

# Market Report Renewable Energy

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## October 2017



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## Summary (1/2)

### 1. Overview of Renewable Energy

- Keeping in mind the goals of increasing the energy self-sufficiency rate and creating a low carbon society, implementing renewable energy has continued to be important for the Japanese government. Since the introduction of the feed-in tariff (FIT) scheme, the installed capacity of renewable energy has grown by 2.5 times, with solar energy in particular taking center stage.

### 2. Overview of FIT Revisions

- Since its introduction, the FIT scheme has driven the growth of renewable energy in Japan. However, the growing costs shouldered by consumers led the government to make revisions in FY 2016. Prices were lowered for solar power, which had experienced the biggest growth, while prices for geothermal, hydropower, biomass, and other energy sources remained the same to promote their further growth.
- Under the old FIT scheme, a large number of approved projects never moved forward to the operational stage. The revised system addresses this issue by only approving business plans that have concluded a grid connection agreement with an electrical utility. Solar power projects must also be operational within prescribed timeframes once certification has been obtained.
- Under the old scheme, retail electricity providers bore the obligation to purchase electricity from FIT certified facilities. The revised scheme has transferred the obligation to transmission and distribution companies, which are responsible for power system operations and adjusting supply and demand. After purchase, transactions will then generally take place in the wholesale electricity market.

### 3. Solar Power

- In 2016, Japan's solar power market was the second largest in the world. Stable growth is expected to continue, with installed capacity projected to reach 100GW by 2030.
- Many foreign companies have already entered the upstream sector. A number have also entered the downstream sector and are engaged in power generation businesses, etc.

### 4. Small to Medium-sized Hydropower

- Japan's abundance of rivers and other water resources means that nationwide, it holds more potential than Europe, and is closer to North and Central America in terms of scale of potential installed capacity for small to medium-sized hydropower. In the coming years, development is expected to progress further to reach around 24 million kW by 2050.
- Not all small to medium-sized hydropower businesses directly apply large-scale hydropower technologies, and there are startups already developing new water turbines to tackle cost reduction and other issues unique to the industry. A number of Japanese businesses have also been utilizing innovative technology-based products provided by foreign companies such as Natel Energy.

## Summary (2/2)

### 5. Biomass Energy

- The annual installed capacity of biomass energy in Japan was approximately 4.8GW in 2015, making it the 5<sup>th</sup> largest biomass market in the world. The Japanese government has set a further target of 32.8TWh by 2030, and has been promoting initiatives to achieve this growth.
- At many biomass power plants in Japan, the main biomass-specific components utilize technologies and products made by foreign manufacturers.

### 6. Wind Power

- The Japan Wind Power Association predicts that in the 15 year period between 2015 to 2030, Japan's cumulative installed capacity for wind power will grow by 10 times.
- A number of leading foreign companies have entered the market as wind turbine manufacturers and developers, with more foreign players expected in the future.

### 7. Future Outlook

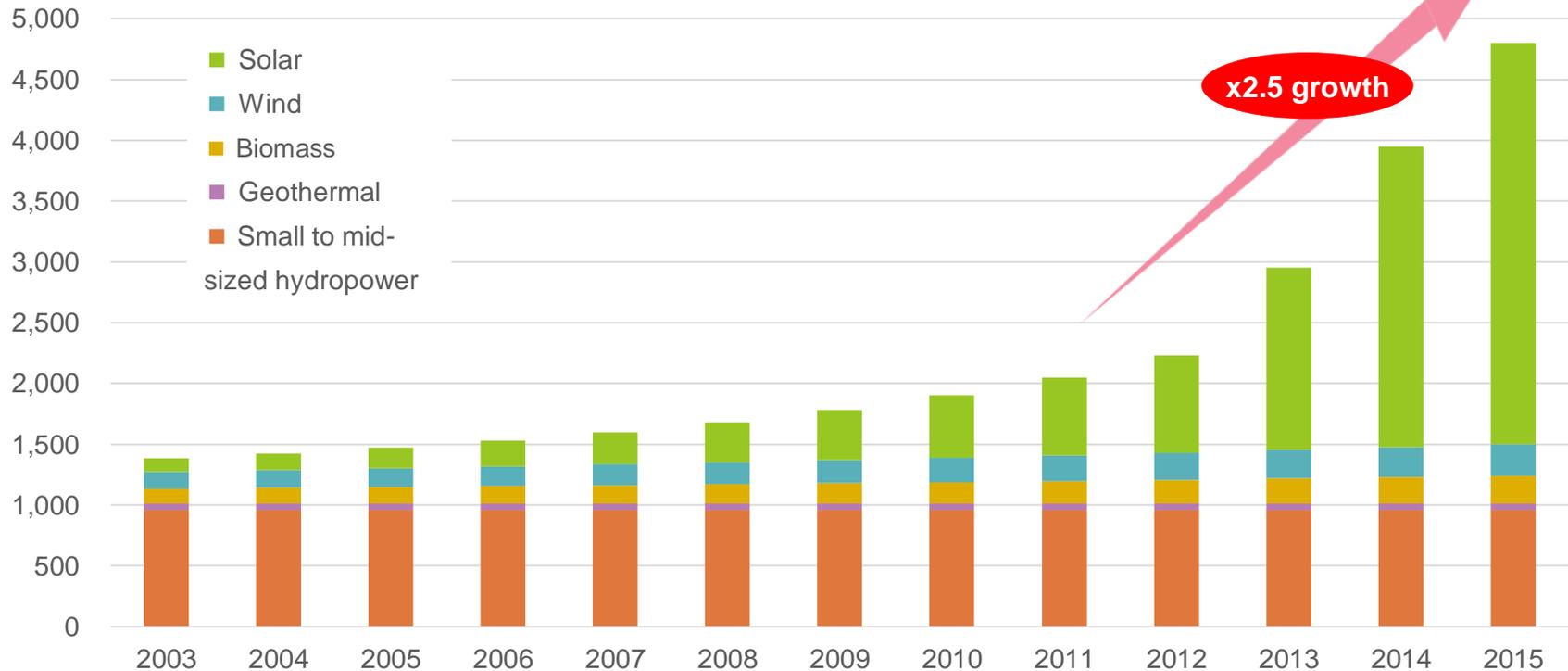
- Although globally, it is still early days for hydrogen fuel cells, rapid growth is predicted in the area of automobiles in particular. On the back of a strong domestic automobile industry, the hydrogen fuel cell market in Japan is expected to become one of the world's largest.
- The global market for on-board and energy storage batteries is projected to grow at a CAGR of 13 – 22% in the period between 2013 to 2025. Since Japan's global share in the storage batteries used for these purposes is expected to be around 10%, foreign companies may find the Japanese market to be highly attractive.
- Technological developments for ocean energy resources have gradually been moving from research facilities to trial sites, and the plan is to achieve a generation capacity of 7,600MW by 2050.

# 1. Overview of Renewable Energy

Keeping in mind the goals of increasing the energy self-sufficiency rate and creating a low carbon society, implementing renewable energy has continued to be important for the Japanese government. Since the introduction of the feed-in tariff (FIT) scheme, the installed capacity of renewable energy has grown by 2.5 times, with solar energy in particular taking center stage.

Installed Capacity of Renewable Energy

(10,000's of kW)



Feed-in tariff (FIT) scheme

\*1 Source: Agency for Natural Resources and Energy, Preliminary Briefing on the Amended FIT Act (Feb/Mar., 2017)

## 2. Overview of FIT Revisions

### i. Purchasing Prices

Since its introduction, the FIT scheme has driven the growth of renewable energy in Japan. However, the growing costs shouldered by consumers led the government to make revisions in FY 2016. Prices were lowered for solar power, which had experienced the biggest growth, while prices for geothermal, hydropower, biomass, and other energy sources remained the same to promote their further growth.

#### Purchasing Prices

Energy Source	Procurement Category		Price per 1kWh		
			2017	2018	2019
Solar power	10kW or less	Output control equipment not required	28 yen	26 yen	24 yen
		Output control equipment required	30 yen	28 yen	26 yen
	10kW or less ("double generation")	Output control equipment not required	25 yen		24 yen
		Output control equipment required	27 yen		26 yen
	10kW or more, but less than 2,000kW		21 yen + tax	-	
Wind power	20kW or more (onshore wind power)		21 yen + tax 22 yen + tax until end of Sept. 2017	20 yen + tax	19 yen + tax
	20kW or more (onshore wind power) - replacement		18 yen + tax	17 yen + tax	16 yen + tax
Geothermal energy	Replacement	More than 15,000kW Replacement of all facilities	20 yen + tax		
		More than 15,000kW Use of underground facilities	12 yen + tax		
		Less than 15,000kW Replacement of all facilities	30 yen + tax		
		Less than 15,000kW Use of underground facilities	19 yen + tax		
Hydropower	5,000kW or more, but less than 30,000kW		20 yen + tax 24 yen + tax until end of Sept. 2017		
	1,000kW or more, but less than 5,000kW		27 yen + tax		
Hydropower (utilizing existing canals)	5,000kW or more, but less than 30,000kW		12 yen + tax		
	1,000kW or more, but less than 5,000kW		15 yen + tax		
Biomass energy	General wood materials	More than 20,000kW	21 yen + tax 24 yen + tax until end of Sept. 2017		

\*Source: Ministry of Economy, Trade and Industry, [http://www.enecho.meti.go.jp/category/saving\\_and\\_new/saiene/kaitori/dl/kaisei/2017\\_fit.pdf](http://www.enecho.meti.go.jp/category/saving_and_new/saiene/kaitori/dl/kaisei/2017_fit.pdf)

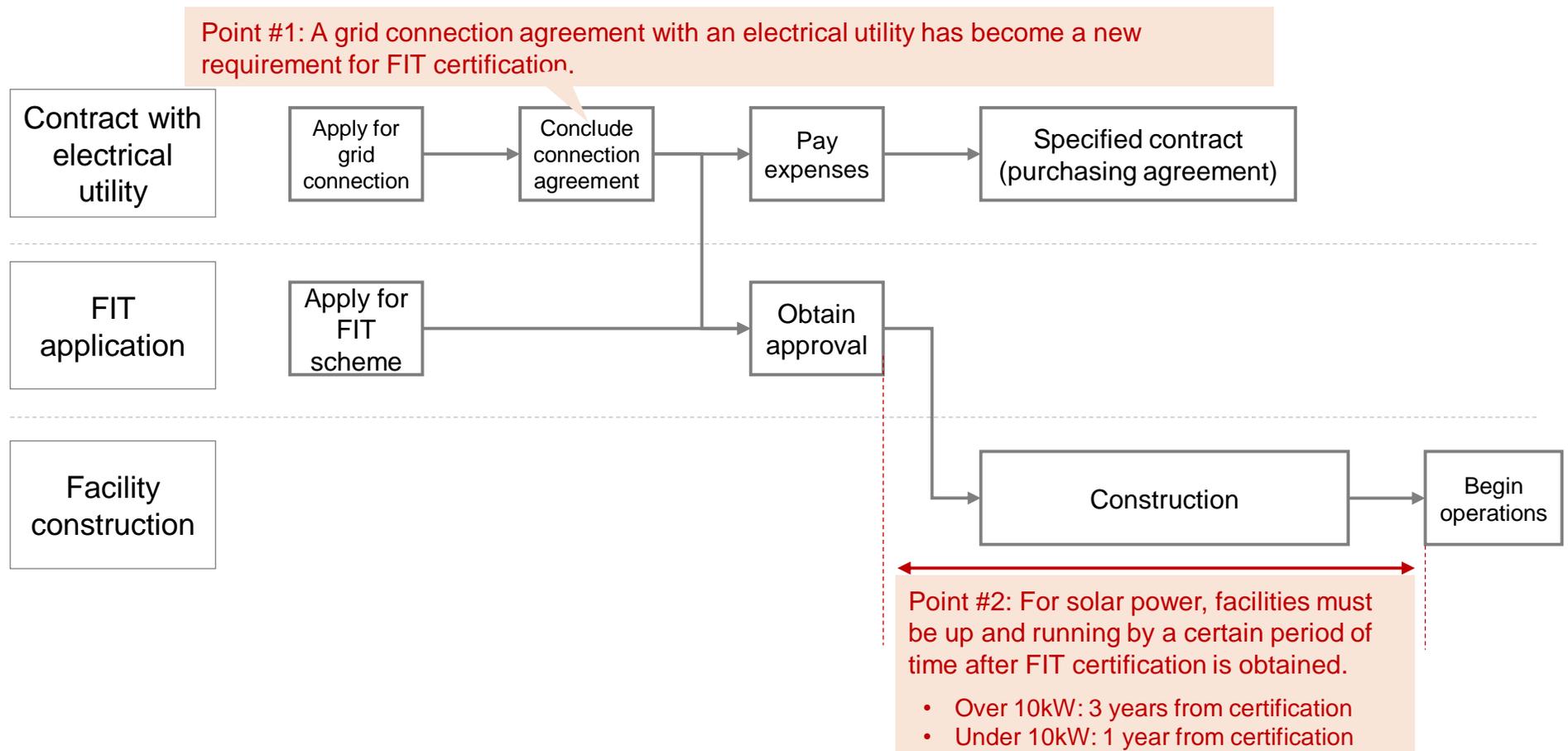
\*NB: For solar power stations with outputs of over 2,000kW, an auction system has been introduced. Bidding will take place across the country, with the winning bid receiving FIT certification and the bid's pricing becoming the official purchasing price. (First auction to be held in fall 2017).

## 2. Overview of FIT Revisions

### ii. From Facility Certification to Business Plan Approval

Under the old FIT scheme, a large number of approved projects never moved forward to the operational stage. The revised system addresses this issue by only approving business plans that have concluded a grid connection agreement with an electrical utility. Solar power projects must also be operational within prescribed timeframes once certification has been obtained.

#### Business Plan Utilizing FIT

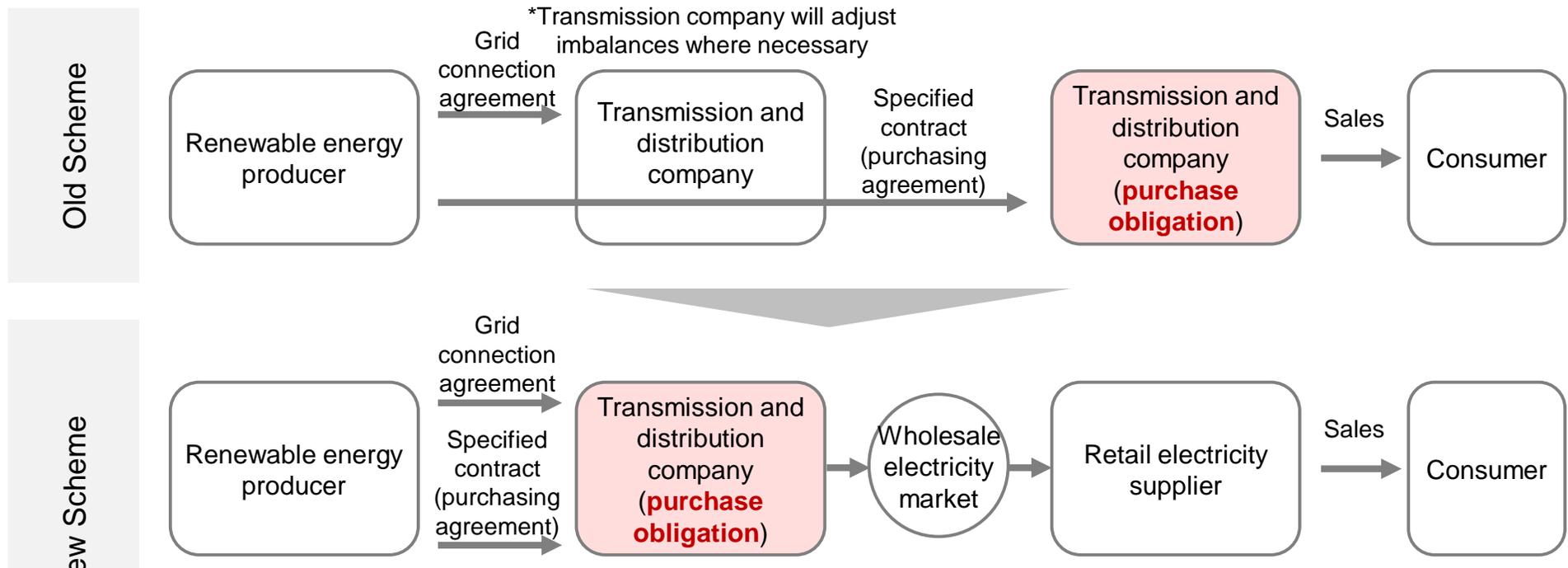


## 2. Overview of FIT Revisions

### iii. Purchasing Obligations

Under the old scheme, retail electricity providers bore the obligation to purchase electricity from FIT certified facilities. The revised scheme has transferred the obligation to transmission and distribution companies, which are responsible for power system operations and adjusting supply and demand. After purchase, transactions will then generally take place in the wholesale electricity market.

#### Contractual Supply of Electricity



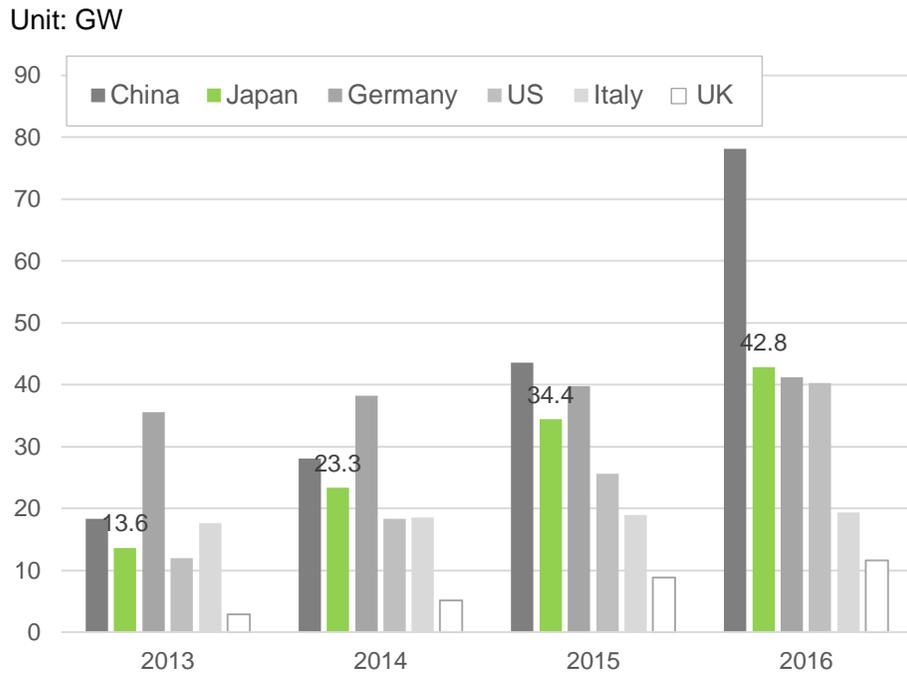
NB: In principle, transactions will take place via the wholesale electricity market. However, where the power producer has concluded a contract with a retail electricity supplier, the transmission and distribution company may directly supply the retail electricity supplier without going through the wholesale market.

### 3. Solar Power

#### i. Overview

In 2016, Japan's solar power market was the second largest in the world. Stable growth is expected to continue, with installed capacity projected to reach 100GW by 2030.

Cumulative Installed Capacity of Solar Power, by Top Solar Energy Countries\*1



Projected Growth of Solar Cells in Japan (cumulative)\*2



\*1 Source: IEA, PVPS Report Snapshot of Global PV (2014, 2015, 2016, 2017) (2013)

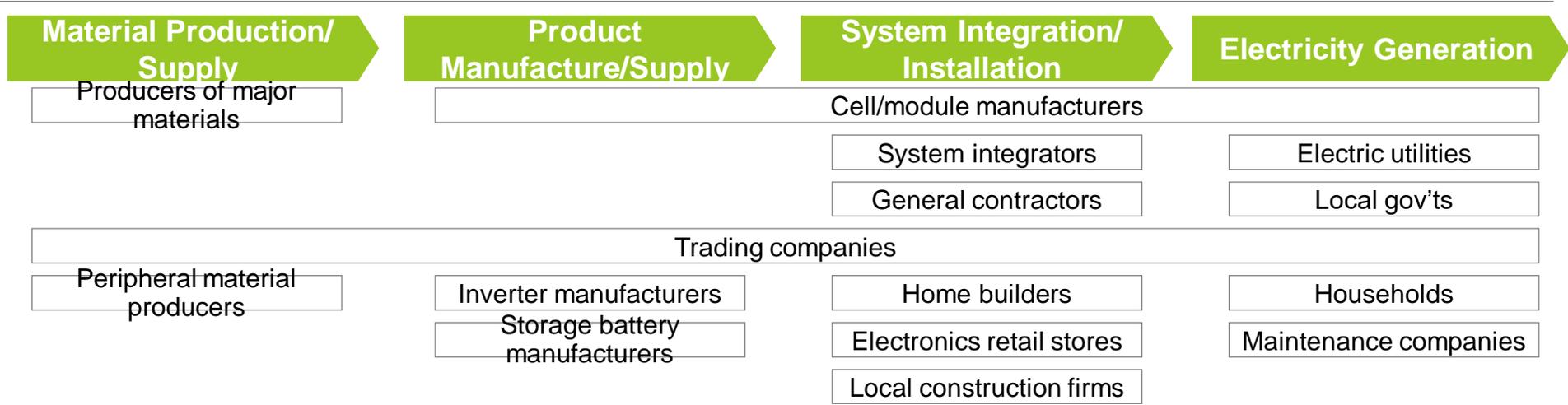
\*2 Source: Japan Photovoltaic Energy Association, JPEA PV OUTLOOK 2030 (2015)

### 3. Solar Power

#### ii. Foreign Companies in the Market

Many foreign companies have already entered the upstream sector. A number have also entered the downstream sector and are engaged in power generation businesses, etc.

#### Examples of Foreign Companies in the Market



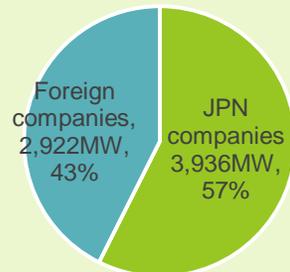
• Many foreign companies

- Wacker-Chemie
- Elkem Solar
- Dow Corning
- PV Crystalox Solar
- Sun Edison
- Rene Sola
- SKC
- Saint-Gobain
- Dow Chemical
- Sumitomo 3M, etc.

Source: Fuji Keizai, *Present Status and Future Outlook of Solar Cell Technologies and Market 2014*; company websites

• In 2016, foreign companies accounted for around 43% of market share.

- First Solar
- Canadian Solar
- Sopray Solar
- REC, etc.



Source: Japan Photovoltaic Energy Association

• Previously, Japanese companies monopolized these areas of the market, but a growing number of foreign companies have entered the market via mega solar projects, etc.

Mega solar projects involving foreign companies

- = Operational
- = Under development/construction



- CanadianSolar
- SuntechPower
- HanwhaSolar
- TrinaSolar
- REC
- SkySolar
- HanwhaQcells
- FirstSolar
- Juwi
- Prologis, etc.

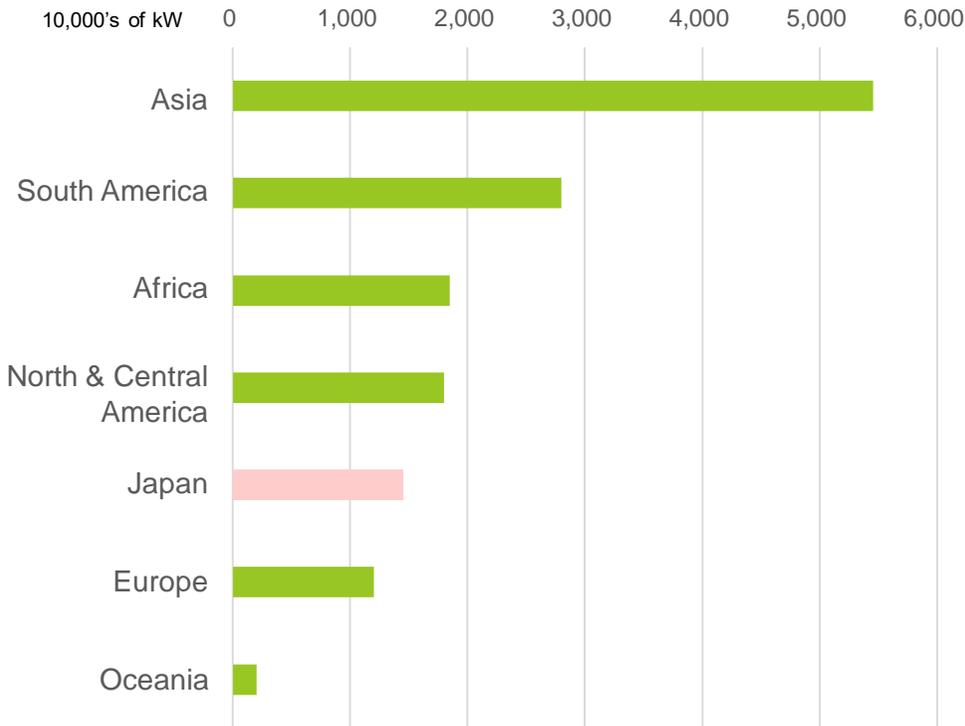
Source: Vis On Press, 'PV Eye Web'; National Institute of Informatics, *Electric Japan* (2014)

# 4. Small to Medium-sized Hydropower

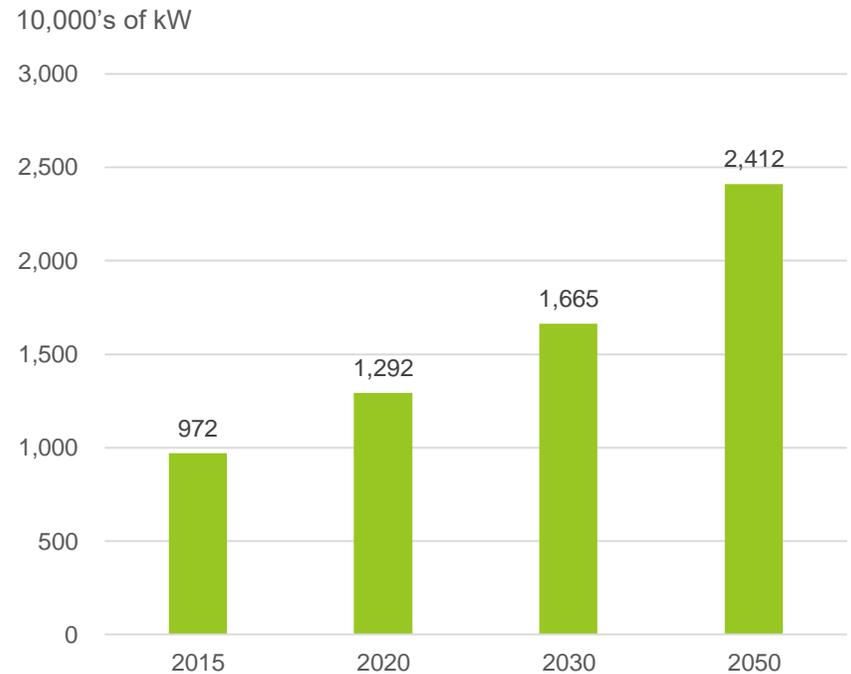
## i. Overview

Japan's abundance of rivers and other water resources means that nationwide, it holds more potential than Europe, and is closer to North and Central America in terms of scale of potential installed capacity for small to medium-sized hydropower. In the coming years, development is expected to progress further to reach around 24 million kW by 2050.

Installation Potential of Small to Medium-sized Hydropower



Projected Installed Capacity of Small to Medium-sized Hydropower (2015 – 2050)



Sources: ESHA website (<http://www.esha.be/>); Ministry of the Environment, *Renewable Energy Introduction Potential Survey*

Sources: NEDO, *Renewable Energy Technology White Paper*. NB: NEDO's *White Paper* presents three cases for estimated installed capacity, with the projected figures above for 2020 – 2050 displaying the median case.

## 4. Small to Medium-sized Hydropower

### ii. Foreign Companies in the Market

Not all small to medium-sized hydropower businesses directly apply large-scale hydropower technologies, and there are startups already developing new water turbines to tackle cost reduction and other issues unique to the industry. A number of Japanese businesses have also been utilizing innovative technology-based products provided by foreign companies such as Natel Energy.

#### Examples of Foreign Companies in the Market

##### Providers of Power Generation Systems

Power generation systems manufacturers

- Although the majority of players are Japanese companies, Natel Technology's hydropower equipment with its innovative turbine has been utilized at several plants.
  - Ishigaki
  - EAML Engineering
  - Ebara Corp.
  - Kawasaki Heavy Industries
  - Kubota
  - Seabell International
  - Sinfonia Technology
  - Tanaka Hydropower
  - Denyo
  - Toshiba
  - Mitsubishi Electric
  - **Natel Technology (US)**

##### Power Generation

Local governments

Land Improvement Districts (LIDs)

NPOs

Independent power producers

Maintenance companies

- Since rivers, dams, water and sewage systems, etc., are utilized, local governments are central players.

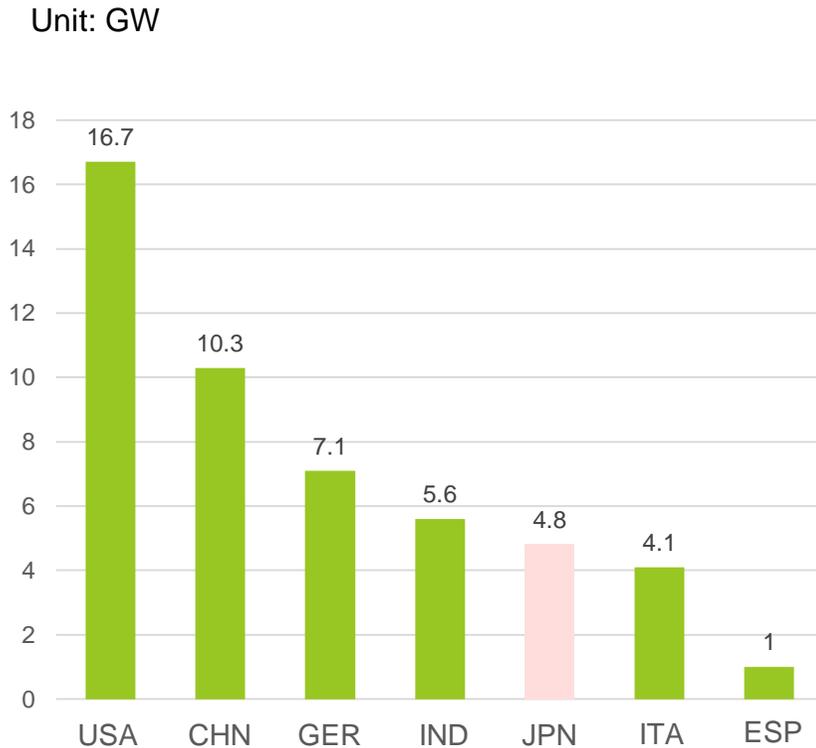
\*Red indicates foreign companies.

# 5. Biomass Energy

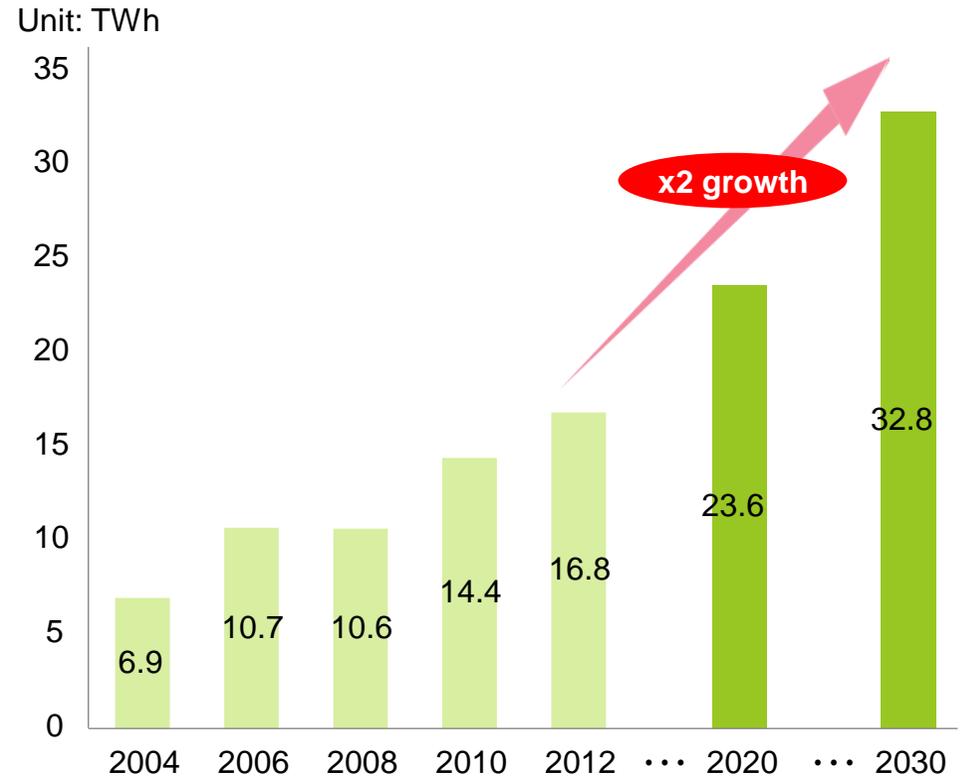
## i. Overview

The annual installed capacity of biomass energy in Japan was approximately 4.8GW in 2015, making it the 5<sup>th</sup> largest biomass market in the world. The Japanese government has set a further target of 32.8TWh by 2030, and has been promoting initiatives to achieve this growth.

Global Installed Capacity of Biomass (2015)\*1



Estimated Electricity Output of Biomass in Japan



\*1 Source: REN21, *Renewables 2016* (2013)

\*2 Source: Agency for Natural Resources and Energy website, <http://www.enecho.meti.go.jp/statistics/>

\*3 Source: Energy and Environment Council, *Energy and Environmental Options* (Jun. 29, 2012)

# 5. Biomass Energy

## ii. Foreign Companies in the Market

At many biomass power plants in Japan, the main biomass-specific components utilize technologies and products made by foreign manufacturers.

Examples of Foreign Companies in the Market

	Material Production/ Supply	Component Mfg./ Supply	Plant Installation	Power Generation
<b>Direct Firing</b>	Woody material producers	Steam turbine manufacturers Steam turbine manufacturers	Engineering companies	Electric utilities Maintenance companies
<b>Pyrolysis</b>	Woody material producers Food plants	Power unit manufacturers	Gasification plant manufacturers	Electric utilities Maintenance companies
<b>Methane Combustion Systems</b>	Wastewater treatment companies Industrial waste mgmt. companies	Power unit manufacturers	Gasification plant manufacturers	Electric utilities Maintenance companies
	<ul style="list-style-type: none"> <li>✓ Dominated by Japanese players, but foreign companies also in the market</li> <li>• Eco Green (acquired by US company similar to Goldman Sachs)</li> </ul>	<ul style="list-style-type: none"> <li>✓ Many foreign companies</li> <li>• Empacher (Australia)</li> <li>• Man (Germany)</li> <li>• SEVA (Germany)</li> <li>• Capstone (US)</li> <li>• STM Power (US)</li> <li>• Turbec (Sweden)</li> </ul>	<ul style="list-style-type: none"> <li>✓ Mainly Japanese players</li> </ul>	<ul style="list-style-type: none"> <li>✓ Dominated by Japanese players, but foreign companies also in the market</li> <li>• Japan Renewable Energy (subsidiary of Goldman Sachs (US))</li> </ul>

\*Sources: Sogo Giken, Current State and Future Prospects of the Renewable Energy and Environmental Products Market 2013, The Nikkei

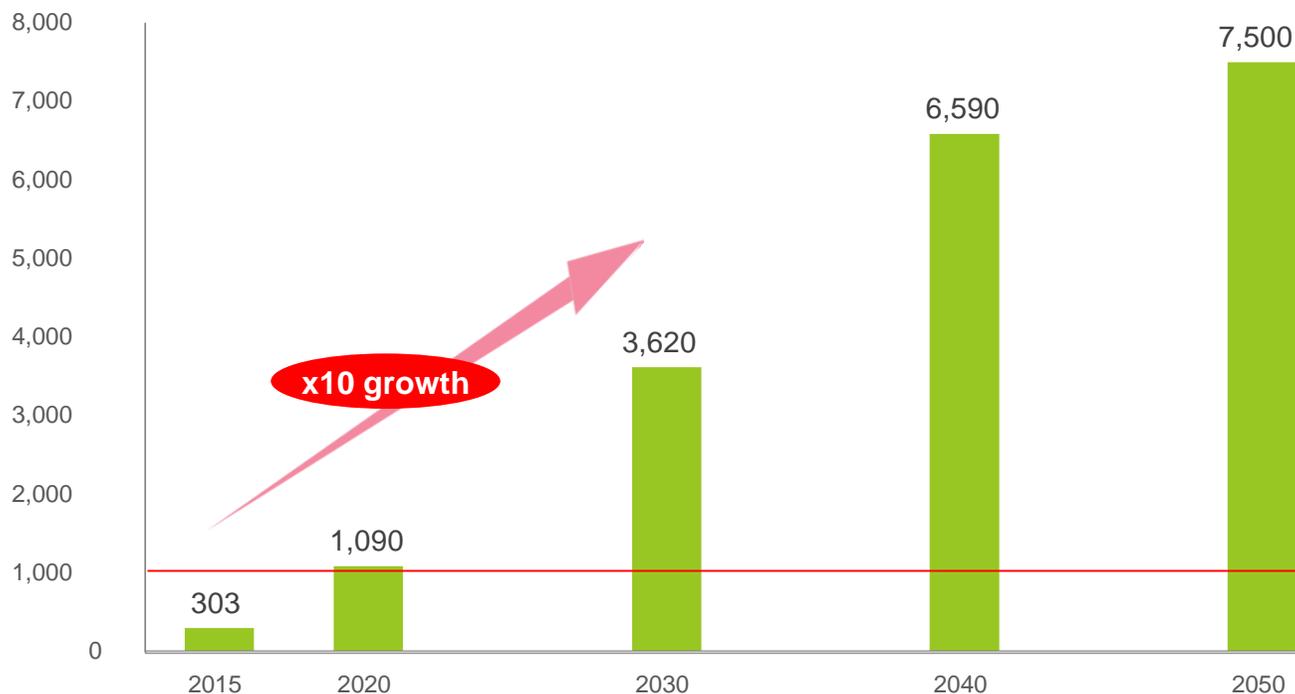
## 6. Wind Power

### i. Overview

The Japan Wind Power Association predicts that in the 15 year period between 2015 to 2030, Japan's cumulative installed capacity for wind power will grow by 10 times.

#### Japan's Cumulative Installed Capacity Target for Wind Power\*1

(in 10,000kW)



Cumulative installed capacity is projected to hit the government's targets (10M kW by 2030) by 2020

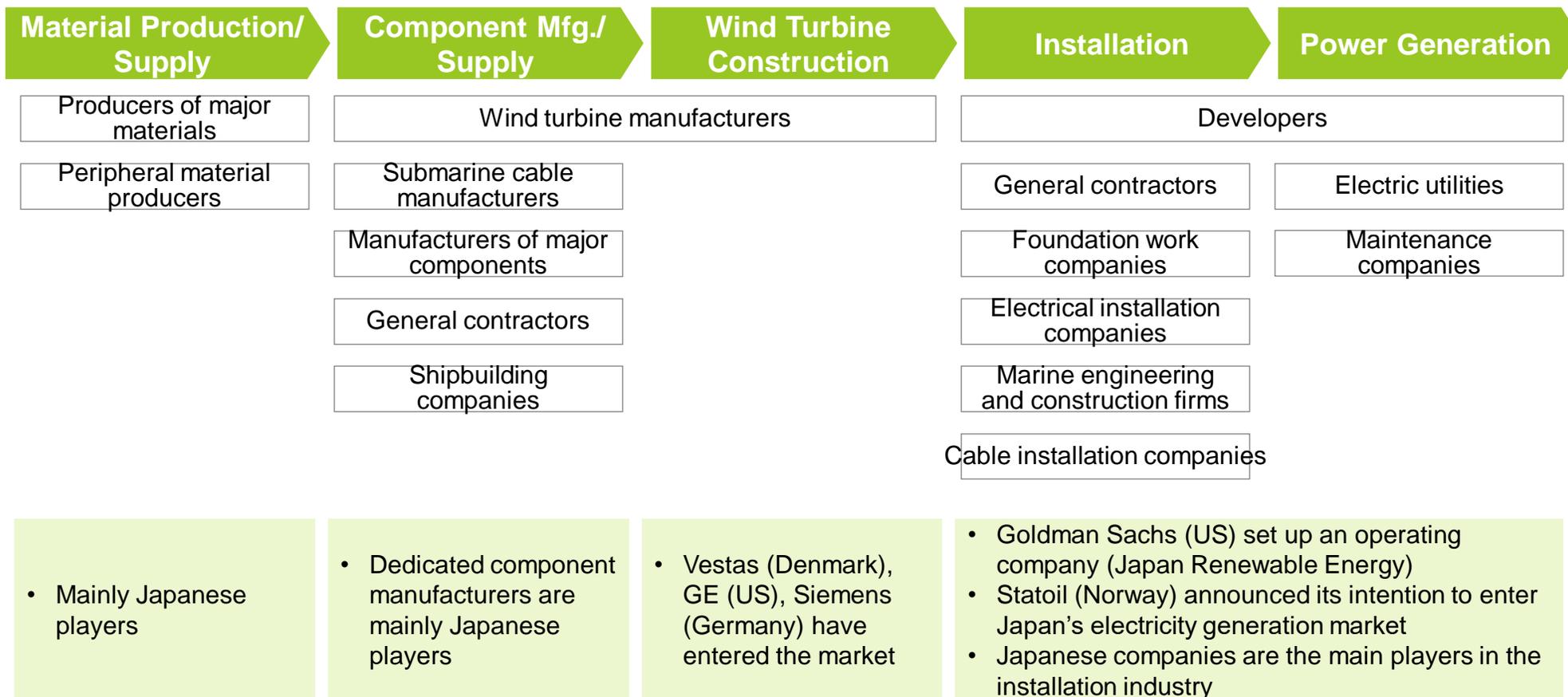
\*1 Japan Wind Power Association, *State of Offshore Wind Power and Future Outlook*  
Additionally, according to the Association, as of the end of January 2016, 7.06 million kW of wind power projects are undergoing environmental assessments.

# 6. Wind Power

## ii. Foreign Companies in the Market

A number of leading foreign companies have entered the market as wind turbine manufacturers and developers, with more foreign players expected in the future.

### Examples of Foreign Companies in the Market



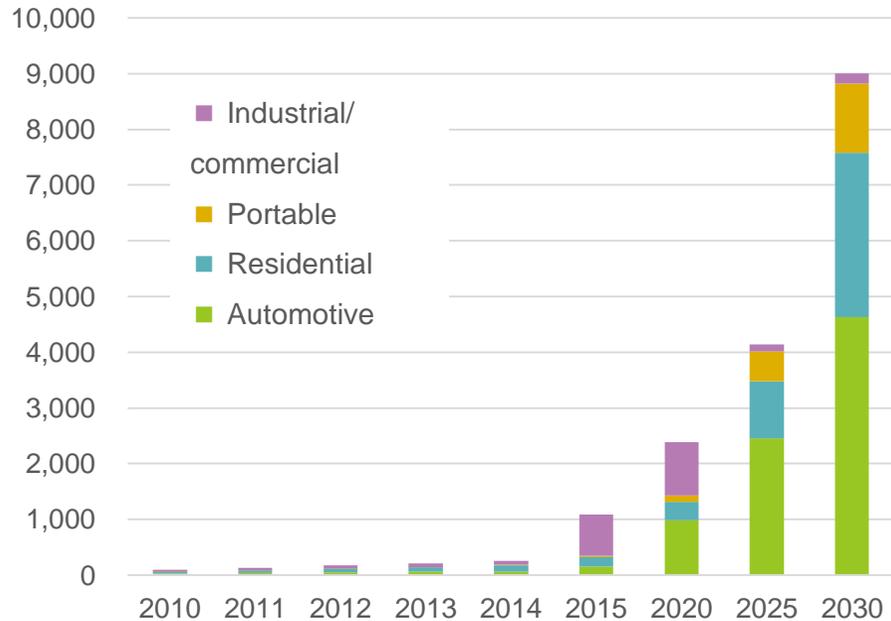
# 7. Future Outlook

## i. Hydrogen

Although globally, it is still early days for hydrogen fuel cells, rapid growth is predicted in the area of automobiles in particular. On the back of a strong domestic automobile industry, the hydrogen fuel cell market in Japan is expected to become one of the world's largest.

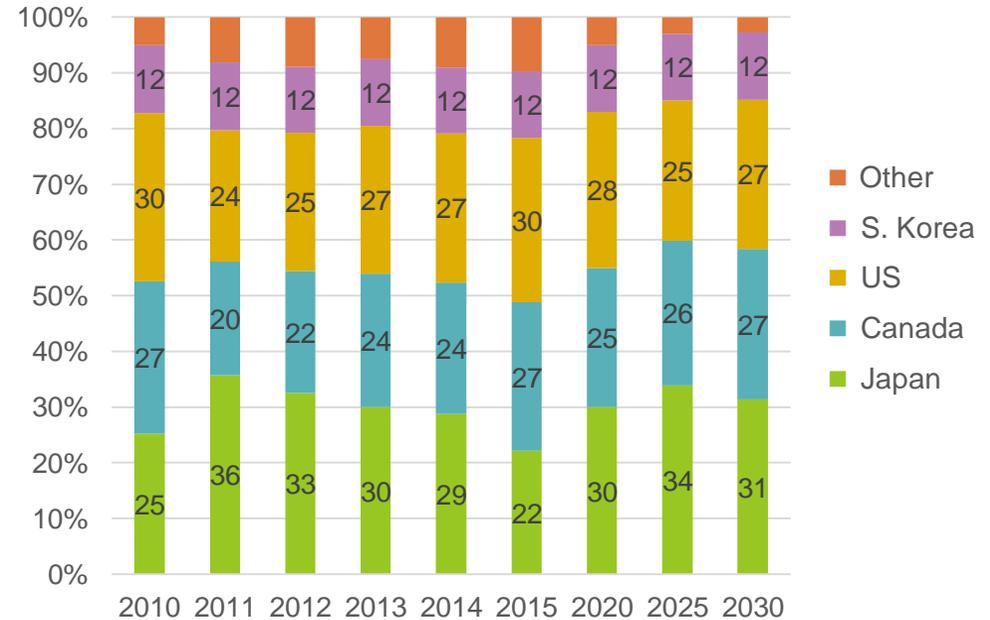
Global Market for Hydrogen Fuel Cells (by end-use)

(Unit: in billions of yen)



Global Market for Hydrogen Fuel Cells (by country)

(Unit: %)



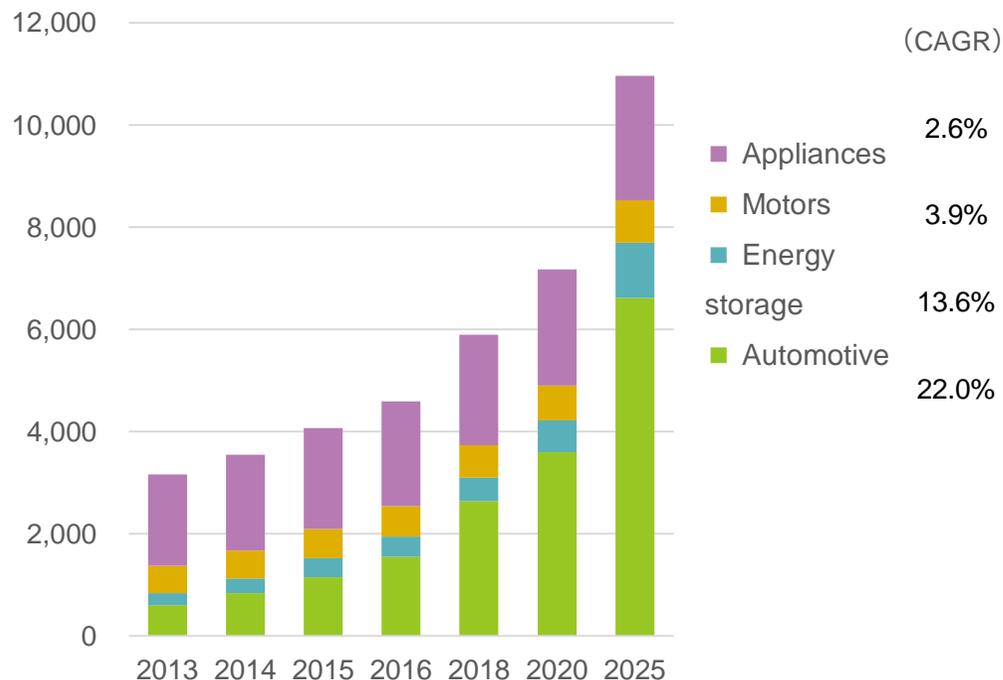
# 7. Future Outlook

## ii. Storage Batteries

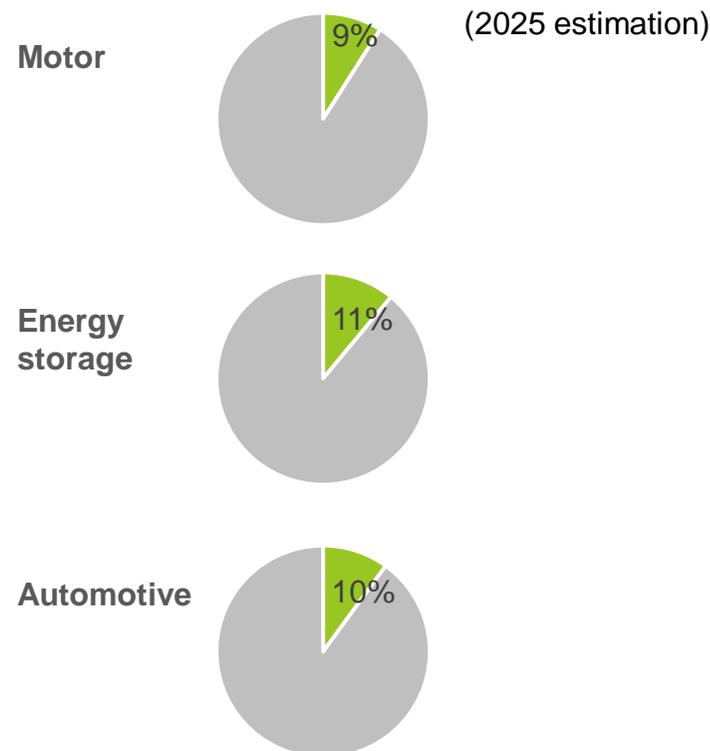
The global market for on-board and energy storage batteries is projected to grow at a CAGR of 13 – 22% in the period between 2013 to 2025. Since Japan’s global share in the storage batteries used for these purposes is expected to be around 10%, foreign companies may find the Japanese market to be highly attractive.

Global Storage Battery Market (by main end-use)

(Unit: in billions of yen)



Japan’s Share of the Global Storage Battery Market (by end-use)



CAGR = Compound Annual Growth Rate

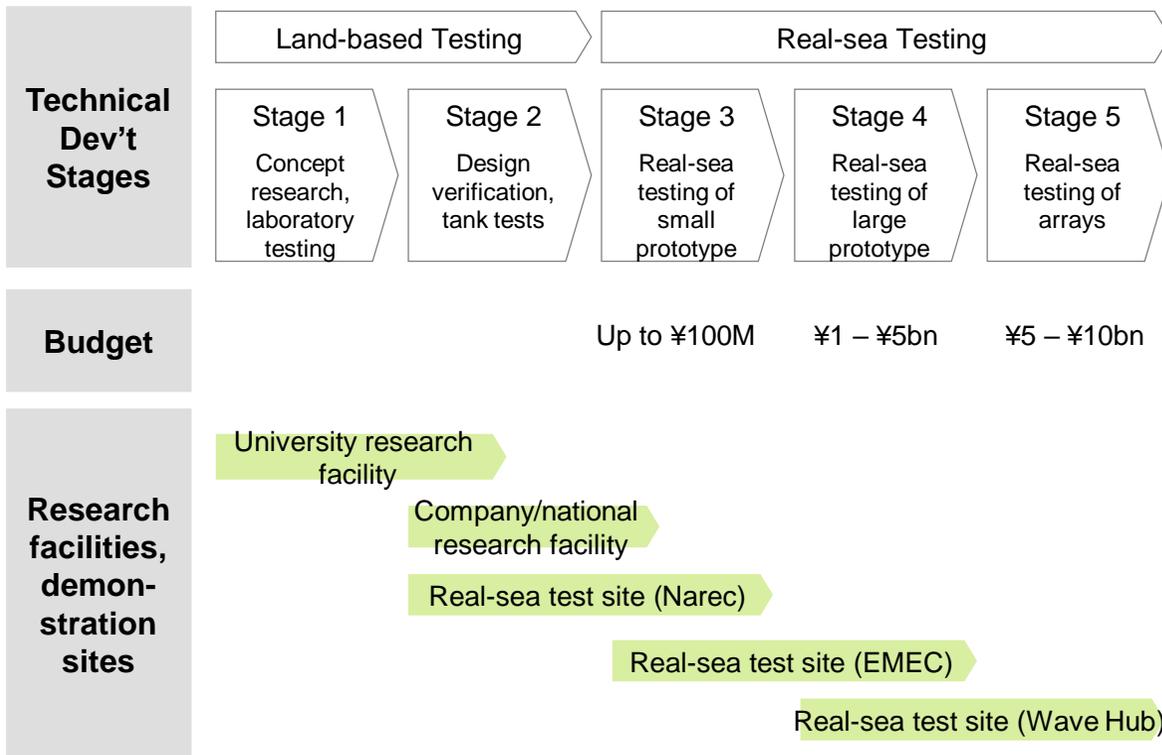
Source: Fuji Keizai, *Future Outlook of Energy, Large Scale Secondary Battery, and Materials 2015*

# 7. Future Outlook

## iii. Tidal Power

Technological developments for ocean energy resources have gradually been moving from research facilities to trial sites, and the plan is to achieve a generation capacity of 7,600MW by 2050.

Technical Development Stages of Ocean Energy



Source: NEDO, Renewable Energy Technology White Paper

Electricity Output of Tidal Power in Japan



Source: Ocean energy development roadmap for 2050, compiled by the Ocean Energy Association – Japan.