

Bankability Evaluation on Japan's PV System

- The Potential of Bifacial PV System -

September 29th, 2016

The Third Bifi PV Workshop, Miyazaki, Japan

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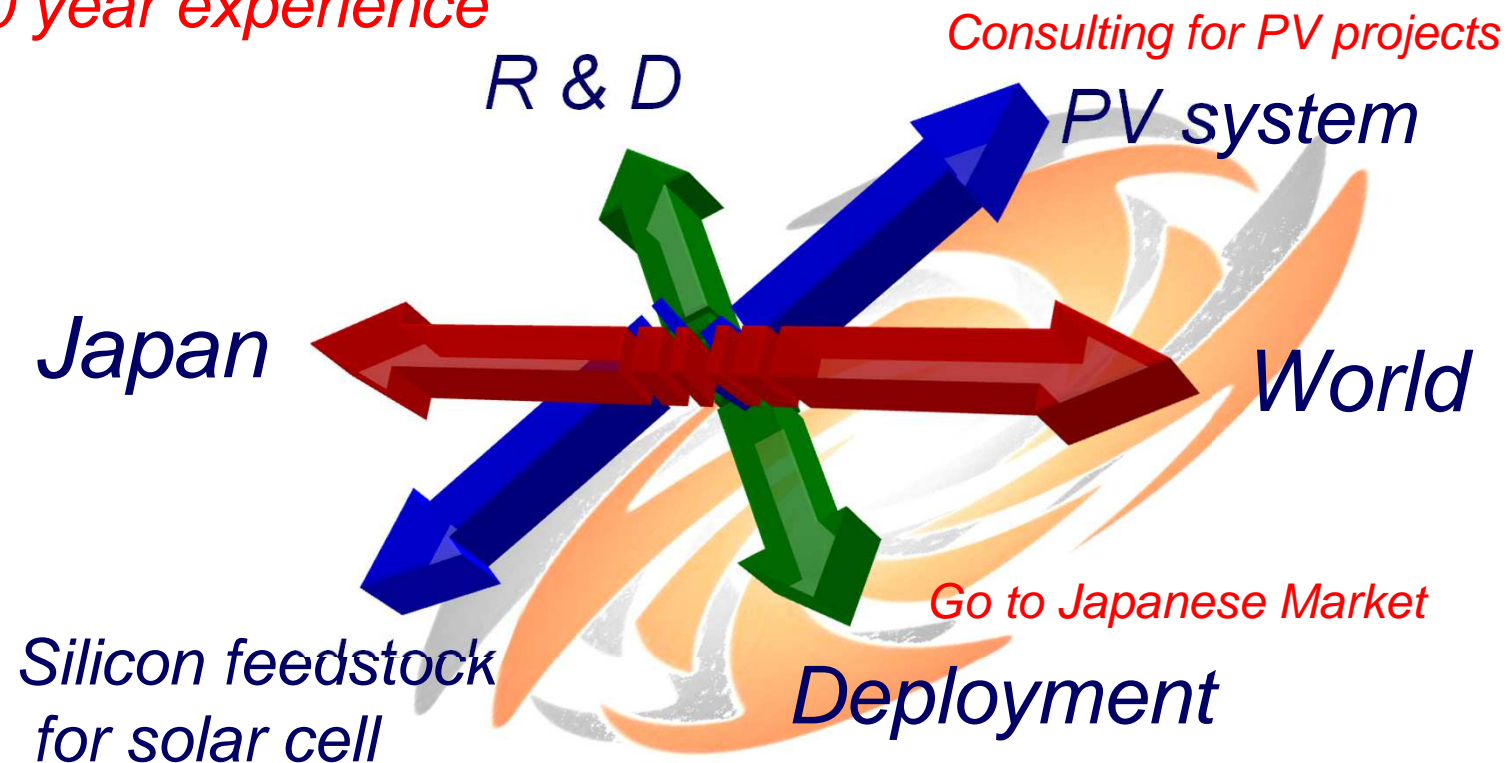
About RTS Corporation, founded in 1983

-- 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



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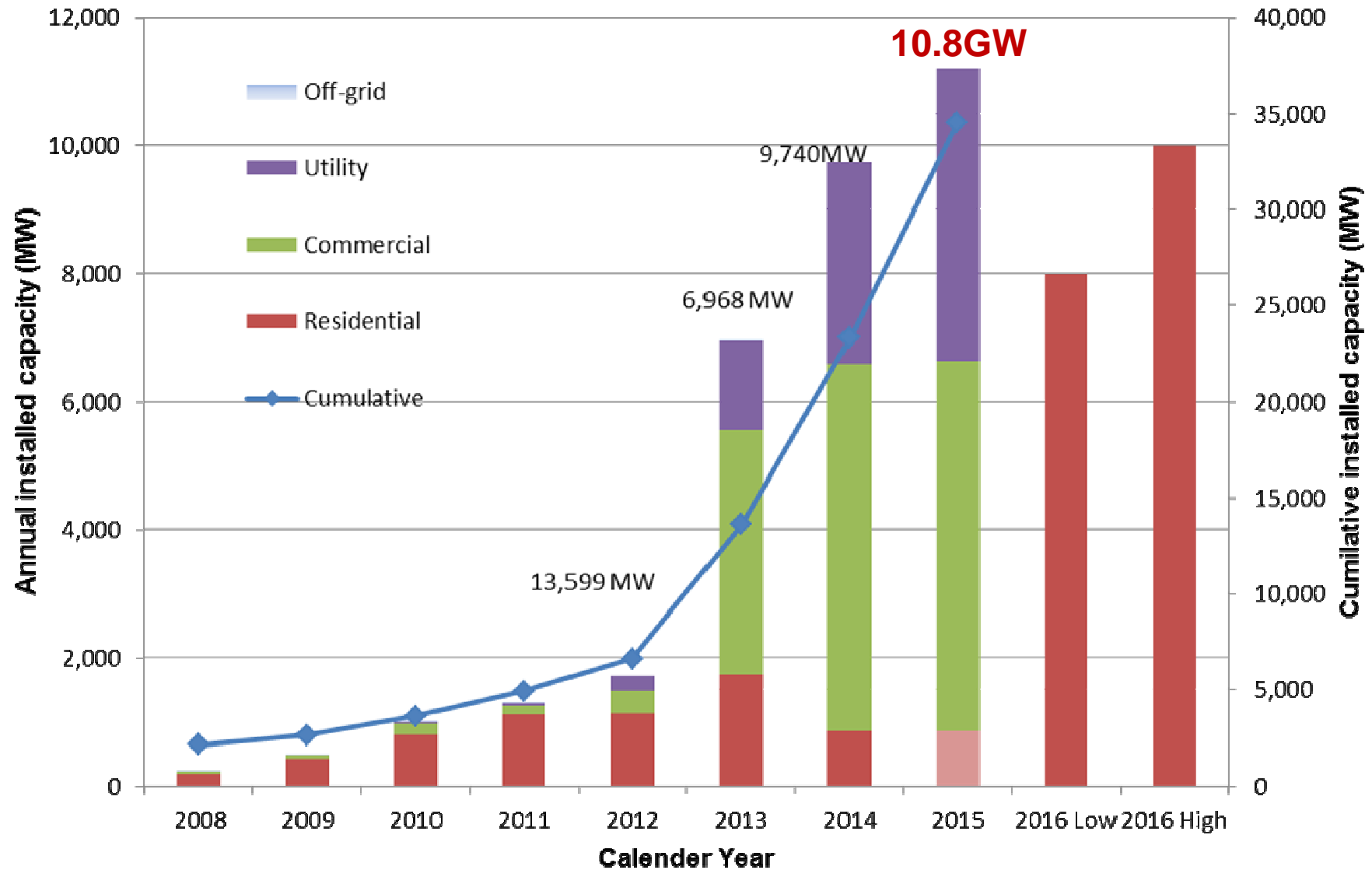
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2. PV Bankability and LCOE
3. Other Factors for PV Bankability
4. Comparison of Conventional with Bifi PV System
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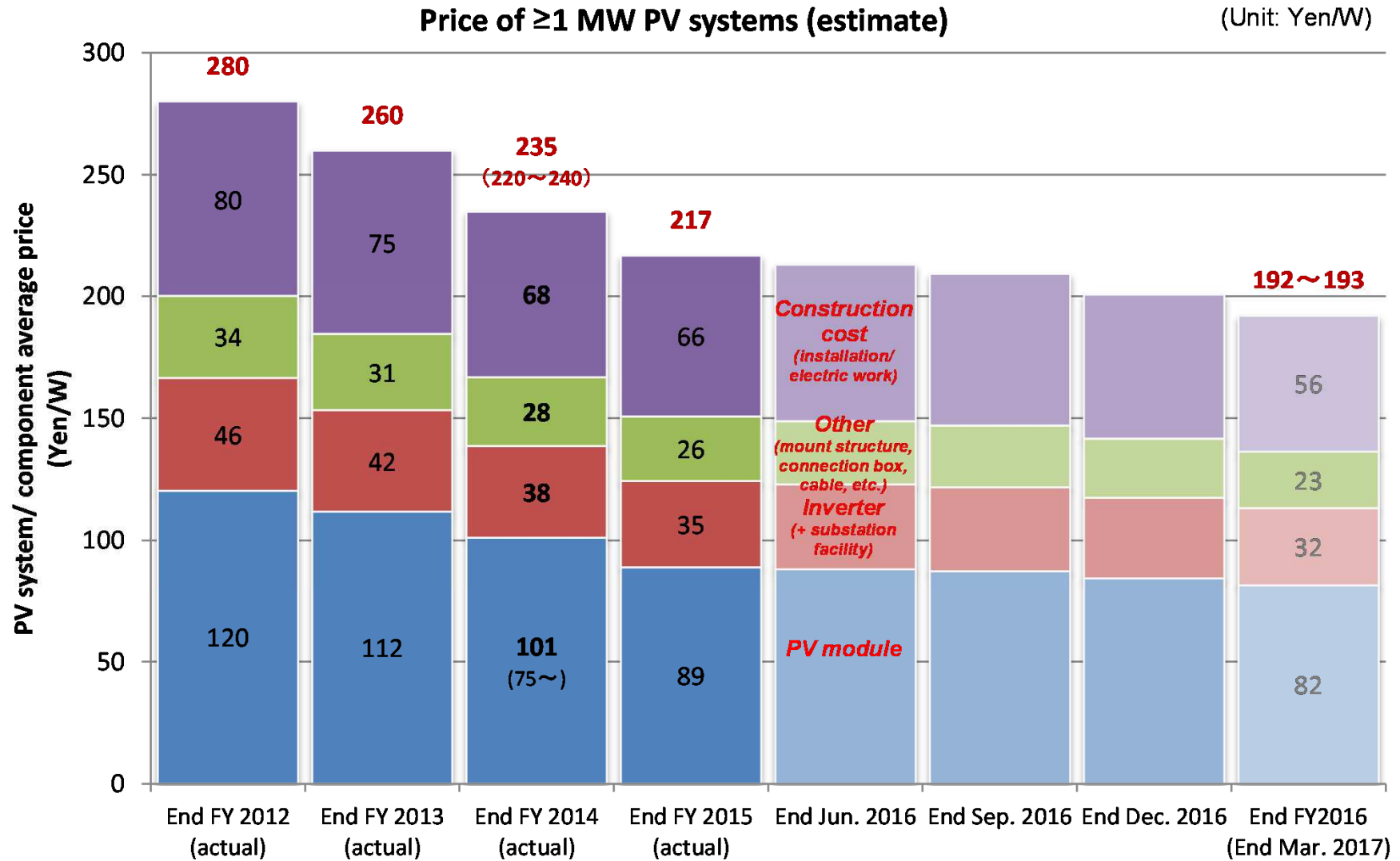
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Japan's PV Market Status and Outlook (DC)

Installed capacity Q1 2016 (DC) : ~ 2.3 GW



PV prices trends in Japan (≥ 1 MW, Large-scale PV System)



* Expenses are included in the inverter price. Grid connection cost is NOT included.

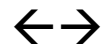
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PV Bankability (Possibility for financing, eligibility of investment)

“**PV Bankability**” means the reliability rating of PV projects at the moment of investment by financing organizations.

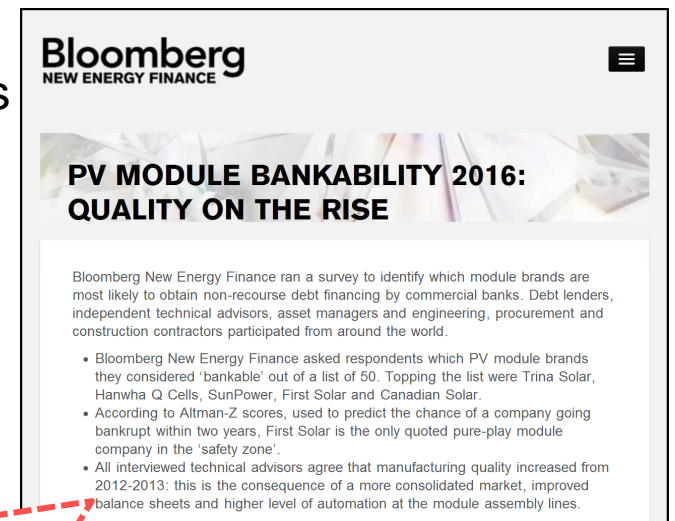
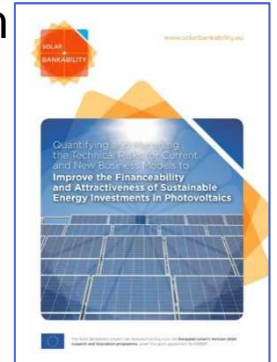
❑ “PV power generation” is a stable revenue-generating business for long term



❑ For our investments to PV:

- ✓ **PV Power Generation Output [kWh]**
- ✓ **Initial costs, O&M costs, removal (recycle) costs, etc. [Yen] (“LCOE” includes these factors.)**
- ✓ Many risks of degradation, accident, etc. of components (modules, inverters, support structures, cables, etc.) in PV plants lifetimes
- ✓ Sustainability of enterprises (for a maintenance service of PV system)
- ✓ Company rating (by investment firms, journals, etc.)
- ✓ Name recognition (well-known or not)

→ **Criteria for Bankability Evaluation (at financiers)**



- Bloomberg New Energy Finance asked respondents which PV module brands they considered 'bankable' out of a list of 50. Topping the list were Trina Solar, Hanwha Q Cells, SunPower, First Solar and Canadian Solar.

LCOE (Levelized Cost of Energy) and related factors

$$\text{LCOE [Yen/kWh]} = \frac{\sum_{t=1}^n \text{[Yen]}}{\sum_{t=1}^n \text{[kWh]}}$$


[Yen]
↓ Want to decrease!


[kWh]
↑ Want to increase!

Needs for ...
System cost reduction
Installation cost reduction
Reduction of land, basement costs, etc.

Needs for ...
O&M cost reduction
Outsourcing to professional O&M player

Needs for ...
Minimization of removal cost
Prolonging of land use contract
Using of more reliable components

$$= \frac{\sum_{t=1}^n (\text{Capital Expenditure}^*) + \sum_{t=1}^n (\text{O\&M Cost}^*) + \text{Removal Cost}^* \text{ [Yen]}}{\sum_{t=1}^n (\text{All Power Generation Electricity Volume}^*) \text{ [kWh]}}$$

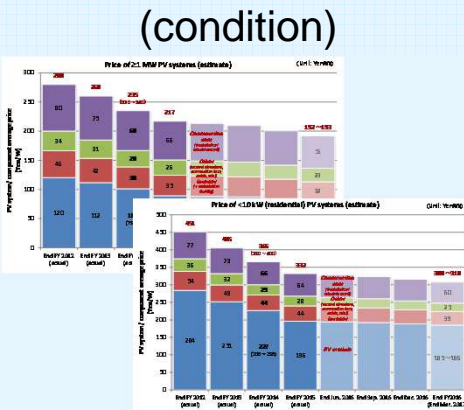
Needs for ...
R&D for increasing efficiency
Optimization of PV system design

Needs for ...
Suitable maintenance of PV system

* Should be considered discount rate and depreciation for present values of all investments, costs, generation electricity volume

LCOE of Conventional PV Systems (RTS Estimation)

		Conventional PV (c-Si)			
System type		Large-scale		Residential	
Year (FY)		2015	→ 2030 (est.)	2015	→ 2030 (est.)
System price (Yen/W)	PV module	89	40 ~ 49	196	60 ~ 89
	Inverter	35	18 ~ 22	44	19 ~ 24
	Support structure	26	10 ~ 13	28	14 ~ 17
	Installation	66	27 ~ 33	64	33 ~ 41
	(Total)	217	95 ~ 117	332	171 ~ 126
LCOE (Yen/kWh)		18.7	8.6 ~ 9.5	18.3	7.4 ~ 9.0
(condition)		20 yrs lifetime, 6,000 Yen/yr O&M cost, 5% remove cost, 3% discount rate, Not including land-related and grid-connection costs	30 yrs lifetime, 2,000 ~ 3,000 Yen/yr O&M cost, 5% remove cost, 3% discount rate, Not including land-related and grid-connection costs	20 yrs lifetime, 4,000 Yen/yr O&M cost, 3% discount rate	30 yrs lifetime, 2,000 Yen/yr O&M cost, 3% discount rate



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Bankability evaluation by third party inspectors



TUV Rheinland Japan:

Technical evaluation of the bankability based on JIS and/or JEMA prescriptions
(PV generation stations evaluation services in Japan)

(for system planning – before system installation)

- PV generation forecasting with sites inspection and evaluation
- System specs evaluation

(after system installation)

- Safety verification
- I-V strings measurements
- Thermography measurements

(Examples): 5 PV station Projects at Kushiro and Tokachi-region, Hokkaido Pref., operated by JAG Energy (Shinsei Bank decided project finances for them in 2012)



TUV Sud Japan:

Bankability services (feasibility evaluation) for investors, developers and EPCs

PV plants accreditation based on IEC 62446

(Examples): 1.414 MW PV power station at Yamaguchi City, Yamaguchi Pref. constructed and owned by West Holdings

Bankability evaluation by third party inspectors



Japan Credit Rating Agency (JCR) - Rating for PV projects:

(Example): 10.2 MW PV power station (at Misawa City, Aomori Pref. owned by Canadian Solar Japan) has “A” grade of the rating

→ Contracted 3 billion loan financing with Goldman Sachs Japan (+ Shinsei Trust as a lender)

(Concepts)

Against “Default risks of PV Module Manufacturers”

- ✓ PV module output guarantee reports by third party organization, against performance degradation risks by PID, etc.
- ✓ Credit capability of PV manufacturer for long term

The evaluation points of view for the selection of PV components

- ✓ The specs of the components brochures, field experiences, and actual data of PV
- ✓ Manufacturers’ credit
- ✓ Reliability of long-seller components with no defects
- ✓ Maintenance points throughout Japan (advantages of Japan’s company).
- ✓ The business sustainability of the companies: Positive figure, Multi-businesses (> single-)

Bankability evaluation by third party inspectors, etc.

R&I JapanRating and Investment Information (R&I)

Example:

Giving “A” (single A flat) grade of a reserve rating (credit rating) for the project bond with large-scale PV power plant at Himeji-City, Hyogo Pref.

(+ Goldman Sachs Japan as an arranger)

The bond was issued at 326 million Yen as of April 2014.

The role of small and medium-sized enterprises (beyond economical advantage)

- ✓ Strong relationship between SMEs and local governments
- ✓ SME’s important position in the local economy
- ✓ Integrity of the local economy
- ✓ SME’s reliability, long history and contribution
- ✓ Full knowledge of local resources, nature, climate, etc.

→ Important factors for **sustained and community-based business**

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Comparison of Conventional and Bifacial PV System

		Conventional PV	Bifacial PV		
System type		Ground-mounted (1 MW)	Ground-mounted (1 MW)	Rooftop (1 MW)	Vertical Installation (1 MW)
System price (Yen/W)	PV Module	60	90	90	90
	BOS & Install.	140	150	130	200 (est.)
	Grid-connection	10	10	10	10
	Land-related	30	36	0	3
	(Total)	240	286	230	303
Annual Generation Power (kWh/kW/yr)		1,160 (Reference = 100%)	1,450 (125 %)	1,440 (124 %)	1,250 (107 %)
Utilization Ratio (%)		13.3	16.6	16.5	14.2
LCOE (Yen/kWh)		20.9	19.6	16.2	24.0
(condition)		Miyazaki City, South with 10 deg., 20 yrs lifetime, 2,400 Yen/yr O&M cost, -0.5%/yr degradation rate, 6% discount rate	Miyazaki City, South with 25 deg. and reflection materials, 20 yrs lifetime, 2,400 Yen/yr O&M cost, -0.5%/yr degradation rate, 6% discount rate	Miyazaki City, South with 20 deg., 20 yrs lifetime, 2,400 Yen/yr O&M cost, -0.5%/yr degradation rate, 6% discount rate	Miyazaki City, Fronting onto east and west with 90 deg., 20 yrs lifetime, 2,400 Yen/yr O&M cost, -0.5%/yr degradation rate, 6% discount rate

Comparison of Conventional with Bifi PV System (cont.)

	Conventional PV	Bifacial PV		
System type	Ground-mounted (1 MW)	Ground-mounted (1 MW)	Rooftop (1 MW)	Vertical Installation (1 MW)
LCOE (Yen/kWh)	20.9	19.6	16.2	24.0
Total Investment (million Yen)	240	286	230	303
Total Net Income (million Yen, FIT = 24 Yen/kWh)	480	616	612	523
ROI (%)	201	215	266	173
IRR (%)	8.0	9.0	12.2	6.0
Payback Time (years)	9.7	9.1	7.3	11.4
Pros 😊	<ul style="list-style-type: none"> ✓ Good IRR and Payback Time ✓ Promising roadmap of c-Si, CIGS, CdTe PV 	<ul style="list-style-type: none"> ✓ Good LCOE, IRR, Payback Time ✓ Many manufacturers are focusing bifacial PV module products 		
Cons 😞	<ul style="list-style-type: none"> ✓ Need for more lessons learned under strict conditions ✓ Energy rating 	<ul style="list-style-type: none"> ✓ Limited applications of Bifacial PV systems (poor experiences) ✓ No comparable evaluation of nominal output rating of bifacial PV module ✓ Difficulties of a simulation of PV power generation 		

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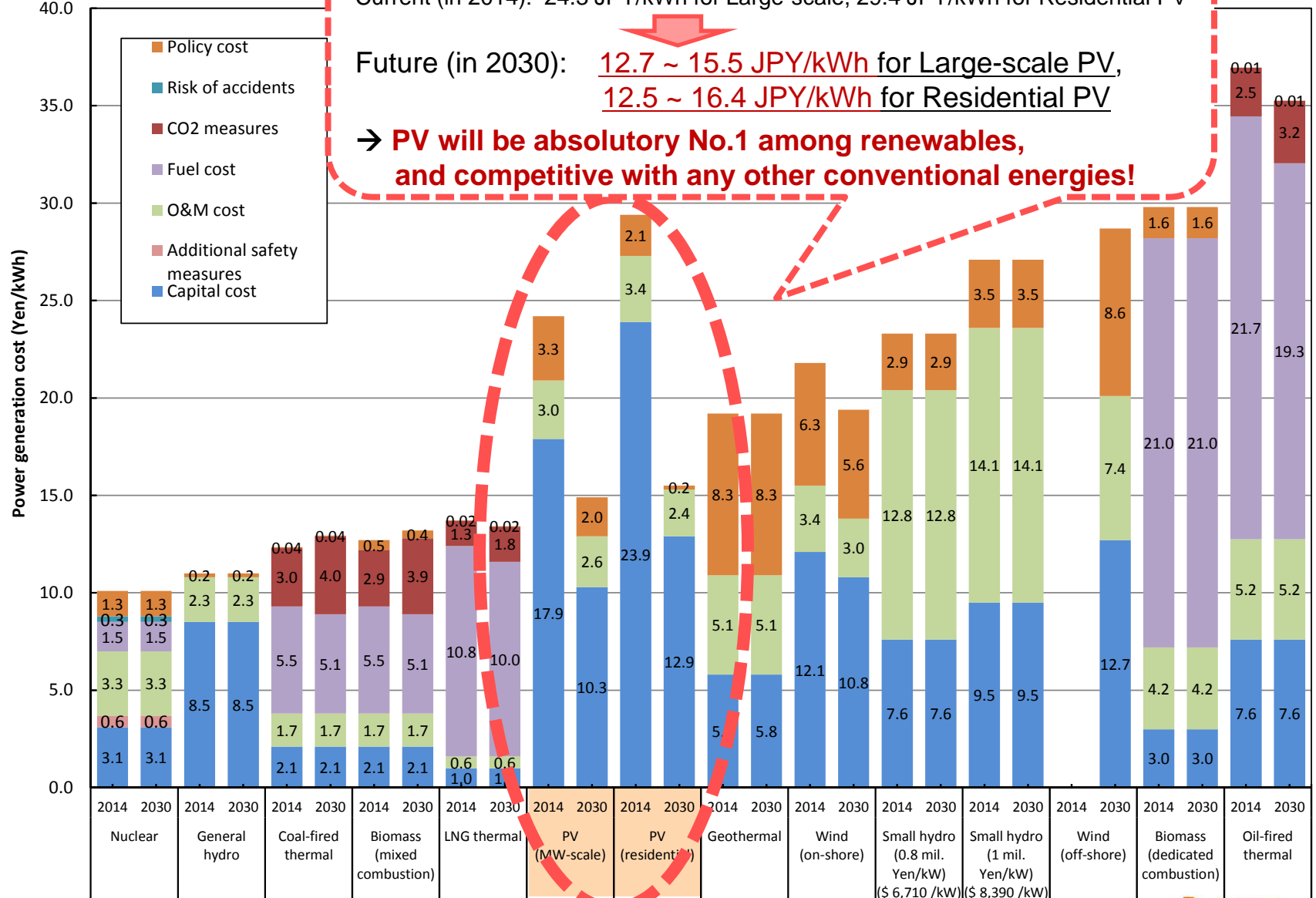
LCOE forecasts in Japan - Generation cost by energy source (METI)

LCOE of Photovoltaics:

Current (in 2014): 24.3 JPY/kWh for Large-scale, 29.4 JPY/kWh for Residential PV

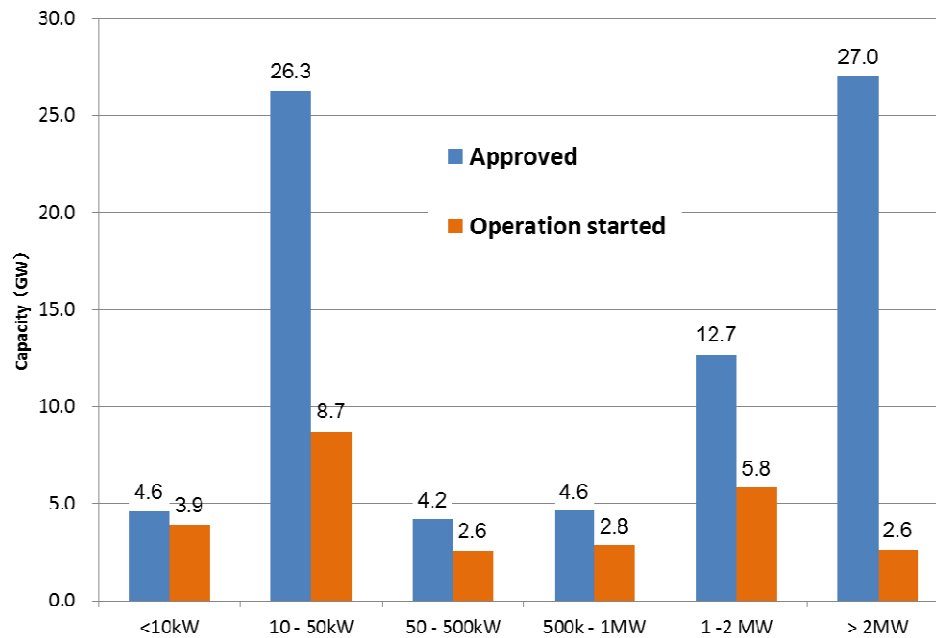
Future (in 2030): 12.7 ~ 15.5 JPY/kWh for Large-scale PV,
12.5 ~ 16.4 JPY/kWh for Residential PV

→ PV will be absolute No.1 among renewables,
 and competitive with any other conventional energies!

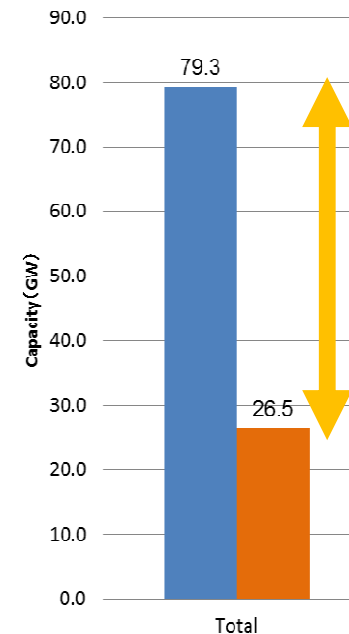


Source: Materials of the Ministry of Economy, Trade and Industry (METI), compiled by RTS Corporation

New Approval Process and Due Date



Source: METI, compiled by RTS Corporation



~ 53 GW Pipelines

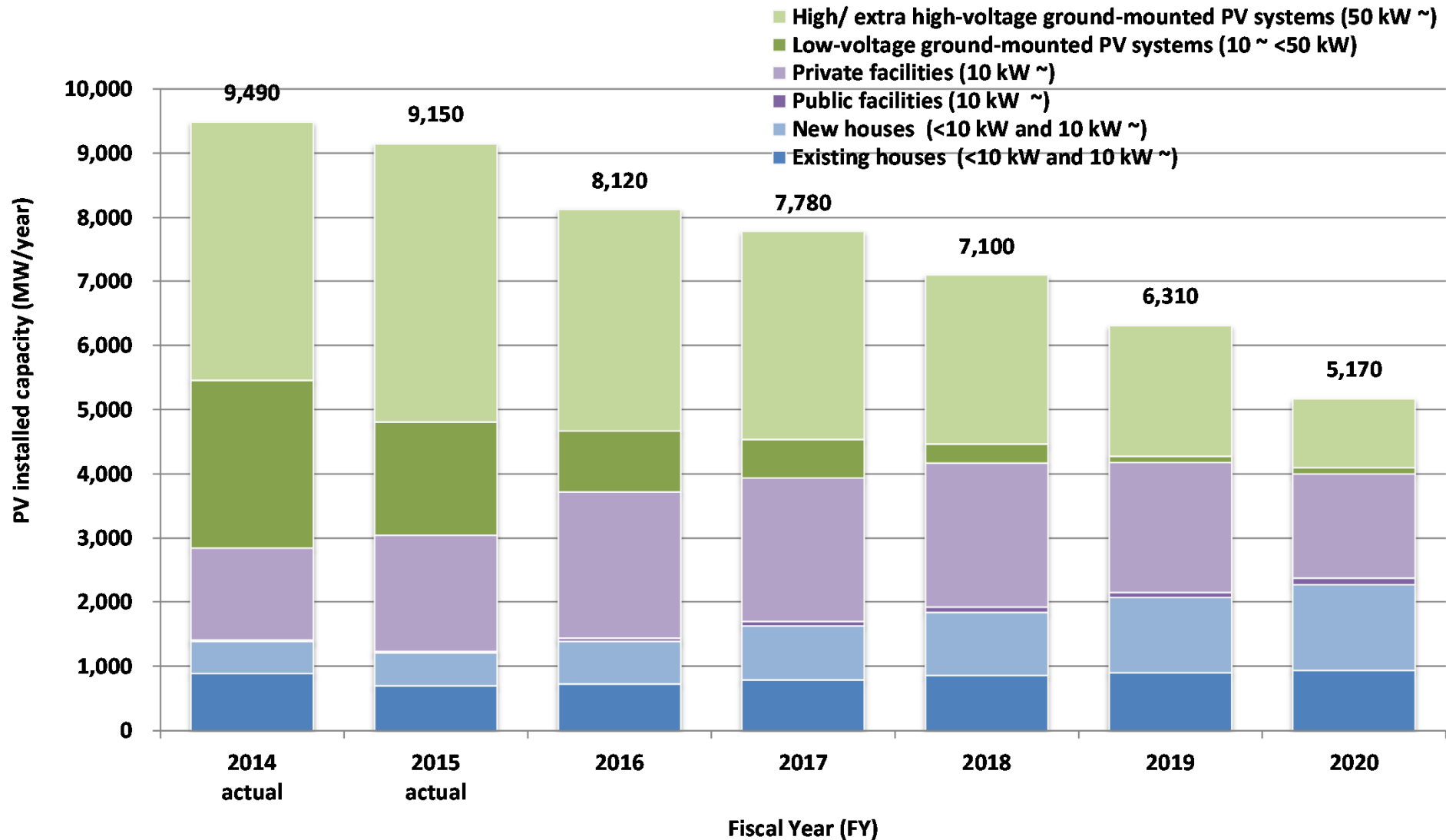
- Additional approval system : facility approval + business approval
- Approved projects needs to conclude grid connection contract by March 31 2017
- Projects should start operation within 3 years from the date of business approval (Projects concluded grid connection contracts after 1st Aug. 2016)
- Existing projects should start operation within 3 years from 1st April 2017

Cancellation of projects may create space for new project with lower tariff

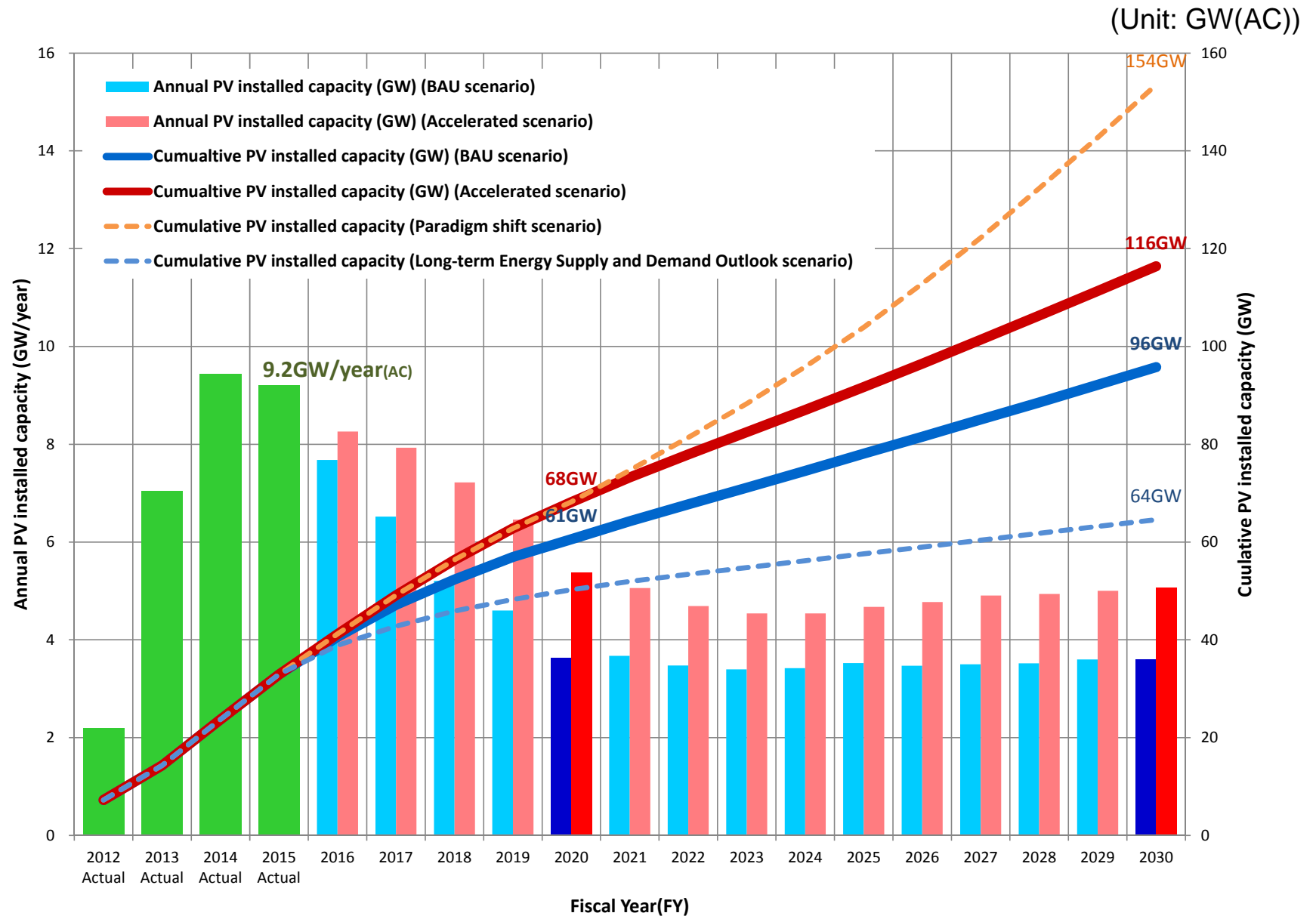
PV installed capacity forecasts by application (RTS)

[Accelerated scenario]

(Unit: MW(AC))



RTS forecast on the PV installed capacity by fiscal year (RTS)



Source: Estimates by ©RTS Corporation

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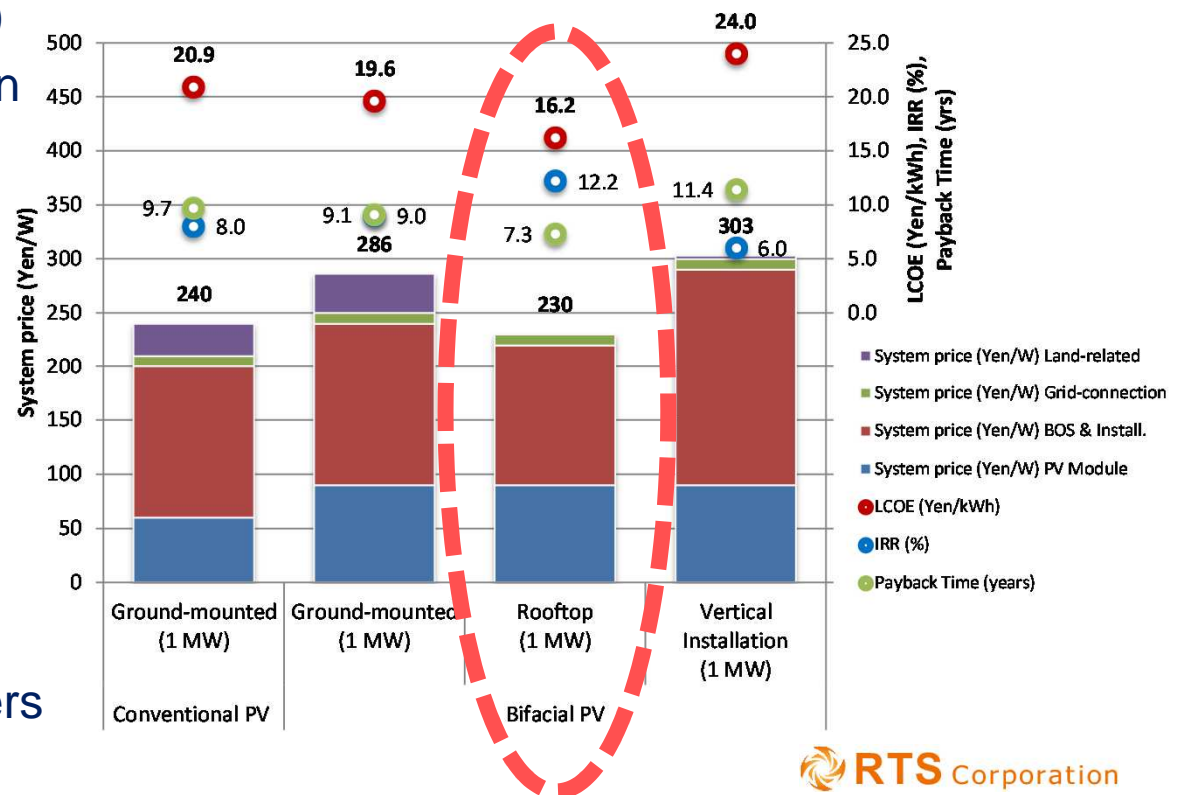
Summary

- “PV Bankability” is evaluated with multiple factors – Initial and running costs, generation volume, credits of PV system providers and EPCs, owners’ effort for a sustainable business, relationship with local economy, etc.
→ Reasons why LCOE/IRR and company ratings receive many attentions
- Japan's PV LCOE is steadily decreasing with cost reduction efforts, and will reach a comparable level of conventional energy's LCOEs toward 2030.

- Bifacial PV (especially for Rooftop) are contributing for LCOE reduction with advantages of generation outputs.

- For bifacial PV-related companies: Company ratings, business sustainability, actual results, etc.

- Japan's FIT revision promotes more promising PV projects
→ Many opportunities for bifi players





ご清聴ありがとうございました
Thank you for your kind attention !



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