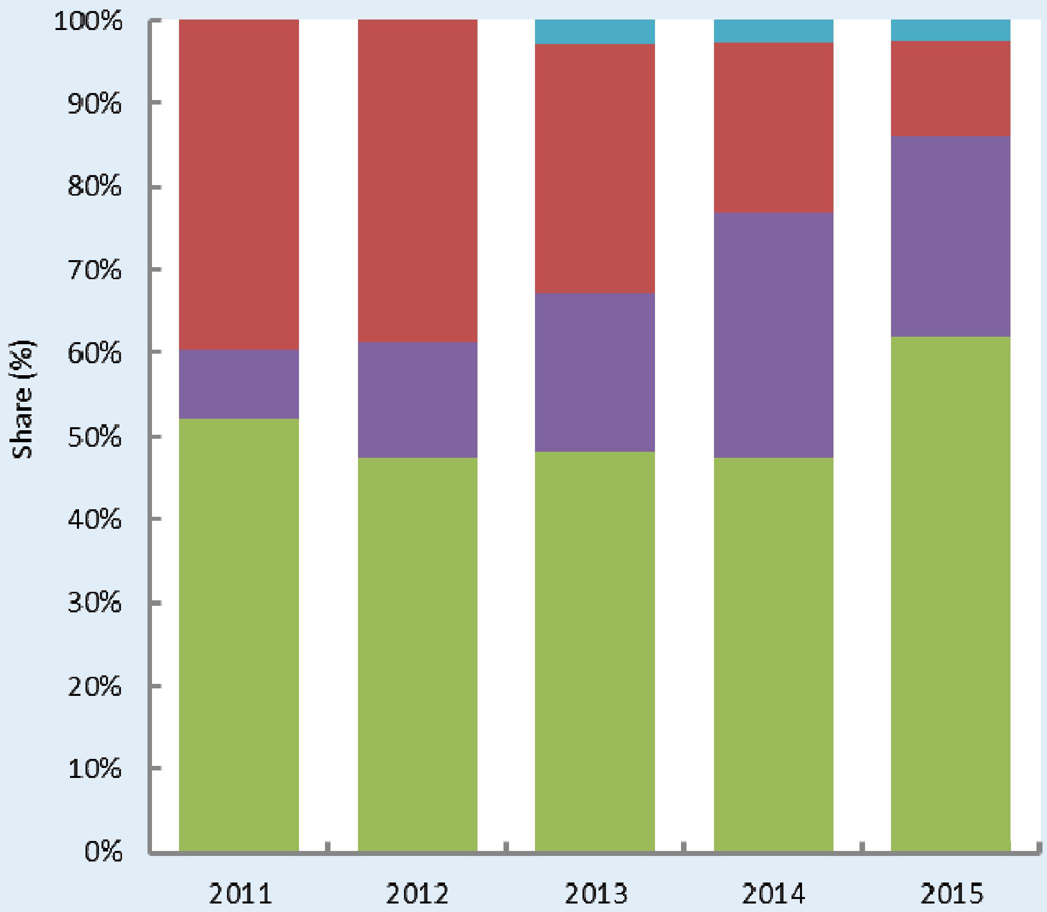
2016 PV module manufacturers ranking may change

Ranking of shipment in the Q3 2016

Ranking	Company (2015 ranking)	1Q－3Q 2016 (MW)	Guidance of 2016 （GW）
1	JinkoSolar (No.3)	4,992	6.6 - 6.7
2	Trina Solar (No.1)	4,443	6.3 - 6.55
3	Canadian Solar (No.2)	3,673	5.4 - 5.5
4	JA Solar (No.5)	3,254	4.9 -5
5	Hanwha Q CELLS (No.4)	N.A	4.8 - 5.5



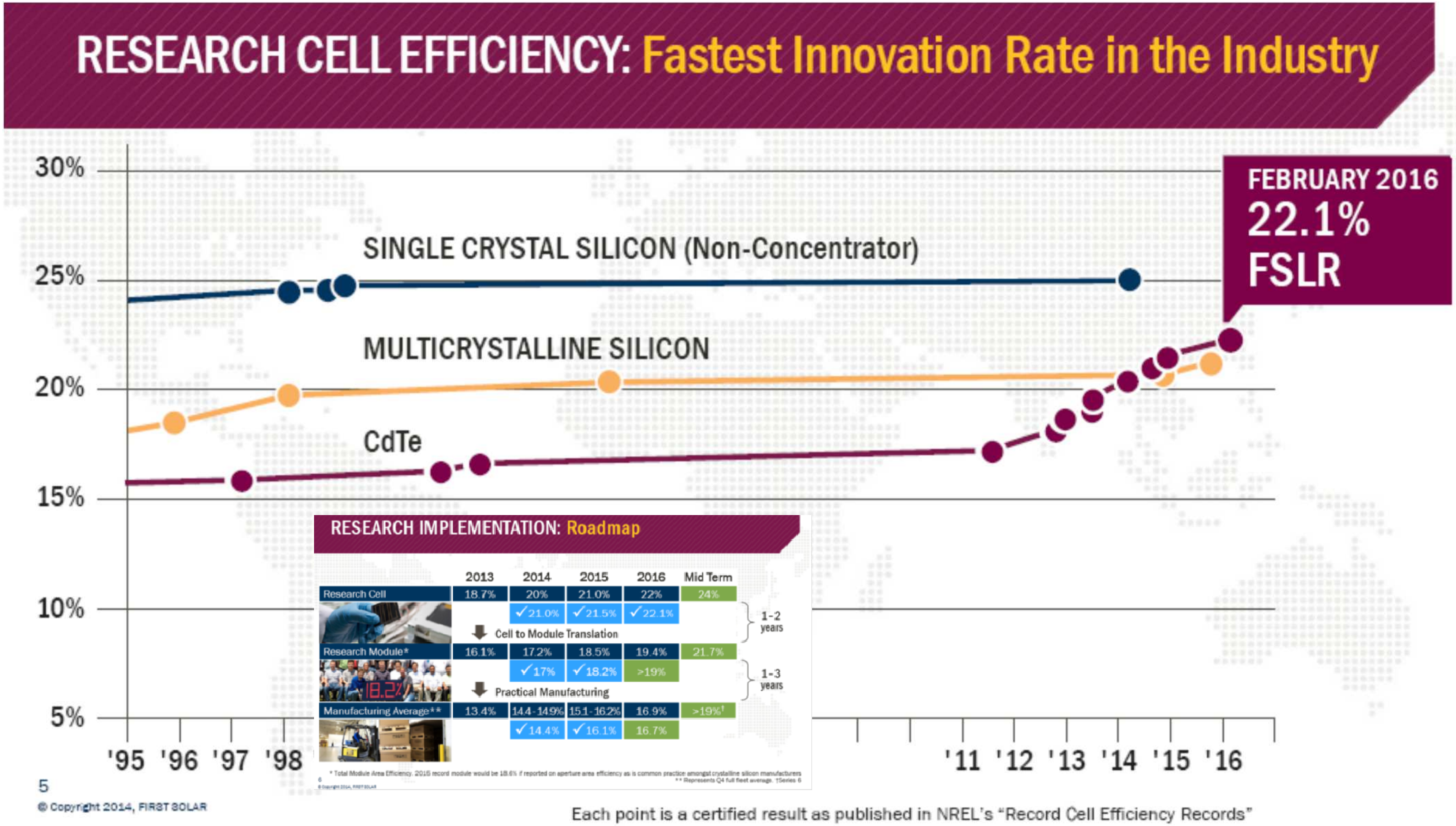


Thin film PV module share (%)

Source: RTS Corporation

First Solar.

- Focusing on CdTe Thin film
- Decided to discontinue TetraSun



Source: Raffi Garabedian, "Technology Update", First Solar Analyst Day, April 2016

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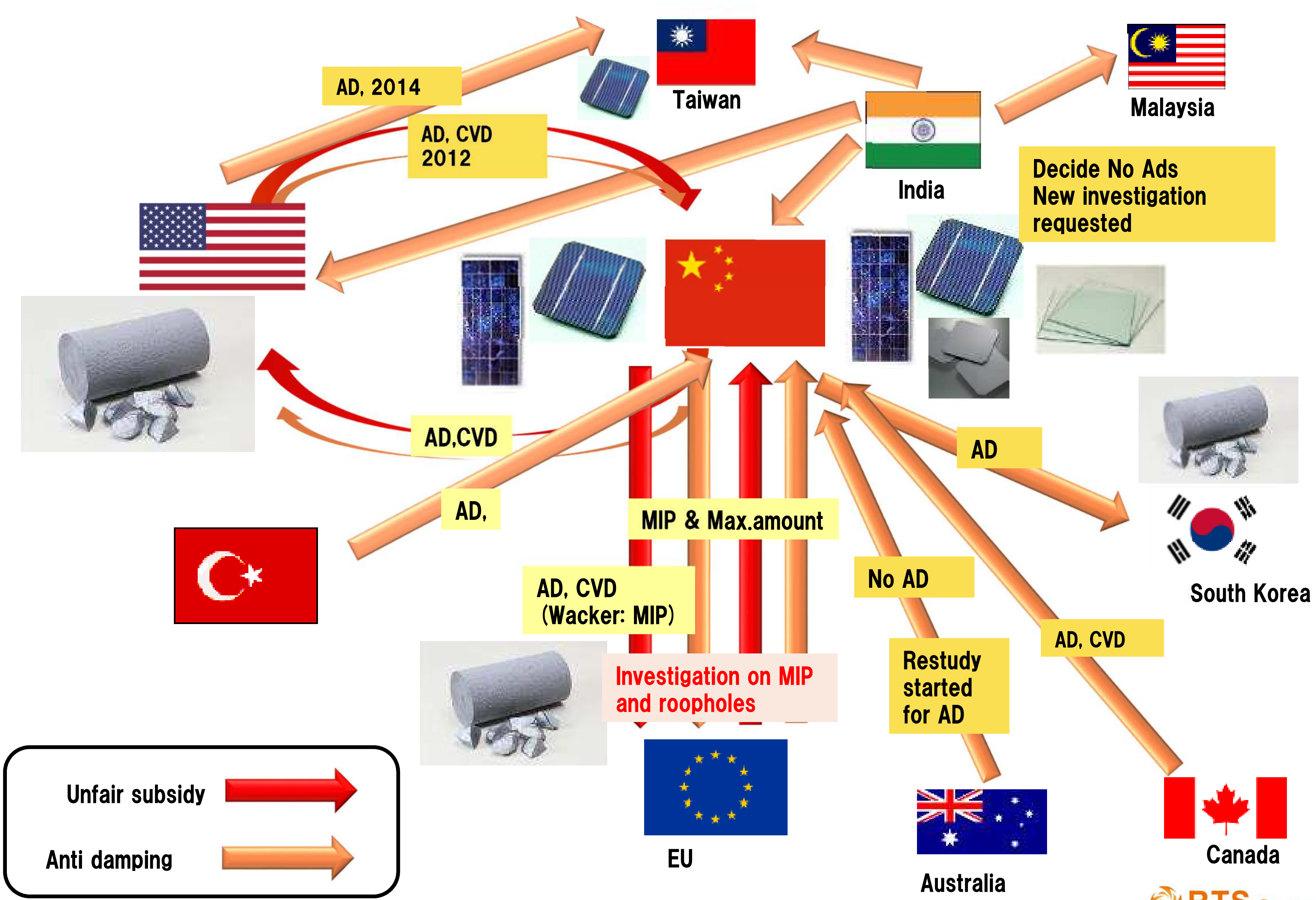
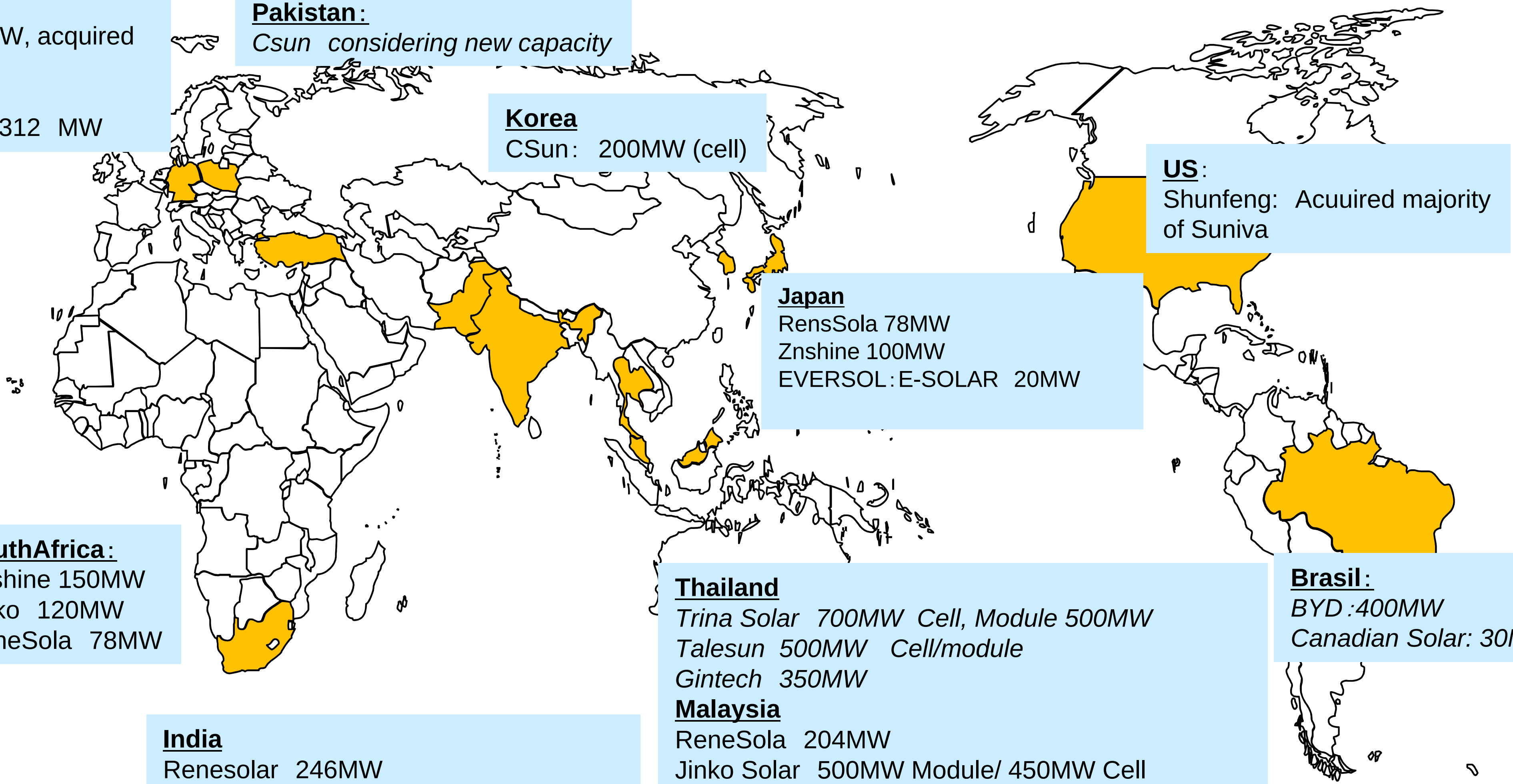
Trade friction over PV cell/module and polysilicon



Manufacturing site by Chinese and Taiwanese companies (Italic: under planning)



<u>Europe</u>
Germany :
Chint 200MW, acquired Conergy
Poland :
ReneSola 312 MW

<u>Pakistan</u> :
Csun considering new capacity

<u>Korea</u>
CSun : 200MW (cell)

<u>US</u> :
Shunfeng: Acuuired majority of Suniva

<u>Japan</u>
RensSola 78MW
Znshine 100MW
EVERSOL : E-SOLAR 20MW

<u>SouthAfrica</u> :
Znshine 150MW
Jinko 120MW
ReneSola 78MW

<u>Thailand</u>
Trina Solar 700MW Cell, Module 500MW
Talesun 500MW Cell/module
Gintech 350MW
<u>Malaysia</u>
ReneSola 204MW
Jinko Solar 500MW Module/ 450MW Cell
JA Solar 400MW (Cell)
Gintech/Green Energy Technology : Cell
<u>Vietnam</u>
Canaidan Solar: 300 MW
<u>Indonesia</u>
Canadian Solar 30MW

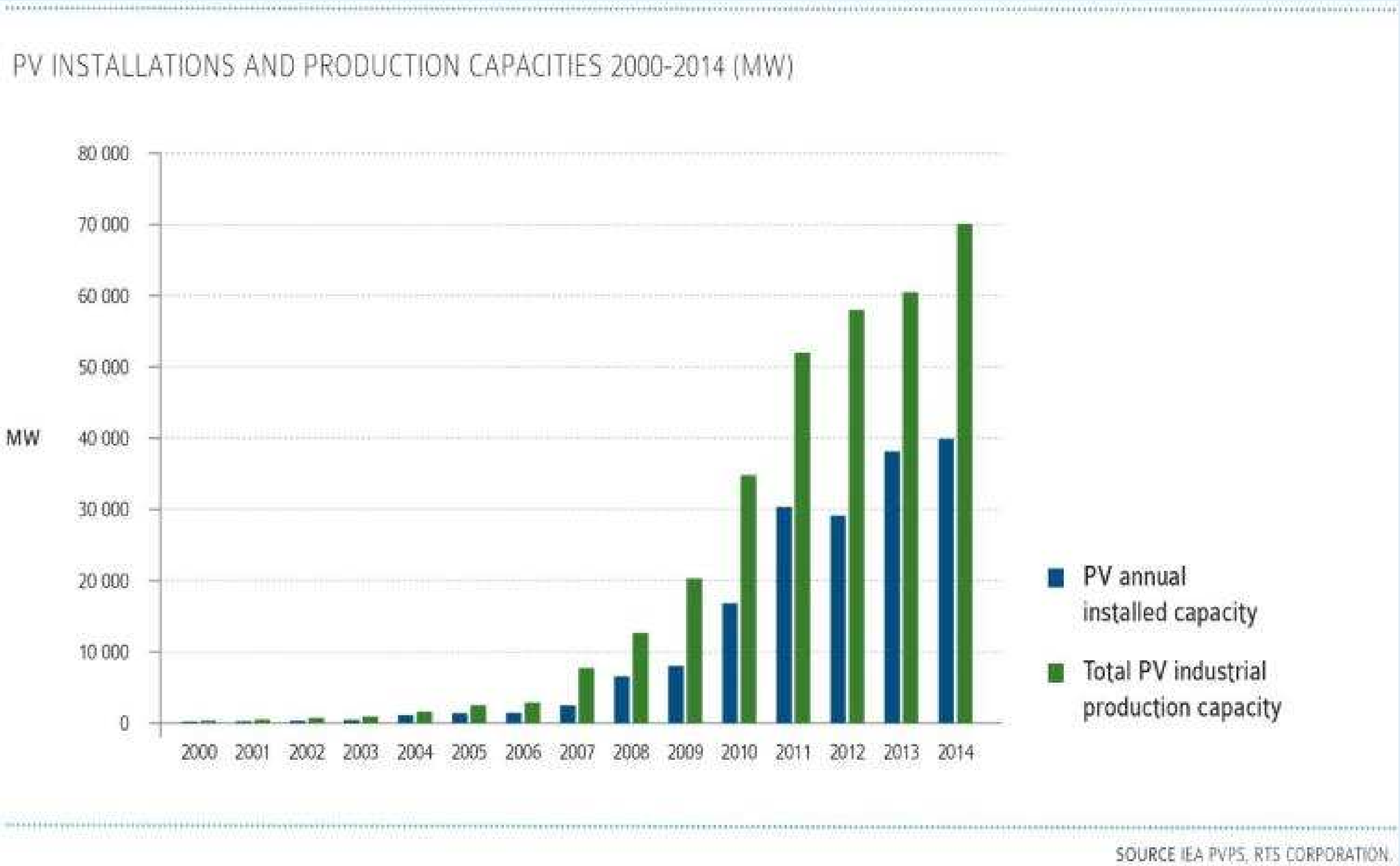
<u>Brasil</u> :
BYD :400MW
Canadian Solar: 30MW

<u>India</u>
Renesolar 246MW
JA Solar/Essel :Cell/ Module 500MW
Trina Solar/Wellspun Energy :Cell /Module 500MW
Canadian Solar /Sun Group : Module

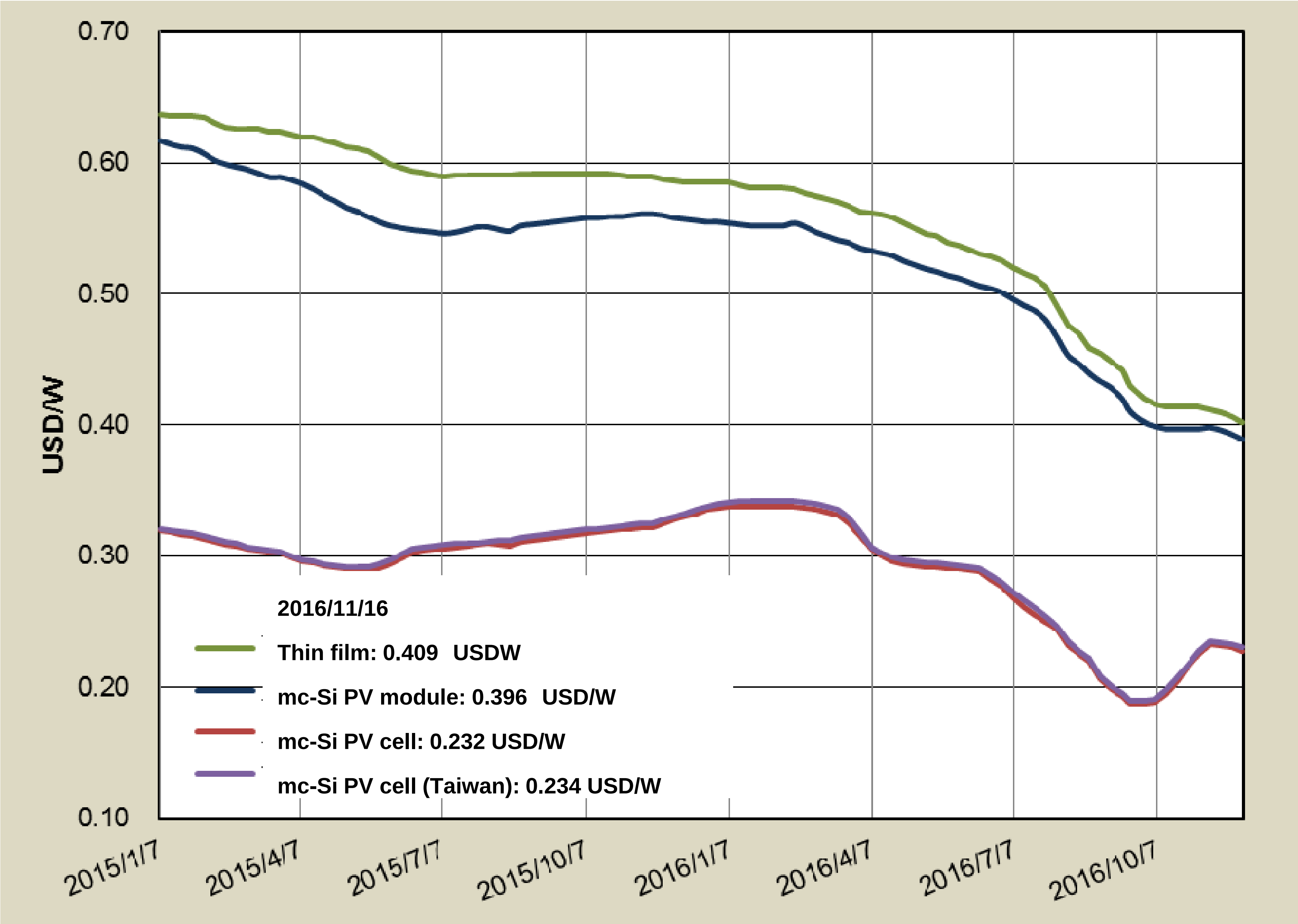
Challenges the industry facing

- Overcapacity
- Lower margin for manufacturing
- Lowering stock performances
  - Consolidation will continue
- Financing
  - Manufacturing for new technologies
  - Recent IPO cases: downstream companies

Overcapacity continues



Lower margins: recent spot prices



Source: Pvinsight, compiled by RTS Corporation

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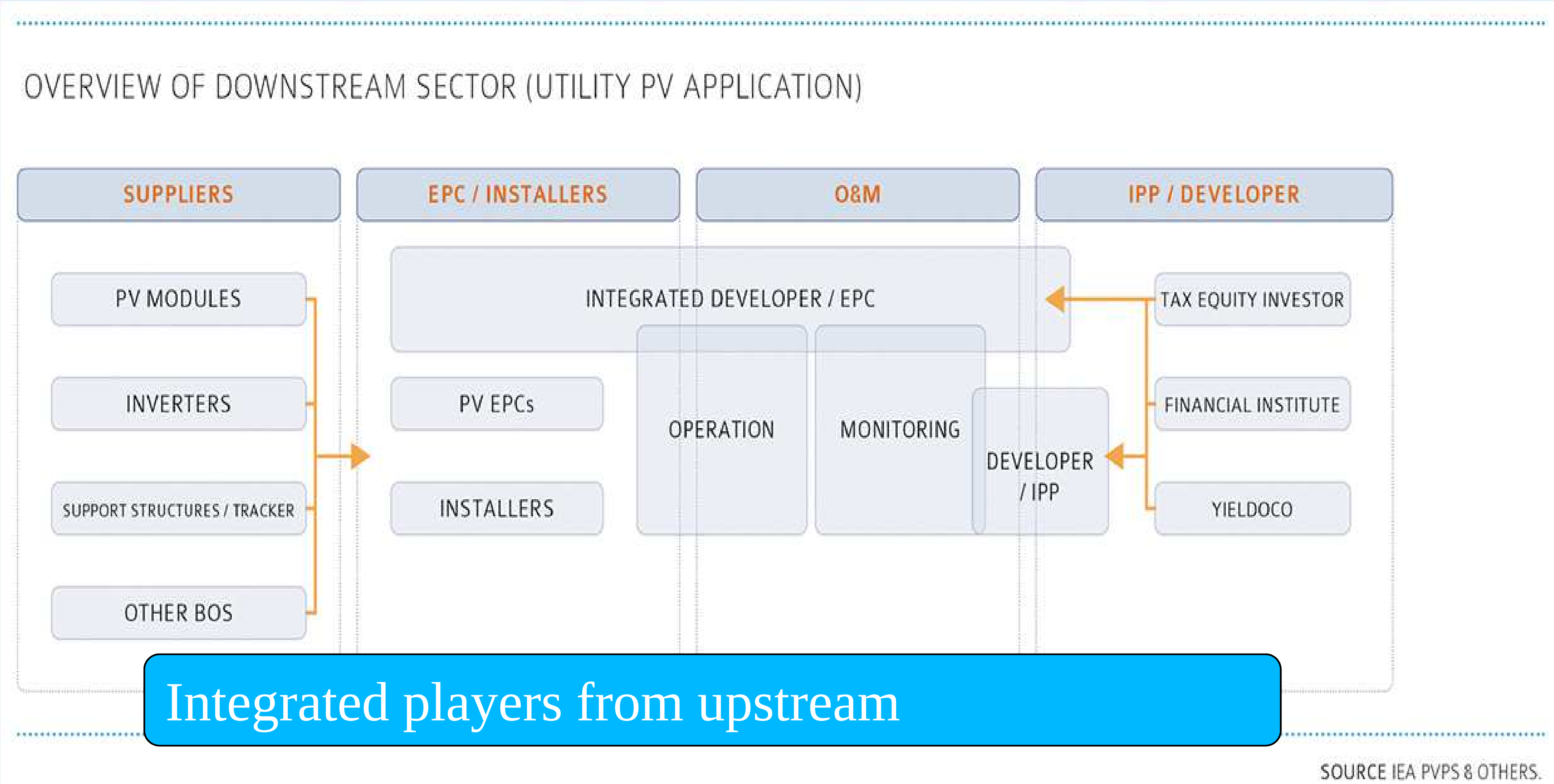
Challenges the manufacturing industry facing

- Overcapacity : entire value chain
- Lower margin for manufacturing
  - Consolidation will continue in 2017
- Financing
  - Manufacturing for new technologies
  - Recent IPO cases: downstream companies

The way forward

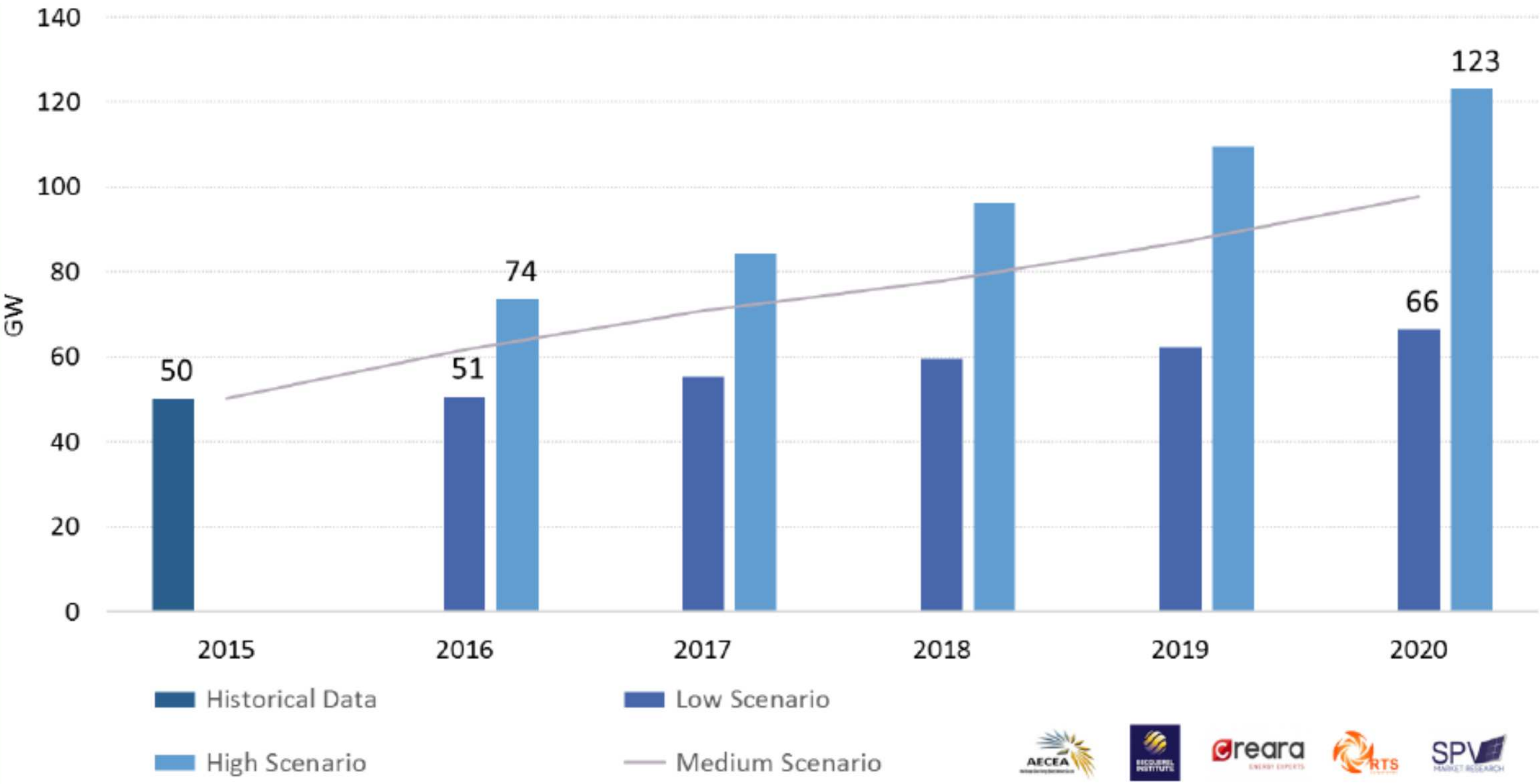
- Differentiation
  - Manufacturing cost:
    usage of materials, operation ratio, yield, standardization of materials and parts, etc.
  - Products
  - Higher efficiency, Reliability, added-value (BIPV, PV + HEMS+ Batteries)
  - Customers : High-end or volume zone?
  - Business models
    - Towards downstream
      - Equipment provider to energy provider
    - Towards upstream???
      - SolarCity acquired Silevo



Integrated players from upstream

Integrated players from dwonstream???

Outlook of the Global PV Market



Source: Global PV Market Alliance, "GLOBAL PV MARKET REPORT 2015-2020" (May 2016)

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

<u>Reference</u>

IEA PVPS “Trends Report 2015”

IEA PVPS, “2015 A Snap Shot of Global PV Market”

http://www.iea-pvps.org/fileadmin/dam/public/report/PICS/IEA-PVPS_-__A_Snapshot_of_Global_PV_-_1992-2015_-_Final_2_02.pdf

Global PV Market Alliance, “GLOBAL PV MARKET REPORT 2015-2020”

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PV Activities in Japan and Global PV Highlights

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